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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_2, 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 net system costs for a $20 and $40 carbon tax, increasing at 3% 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 uses a modification of 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_2 emissions and net system costs (in $/MWh), which are a proxy for the average wholesale price of electricity.[1]

Table 1 summarizes results for emissions in 2035, cumulative abatement through 2035, abatement costs, and fiscal impacts. The paths of emissions and net 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 81% emissions reduction by 2030 and 83% by 2035 (the ranges across price scenarios are 75%-90% for 2030 and 80%-91% for 2035). Combining a $40 tax with the tax credits results in at least 88% emissions reductions by 2030 across the three scenarios, and at least 90% by 2035.

- As in Stuart and Stock (2021), the tax credit alone results in only modestly more emissions reductions than under BAU.

[1] 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.

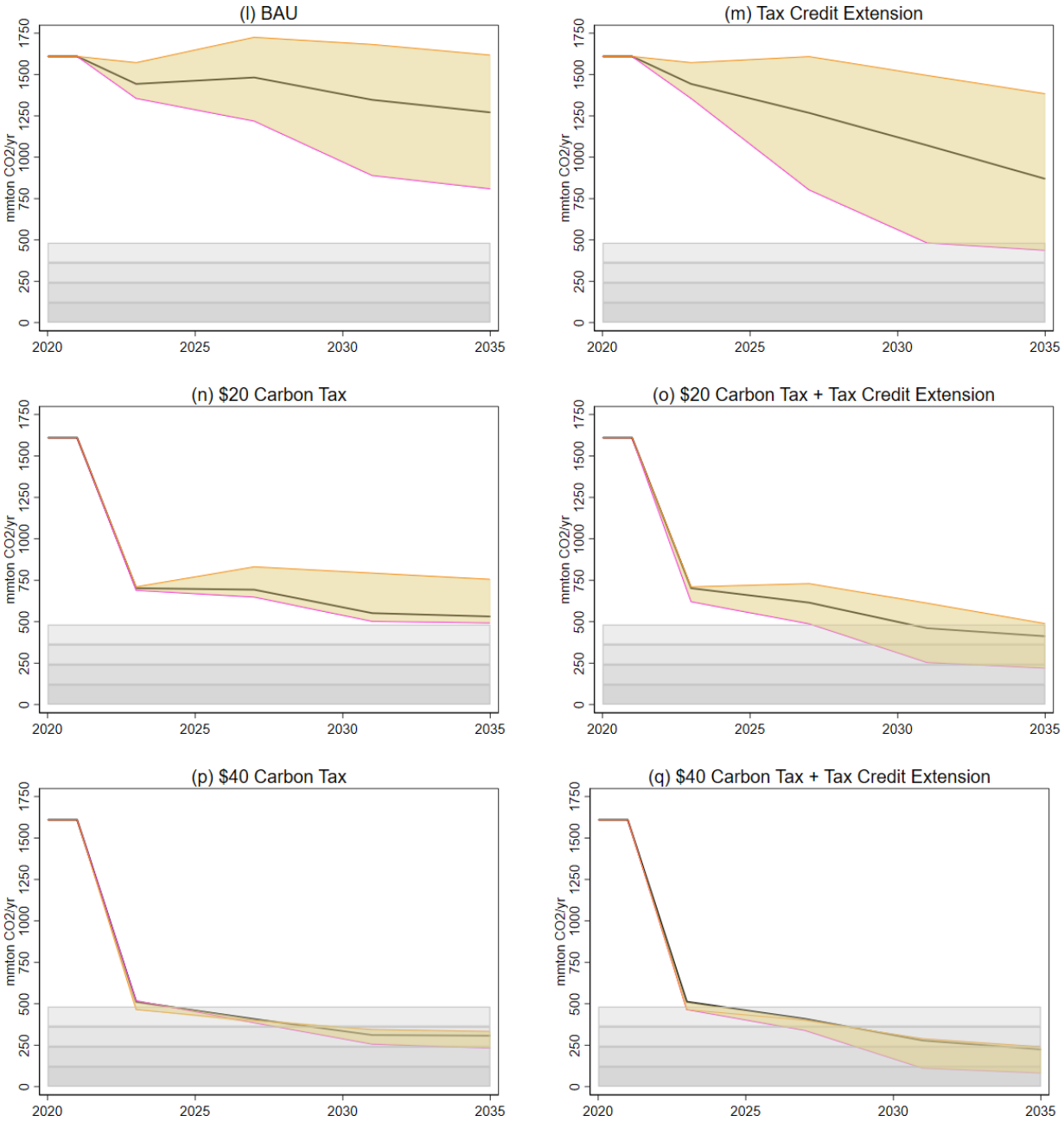
Table 1. Carbon Emissions and Average Abatement By Climate Policy and Technology Scenario

Climate Policy	Annual CO2 Emissions in 2035	2035 Emissions as fraction of 2005 Emissions	Cumulative Abatement	Average Abatement Cost	Tax Credit Expenditures	Carbon Tax Revenues	Net Federal Cost
Reference Technology Scenario:							
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
Low renewables/low gas price scenario							
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
High renewables/high gas price scenario							
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.

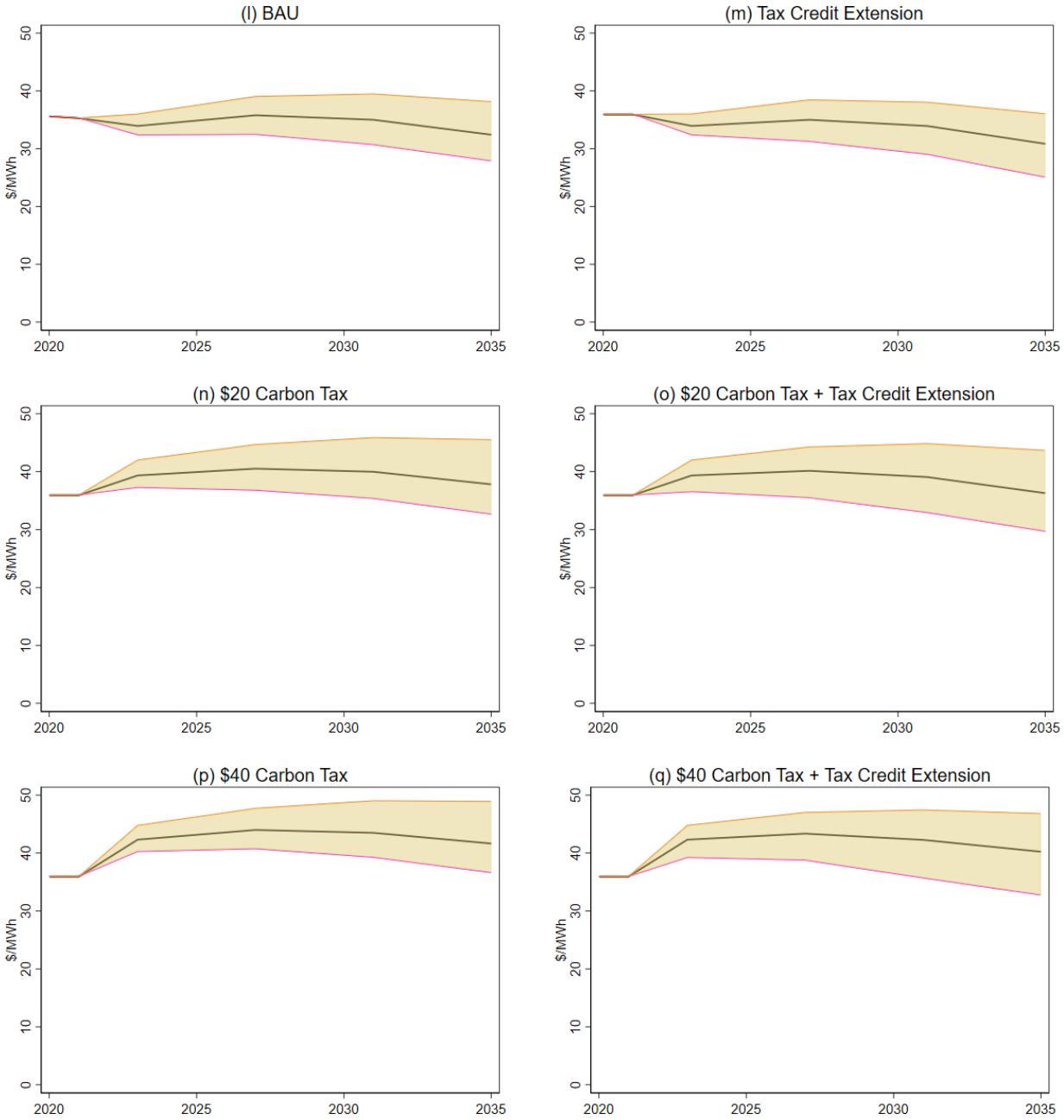
- Even under the most ambitious policy, the $40 carbon tax, the tax credit holds down net system costs, which rise by only $7/MWh from 2020 to 2030 under the reference scenario, and by only $3/MWh under the low renewables cost scenario. Under a $20 carbon tax combined with tax credits, net system costs 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 in cost 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

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