Federal Appliance Standards Should be the Floor, Not the Ceiling: Strategies for Innovative State Codes & Standards

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ABSTRACT

Roughly eighty percent of U.S. building energy consumption is associated with end-uses covered by federal appliance standards that preempt states from adopting more efficacious standards. In the past twenty-five years, federal standards have achieved significant benefits; however, given the energy and climate challenges that we face today, federal standards often fall short on delivering the most cost-effective savings. Furthermore, despite recent adoptions, the Department of Energy's history of rulemaking delays exacerbates the missed opportunity. Federal appliance standards also limit states or local governments from adopting innovated building codes (or "green codes") that take us closer to reaching zero-net energy building goals.

The most often stated reason for federal preemption is that it avoids an unworkable fifty-state patchwork of standards. This paper challenges that conclusion and outlines sensible strategies for modifying preemption law in ways that foster innovation and fuel energy efficiency. We present a detailed assessment of all major federal appliance standards and the incremental savings that could be achieved if more flexibility were integrated into the preemption law to allow regional optimization. We also outline how building codes could be simplified and made more effective with some changes to the preemption law. We then suggest policy changes that could lead to a more synergistic relationship between the federal government and states in the standards setting arena. These solutions would allow states or regions to innovate while also minimizing—or effectively avoiding—the "patchwork" concern.

I. Introduction

For the past four decades, appliance and equipment efficiency standards have been a proven tool for individual states and the U.S. government to address energy reduction goals. In the wake of the early 1970's OPEC oil embargo and increased environmental concerns regarding power plant citing, California passed the 1974 Warren-Alquist Act, which established the California Energy Commission (CEC) and gave it the authority to set appliance efficiency standards. The first state standards for refrigerators, freezers, and air conditioners were adopted by the CEC in 1976. By 1986, six states had adopted standards on one or more products. Due to a mixture of federal inaction and concern from trade associations about varying state standards, energy efficiency advocates and appliance manufacturers negotiated a compromise solution, which Congress enacted as the National Appliance Energy Conservation Act of 1987 (NAECA). NAECA established efficiency standards for major residential appliances and also established preemption provisions that remain in effect today. For a more in-depth history of appliance standards, see Nadel (2002) and Klass (2010).

The current preemption provision states that "no State regulation, or revision thereof, concerning the energy efficiency, energy use, or water use of [a product covered by a federal efficiency standard] shall be effective with respect of such covered product." States can request a preemption waiver based on "unusual and compelling State or local energy or water interests" that are "substantially different in nature or magnitude than those prevailing in the United States generally." However, to date, the U.S. Department of Energy (DOE) has never granted a preemption waiver and these waivers are not seen as a viable pathway (Klass 2010).

Given the energy and climate goals established by many states today, we advocate for a reevaluation of the 25-year old preemption provision that would allow states to achieve greater energy savings through new innovative standard approaches. Section II reviews all the major end-uses in residential and commercial buildings and shows that the overwhelming majority of all end-uses are now federally preempted. Section III identifies the equipment with the best opportunity for savings beyond the current federal standards and Section IV presents a savings scenario for California if it were able to set standards for those products. Section V outlines building code considerations and issues with respect to preemption. Section VI introduces policy approaches that could allow states or regions to innovate with federally covered products while also minimizing or avoiding the "patchwork" concern. We provide conclusions and recommended future work in Section VII.

II. Federally Covered Appliances and Equipment

Figure 1 shows the major residential end-use categories tracked by the Energy Information Administration for the purposes of reporting historic trends and developing forecasts. The figure shows Total Energy Consumption[1] and shows values in quadrillion BTUs (quads).[2] The residential sector accounts for roughly 21% of total U.S. energy consumption (21 out of 98 quads). We classify major equipment within each category as federally preempted, partially preempted, or not preempted. The overwhelming majority of equipment within eleven of the fourteen categories is federally preempted. These categories account for 78% of residential energy use and are mostly related to HVAC, water heating, lighting, and appliances. The "Other Uses" category is a catch-all category for all the miscellaneous products not included in the other thirteen categories. It is the second largest category (14% of total) and the fastest growing. Many products within this category have energy consumption profiles too small to meet the DOE's minimum threshold for setting standards[3] and will not likely be preempted in the near future. However, we list this category as "partially preempted" because many of the small or portable electronic devices in this category have external power supplies (EPSs) that convert AC supply voltage to lower AC or DC voltages (~120V). California first adopted a standard for EPSs in 2004 and a national standard was Energy Independence and Security Act (EISA) of

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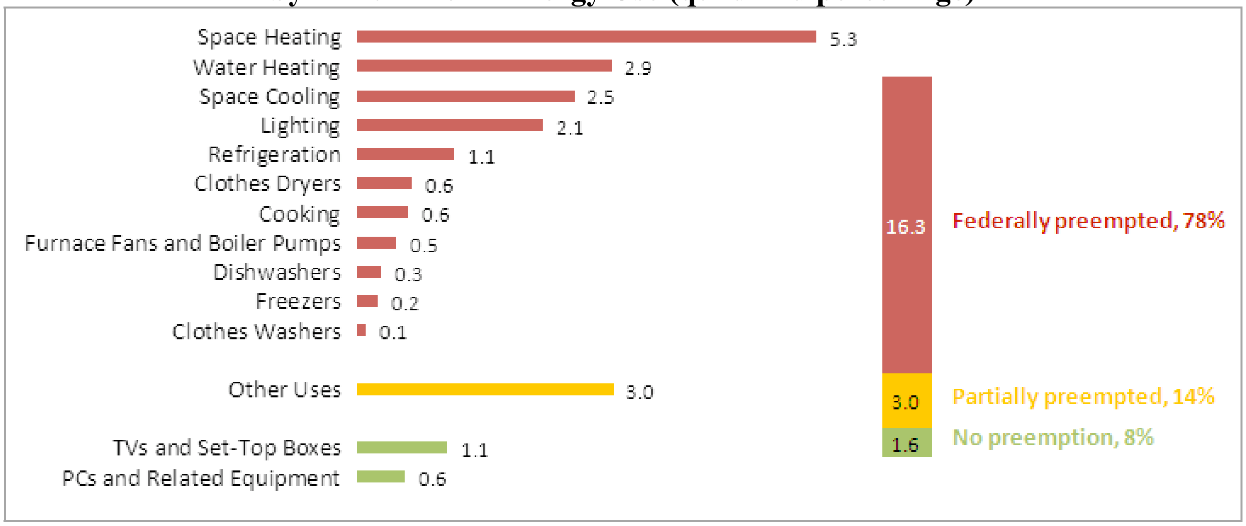
[1] Total Energy Consumption is the *primary energy consumption* in the end-use sectors, plus electricity retail sales and *electrical system energy losses*. *Primary Energy Consumption* is the consumption of primary energy (energy in the form that it is first accounted for in a statistical energy balance, before any transformation to secondary or tertiary forms of energy. For example, coal can be converted to synthetic gas, which can be converted to electricity; in this example, coal is primary energy, synthetic gas is secondary energy, and electricity is tertiary energy.). *Electrical System Energy Losses* are the amount of energy lost during generation, transmission, and distribution of electricity, including plant and unaccounted-for uses (EIA 2011b).

[2] A quad is a unit of energy equal to 10^{15} British thermal units (Btu). Comparing the end-uses using quads allows us to use a common metric when comparing different kinds of energy. This is most helpful when comparing appliances and equipment that consume either electricity or natural gas.

[3] For DOE to set standards for a type of consumer product, that product must use more than 150 kWh/yr per household on average and the aggregate household energy use must be more than 4.2 TWh/yr.

2007, thus preempting future state efforts. The only two categories with no current preemption contain consumer electronics such as TVs, set-top boxes (STB), and computers. The California Energy Commission (CEC) took advantage of the opening and adopted TV standards in 2009, with Connecticut passing similar standards in 2011. The DOE is now actively pursuing federal standards for TVs and STBs and has signaled an intention to finalize standards in 2013—thus potentially preempting states from setting different efficiency levels in the future.

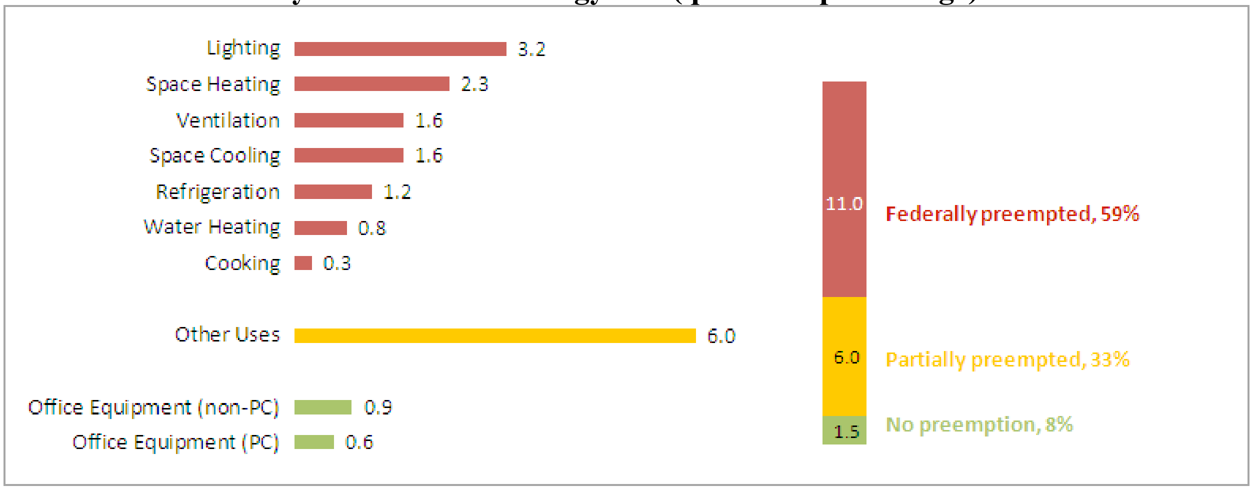
Figure 1. U.S. Residential Equipment Stock, Covered and Uncovered by DOE, by Annual Total Energy Use (quad and percentage)



Source: Authors' analysis of the *Annual Energy Outlook 2011* (EIA 2011a). Quad values are for 2012. The major equipment types within the "Federally preempted" category are all preempted, but there may be some smaller loads that are not covered by DOE standards. For example, the lighting category includes some product categories that are not currently covered by DOE standards, such as multifaceted reflector lamps. The "Other Uses" category includes all products not included in the other categories, such as audio equipment, game consoles, vacuum cleaners, DVD players, coffee makers, etc.).

Figure 2 shows the federal preemption of commercial equipment stock. The commercial sector accounts for about 19% of total U.S. energy use. The commercial preemption profile is similar to that of the residential sector: major end-uses (HVAC, lighting, refrigeration, water heating, and cooking) are preempted. These devices account for roughly 59% of commercial energy use and are thus "blocked" from more innovative state standards. The "Other Uses" category is the largest (33%), over twice the size of the second largest category (lighting). This category includes equipment that could be eligible for state standards (e.g., pumps) but also includes energy consumed by processes not amenable to standards (e.g., combined heat and power and manufacturing performed in commercial buildings). Thus, the best remaining opportunity for states to address commercial energy consumption through standards is in the office equipment categories (8% of total). The CEC has signaled its intention to explore future standards for products within this category, such as computers, servers, monitors, and imaging equipment (CEC 2012).

Figure 2. U.S. Commercial Equipment Stock, Covered and Uncovered by DOE, by Annual Total Energy Use (quad and percentage)



Source: Authors' analysis of the *Annual Energy Outlook 2011* (EIA 2011a). Quad values are for 2012. The major equipment types within the "Federally preempted" category are all preempted, but there may be some smaller loads that are not specifically covered by DOE standards. The lighting category includes some product categories that are not currently covered by DOE standards (e.g., MR lamps). The "Other Uses" category includes equipment such as service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings, plus residual fuel oil, liquefied petroleum gases, coal, motor gasoline, and kerosene.

When considering both the residential and commercial sectors, we estimate that roughly eighty percent of the energy associated with appliances and building equipment is federally preempted. Thus, states interested in setting appliance standards to meet energy and climate goals have had to focus on the remaining twenty percent, which is comprised mostly of consumer electronics, office equipment, and smaller miscellaneous devices. States such as California have responded by adopting standards for televisions (2009) and battery chargers (2012) and intend to consider future standards targeting non-preempted topics (CEC 2012). However, significant additional saving could be achieved if states had the opportunity to establish more stringent standards for the major preempted end-uses. The next Section discusses those potential savings.

III. Energy Saving Potential Beyond Current Federal Standard Levels

Relying on the recent report, *Max Tech and Beyond,* from Lawrence Berkeley National Lab researchers (Desroches & Garbesi 2011a, 2011b), we estimate potential energy savings for federally covered products. The *Max Tech and Beyond* report analyzed 150 product categories—both federally covered and uncovered—and attempted to estimate the "Base Case," "Best-on-Market," and "Max Tech" efficiency levels for each category.[4] For this paper, we analyzed the

[4] The Base Case estimates the typical efficiency for the current building stock. In cases where a new standard is about to come into effect, the researchers incorporated that standard's stipulated efficiency level into the estimates of new shipment efficiencies to prevent double-counting the energy savings from new technologies that are already achieved through Federal minimum standards. The Best-on-Market case represents best on the market efficiencies for units available today. The Max Tech efficiency levels represent efficiencies that could be manufactured today or in the near future (i.e., less than 5 years) (Desroches & Garbesi 2011a).

potential savings if a standard were established at the best-on-market efficiency level. **Figure 3** shows the savings potential in the U.S. for products within the lighting, HVAC, water heating, and appliances categories. On a national basis, the biggest opportunity for savings beyond baseline is in the lighting category, mostly from shifting away from general service incandescent lamps. HVAC and water heating products represent significant savings potential (roughly 1 quad/yr each), although savings potential varies by state, depending on existing infrastructure and heating and cooling demand. Altogether, the savings potential for the four categories is an average of 4.7 quads/yr. This is an enormous amount of savings, roughly twelve percent of the U.S. residential and commercial primary energy consumption.

We recognize that even with relaxed preemption provisions, it would be politically (and in some instances legally) difficult or impossible for states to adopt standards equivalent to best-on-market efficiency levels. However, the analysis is useful for understanding the full potential and demonstrates that significant savings could be achieved even by setting standard levels somewhere between baseline and base-on-market efficiency levels. Furthermore, there is precedent for major economies establishing standards at best-on-market levels—specifically in Japan and Australia (see Klass 2010, Part V.B.4).[5]

Figure 3. Potential U.S. Average Annual Primary Energy Savings After Shifting to Best-On-Market Efficiencies for Federally Covered (Preempted) Products

Lighting	Quads/yr
Residential lighting (general service)	0.88
Commercial lighting (general service)	0.79
Industrial lighting	0.20
Exterior Lights (e.g. parking)	0.17
Street Lights	0.15
Torchieres	0.10
Metal Halide Fixtures	0.09
Lighting Total	*2.39*

HVAC	Quads/yr
Central AC	0.45
Gas Furnaces	0.28
Central HP	0.19
Ceiling Fans	0.09
Small CUAC	0.03
Large CUAC	0.03
Boilers (gas)	0.02
Commercial Unitary Acs (Very small)	0.02
Commercial Unitary Acs (Very large)	0.02
HVAC Total	*1.13*

Water Heating	Quads/yr
Res. Elec. Water Heaters	0.53
Comm. Storage Water Heaters (gas)	0.17
Res. Gas Water Heaters	0.12
Comm. Storage Water Heaters (elec.)	0.11
Water Heating Total	*0.93*

Appliances	Quads/yr
Dishwashers	0.07
Clothes Washers	0.06
Clothes Dryers (elec.)	0.05
Refrigerators	0.03
Appliance Total	*0.22*

Total average savings = 4.7 quads / yr

This is equal to 12% of the U.S. residential & commercial primary energy consumption. For perspective, California's primary energy consumption for electric power sector consumption is ~1.7 quad per year.

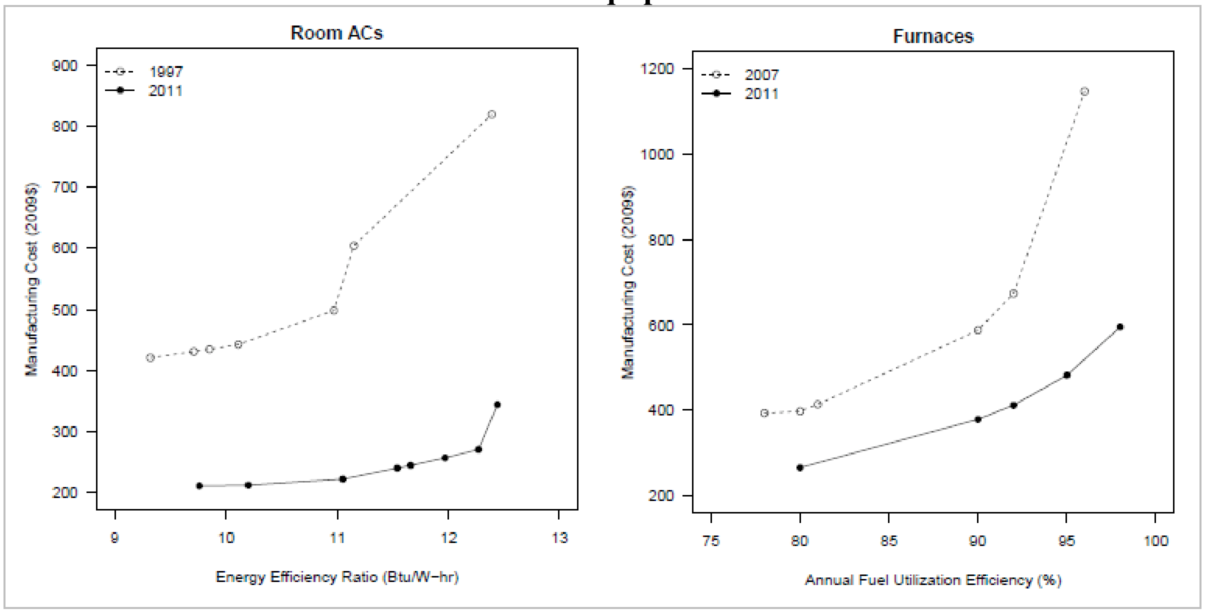
Source: Authors' analysis of Desroches & Garbesi spreadsheet (2011b). Savings analysis compares "Base" case to "Best-on-Market" case. The list is not exhaustive, as only the top saving categories are shown. Industrial lighting, exterior lights, and street lights all have federal standards covering HID lamps, but the fixtures (luminaire) themselves are not covered. See additional details in Desroches & Garbesi (2011a, 2011b).

[5] This paper does not explore the success of these programs—thus, we do not suggest that this precedence implies success or is without its own set of issues.

It was beyond the scope of this paper to assess the optimal standard levels for the specific products—shown in Figure 3—that would meet the technical feasibility and economically justified requirements that the U.S., California, and other states have for setting appliance standards. And as discussed above, we recognize that it would be difficult to pass the current cost-effectiveness tests for setting standard levels close to or at the best-on-market levels. However, research has shown that previous DOE economic analyses for potential standards have undervalued the economic benefits of candidate standard levels, and in some cases, a previously determined cost-negative potential standard should have been cost-positive (Desroches et al. 2011). The historical evidence suggests the following findings as described in Desroches et al. (2009. Original cited research is Dale 2009): "(1) for the past several decades, the retail price of appliances has been steadily falling while efficiency has been increasing; (2) past retail price predictions made by the DOE analyses of efficiency standards, assuming constant prices over time, have tended to overestimate retail prices; (3) the average incremental price to increase appliance efficiency has declined over time, and DOE technical support documents have typically overestimated this incremental price and retail prices; and (4) changes in retail markups and economies of scale in production of more efficient appliances may have contributed to declines in prices of efficient appliances."

Figure 4 shows how quickly cost-efficiency curves can drop for appliances. Desroches et al. (2011) analyzed past technical support documents for DOE rulemakings (room ACs, central ACs, furnaces, refrigerators, and freezers) and in all cases, the manufacturing cost for meeting a given efficiency level decreased significantly. As shown in Figure 4, the cost to meet different energy efficiency ratios (EER) has declined by as much as 60% between 1997 and 2011. In the case for furnaces, manufacturing costs dropped by as much as 55% for meeting certain annual fuel utilization efficiencies (AFUE) *in just four years between 2007 and 2011*. (See Desroches et al. (2011, section 4.5) for additional details on declining cost-efficiency curves and the importance of incorporating experience or learning curves into appliance standards analysis.) These important trends suggest that advanced efficiency levels (in some cases close to best-on-market) can be justified for certain appliance and equipment types—something to keep in mind as we consider California-specific savings in the next section.

Figure 4. Comparison of Past and Recent DOE Cost-Efficiency Curves for HVAC Equipment



Source: reprinted from Desroches et al. (2011, Figures 12 and 14). The results are from the engineering analyses in support of DOE appliance efficiency standards rulemaking for room ACs and furnaces. The room AC curves represent averaged or interpolated costs for a typical 12,000 Btu/hr louvered room air conditioner. The furnaces curves represent average or interpolated costs for a typical 75,000-80,000 Btu/hr non-weatherized furnace. Prices have been deflated using the CPI.

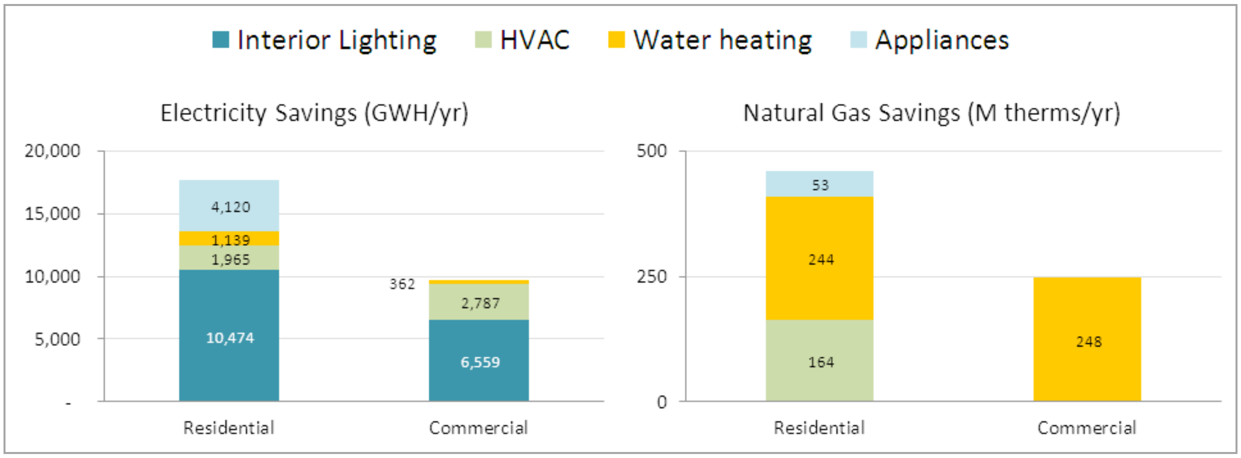
IV. Energy Savings Technical Potential in California

In this section we examine potential savings in California if the state had the flexibility to adopt new standards for federally-covered products. We use the product-specific savings presented in Section 3 and weight the savings based on recent residential and commercial equipment stock surveys for California (see **Table A1** in Appendix A for the specific methodology). The savings by sector and category are presented in **Figure 5**. The savings presented are the *technical potential*, representing annual savings once the full stock has been replaced with current best-on-market efficiency levels and assuming 100 percent compliance. Depending on the product category, this could take 20 years or more to achieve.

Savings are separated by electricity (GWh/yr) and natural gas (million therms/yr). Lighting represents the largest electricity savings opportunity for both the residential and commercial sectors. The appliances category is the second largest opportunity for residential electric savings, followed by HVAC and water heating.

Because nearly all major natural gas-using equipment is preempted, natural gas savings are exceedingly difficult to achieve through new state standards. Water heating presents the most significant natural gas savings opportunity for both the residential and commercial sector. Additional significant savings are achievable for residential HVAC and appliances.

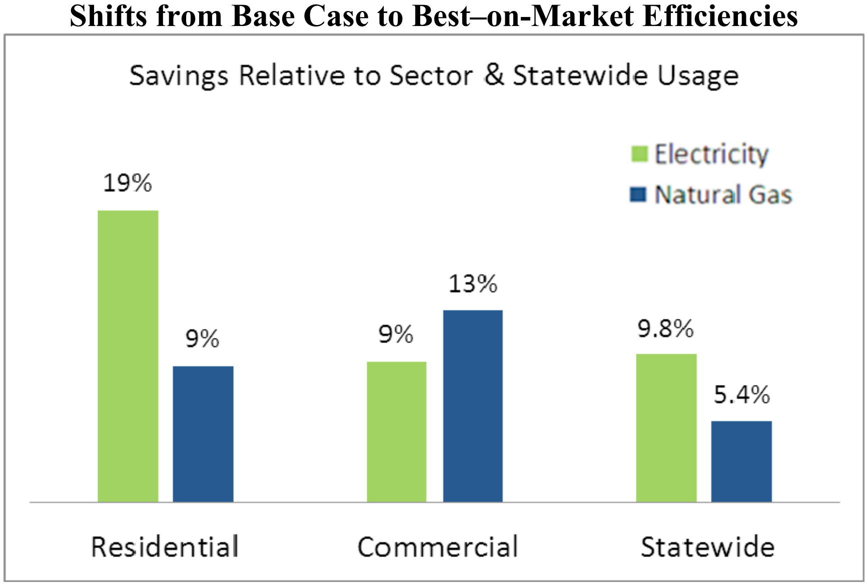
Figure 5. Projected California Annual Savings After Full Stock Turnover if Equipment in Major Preempted End-Use categories (Lighting, HVAC, Water Heating, and Appliances) Shift from Base Case to Best-on-Market Efficiencies



Source: See Appendix A, Table A1.

Figure 6 outlines the enormous value that California could achieve by setting standards beyond the DOE ceiling. Assuming the technical potential levels discussed above, after full stock turnover, electricity and natural gas usage could decrease by 19 and 9 percent, respectively, within the residential sector, and by 9 and 13 percent within the commercial sector. On a statewide basis, the savings represent 9.8 percent of annual electricity consumption and 5.4 percent natural gas usage. These savings would be critical for meeting growing future demand while also contributing significantly to the greenhouse gas reduction targets established AB 32, the *Global Warming Solutions Act of 2006*. In fact, the theoretical GHG reductions of 15.7 MMT CO_2e per year (see Table A1) represents roughly 20 percent of the total AB 32 reduction goal (80 MMTCO2e by 2020).

Figure 6. Projected California Annual Energy Savings if Equipment in Major Preempted End-Use Categories (Lighting, HVAC, Water Heating, and Appliances) Shifts from Base Case to Best–on-Market Efficiencies



Source: See Appendix A, Table A1.

V. Building Codes Considerations and Opportunities

When Congress adopted some of California's residential appliance standards as national standards in NAECA, the entire country received the benefits of higher efficiency products for commodity prices, but manufacturers received the significant concession that federal standards would preempt any state standards—even state standards that set higher appliance efficiency requirements. To prevent a "backdoor legislation" of higher appliance efficiencies, NAECA language also specifically prohibited state energy codes from prescriptively requiring higher equipment efficiencies unless *"the code sets forth one or more optional combinations of items which meet the energy consumption or conservation objective, for every combination which includes a covered product the efficiency of which exceeds either standard or level referred to in subparagraph (D), there also shall be at least one combination which includes such covered product the efficiency of which does not exceed such standard or level."* [42USC §6297(f)(3)(E)].

In addition, if an energy code has a performance (software trade-off) approach, *"the baseline building designs are based on the efficiency level for such covered product which meets but does not exceed such standard or the efficiency level."* [42USC §6297(f)(3)(D)]. Thus the preemption provisions of NAECA set both a "floor" and a "ceiling" on equipment efficiencies in both building codes and appliance standards.

Similar language was inserted into the Energy Policy Act provisions that regulated commercial appliances but with a particular twist. Building codes could require higher equipment efficiencies than the federal minimum efficiencies if:

(i) *the standard in the building code does not require that the energy efficiency of such product exceed the applicable minimum energy efficiency requirement in amended ASHRAE/IES Standard 90.1; and*

(ii) *the standard in the building code does not take effect prior to the effective date of the applicable minimum energy efficiency requirement in amended ASHRAE/IES Standard 90.1.* [USC §6316(b)2B].

The federal appliance standards are limited to considering what is cost-effective for the entire country and thus will typically fall short of what can be cost-justified in California or other states. Modification of the preemption terms of NAECA such that it provides for the floor for energy efficiency—but not the ceiling—would provide significant assistance towards fulfilling our goal of cost-effective zero net energy.

However, state energy codes have historically steered clear of federally preempted efficiencies. In a few cases, states have tried to apply for a waiver from federal preemption—these attempts have been costly, taken years to play out, and to date, no application for a waiver has been successful. However, California's Title 24 energy code has adopted the ASHRAE commercial equipment efficiencies that lead the federal efficiency determinations by several years [CA Title 24, Part 6, §112]. At this writing, eleven other states have state water efficiency or energy efficiency appliance standards for equipment that is not covered by the federal standards.[6]

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[6] States that have their own standards include AZ, CT, DC, GA, MD, NV, NH, OR, RI, TX and WA. Many of these states are adopting the same higher standard.

With a few exceptions, the building codes have adopted the minimum federal efficiencies. For the few exceptions, code structure has been key to how successfully they have been able to withstand legal challenges.

In 2007, the City of Albuquerque adopted the Albuquerque Energy Conservation Code which was based upon the 2006 International Energy Conservation Code (IECC) with local amendments. One could comply with this code either on a performance basis or prescriptively. The performance basis as descried in Section 103 was quite simple: *"LEED Silver certification or Build Green New Mexico Silver certification are deemed to meet, or exceed, the energy efficiency required by this code."* As part of these local amendments, Section 403.2, "Mechanical equipment efficiency," prescriptively required higher equipment efficiencies without trade-off provisions. Thus, back in 2007, it would have required that air conditioners have a minimum SEER of 14 when the federal minimum efficiency was SEER 13. This code would have required that gas furnaces have a minimum efficiency of 90% AFUE (condensing) as compared to the federal standard of 78% AFUE. According to Section 403.9.2, "Performance efficiency," and the referenced table 403.9.2(b), *"Conventional gas storage water heaters, electric-resistance water heaters, and electric tankless water heaters not permitted in new construction after January 1, 2009."* Instead, gas tankless water heaters would have a EF ≥ 0.80, non-condensing gas storage water heaters would have EF ≥ 0.70, condensing water heaters would have EF ≥ 0.80 and heat pumps would have a COP ≥ 2.0. There were no alternate prescriptive paths that would allow federally covered equipment to have efficiencies that were minimally compliant with the federal regulations.

The Air Conditioning, Heating and Refrigeration Institute (AHRI) successfully sued the City of Albuquerque and was able to block implementation of this energy code. The prescriptive portions of the code were clearly preempted by federal law. In addition, AHRI was able to successfully argue that the performance approach (LEED certification) should also not be allowed because it was "not-severable," as the entire code would not have been "enacted by the City Council in the absence of the inclusion of the prescriptive paths." (US District Court NM 2012).

A number of states and the IECC (International Energy Conservation Code) have successfully developed methods to require higher than minimum federal equipment efficiencies. The approach is to have multiple paths to compliance: for each approach that uses higher efficiency equipment, there must be another approach that uses standard efficiency equipment and uses similar amounts of energy. In the 2012 IECC, there are three pathways to compliance:[7]

1. High efficiency HVAC equipment (if this requirement were by itself, it would violate preemption)
2. Lower lighting power density lighting requirements
3. Provision of 0.5 W/sf of renewable generation.

Chapter 9 of the 2009 Washington State Energy Code (WSEC 2009) energy code contained "*Additional residential energy efficiency requirements.*" These additional requirements could either be achieved by exceeding the performance approach base efficiency levels by 8%, or prescriptively, one could choose between thirteen different options that had point credits associated with each and score at least one extra point. The options included three

[7] Section C406 *Additional Efficiency Package Requirements*. 2012 IECC

different options of higher HVAC efficiencies and two different levels of higher water heating efficiencies. If these were the only options, it would have violated preemption, but as there were a number of other options that did not require higher equipment efficiencies. This was designed to avoid violating federal preemption. The other options included: 1) all HVAC equipment and ducts in conditioned spaces (but did not allow direct combustion); 2) three different levels of low conductance opaque envelope packages; 3) low air leakage combined with a heat recovery ventilator; 4) credit for a dwelling unit less than 1,500 sf (also a demerit for a dwelling unit larger than 5,000 sf); and 5) credits for on-site renewable energy generation (wind and photovoltaics).

The State of Washington was sued by the Building Industry Association and others who believed that the new code violated preemption. This challenge was dismissed in the U.S. District Court in Tacoma (2011) as it was shown that the state had multiple paths to compliance and included paths that allowed covered equipment to be minimally compliant with the federal appliance efficiency regulations.

Oregon provides another successful example. For compliance with the Oregon Residential Specialty Code, the designer must select one advanced equipment efficiency measure out of seven different "additional measures."[3] Two of the measures (furnace ≥ 90% AFUE and water heating ≥ 80% EF)—if they were taken in isolation—would violate federal preemption, but form part of a list of five other measures that do not require efficiencies higher than the federal minimums: "*at least one combination which includes such covered product the efficiency of which does not exceed such standard.*" Briefly, the other five measures are: 1) ducts in conditioned space, 2) ductless heat pumps, 3) whole building energy management devices, 4) duct sealing, and 5) 1 W/sf solar photovoltaics or at least 40 sf of solar water heating collector area. Anecdotally, we have heard that this multiple path process has transformed the market for condensing furnaces, the most commonly used method of compliance.

VI. Preemption Policy Changes for Consideration

In this section, we summarize four policy approaches that would modify the current preemption law to allow states greater flexibility to pursue increased energy savings through more innovative standards. The options are adapted from Alexandra Klass's *Harvard Environmental Law Review* article, "State Standards for Nationwide Products Revisited: Federalism, Green Building Codes, and Appliance Efficiency Standards."[8]

1. *Multi-State Standards*. For this option, Congress would need to relax the preemption waiver process to make it easier for a group of states to set a uniform, multi-state standard. In order to avoid a multi-state "patchwork" of regulation, the maximum number of standards that could be in effect is two: the federal standard and the state-based standard. If another group of states subsequently submits a petition to DOE for a more stringent standard, DOE could grant that petition only if it supersedes the first waiver petition. This option builds upon the first-ever regional standards adopted by DOE in 2011 for air conditioners and furnaces, which were based on a joint recommendation filed

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[8] Section N1101.1 and Table- N1101.1(2) "Additional Measures" (OBCD 2011)

[9] The insightful article provides a more in depth review of the history of appliance standards, the principles and theories of federalism, and how the U.S. appliance efficiency program could better reflect the modern principles of federalism.

by efficiency advocates and industry groups to the DOE in 2009 (ASAP 2011). Through this rulemaking, the DOE acknowledged that regional differences in the U.S. necessitate the need for regional standards, especially for climate-sensitive products such as HVAC equipment. In addition to addressing weather-related issues (e.g., cooling needs in the South and West and heating needs in the North), this multi-state policy option could also be based on other factors, such as multiple states sharing similar GHG emission reduction goals. Relatedly, the Governors of California, Oregon, Washington, and the Premier of British Columbia recently signed the *2012 West Coast Action Plan on Jobs*, committing to "Develop regional energy efficiency standards for appliances and equipment to lead by example and promote harmonized action by our respective federal governments" (WCAPJ 2012).

2. *Relaxed Waiver for California.* This policy option would give California the ability to set more stringent efficiency standards and then allow other states to adopt the same standard levels. In practice, this is the historical precedent for non-preempted topics. As with the multi-state standards option above, the maximum number of standards would be two: the federal standard and the California standard (and any other state that adopts the California standard). Klass (2010) argues that "Congress could justify a more relaxed waiver standard for California based on the state's long history of regulating appliance efficiency as well as the unique energy and water needs of California, which dwarf that of any other state. It is this unique history and unique need that led Congress to grant California special status with regard to auto emissions, and that same history and need support special status for California in the area of appliance efficiency."
3. *Expanded Sunset Provisions*. A sunset provision results in an automatic waiver of preemption if the DOE fails to set or revise a specific standard within a designated timeframe. For example, sunset provisions were established for water products (toilets, faucets, and showerheads) in EPACT 1992 that required the DOE to update the standards within five years.[9] This policy option would expand the sunset provision to a wider range of federally-covered products—perhaps all of them. Thus, if the DOE failed to update standards within a reasonable timeframe, states could then pursue standards on their own.
4. *A Non-Uniform Approach.* This policy option would essentially eliminate the preemption provision and would give greater flexibility to the states. It is based on challenging the assumption that individual state standards would create significant problems. To answer that question, Klass (2010) suggests considering the following questions:
   a) "Are there concerns regarding states acting in a protectionist manner at the expense of out-of-state industry?
   b) Will state regulation result in the product manufacturer being forced to create individualized products for each state, or can the manufacturer create a single product designed to comply with the strictest state standard and thus necessarily meet the standard of all other states?
   c) Will regulation by one state stifle rather than encourage innovation on a nationwide basis because of the influence a single state's regulation will have on the regulated party's activities in the rest of the country?

[10] The DOE ultimately did miss the five-year deadline and California, Georgia and Texas implemented their own more stringent standard levels (Klass 2010). Sunset provisions have also been previously established for refrigerators, but DOE met the deadline so new state standards were not allowed.

d) Will state-by-state regulation produce outcomes that are against the policy preferences of some states, or will all states see their policy preference vindicated?"

Klass argues that these concerns are largely absent with respect to appliance standards; thus, given the significant benefits discussed in Sections III and IV, policymakers and other stakeholders should at least revisit the guiding motivation for preemption and consider one or more of these policy approaches.

This non-uniform approach is generally the case in Canada.[10] Provinces have either adopted standards more stringent than federal levels, or have accelerated effective dates for standards adopted federally but not yet effective. For example, British Columbia adopted more stringent standards for gas and electric water heaters, and Manitoba has a more stringent furnace standard. British Columbia has also accelerated the effective date by two years for furnaces and general service light bulbs. We recommended future research to explore the implications—both good and bad—of the Canadian policy (and any other major economy with a non-uniform approach) and to develop lessons learned for U.S. policymakers.

VII. Conclusion

Appliance standards have achieved significant cost-effective energy savings in the U.S. over past twenty-five years. California has played an influential role by frequently setting state standards that eventually get adopted by other states and/or the DOE. However, twenty-five years of DOE rulemakings and federal legislation has also resulted in roughly eighty percent of U.S. building energy consumption being linked to preempted products. This preemption limits the States' continued opportunity to innovate with new appliance standards and building codes. We show evidence that huge energy savings and GHG reductions are possible if the current preemption law could be modified and states had the ability to adopt standards above the federal "ceiling." Policymakers and stakeholders should continue to study the specific savings opportunities for individual preempted topics and the suggested policy changes deserve a critical assessment.

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[11] A Canadian province can set a more stringent standard for a product sold in the province, whether it is manufactured in the province or not. In the case of an imported product, both the federal and provincial regulations are triggered, but the more stringent one applies. Exports from the province are exempted and would thus be subject to the federal regulation only. If the federal regulation is more stringent, then products imported into the province would need to meet the more stringent federal standard (Pape-Salmon 2012).

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Appendix A. California Savings Scenario

Table A1. Projected Savings if Equipment in Major Preempted End-Use Categories (Lighting, HVAC, Water Heating, and Appliances) Shift from Base Case to Best-on-Market Efficiencies

Sector & Category	% Usage (1)		Annual Energy Usage (2)		Savings after stock turnover if baseline is replaced with 2011 best on the market efficiencies (3)							
	Electricity	Natural Gas	Electricity (GWh)	Natural Gas (million therms)	Electricity (%)	Natural Gas (%)	Electricity (GWh/yr)	Natural Gas (million therms/yr)	CO_2e (MMT)	Electricity ($M/yr)	Natural Gas ($M/yr)	Combined ($/yr)
Residential												
Key preempted end-uses												
Interior Lighting	22%	0%	20,183	-	52%	-	10,474	-	4.6	$ 1,363	-	$ 1,363
HVAC	9%	37%	8,257	1,882	24%	9%	1,965	164	1.7	$ 256	$ 158	$ 414
Water heating	3%	49%	2,752	2,492	41%	10%	1,139	244	1.8	$ 148	$ 235	$ 383
Appliances	28%	5%	25,687	254	16%	21%	4,120	53	2.1	$ 536	$ 51	$ 587
All other end-uses	38%	9%	34,861	458	na	na	na	na	na	na	na	na
Residential subtotal	*100%*	*100%*	*91,740*	*5,087*	*19%*	*9%*	*17,698*	*461*	*10.2*	*$ 2,303*	*$ 444*	*$ 2,747*
									-			
Commercial									-			
Key preempted end-uses									-			
Interior Lighting	29%	0%	29,765	-	22%	-	6,559	-	2.9	$ 853	-	$ 853
HVAC	28%	38%	29,516	739	9%	na	2,787	na	1.2	$ 363	na	$ 363
Water heating	1%	32%	944	620	38%	40%	362	248	1.5	$ 47	$ 198	$ 246
All other end-uses	42%	30%	43,410	590	na	na	na	na	na	na	na	na
Commercial subtotal	*100%*	*100%*	*103,636*	*1,948*	*9%*	*13%*	*9,709*	*248*	*5.6*	*$ 1,263*	*$ 198*	*$ 1,462*
									-			
Res and Comml subtotal			195,375	7,035	14%	10%	27,407	709	15.7	$ 3,566	$ 643	$ 4,208
									-			
Statewide total			280,437	13,111	9.8%	5.4%	27,407	709	15.7	$ 3,566	$ 643	$ 4,208

na = not analyzed

(1) Residential usage is from KEMA (2010, Figure ES-1 for electricity and Figure ES-6 for natural gas).

(2) Sector and statewide totals are 2012 estimates from CEC (2011, Mid-Case Preliminary Demand Forecast Forms). Category usage is calculated using the values in the "% Usage" column.

(3) Percent improvements are from Desroches and Garbesi. 2011b. GWh/yr and Million therms/yr savings are calculated from percent improvement values and Annual Energy Usage values. The MMTCO2e savings are calculated using the emission rates outlined in the AB 32 Scoping Plan (I-24, http://www.arb.ca.gov/cc/scopingplan/document/appendices_volume2.pdf). Electricity prices are calculated using a $0.13/kWh average retail price from EIA's California State Electricity Profile (http://www.eia.gov/electricity/state/, Release date: January 30, 2012). Natural gas prices are calculated using a $9.90 per Thousand Cubic Feet (converted to $0.96/therm) for residential and $8.23 per Thousand Cubic Feet (converted to $0.80/therm) for commercial, from EIA's Natural Gas data table for California (2011 Annual values, http://www.eia.gov/electricity/state/, Release date: Feburary 29, 2012.