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## **Emissions and Electricity Price Effects of a Small Carbon Tax Combined with Renewable Tax Credit Extensions**

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### **Summary**

A carbon tax of \$20 per ton CO<sub>2</sub>, increasing at 5% per year, combined with an extension of the renewable electricity production and investment tax credits, would reduce power sector emissions by 80%+ by 2030, relative to 2005 and would result in small (if any) increases in wholesale electricity prices.

This note assesses power sector emissions and total system costs for a \$20 and \$40 carbon tax, increasing at 5% per year, in each case with and without the extension of currently-available renewable electricity tax credits. We also consider a policy scenario in which the only new power sector policy is the tax credit extension. The modeling framework and assumptions are laid out in Stock and Stuart (2021). The contribution of this note is to examine the joint policies of a carbon tax combined with a tax credit extension.

The analysis is performed using the NREL ReEDS model of the US power sector. We consider three sets of price assumptions: the NREL (2020) reference case (similar to the EIA *Annual Energy Outlook* (2021) reference case), a case with low prices of new renewables and high natural gas prices, and a case with high prices of new renewables and high natural gas prices. In this note, we focus on CO<sub>2</sub> emissions and net private system costs (in \$/MWh), which are a proxy for the average wholesale price of electricity under the indicated scenario.<sup>1</sup>

Table 1 summarizes results for emissions in 2035, cumulative abatement through 2035, abatement costs, and fiscal impacts. The paths of emissions and net private system costs are shown in Figure 1 and Figure 2, respectively. We find that:

- The emissions reductions achieved by combining the carbon tax with the tax credit extension are greater than under either policy alone. In the reference price case, the combination of a \$20 carbon tax and the tax credit extension achieves 80% emissions reduction by 2030 and 83% by 2035. Combining a \$40 tax with the tax credits results in 87% to 93% emissions reductions by 2030 across the three scenarios, and 90% to 97% emissions reductions by 2035.
- As in Stuart and Stock (2021), the tax credit alone results in only modestly more emissions reductions than under BAU.

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<sup>1</sup> Average system costs are the private costs associated with the power system including capital, operating and maintenance, fuel and transmission costs, plus carbon tax payments, minus tax credits. In contrast to average system costs, marginal electricity prices will tend to be lower in high renewable penetration scenarios than the BAU scenario due to an increase in the number of hours with negative or zero prices. However, marginal prices do not reflect the increase in capital or transmission costs. See Stock and Stuart (2021) for details.

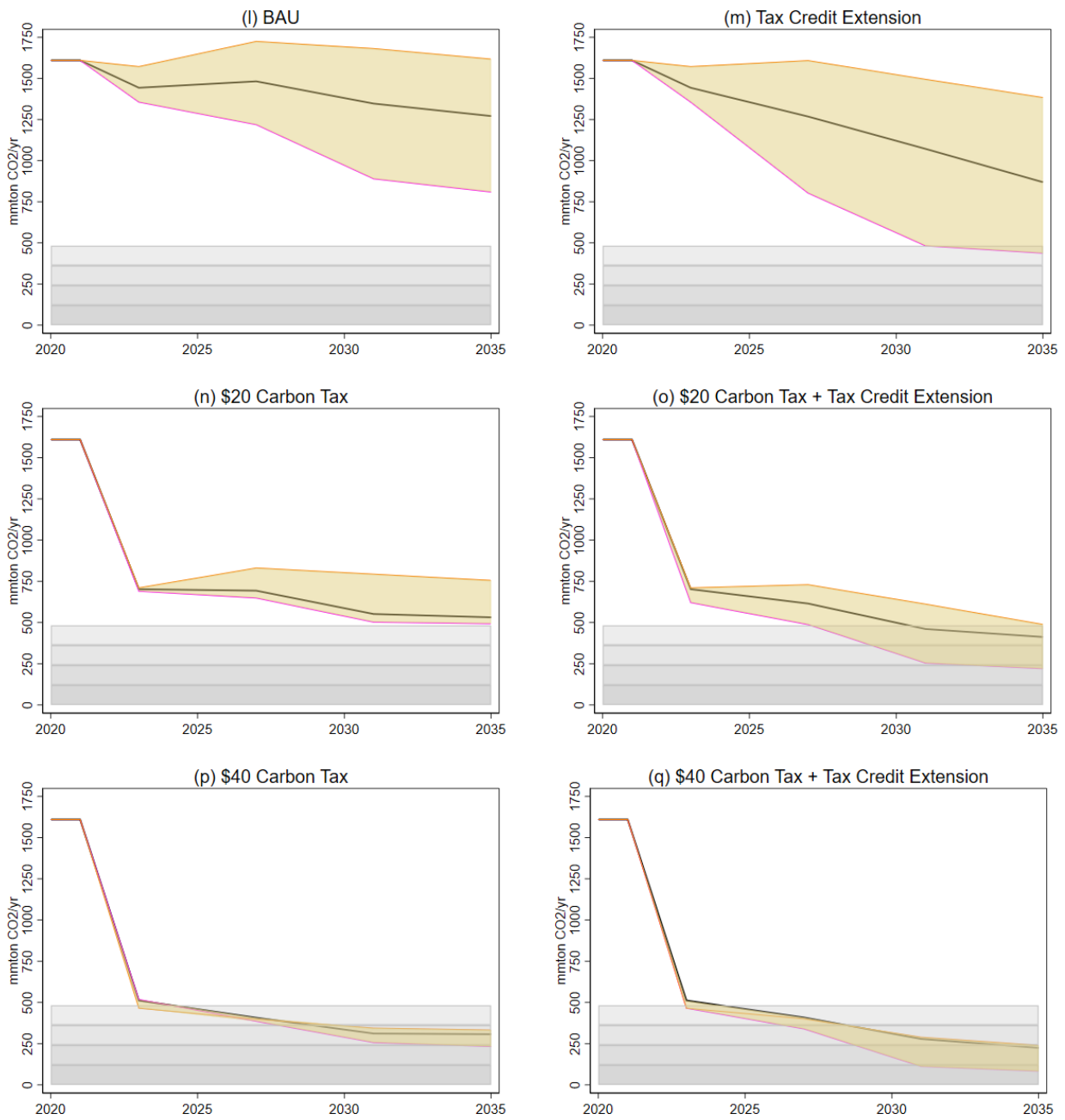
**Table 1. Carbon Emissions and Average Abatement  
By Climate Policy and Technology Scenario**

| Climate Policy                                 | 2035                         |   | Cumulative Abatement | Average Abatement Cost | Tax Credit Expenditures | Carbon Tax Revenues | Net Federal Cost |
|--|------------------------------|---|----------------------|------------------------|-------------------------|---------------------|------------------|
|  | Annual CO2 Emissions in 2035 | Emissions as fraction of 2005 Emissions |                      |                        |                         |                     |                  |
| <i>Reference Technology Scenario:</i>          |                              |   |                      |                        |                         |                     |                  |
| BAU  | 1,271                        | 0.526                                   | -                    | -                      | -7.55                   | 0.00                | -7.55            |
| \$20 Carbon Tax                                | 531                          | 0.220                                   | 12,260               | \$12.9                 | -13.30                  | 16.55               | 3.25             |
| \$40 Carbon Tax                                | 307                          | 0.127                                   | 16,020               | \$22.9                 | -17.18                  | 20.15               | 2.97             |
| PTC/ITC Extension                              | 869                          | 0.360                                   | 3,565                | \$35.4                 | -16.08                  | 0.00                | -16.08           |
| \$20 Carbon Tax + PTC/ITC Extension            | 412                          | 0.171                                   | 13,414               | \$20.6                 | -19.96                  | 14.13               | -5.83            |
| \$40 Carbon Tax + PTC/ITC Extension            | 224                          | 0.093                                   | 16,479               | \$27.5                 | -22.52                  | 17.56               | -4.96            |
| <i>Low renewables/low gas price scenario</i>   |                              |   |                      |                        |                         |                     |                  |
| BAU  | 809                          | 0.335                                   | -                    | -                      | -7.58                   | 0.00                | -7.58            |
| \$20 Carbon Tax                                | 493                          | 0.204                                   | 7,758                | \$20.5                 | -12.98                  | 15.52               | 2.54             |
| \$40 Carbon Tax                                | 232                          | 0.096                                   | 11,522               | \$34.6                 | -16.61                  | 17.43               | 0.81             |
| PTC/ITC Extension                              | 437                          | 0.181                                   | 4,782                | \$71.0                 | -25.01                  | 0.00                | -25.01           |
| \$20 Carbon Tax + PTC/ITC Extension            | 220                          | 0.091                                   | 10,765               | \$56.4                 | -31.54                  | 9.54                | -22.00           |
| \$40 Carbon Tax + PTC/ITC Extension            | 82                           | 0.034                                   | 13,101               | \$65.1                 | -36.36                  | 11.03               | -25.32           |
| <i>High renewables/high gas price scenario</i> |                              |   |                      |                        |                         |                     |                  |
| BAU  | 1,618                        | 0.670                                   | -                    | -                      | -7.89                   | 0.00                | -7.89            |
| \$20 Carbon Tax                                | 756                          | 0.313                                   | 14,022               | \$14.3                 | -14.62                  | 21.41               | 6.79             |
| \$40 Carbon Tax                                | 333                          | 0.138                                   | 20,220               | \$21.7                 | -18.92                  | 20.60               | 1.68             |
| PTC/ITC Extension                              | 1,384                        | 0.573                                   | 2,150                | \$41.9                 | -15.72                  | 0.00                | -15.72           |
| \$20 Carbon Tax + PTC/ITC Extension            | 489                          | 0.202                                   | 16,223               | \$20.4                 | -21.67                  | 16.42               | -5.26            |
| \$40 Carbon Tax + PTC/ITC Extension            | 240                          | 0.100                                   | 20,805               | \$24.9                 | -25.10                  | 17.55               | -7.55            |

*Notes:* Carbon dioxide emissions are expressed in millions of metric tons. Average costs are expressed in 2018\$ per metric ton CO2 and include all privately-borne system costs (defined as capital, O&M, fuel and transmission costs) plus federal tax expenditures (defined as ITC and PTC expenditures). Federal revenues and expenditures are expressed in billions of 2018\$ and are annuitized using a 5% discount rate and 20 year time horizon.

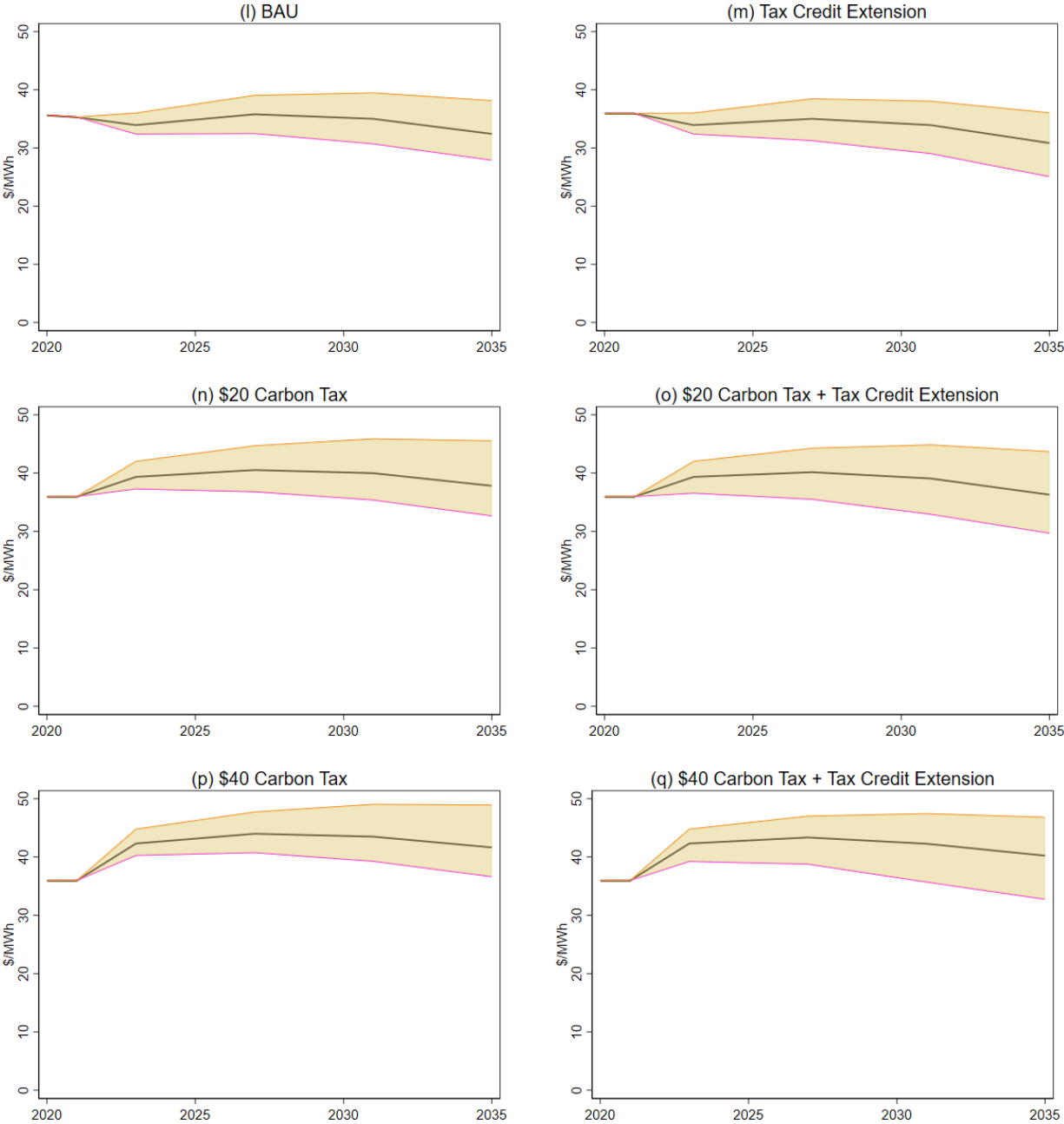
- The \$20/ton carbon tax achieves greater decarbonization than the tax credits alone, however on its own it does not achieve 80% emissions reduction by 2030 under any of the three scenarios. The \$40 carbon tax on its own achieves greater emissions reductions, between 85% and 88% by 2030.
- Even under the most ambitious policy, the \$40 carbon tax, the tax credit holds down net system costs, so that net system costs rise by only \$7/MWh from 2020 to 2030 under the reference scenario, and by only \$3/MWh under the low renewables cost scenario. Under a \$20 carbon tax combined with tax credits, the net system costs increase from 2020 to 2030 by \$4/MWh under the reference scenario, fall by \$3/MWh under the low-renewables price scenario, and increase by \$7/MWh under the high renewables price scenario.

**Figure 1. Annual Carbon Emissions by Climate Policy**



Notes: Shading at bottom denotes 80%, 85%, 90%, and 95% annual emissions reduction, relative to 2030. Shading in emissions paths denotes the range across the natural gas and renewables price scenarios. Source: Authors' calculations using a modification of the NREL ReEDS model.

**Figure 2. System Costs, net of Tax Credits, by Climate Policy**



Notes: Shading at bottom denotes 80%, 85%, 90%, and 95% annual emissions reduction, relative to 2030. Shading in emissions paths denotes the range across the natural gas and renewables price scenarios. Source: Authors' calculations using a modification of the NREL ReEDS model.

## References

- National Renewable Energy Laboratory. 2020. “2020 Standard Scenarios Report: A U.S. Electricity Sector Outlook.” Technical Report.  
<https://www.nrel.gov/docs/fy21osti/77442.pdf>
- Stock, James H. and Daniel Stuart. 2021. “Robust Decarbonization of the US Power Sector: Policy Options,” NBER Working Paper 28677, April 2021.