Simplifying Climate Change Legislation: Output-Based Allocations

An output allowance system is quintessentially American, solidly based on market forces and rewarding power entrepreneurs for "doing the right thing." Yet the system allows markets to set the price.

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I. The Reason for Output-Based Allocations

The United States Congress is debating legislation to reduce carbon dioxide emissions and combat climate change. Unfortunately, the major policy vehicle – the Climate Security Act, otherwise known as the Lieberman–Warner bill, named for its Senate sponsors – is a convoluted grab bag of trillion-dollar subsidies spread out over the next 42 years to interest groups and technologies with powerful lobbyists. There is a more direct and effective approach.

What Lieberman–Warner does well is to limit greenhouse-gas emissions to 19 percent below the 2005 level by the year 2020. The bill further demands a 71 percent reduction by 2050. Some argue that these goals should be stricter or looser, but the legislation does set clear targets and timetables.

Then the legislation becomes fatally and needlessly complicated. In order to provide "transaction assistance" (or what might be described as "bribes for the unwilling"), the bill offers subsidies or allowances to utilities, petrochemical refiners, natural gas distributors, carbon

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dioxide sequesterers, state governments updating their building codes, and even Forest Service fire fighters. None of these "gifts" induce construction of clean energy generation.

Output-based allocations offer a more elegant, market-oriented approach. Consider these three simple steps.

First, each electric producer would receive initial allowances of 0.62 metric tons of CO_2 emissions per delivered megawatt-hour of electricity (MWh_E), the 2007 average emissions. Each thermal energy producer would obtain initial allowances of 0.44 metric tons of CO_2 emissions per delivered megawatt-hour of thermal energy (MWh_T), roughly the 2007 average emissions.

Second, every plant that generates heat and/or power would be required to obtain total allowances equal to its CO_2 emissions. Dirty plants must purchase extra allowances from clean plants at market prices. Since allowance purchases equal allowance sales, the economy feels no increase in the average cost of producing heat and power, but clean plants are encouraged and dirty plants are discouraged.

Third, reduce these allowances every year to insure total emission reductions.

Under this output allocation system, clean energy such as wind turbines or industrial waste-energy-recovery plants that have no CO_2 emissions can sell their pollution allowances, thus improving their economics. Combined heat and power units, by earning allowances for both electric and thermal output, would have spare allowances to sell, increasing their financial attractiveness. Improving efficiency at any energy plant would lower emissions (and fuel costs) without lowering output, thereby saving allowance purchases or creating allowances to sell. In contrast, a dirty power plant that did not increase its efficiency would have to buy allowances.

By penalizing efforts to upgrade old, dirty plants, New Source Review has effectively blocked investments to increase efficiency.

Output-based allocations – by supplying both carrots and sticks – offer immediate fiscal incentives to anyone who lowers greenhouse-gas emissions. Lieberman–Warner, in contrast, imposes a cost on polluters but provides no incentive to clean energy sources.

The total cost of the sticks – allowance purchases by dirty plants – equals the value of the carrots – allowance sales by clean plants. Put another way, they are fiscally neutral since dirty generators are paying cleaner generators.

Output-based allowances leverage America's innovative and creative spirit by encouraging all actions that lower greenhouse-gas emissions per unit of useful output, and penalizing above-average pollution per unit of output. The Lieberman–Warner approach, in contrast, has government picking "winners" and distributing up to $5.6 trillion to a hodgepodge of political interests.

Output-based allocations also could improve several provisions of the Clean Air Act, which has achieved impressive results but has blocked investments in energy productivity. The current approach, crafted in 1970 before global warming concerns, gives existing energy plants the right to continue dirty operations but forces new facilities to achieve significantly lower emissions. By penalizing any effort to upgrade these old, dirty plants, the law's New Source Review has effectively blocked investments to increase efficiency.

Output-based allocations, moreover, can effectively control sulfur dioxide (SO_2), nitrogen oxide (NO_x), and particulates, as well as carbon dioxide. A four-pollutant (4-P) approach would reward all pollution control technologies, as opposed to today's rules that mandate *b*est *a*vailable *c*ontrol *t*echnology (BACT) even when BACT costs *10* to *100* times more per unit of avoided pollutant emissions than non-BACT approaches. In other words, a 4-P output approach would unleash market forces to deploy the most cost-effective pollution-reduction strategies, including increased efficiency, thereby guaranteeing a steady drop in total emissions of each pollutant.

Measurement and verification for electric output and CO_2 are easy since all plants have fuel bills and electric meters, and thermal output can be calculated. Continuous-emission meters that track SO_2, NO_x, and particulates are now affordable and proven. Regulators simply need energy plants to submit annual audited records, along with allowances covering actual emissions of each pollutant.

Output allowances can cover the generation of heat and power, which accounts for 69 percent of U.S. carbon dioxide emissions. An adaptation or another approach can address emissions from the burning of transportation fuels.

By unleashing market forces and sending clear signals, output-based allocations can stimulate an investment boom in increased energy productivity and cause the profitable reduction of greenhouse-gas emissions.

II. How It Works

An output allowance system treats all delivered, useful electricity equally and all useful thermal energy equally. Each MWh of delivered electricity – regardless of the fuel burned, the technology employed, or the power plant's age – receives an equal allowance for each criteria pollutant and carbon dioxide. The same is true for each unit of thermal energy.

Each heat and/or power plant is required to continuously monitor each pollutant's actual emissions. At the end of each year, that plant's owner must turn in allowances for each pollutant equal to actual output. Congress sets a schedule of future allowances per unit of output that declines each year and is corrected to offset any growth in total U.S. emissions of each pollutant.

Allowance credits would be fully tradable and interchangeable between heat and power.

Consider carbon dioxide. Every producer of heat and/or power (electricity or mechanical energy) would keep track of all fossil fuel burned in the prior year and calculate the total carbon dioxide released. Each plant also would record the MWh of electricity produced, reduce the amount for line losses, and record each unit of useful thermal energy produced and delivered. The plant would automatically earn the scheduled allowance of CO_2 per MWh and per unit of thermal energy, but it must turn in allowances for every ton of carbon dioxide actually emitted in the prior year.

The allowance credits would be fully tradable and interchangeable between heat and power. Note that efficiency improvements reduce the burning of fossil fuel and thus reduce carbon emissions, but they do not decrease the plant's output, and thus would not decrease total output allowances. Any production of heat or power without burning incremental fossil fuel would earn an emission credit but produce no added emissions, which enables the producer to sell the allowance and improve the profitability of cleaner energy.

An example will illustrate the beauty of an output allowance system. Assume Congress sets the initial allowance credit for each MWh of delivered electricity equal to the U.S. average carbon emissions per MWh for all electricity delivered to consumers in 2007, and sets initial allowances of CO_2 for each MMBtu of useful thermal energy equal to the U.S. average fossil carbon emissions per MMBtu of thermal energy. In other words, the initial allowance credits would precisely equal the total emissions of fossil carbon dioxide in 2007 from heat and power production. The rules, as explained below, offer a powerful incentive for every heat and power plant to improve fossil efficiency.

In 2007, U.S. fossil-fired power plants emitted 2.7 gigatons of carbon dioxide, or 0.62 tons of CO_2 per delivered MWh. Roughly 29 percent of all electricity was generated by plants that used no fossil fuel – hydro, nuclear, wind,

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other renewable, and recycled industrial-waste energy. The 71 percent of the power generated with fossil energy actually produced almost a full ton of CO_2 emissions per MWh, while production from the other sources emitted no CO_2.

If the output allowance system was applied only to electric production, the average fossil-fired generator would earn a credit of 0.62 tons of CO_2 emissions for every delivered MWh, but would emit 0.96 tons and need to obtain added allowances equal to 0.34 tons for each MWh. On the other hand, each MWh of delivered electricity from hydro, renewable, nuclear, and recycled energy also would earn 0.62 tons of CO_2 emission allowance, but since they emit no CO_2 these clean energy producers could sell their allowances to the fossil-fueled generators.

An output allowance system covering just electricity would let the market determine a clearing cost of CO_2 emissions, and then raise the cost of power from fossil-fueled generators and decrease the cost from clean energy plants. Efficiency improvements would be profitable whenever the value of the fuel savings and avoided allowance purchases exceeded the efficiency improvement's financing cost. An electric-only output allowance system would induce some efficiency investments and increase the attractiveness of investing in new clean energy generation, but it would not reward the use of byproduct heat from power generation to displace boiler fulegy. That's why thermal energy also needs to be considered.

For purposes of this analysis, assume the average U.S. MWh of useful thermal energy caused 0.44 tons of CO_2 emissions – about 30 percent less than was produced by the average MWh of electricity. Under the proposed output allowance system, every MWh of useful thermal energy receives 0.44 tons of CO_2 allowance.

A key point: carbon allowances could be exchanged between thermal and electric production.

Carbon allowances, as stated above, could be exchanged between thermal and electric production. To understand the implications, consider four power plants with the same input energy, and assume the average price of CO_2 allowance is $20 per ton.

1. An electricity-only plant burning 3 MWh of fossil fuel generates 1.08 MWh to deliver 1 MWh, and vents 2 MWh of byproduct heat. This central plant earns 0.62 tons of CO_2 credit for its 1 WMh of delivered power. Since the average fossil-fueled electric-only plant emitted 0.96 tons of CO_2 per delivered MWh of electricity, this plant must purchase 0.34 tons of additional CO_2 allowance. This purchase will add $6.80 to the cost of each delivered MWh. Since the average U.S. retail price in 2007 of a MWh was $89, the output allowance system would add 8.5 percent to the cost of the average fossil-fueled electric-only generator.

2. A local plant that generates both heat and power burns the same 3 MWh of fossil fuel to deliver 1 MWh of electricity, earning 0.62 tons of CO_2 credit, but it also recycles 1 MWh of useful thermal energy to displace boiler fuel, earning a further 0.44 tons of credit. This plant, then, earns total allowances of 1.06 tons of CO_2. Since the average local generation plant is more likely to burn gas, it produces 0.6 tons of CO_2 emissions per MWh of electricity. This plant can sell 0.46 tons of CO_2 allowances, worth, in this example, $9.20.

3. Another local generation plant uses 3 MWh of flare gas from a blast furnace to deliver 0.75 MWh of electricity and 2.25 MWh of useful thermal energy, earning 1.4 tons of CO_2 credit. Since this waste-energy recycling plant burns no incremental thermal energy, it has zero incremental carbon emissions and can sell 1.45 tons of CO_2 allowances, worth $29.20

4. A wind turbine delivers 1 MWh of electricity and earns 0.62 tons of CO_2 credits. Since it

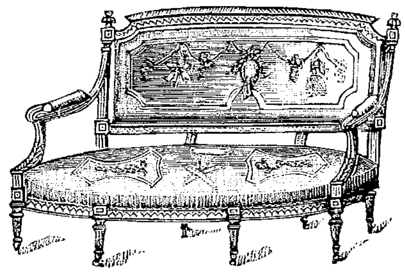
produces no CO_2 emissions, it can sell the full 0.62 tons of CO_2 credits, worth $12.40.

These numbers are representative of actual plants and illustrate an output allowance's directional impact. The clean energy plants receive a carrot of $9.20 to $29.20 per delivered MWh, while the dirtier electric-only units face a stick of having to pay an added $7.60 per delivered MWh.

Heat and power producers, of course, have many options. By increasing efficiency, the owner can reduce CO_2 emissions, save fuel, reduce purchases of allowances, or add revenue from sold allowances. By installing a combined heat and power unit sized to the facility's thermal load, she would earn additional allowances, providing revenues above the value of the saved fuel.

Consider a typical carbon black plant that produces the raw material for tires and inks. It currently flares its tail gas, producing no useful energy service. If the owner built (or had a third party build) a waste-energy recycling plant to convert the flare gas into electricity, it would earn 0.62 tons of CO_2 allowance for every delivered MWh. A typical carbon black plant could produce to MWh per hour, or about 160,000 MWh per year, of clean energy. At $20/ton CO_2, the plant would earn $3.2 million per year from the output allowance system to induce development of this clean power.

Now consider the options for the owner of a coal-fired electric-only generator that emits 1.15 tons of CO_2 per delivered MWh. (This is above the 1.0 tons of CO_2 from the average electric-only plant because coal emits nearly two times as much CO_2 per unit of raw energy as does burning natural gas.) The average coal plant receives only 0.62 tons of CO_2 allowance and must purchase an additional 0.53 tons,



costing, in our example, $10.60 per delivered MWh.

The coal plant owner also has many options. She can invest in devices to improve the plant's efficiency and lower the amount of coal burned per MWh. Second, she could entice a thermal-using process to locate near the power plant and sell some of her presently wasted thermal energy, earning revenue from that sale and added CO_2 allowances for the useful thermal energy. Third, she could invest in a wind farm or other renewable energy production facility and earn CO_2 credits. Fourth, she can pay for an energy recycling plant to earn added allowances. Fifth, she could purchase allowances. Or, sixth, she can consider operating the plant for intermediate instead of baseload. Note that all of her options reduce U.S. total CO_2 emissions.

The output allowance system sends powerful signals to every producer of heat as well as every producer of power. The total money paid for allowances exactly matches the total money received from the sale of allowances, so the average consumer pays no added cost for electricity. The market decides the clearing price of the allowances, and every producer – regardless of technology, fuel, age of plant, or location – receives the same price signals.

The dynamic effect will induce added efficiency, enhance deployment of clean energy, and spur the recycling of waste energy from electric generation and industrial processes. These changes will reduce the burning of fossil fuels and its associated CO_2 emissions.

III. Tasks for Congress

Congress has only two key tasks: to set fair rules for calculating useful output, and to establish the decline rate for the allowances per unit of useful output. Current scientific thinking suggests we must reduce total carbon emissions by 70 percent or more over the next 50 years. If initial output allowances are set equal to average outputs in 2006 for each MWh of electricity and useful thermal energy, allowances would need to decline by 2.38

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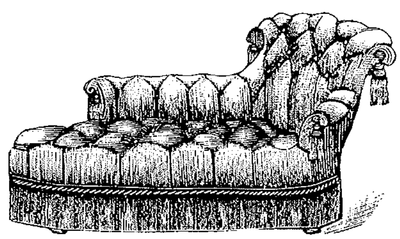
percent per year for the next 50 years in order to reach the 70-percent drop. If there was no increase in the amount of useful energy consumed for the next 50 years, this reduction would cause CO_2 emissions to drop to 30 percent of 2006 emissions.

If the economy consumes more units of useful energy, an additional correction is needed to assure that total CO_2 emissions decline. Congress could mandate an annual and automatic adjustment for the scheduled CO_2 allowances to account for such growth of fossil fuel use. This automatic adjustment would annually calculate the actual units of greenhouse-gas emissions in the immediately prior year and correct the scheduled allowance credits for load growth.

Rather than predict consumption of electricity and thermal energy, this proposed system automatically adjusts to every possible change in consumption. If new technology and more rapid deployment improve energy productivity faster than economic growth, the amount of greenhouse-gas emissions will decline relative to the base year, and there will be larger allowances, making the transition to low-carbon emissions less expensive. If total U.S. greenhouse-gas emissions grow, allowances for the next year will be reduced and presumably become more expensive, which will suppress demand.

IV. Virtues of the CO_2 Output Allowance System

The output allowance system is simple, keeps government from picking technology (which is always a bad bet), allows maximum flexibility for the market to lower fossil fuel use, and encourages profitable green-



house-gas reduction. Consider the faults of other approaches.

A carbon tax requires legislators to determine the precise price per ton of CO_2 emissions that would cause the desired reduction of fossil fuel consumption. Congress then must decide how to spend the money, creating an atmosphere ripe for mischief.

A cap-and-trade system that allocates initial allowances to existing emitters, as was done with sulfur emissions in 1990, rewards pollution rather than clean energy. Awarding allowances based on past emissions rewards the historically dirtiest energy producers but raises costs for new clean power plants. A new combined-heat-and-power facility, although emitting half of the CO_2 per MWh of older plants, would receive no baseline allowances, be required to purchase carbon allowances for all CO_2 emissions, and then would compete with an old plant that was gifted sufficient allowances to cover all emissions. Such an allocation approach is favored by owners of existing plants, for obvious reasons, but it retards efficiency.

A system of allowances per unit of input fuel, such as the Clean Air Act's approach towards criteria pollutant emissions, pays no attention to energy productivity and gives no credit for energy efficiency. By contrast, an output-based allowance system rewards every approach that emits less CO_2 per MWh, regardless of technology, fuel, location, or age of plant. Thus, the output allowance approach will produce the lowest possible cost CO_2 reductions. In fact, if the output allowance system is coupled with modernizing energy sector regulations, there will be both strong economic gains and emission cuts. In other words, they will induce profitable greenhouse-gas reductions.

Perhaps most important, the output allowance system is quintessentially American, solidly based on market forces and rewarding power entrepreneurs for "doing the right thing." Yet the system allows markets to set the price. An output system will trigger a massive investment boom in all clean power and enable America to provide world leadership in profitably reducing emissions.■