Carbon emissions and management scenarios for consumer-owned utilities

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A R T I C L E   I N F O

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A B S T R A C T

An important subset of the utility sector has been scarcely explored for its ability to reduce carbon dioxide emissions: consumer-owned electric utilities significantly contribute to U.S. greenhouse gas emissions, but are often excluded from energy efficiency and renewable energy policies. They sell a quarter of the nation’s electricity, yet the carbon impact of these sales is not well understood, due to their small size, unique ownership models, and high percentage of purchased power for distribution. This paper situates consumer-owned utilities in the context of emerging U.S. climate policy, quantifying for the first time the state-by-state carbon impact of electricity sales by consumer-owned utilities. We estimate that total retail sales by consumer-owned utilities account for roughly 568 million metric tons of CO2 annually, making this sector the 7th largest CO2 emitter globally, and examine state-level carbon intensities of the sector in light of the current policy environment and the share of COU distribution in the states. Based on efficiency and fuel mix pathways under conceivable regulations, carbon scenarios for 2030 are developed.

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1. Introduction

The U.S. electricity sector contributes roughly 40% to U.S. greenhouse gas emissions, making it a key target for meaningful emission reductions (Pacala and Socolow, 2004). While carbon cap-and-trade efforts are emerging regionally and nationally in the United States, the most widely used approaches to curb carbon emissions in the electric utility sector are to increase the amount of renewable generation and to reduce energy demand growth through efficiency programs. These proven strategies represent core carbon mitigation strategies for the electricity sector. However, with few exceptions, regulatory efforts in this area have targeted large, investor-owned utilities, often excluding municipal utilities, rural electricity cooperatives, and district power providers. These energy service providers, collectively referred to as consumer-owned utilities (COUs) due to their non-profit and customer empowering models of governance, hold a unique set of organizational challenges when implementing carbon management policies, from their relatively small size and limited access to resources to their complex ownership models and often dispersed rural focus. Yet, their broad presence across the nation (COUs operate in all U.S. states) and their significant share of the electricity market (amounting to more than a quarter of retail sales) underscore their importance.

While significant strides in U.S. climate change legislation in the electricity sector have been made in recent years, mainly driven by the states (Rabe, 2008), COUs have largely been ignored by these provisions. Almost all state energy efficiency policies exempt COUs or grant them exceptions, as do almost half of all state renewable portfolio standards.
The policy realm’s inattention to COUs is compounded by the general lack of available data on COUs. Indeed, the majority of current research efforts, while offering important contributions, explicitly or implicitly focus solely on the investor-owned sector (Eto and Vine, 1996; Fershee, 2008; Loughran and Kulick, 2004; Wiser et al., 1998). Creating policies that reward building renewable and energy efficiency capacity in these organizations is compounded by the difficulty in assessing the carbon impact of COUs. The vast majority of these organizations do not own or operate all of the necessary generation to satisfy the loads they serve. However, with state renewable policies mandating shares in sales, rather than in generation, and utility-run energy efficiency programs at the distribution level being the preponderant model of deployment, addressing COUs is a reasonable future pathway of policy extension for many states. As a point source, electric generation represents a relatively straightforward target for pollution regulation, as opposed to mobile sources, where regulation faces significant information costs (Cabe and Herriges, 1992; Segerson, 1988). A small number of COUs already run innovative and high performing energy efficiency (Flanigan and Hadley, 1994) or renewable energy programs (Dracker and De Laquil, 1996), demonstrating that capacity for these carbon mitigation strategies exists.

In this paper, we address the growing relevance of COUs within the context of climate change. First, we examine the role of COUs within the context of the U.S. electricity industry. Second, we provide an overview of the policy landscape and the present state of energy efficiency and renewable generation among COUs. Third, we estimate the carbon intensity of electricity sales from the COU sector, incorporating both generation and purchased power on a state-by-state basis. Fourth, we analyze the implications of several carbon management scenarios for COUs through the year 2030. Finally, conclusions and recommendations are provided for greenhouse gas reduction strategies for the COU sector at both the state and federal levels.

2. Growing relevance of consumer-owned utilities under climate change

2.1. Consumer-owned utilities in the US energy system

COUs are comprised of rural electric cooperatives and municipal and district utilities. In contrast to investor-owned utilities, COU governance relies on direct customer control. Cooperatives fall into two categories: distribution and generation and transmission (G&T) units. Sixty-six G&T cooperatives provide power for more than 800 distribution units in the U.S., often operating under long-term exclusive power purchasing contracts. Municipal and district utilities are owned by the government and under direct customer control, while state and federally owned utilities do not have direct customer control and are therefore excluded from this study. These organizations often have some generation capacity of their own, but generally enter into long-term contracts with municipal marketing authorities, investor-owned utilities and power marketers. Currently, the US has 1852 municipal utilities and 102 district utilities. Overall, COUs are significantly smaller than investor-owned utilities, which, on average, sell more than 25 times the amount of power as the average COU. Despite the small size of individual COUs, taken together, they are large suppliers of electricity. In 2006, they accounted for 25.5% of end consumer electricity sales and serviced 26.9% of all customer accounts (Fig. 1). In the same year, they generated more than 500 TWh, accounting for close to 20% of power production by regulated utilities. In addition, COUs have tremendous reach across the U.S. Municipal utilities are found in every state but
Hawaii and cooperatives supply over 75% of the U.S. land area with power. In view of COUs’ geographic reach and large customer-base, excluding them from carbon reduction policies places greater burdens on investor-owned utilities and their customers, who have to shoulder a disproportionate share of the costs associated with the transition to cleaner electric power. Exclusion of COUs from such policies is aided by their historical position within policy and political institutions. COUs largely govern themselves, often based on the notion that their direct ownership and governance structures can guarantee fair rate-making even under monopoly conditions. They set their own rates in all but a few states. In fact, fewer than 20 state commissions regulate cooperatives (Greer, 2003) and most do not have jurisdiction over municipal utilities either (APPA, 2007; Bachrach et al., 2004). Only seven states have full rate regulation authority over municipal utilities, with another seven states regulating utility rates under specific conditions (APPA, 2007). Additionally, large swaths of regulation address solely the generation level, particularly where emissions are concerned, and many regulations exclude small sources. Finally, the geographical pervasiveness of COUs provides them with considerable political clout. Electoral districts of many state senators and federal members of Congress overlap with their service territories and board members of COUs are often part of the local elite.

The widespread practice of excluding COUs from regulations may become more problematic in light of new climate change mitigation approaches. It has been suggested that a carbon cap-and-trade system might be best situated at the distribution level to stimulate end-use efficiency in direct contact with customers, and to avoid windfall gains for generators (RAP, 2006). More generally, market-based pollution control systems necessitate the inclusion of all types of providers. As described by Bushnell et al. (2008: 175), regionalized policy regimes can result in both leakage (“physical relocation of the [...] economic activity”) and reshuffling (changes in “who buys from whom”), effectively eliminating any gains from environmental policies. While the concept of leakage has primarily been conceptualized geographically (Cowart, 2006), leakage can also result from the exclusion of industry sectors (Palset, 2001). Where renewable mandates or a potential carbon cap-and-trade system is concerned, this may lead to power purchase reshuffling at the wholesale or end sale level. As a result, COUs might switch to dirtier fuels or purchase electricity from dirtier sources. This phenomenon may already be emerging. Despite a recent bout of project cancellations, COUs still propose 20% capacity growth from coal, compared to 4.9% for investor-owned utilities.\(^1\) A large number of coal plants are also being proposed by independent power providers, a major source of purchases for COUs. In short, both generation and purchases by COUs are at risk of becoming significantly more carbon intensive. On top of production shifts, in deregulated states, price advantages associated with cheaper dirtier fuels might lead to consumer shifts.

2.2. Present policy efforts for carbon management: energy efficiency regulations and renewable portfolio standards at the state level

The most prominent strategies levied to reduce carbon emissions from electric utilities are energy efficiency and renewable generation programs. Utility-based energy efficiency programs encourage or require active intervention by a utility to influence the shape or the amplitude of its load curve through demand side measures (Gellings and Chambélin, 1988). They mandate utilities to attain either a spending or energy savings goal. In response to deregulation, systems benefit charges have also been introduced to provide funds for services that had so far been assumed by utilities (Heiman and Solomon, 2004). This surcharge is levied on customer bills to finance energy efficiency programs, R&D, education programs, renewable energy, etc. Renewable portfolio standards specify goals for renewable electricity generation, usually expressed as a percentage of electricity sales or absolute capacity. Goals vary in the quantity of renewable generation and the time horizon they prescribe. Many state RPS systems mandate a 15–25% renewable share of total capacity (Table 1).

Initially motivated by concerns about pollution control and resource management, policies supporting renewable generation and energy efficiency have come to represent key pathways for reducing greenhouse gas emissions in the electricity sector. Over the past 25 years, utilities have gained considerable experience with implementing these policies. Utility-centered strategies for carbon management benefit from positive public perception and fit the American model of private implementation of public goals, contributing to their political feasibility. In a significant number of U.S. states, these strategies are at the core of utility sector carbon management. U.S. energy regulation is largely in the domain of the states (Rabe, 2008), and carbon management in this sector is driven by state action. Presently, there are no federal policies on utility-based energy efficiency or renewable generation goals (Byrne et al., 2007), although the federal government grants the Production Tax Credit and R&D subsidies. While the federal government may move to act on climate change in the near future, state action is likely to remain relevant since federal action often determines a minimum requirement with individual states being allowed to set more rigorous policy. Current deliberations at the federal level apply only to very large utilities and target renewable energy levels substantially lower than many state policies. For instance, under the House approved “American Clean Energy and Security Act of 2009” (H.R. 2454), a national renewable mandate of 15% by 2025 would only apply to utilities selling more than 4 million kWh. This would result in the exclusion of all but the 23 largest COUs. State-level carbon mitigation policies are therefore likely to retain their importance, and their architecture.

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1 Based on a comparison of proposed capacity additions from coal between 2003 and 2009 (DOE-NETL, 2007; Sierra Club, 2009) and 2006 nameplate capacity for all fuels (EIA, 2007a), investor-owned utilities plan to increase their capacity by 4.9%, where municipal and district utilities propose to add 10.5% additional capacity and cooperatives plan to add 33%. While at the time of publication IOUs have 31 coal plants in all stages from initial proposal to approval and COUs have 30 such plants, relative to current capacity, COUs are adding new coal generation at a rate four times that of IOUs.

<table>
<thead>
<tr>
<th>State</th>
<th>COU sales in state (GWh)</th>
<th>Annual demand growth (%)</th>
<th>Renewable portfolio standard</th>
<th>Energy efficiency regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total (GWh)</td>
<td>% share</td>
<td>COU status</td>
<td>Goal</td>
</tr>
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<td>5,683</td>
<td>93</td>
<td>2.4</td>
<td>Not included</td>
</tr>
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<td>28,116</td>
<td>33</td>
<td>2.5</td>
<td>Not included</td>
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<td>17,965</td>
<td>44</td>
<td>3.3</td>
<td>Included with exceptions</td>
</tr>
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<td>30,805</td>
<td>41</td>
<td>3.7</td>
<td>Included with exceptions</td>
</tr>
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<td>62,371</td>
<td>24</td>
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<td>Fully included</td>
</tr>
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<td>19,863</td>
<td>38</td>
<td>3.0</td>
<td>Included with exceptions</td>
</tr>
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<td>2,086</td>
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<td>Fully included</td>
</tr>
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<td>Not included</td>
</tr>
<tr>
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<td>50,458</td>
<td>37</td>
<td>3.2</td>
<td>-</td>
</tr>
<tr>
<td>HI</td>
<td>452</td>
<td>4</td>
<td>1.4</td>
<td>Not included</td>
</tr>
<tr>
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<td>10,333</td>
<td>21</td>
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<td>Not included</td>
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<tr>
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<td>2,981</td>
<td>18</td>
<td>1.6</td>
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<tr>
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<tr>
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<tr>
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<td>37</td>
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<td>-</td>
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<td>32,542</td>
<td>51</td>
<td>2.5</td>
<td>-</td>
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<tr>
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<td>12,467</td>
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<td>-</td>
</tr>
<tr>
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<td>7,870</td>
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<tr>
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<td>4,882</td>
<td>5</td>
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</tr>
<tr>
<td>ME</td>
<td>169</td>
<td>92</td>
<td>0.1</td>
<td>Fully included</td>
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<tr>
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<td>11,872</td>
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<tr>
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<td>22,764</td>
<td>32</td>
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</tr>
<tr>
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<td>49</td>
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<td>-</td>
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<tr>
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<td>5,885</td>
<td>70</td>
<td>3.1</td>
<td>(voluntary)</td>
</tr>
<tr>
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<td>26,888</td>
<td>100</td>
<td>2.7</td>
<td>-</td>
</tr>
<tr>
<td>NH</td>
<td>922</td>
<td>9</td>
<td>1.3</td>
<td>Fully included</td>
</tr>
<tr>
<td>NJ</td>
<td>1,368</td>
<td>3</td>
<td>1.5</td>
<td>Not included</td>
</tr>
<tr>
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<td>6,936</td>
<td>47</td>
<td>2.8</td>
<td>Included with exceptions</td>
</tr>
<tr>
<td>NV</td>
<td>2,307</td>
<td>7</td>
<td>4.7</td>
<td>Not included</td>
</tr>
<tr>
<td>NY</td>
<td>4,842</td>
<td>4</td>
<td>0.8</td>
<td>Not included</td>
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<tr>
<td>OH</td>
<td>17,440</td>
<td>6</td>
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<td>Not included</td>
</tr>
<tr>
<td>OK</td>
<td>13,532</td>
<td>35</td>
<td>1.5</td>
<td>-</td>
</tr>
<tr>
<td>OR</td>
<td>13,965</td>
<td>16</td>
<td>0.7</td>
<td>Included with exceptions</td>
</tr>
<tr>
<td>PA</td>
<td>3,996</td>
<td>3</td>
<td>1.6</td>
<td>Not included</td>
</tr>
<tr>
<td>RI</td>
<td>52</td>
<td>1</td>
<td>1.3</td>
<td>Not included</td>
</tr>
<tr>
<td>SC</td>
<td>18,720</td>
<td>36</td>
<td>2.3</td>
<td>-</td>
</tr>
<tr>
<td>SD</td>
<td>4,531</td>
<td>61</td>
<td>3.0</td>
<td>(voluntary)</td>
</tr>
<tr>
<td>TN</td>
<td>92,949</td>
<td>74</td>
<td>1.9</td>
<td>-</td>
</tr>
<tr>
<td>TX</td>
<td>82,046</td>
<td>24</td>
<td>2.1</td>
<td>Included with exceptions</td>
</tr>
</tbody>
</table>
provides valuable information on the future design and effectiveness of different approaches.

With regard to state-level energy efficiency policies, most of the requirements only apply to investor-owned utilities. As of 2007, among the 27 states with utility-administered energy efficiency programs or public benefits funds, 16 completely exclude COUs (Table 1). With regard to the coverage of COUs under state renewable portfolio standards (RPS), out of 30 states with mandatory renewable portfolio standards in 2007, only seven fully include COUs, and another nine include them with exceptions or special provisions. Some states, while not explicitly differentiating between provider types, link targets to size or exclude the smallest utilities. This often results in exemption or exceptions for high percentages of COUs. Finally, some states leave the decision to participate in these policies to COUs or exempt them from binding targets.

2.3. Existing energy efficiency and renewable energy efforts in consumer-owned utilities

The electric utility industry spent $1.9 billion in 2005 for energy efficiency (EIA, 2006a), and reported energy savings of 54 TWh in 2004, accounting for 1.4% of total retail sales (EIA, 2006b). Close to half of all investor-owned utilities reported efficiency programs of some form in 2005, but only 11% of municipal utilities and 21% of cooperatives reported implementing these programs (EIA, 2006b). Since only larger utilities report on these programs, these numbers may underestimate actual usage of efficiency programs by COUs. Industry sources suggest that close to half of all COUs run some type of energy efficiency program (Moline, 1992; NRECA, 2007). The evidence on cost-efficiency of COU-run energy efficiency programs is mixed. Comparable nationwide data is not available and few states require comprehensive reporting of costs and savings. For the state of Minnesota, lifetime costs per kWh were found to range from 7.5 cents to 28 cents (OLA, 2005). A recent study of energy efficiency in California public utilities found an average lifetime cost of 0.032 cents/kWh, a figure almost on par with the costs incurred by investor-owned utilities (CMUA, 2006) and significantly below those in Minnesota. One possible explanation for these divergent assessments is that California counts a number of very large COUs, with longstanding experience in energy efficiency. These numbers compare to a range from 0.8 to 22.9 cents/kWh reported in a recent review of the relevant literature on investor-owned utilities (Gillingham et al., 2006). Over all, this may indicate that smaller organizations face unique hurdles in initiating cost-effective energy efficiency programs, although anecdotal evidence suggests that some COUs have the capacity and political will to run far-reaching and successful energy efficiency programs (Flanigan and Hadley, 1994).

Similar to other regulated utilities, investment in renewable generation technology has been slow among COUs. In 2006, electric utilities generated 10,000 GWh of non-hydro renewable electricity (EIA, 2007c). This represents a mere 10.4% of all renewable energy generated in the U.S., bearing witness to the fact that many electric utilities buy from independent generators instead of engaging in renewable generation themselves. Data on generation for each electric provider type are lacking, making it difficult to assess the U.S.
share of renewable electricity generation by COUs. However, capacity data suggest that renewable energy is not a significant factor in COUs’ fuel mix, with 0.5% capacity reported among municipal utilities and 0.2% among cooperatives (EIA, 2007a). While overall renewable capacity is small, significant individual efforts by COUs suggest they could increase renewable generation and sales in the future. Municipal utilities, in particular, have been among the first proponents of renewable energy commercialization (Dracker and De Laquil, 1996) and many have established ambitious renewable energy targets (APPA, 2008).

3. Not all kilowatt-hours are created (or sold) equally

The electric generation mix determines the carbon intensity of a kilowatt-hour, and the contribution of COUs to U.S. greenhouse gas production is considerable. Cooperatives, in particular, are greenhouse gas emissions intensive, with 82% of their electricity generated from coal plants (EIA, 2007d). Coal’s share of total electricity generation is more than a third higher among cooperatives than among other electric utilities.2 Not surprisingly, cooperatives’ coal-intensive fuel mix translates into above-average carbon emissions. They discharged at least 120 million tons of CO2 in 2005 (EPA, 2007), on average, U.S. generating plants emitted 630 kg of CO2 per MWh generated, where cooperatives emitted 850 kg (EPA, 2007). Carbon intensity of cooperatives’ generation is exacerbated by the disproportionate system losses occurring in low density areas. The median line loss for distribution-level cooperatives was 6.6% in 2003, with additional system losses of 3% at the generation and distribution level (APPA/ NRECA, 2005), while average combined losses in the U.S. amounted to 5.8% the same year (World Bank, 2004).

Municipal and district utilities, in contrast, run natural gas fired-plants and hydropower plants for 20% and 22% of their own generation, respectively (EIA, 2007d), with coal accounting for only 49% of owned generation, making them appear much less carbon intensive. However, the manner in which data on these organizations are collected by government makes summarizing carbon intensity for municipal and district utilities exceedingly difficult. Accurate evaluation of their emissions is hampered for two primary reasons: (1) many of these facilities are small and excluded from reporting requirements, with emissions data available for only about 40% of total generation,4 and (2) many purchase a significant portion of their electricity, of which the source is not known.

Based solely on generation, municipal utilities appear quite different from cooperatives in their carbon impacts. However, given that existing policies focus on distribution, it seems relevant to investigate the carbon impact of retail sales. When analyzing retail sales, this difference is substantially reduced due to the large amount of power purchased by COUs. For example, in Oklahoma and Wisconsin, generation by municipal utilities appears quite clean, with Oklahoma’s generation primarily produced from natural gas (82%) and Wisconsin relying on coal for only 31% of their generation. However, in both cases, municipal utilities purchased over 90% of their electricity. Regional grids for both states, which, one might reasonably assume, reflect the carbon intensity of power purchases, have significantly higher coal dependencies. Similarly, cooperatives in Kansas and Mississippi appear very coal intensive (95% and 86%, respectively), however, 44% and 82% of cooperatives’ retail sales in these states are derived from purchased power from less coal-intensive regional grids (64% and 59% coal, respectively). These examples illustrate the importance of examining carbon impacts at the sales level, where purchased power is included. While significant differences undoubtedly remain between ownership models, with regard to state-level renewable and energy efficiency policies, municipal, cooperative and district utilities tend to be included (or excluded) together. Thus, in the following section, we estimate the carbon intensity of electricity sales across the COU sector, in aggregate and on a state-by-state basis.

3.1. Carbon intensity of consumer-owned utility sales

Where a kilowatt-hour is produced affects its carbon intensity. This is important to the examination of carbon management policies, as carbon intensity of COU sales varies significantly across the U.S. The lack of emission data for COUs complicates any reliable assessment of their carbon impact. This is compounded by the fact that generation owned by COUs makes up only a part of the electricity sold. Based on the trend of state renewable policies mandating shares in sales, rather than in generation, and utility-run energy efficiency programs requiring spending and savings targets at the retail level, carbon impacts must be examined at both the source of generation and also at the retail sales level. Yet, the carbon impacts of purchases are not well understood, particularly when COUs are involved, since individual utility supply data are not readily available and cross-state transfers of electricity play a role that is not well documented (Jiusto, 2006).

In order to arrive at an estimate for carbon emissions of electricity sold by COUs, we calculated the weighted fuel mix for their retail sales and report findings in Table 2. Due to the relatively large amount of power sold by COUs that is either purchased or for which fuel mix data is not available (64% of sales in 2006, EIA, 2007b, 2007d), we begin by obtaining available fuel mix data for COU generation, then estimate the fuel mix of the remaining sales by deducting generation from retail sales and applying the fuel mix of the state’s respective regional grid (North-American Electric Reliability Corporation region). We also calculate total carbon emissions and carbon intensity (tons/MWh) associated with the retail sales of COUs by state. To this end, we calculate state-by-state fuel-input intensity data (EIA, 2007d), and then apply fuel-input specific emission coefficients for electricity generation to arrive at carbon intensity figures (EIA, 2008c). A more detailed explana-
tion of methods used can be found in the supplementary online material.

In total, we estimate that COUs' 2006 electricity sales are responsible for approximately 568 million tons of carbon emissions, equal to about a quarter of emissions generated by the electric power sector (EIA, 2008d) and 10% of all U.S. CO2 emissions (EIA, 2008a). This is roughly equivalent to the 2005 CO2 emissions of the United Kingdom, the 7th largest CO2 emitter in the world (World Resources Institute, 2008). Carbon emissions associated with COU sales also surpass energy-related greenhouse gas emissions of the U.S. chemical industry by 80%, are two and a half times that of steel industry emissions and five times as large as paper industry emissions (Schipper, 2006). Not only are these emissions too large to be system-
atically ignored by state or emerging federal policy, they are also of similar carbon intensity to the U.S. electric utility average. We estimate that overall COU sales produced 0.64 tons of carbon dioxide emissions for every MWh sold in 2006, compared to 0.66 tons/MWh for the electric power sector in 2005, the last year for which carbon emission data is available (EIA, 2007c).

While average carbon intensity is not significantly different from the industry as a whole, the state-by-state analysis illuminates geographic differences. Tremendous variation exists among COUs across states, both in carbon intensity and in the share of electricity sold within each state (Fig. 2). The variation of carbon intensity across the states is dramatic, ranging from 0.068 tons CO₂/MWh in the state of Washington, where municipal utilities serve a third of all electricity demand, to 1.07 tons CO₂/MWh in North Dakota, where cooperatives sold 70% of all electricity in 2006. Within this context, it becomes apparent that a kWh saved or displaced in the most carbon intensive state is—from a greenhouse gas reduction perspective—worth more than a kWh in a less carbon intensive one. For example, approximately a ton of CO₂ is emitted for every MWh sold by COUs in North Dakota, making it four times as carbon intensive as electricity produced in California. Thus, a California energy efficiency program targeting COUs would need to save 4 kWh for every one saved in North Dakota. Dependent on the importance of the COU sector, RPS and energy efficiency policy standards could conceivably reduce greenhouse gases more in some states, and less in others. 16 states can be classified as having a high share of COU sales, which are also relatively carbon intensive (accounting for 42% of all COU emissions). Only 15 states can be classified as having COU sales that are both relatively minor (share of state energy sales below the median) and relatively clean (carbon intensity factor below the state median). Nonetheless, even these states will need to lower carbon emissions in order to achieve necessary levels of emissions reductions.

Overall, the 31 states that have no mandates for COUs account for roughly 60% of total COU retail sales (525,000 GWh) and represent close to two-thirds of COU associated carbon emissions (365 million tons). This results in an average carbon intensity factor of 0.696 tons/MWh, higher than both the overall COU state average and the national utility average. In contrast, only seven states have enacted both renewable portfolio standards and energy efficiency legislation which
include COUs. While these states represent slightly more than a quarter of COU sales, their sales are significantly less carbon intensive—creating only 0.470 tons of CO2 for every MWh sold. Significantly, only two states with relatively dirty COU sales—Minnesota and Wisconsin—count among this group.

In sum, with few exceptions, state-level policies that include COUs are not situated in the states with the dirtiest COU sales, and/or the highest absolute COU sales. As a result, their current impact on COU emissions is limited. Broader, and potentially strategic inclusion of COUs in these and other greenhouse gas reduction regulations could have a more significant effect. From a climate perspective, the importance of including COUs varies significantly by state. Conversely, in states where COUs hold a small share of the market, or where their fuel mix is relatively clean, state governments may be less inclined to spend the resources or political capital required to include COUs, or require higher levels of compliance within existing policies, though it may be easier, politically, to do so.

3.2 Carbon scenarios: including consumer-owned utilities in renewable energy and energy efficiency policies

The long-term goal of any climate policy must be stabilization of atmospheric concentrations of greenhouse gases (IPCC, 2007). As CO2 and other greenhouse gases are long-lived in the atmosphere, stabilization of atmospheric concentrations will require greenhouse gas emissions reductions of roughly 80% by 2050 (Pacala and Socolow, 2004). While it is important to recognize the geographical distribution of COU carbon intensity, future emissions from COUs should be analyzed within the context of a larger climate policy including both utility-based energy efficiency and renewable portfolio policies. Here, we develop a series of scenarios, incorporating COU load share and carbon intensity, state electric generation data, and electric sector growth to examine the implications of adopting varying degrees of energy efficiency and renewable energy policies for COUs across all states. We develop a business-as-usual case, as well as combinations of weak and strong renewable policies (15% and 25% renewables by 2030, respectively) and weak and strong energy efficiency policies (0.5% and 1% annual demand savings).

In developing our scenarios, we make several simplifying assumptions: (1) we assume no significant changes to fuel mix in the business as usual scenario and scenarios that include only energy efficiency; (2) we tie electricity demand growth to an EIA (2008b) projection of 1.1% annual demand growth up to 2030; (3) all renewable generation scenarios assume renewables replacing coal power, with natural gas slightly increasing to counterbalance intermittency (+3% in 2030). This last assumption represents the most favorable scenario from a carbon policy perspective, since replacement of the most carbon intensive fuels by renewables results in the largest emissions savings. Further elaboration on scenario development is provided in the supplementary online material.

Percent change in carbon emissions associated with the COU sector meeting each policy scenario is presented in Fig. 3. Our business-as-usual scenario projects carbon emissions to be nearly 29% larger in 2030 (730 million tons) than current 2006 levels (568 million tons). While each policy scenario in isolation provides reductions over business as usual, carbon emissions increase from 2006 levels under all but the most...
aggressive renewable portfolio standard. Under a strong renewable portfolio standard, without additional energy efficiency improvements, 2030 carbon emissions are estimated to be 495 million tons, a 12.9% reduction (73 million tons) over 2006 levels.

When renewable and energy efficiency policies are combined, carbon reductions become more meaningful. By adding energy efficiency to a strong renewable portfolio goal, the savings approach the deep emissions reductions necessary for atmospheric stabilization of greenhouse gases. Carbon reductions in 2030 more than double with the addition of a weak energy efficiency policy. Carbon emissions under this scenario are estimated to be 453 million tons in 2030. Coupling a strong RPS policy with a strong energy efficiency target results in 2030 estimated reductions of 216 million tons, less than two-thirds of 2006 emissions.

Indeed, pursuing all available policies will be necessary for meaningful greenhouse gas reductions, particularly given the sensitivity of the above estimates to fuel substitution pathways and projected demand growth. We first explored the impact of a fuel substitution pathway where renewables replace natural gas instead of coal. Under this assumption, only the combination of strong renewable and strong energy efficiency policies would result in emissions reduction (16% over 2006 levels). In all other renewable scenarios, emissions would increase, between 5% and 28% over 2006 levels. Structuring fuel replacement pathways therefore has to be an important part of renewable policies.

We also explored the impact of different demand growth rates. The EIA projection used in our analysis likely reflects some demand savings, meaning that our energy efficiency scenarios may underestimate actual demand growth. Based on historical data since 1990, electricity demand grew at an annualized rate of 1.92% (EIA, 2007c). A recalculation of the scenarios at this rate of growth results in 2030 business-as-usual carbon emissions of 1.047 billion tons, an 85% increase over 2006 emissions. Even more striking is that under this demand growth assumption, only the most stringent RPS and energy efficiency policies examined provide any carbon emissions reduction in 2030 below 2006 levels, and only a meager 8.1%. This demonstrates that the success of an RPS policy depends heavily on whether new renewable generation displaces current carbon intense sources, or simply satisfies new demand.

At the individual state level, the importance of pursuing a dual path of energy efficiency and renewable energy strategies for reducing carbon emissions varies greatly—driven primarily by the demand growth rate and the carbon intensity of electricity sales. Between 1990 and 2007, annualized state-level electricity demand growth ranged from Washington’s –0.4% to Nevada’s 4.3% (refer to Table 1). Notably, energy efficiency and RPS policies are not generally applied in states with high growth rates. Only eight states with above median growth rates have at least one of the policies. Four of the seven states that implement both policies for COUs are both relatively clean and slow growing, meaning that the impact of these policies is likely small. We calculate the impacts of strong energy efficiency and strong RPS policy scenarios in four U.S. states—Arkansas, Massachusetts, North Dakota, and Wyoming (see Fig. 4). These states provide examples of “high versus low carbon intensity” and “high versus low demand growth,” for comparison. All COUs in these states currently operate without energy efficiency or RPS mandates.

Under these conditions, even a combination of strong efficiency and renewable policies reduces emissions below 2006 levels in only the slow-growing states of Massachusetts and Wyoming, while fast-growing Arkansas and North Dakota continue to see emissions increases. As one might expect, where growth is low, additional renewable capacity can replace fossil fuel sources, as opposed to servicing new demand. In states with fast-growing electricity demand, slowing growth rates through energy efficiency is an important first step towards keeping carbon emissions in check. In dirty states, RPS gains from replacing dirtier fossil fuels are potentially larger. In Wyoming and North Dakota, where COUs sell highly carbon intensive power, implementing an RPS alone reduces emissions more than implementing only a strong energy efficiency policy. Arkansas and Massachusetts, with their relatively clean electricity sales, provide fewer absolute greenhouse gas emissions reductions for each
kilowatt-hour saved or displaced, and the electric demand growth rate determines which policy in isolation is more effective. Slow-growing Massachusetts, for example, benefits more from an RPS, while emissions reduction potential is greater for energy efficiency in Arkansas, which is both clean and fast-growing.

Implementing these policies in fast-growing states, while most likely not contributing to absolute reductions over 2006, remains crucial to reduce overall sector CO₂ emissions. In fact, the state case studies suggest that reductions over business-as-usual trajectories may be larger in many high growth states. For example, North Dakota’s emission reductions over business as usual projections are expected to be larger than those of Wyoming. Policy efficacy will certainly depend on potential interactions between growth rate, current carbon intensities and the pathways by which fuel sources are displaced or electricity sales are avoided. As new climate policies develop within states and at the national level, interaction among these policies will present new challenges. If the sector as a whole is to contribute significantly to GHG stabilization, energy efficiency goals must play a more prominent role in order to make the most of renewable energy’s carbon reduction potential.

4. Conclusions

As renewable and energy efficiency policies target distribution-level improvements, it is increasingly important to examine carbon impacts of retail sales. What does not get measured does not get managed. Therefore, the first order of business should be to include COUs more completely in greenhouse gas reporting initiatives, and to track the origin of electric retail sales to accurately assess the most important levers for emissions reductions. This places greater emphasis on the role of COUs in carbon management strategies. When thinking about carbon dioxide reduction from COU retail sales, it is helpful to differentiate between states where COUs are particularly active, where their current generated and purchased power is particularly carbon intensive, and where electricity demand growth is particularly high. In short, where COUs are located affects their carbon intensity and the absolute greenhouse gas reduction from any state or federal policy. Depending on COUs’ location and on how much power they purchase, incorporating COUs into state policies may result in small or large emissions reductions, but also creates models, and ultimately political pressure, for future federal action.

We estimate that the COU sector’s electricity sales are similar in carbon intensity to the U.S. average, thus, the 25% share of retail sales held by COUs account for roughly an equal share of total utility carbon emissions. While these estimates are not without their limitations given the static nature of the analysis and the uncertainties surrounding fuel mix developments (e.g., technical change, future role of nuclear energy, emergence of new generation technologies, disposition and substitution of existing capacity), this analysis represents an important first step towards assessing the carbon impact of this significant sector. We highlight the tremendous variation in COU carbon emissions (ranging from 19,000 tons to 61 million tons) and intensity (ranging from 0.07 tons/MWh to 1.07 tons/MWh) across states. We aggregate these findings in calculating carbon scenarios associated with typical RPS and utility-based energy efficiency targets at the national level. We indicate that at an annualized growth rate of between 1% and 2%, a combination of only the most rigorous RPS and energy efficiency policies in practice today (applied across the entire COU sector) can begin to approach the deep reductions necessary to contribute meaningfully to climatic stabilization. Finally, we further explore these policy scenarios by examining their impact on four states without RPS or utility-based energy efficiency policies in place, specifically highlighting the urgent need to reduce demand growth from historic levels.

Our analysis highlights that current state-level policies that include COUs are not situated in the states with the dirtiest COU sales, the highest absolute COU sales, or the highest growth rates, limiting existing policy experience and effectiveness. The relative importance of these factors may require different policy approaches for COUs, across ownership types and states. COUs face obstacles unique to the universe of public power (Wilson et al., 2008). Their governance structure and small size play a role in the low penetration of utility-based energy efficiency and renewable generation, as does their special legal status when compared to investor-owned utilities. COUs can have an interest in energy savings and alternative energy sources, as demonstrated by a growing number of COUs running such programs. Nonetheless, many of them do not engage in these activities, in part because they are ruled by the imperative of least-cost electricity and may not have sufficiently factored the cost of carbon emissions into their future policy calculations. COUs also have not faced the same pressures as investor-owned utilities. As they set their own rates, they have largely been insulated from rate case pressure and litigation from the environmental community. Absent these external drivers, few COUs have pursued these policies on their own.

Despite these disincentives, the non-profit and customer-ownership model of these organization seems reconcilable with the goal of carbon mitigation. To this end, programs must be tailored to COUs in order to facilitate their engagement. Most importantly, this requires adapting policies to the realities of limited resource availability and know-how in small COUs. Such modifications could affect how the federal Production Tax Incentives and rate-making structures are implemented. At the state level, an important step toward engaging COUs in carbon management is to provide the necessary information and financial incentives for their full participation, encourage aggregation of several utilities often adamant to conserve local control over their funds, develop training programs administered by state agencies or utility associations, and link new facility siting to renewable energy or energy efficiency requirements. COUs demonstrate how even small individual actors within larger sectors of the economy can become important under a climate policy. Including COUs in future greenhouse gas reduction policies will require a careful rethinking of traditional governance and regulatory structures for the electric sector, as well as restructuring of existing policies.
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Appendix A. Supplementary data


References


Cambridge University Press, New York (Published for the Intergovernmental Panel on Climate Change).


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