The Development of the Residential Option Table in the Washington State Energy Code

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ABSTRACT

In 2009 the Washington State Legislature updated the legislation authorizing the Washington State Energy Code (WSEC). In the process, the legislature also set a goal that the total energy of new buildings would be reduced 70% over the performance of buildings built to the 2006 WSEC by the 2031 code cycle. To meet this ambitious goal the Washington State Building Code Council (SBCC) was authorized to develop incremental steps that would achieve this goal over the eight code cycles anticipated by 2031. The first step on that path was developed for the 2009 WSEC. For the residential energy code an option table was devised that would allow builders to trade off various measures from a diverse menu of options. The SBCC was then sued under the theory that the federal preemption would prevent measures that exceed the equipment standards. The 9th Circuit Court upheld the option table in 2011. The option table was implemented. The 16 options were organized into 6 categories: envelope, ventilation, HVAC equipment, ducts, domestic hot water, and renewable credits (mostly solar PVs). Points were assigned to each option, roughly proportional to the savings anticipated from each option. Points varied from half a point to 2 points depending on the measure. In the 2009 code only one option point was required for single family homes. Subsequent code cycle added points to the requirements of the code mandating an increasing number of points for compliance. In addition the scope was later expanded to include low rise multi-family buildings. In the most current cycle (2015) 3.5 points was adopted for single family residences. The paper discusses the option table as a path to improve both the flexibility and efficiency of the energy code.

Introduction:

In 2009 Washington's Governor, Christine Gregoire, in response to the Western Governors Climate Initiative, directed the Washington State Department of Commerce (WSDOC) to make proposals to modify the Washington State Energy Code (WSEC). The goal of these proposals was to reduce the energy consumption of new buildings (both commercial and residential) by 30% overall from the 2006 WSEC. A separate action by the 2009 Washington State Legislature enacted a statute directing the Washington State Building Code Council (SBCC) to adopt state energy codes that incrementally move towards achieving a *70% reduction* in annual net energy consumption of new buildings by 2031, using the 2006 WSEC as a baseline.[1] By any standards, these are very ambitious goals.

In 2009 the WSEC was a "stand alone" energy code that existed only as a Washington State code. Like the International Energy Conservation Code (IECC), the energy code requirements were divided between the residential and commercial buildings. In the 2009 WSEC residential code regulated attached and detached single family dwellings. This paper discusses the revisions to the residential sections of that code.

[1] Revised Code of Washington, RCW 19.27a.160

With the governor's directive the WSDOC was required to consider significant new code provisions that could address energy use beyond the traditional space conditioning. Moreover, the requirements were large enough that merely improving the envelope would require such dramatic change in the requirements that it would be politically impossible. The strategy adopted was to add some mandatory provisions in the prescriptive path and enhance these provisions with additional options that allowed builders to take credit for improvements in equipment efficiency, domestic hot water efficiency, renewable energy investments and/or improved ventilation and air tightness.

NEEA[2] and the WSDOC asked Ecotope to develop the analytical basis for this structural change in the WSEC. The analytical matrix served as a basis for scaling the options and the new prescriptive code to include enough provisions that a 30% improvement would be possible. In the end some of the provisions developed in the matrix were used to develop amendments to the prescriptive sections of the code. But most of the measures analyzed were used to develop a table of options which could be selected among by the permit applicant to demonstrate additional energy savings.

In previous codes relatively few provisions were aimed at energy consumption that were not directly linked to space heating[3]. The governor's and the legislature's directives required that the entire consumption be reduced, not merely the fraction linked to heating. This directive presented a significant problem since the federal legislation (EPAC '92) requiring the federal government to set performance standards for various HVAC equipment and specified appliances. EPAC '92 precluded the states for setting a separate standard that was different than the federal standard.[4] That legislation did allow states to use higher standards than mandated if the standards were designed as trade-off with other code requirements that were "substantially equivalent."

Other states (including Oregon and Rhode Island) had added efficient equipment to their codes through the use of voluntary "Reach" code standards. These provisions allowed builders to select particular code provisions and incorporate those selections into the final building plans. The City of Albuquerque actually mandated efficient equipment that exceeded federal standards. That effort was struck down on the grounds that the standards violated the Federal Preemption clauses of the EPAC[5].

With this experience in mind a more novel approach was developed for the WSEC. This approach was based on four principles which would meet the governor's directive and the requirements of EPAC:

1. Options should be designed to substantially improve the code by adding incremental efficiency measures to new homes.
2. Options should be roughly equivalent to one another in their impact on the energy use of the home.
3. There should be options that apply to many of the home's components including building envelope, heating and cooling equipment, domestic hot water use and efficiency, and other aspects of residential energy use.

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[2] The Northwest Energy efficiency Alliance (NEEA) is a consortium of Pacific Northwest Utilities charged with developing energy efficiency resources for the region's electric and gas utilities. Their charter explicitly directs the agency to support the development of energy codes in the four states of the Pacific Northwest region.

3 Cooling loads in Washington residential structures were and are small and were only incidentally addressed in the WSEC. For the most part cooling efficiency is addressed only by federally mandated equipment standards.

4 Energy Policy Act of 1992 ("EPACT"), Public Law No. 102-486, 42 U.S.C. § 6297

[5] AHRI vs. City of Albuquerque, 2008 WL5586316 (D.N.M., Oct.3 2008)

4. Each option should address one component of the home or one piece of equipment.

To develop this approach, the WSDOC and Ecotope created a code change proposal for consideration by the Washington State Building Code Council (SBCC). The SBCC is a governor-appointed independent body charged by the legislature to oversee the development and updates to the Washington State building codes. They are empowered to propose and interpret building codes including the energy code. The code amendment process is generally designed to begin every three years so that a new code update would be available in the following year. Code change proposals are submitted at the beginning of the cycle. The proposals would first go to a "Technical Advisory Group" to be screened and finalized all proposals for review by the full SBCC.

Code Change Development

As mentioned above, the analysis included several important provisions that were under consideration for inclusion in the prescriptive base code. The most significant of these was the provision for a mandatory blower door test as a part of the base code. While the improved levels of air sealing were included with various ventilation measures in the option table, the inclusion of a mandatory test made it possible to specify improved envelope tightness without further specifying the method of testing or other aspects of regulating this testing. In the final code a 6.0 ACH50[6] number was agreed as a part of the base code.

Duct testing followed a similar path. Although two levels of duct tightness were explored the option included was limited to moving all ducts inside the heated envelope.

The lighting measures simulated were subsumed into a single provision (50% high efficacy lamps) and made mandatory for all homes in the prescriptive code. This provision was based on the CFL performance typical at that time. It was assumed that later code cycles could update and extend that provision.

Finally, the prescriptive code changes included a small decrease in the target window U-value (0.32) and an increase in some component insulation values (vault ceilings and basement walls).

Option Table Development

The option table was developed around several distinct areas:

- Heating equipment;
- Interior ducting
- Building envelope improvements
- Ventilation systems
- Domestic Hot Water measures
- On site Renewable energy.

The initial proposal was based on a matrix of simulation runs that were designed to assess the overall impact of the individual measures and combinations of measures on the performance of prototype homes. These prototypes were based on analytical prototypes used in the region by

[6] ACH50 refers to the total air flow of the home divided by the total volume of the home when the pressure within the home is raised to 50pa. The language included in the code proposal was based on a "specific leakage area" (SLA) derived from air flow measurements over a range of pressure differences maintained by the blower door. The value selected was based on an SLA which would give an air flow equal to 6 ACH50. In subsequent code versions the value was simplified to ACH50 and the options were also simplified in this way.

the Regional Technical Forum (RTF)[7]. Table 1 shows the three RTF prototypes and an added large home prototype developed for this analysis. Table 2 shows the baseline assumptions for the building envelope drawn from the 2006 WSEC.

These prototypes were entered into the SEEM building simulation program. SEEM is a tool used by the RTF and the Northwest Power and Conservation Council to conduct parameter studies and evaluation of residential conservation measures. The program was developed by Larry Palmiter of Ecotope in 2008. The program has been updated regularly by Ecotope but remains the primary residential analysis tool for the region. The principle advantage of SEEM is that it is designed for parameter runs of common prototypes. The program uses an hourly simulation model to estimate thermal loads and has algorithms to integrate HVAC performance and controls into the thermal simulation. SEEM is used as an application inside an EXCEL sheet which includes other residential energy calculations including lighting, domestic hot water (DHW) and ventilation equipment. In addition, all prototypes included a base consumption of 4000 kWh/year for miscellaneous electric loads (MELs) not included in the calculations in the workbook.

To develop the options tables all combination of measures were run. Table 3 shows the number of measures in each end use category. For the four prototypes, Washington's two climate zones, and all combinations of measures were simulated (

7 The Regional Technical Forum is a technical advisory committee formed to advise the utilities and regulators of the region on matters of energy efficiency and conservation. The body was authorized by Congress in 1998 and has been operating since 1999.

Table 3a total of about 60,000 runs). Since all combinations were run, interactions between measures could be included in assessing the energy savings impact. This procedure was developed for the Northwest in 1982 and has been used extensively to evaluate residential efficiency measures (e.g. Palmiter, 1982). Savings for particular combination of measures could be derived and include the interactions among measures depending on the particular combination of measures selected by the SBCC in either the option tables or the prescriptive code.

Some measures were not applicable to some of the prototypes. These were removed from the simulations. The overall effect was to evaluate virtually all the measures under consideration for the 2009 code changes. Thus the simulation runs were used to both develop the option tables themselves and to develop the case for cost/effective energy savings for new proposed provisions in the prescriptive code.

Final Option Table

Table 4 shows the final table proposed by the SBCC at the end of the review. This structure allowed a mix of relatively simple provisions and much more complex provisions. Because the analysis matrix predicted the relative saving of the individual provisions, it was possible to scale the options themselves. A target of about 6% overall energy savings was assigned one “point.” This was derived from similar savings observed across several measures in the matrix analysis. Several smaller measures (low flow DHW appliances, modest insulation upgrades and improved ventilation systems) were added as half point measures. In addition, a renewable credit was added to allow the use of on-site solar PV or solar thermal if builders were interested in such measures. The primary directive was that each point that would be available from the table could be expected to deliver roughly equal overall energy savings.

Table 1: Analytical prototypes

Prototype (ft^2):	1344	2200	2688	5000
House Description	Small single story over crawl space	Medium split-level, 1st floor over crawl space	Medium one story house over heated basement	Large two story house over heated basement
Floor area (ft^2)	1344	2200	2688	5000
Volume (ft^3)	10,752	18,700	22,848	40,100
Wall area (ft^2)	1184	2210	1480	2788
Glazing % Western WA	15%	15%	15%	15%
Glazing % Eastern WA	15%	15%	15%	15%
Ceiling area (ft^2)	1344	1784	1344	1800
Slab perimeter (ft)	N/A	N/A	148	164
Below grade wall height (ft)	N/A	N/A	7	7
Door area (ft^2)	40	40	40	40
House infiltration/ventilation (ACH50)	9.0	8.0	7.0	7.5
Supply duct primary location	Crawl	Crawl	Basement – Interior	Basement – Interior
Return duct primary location	Attic	Attic	Attic	Attic
Supply duct surface area (ft^2)	240	300	N/A	N/A
Return duct surface area (ft^2)	50	80	40	60
All prototypes (EPCA defined equipment efficiencies):				
Gas furnace (AFUE)				.78
Split system air Conditioner (SEER)				13
Split system heat pump (HSPF / SEER)				7.7 / 13
Gas hot water tank (EF)				.58
Electric hot water tank (EF)				.90

Table 2: 2009 WSEC baseline insulation requirements (component trade-off method)

	Climate Zone	
Component	Western WA	Eastern WA
Glazing % floor area	15%	15%
Vertical glazing U-factor	U = 0.30	U = 0.30
Overhead glazing U-factor	U = 0.50	U = 0.50
Doors	U = 0.200	U = 0.200
Ceilings	U = 0.027	U = 0.027
Walls	U = 0.056	U = 0.056
Floors	U = 0.029	U = 0.029
Slab on grade	F = 0.36	F = 0.36
Below grade		
Wall R-value	R-21	R-21
7' depth: walls slab	U = 0.037 F = 0.57	U = 0.037 F = 0.57

Table 3: Measures in optimization runs

Component	Number of measures	
	No.	Comments
Envelope	4	5%, 15%, 25%, & 30% Reduction in UA,
Ventilation	2	Efficient Exhaust, HRV
HVAC (gas)	1	AFUE .92
HVAC (HP)	5	HSPF 8.5, HSPF 9.0+, Commission. & Controls*
HVAC (zonal)	1	DHP (single head)
Ducts	3	Sealed(EStar), Sealed(PTCS), Inside
Elec. DWH	5	Low Flow Fixtures*, EF 0.93, HPWH, Solar
Gas DWH	5	Low Flow Fixtures*, EF 0.62, Demand, Solar
Lighting	3	50% 75%, 90% Hi-Efficacy Lamps
Fan	1	ECM Fan (HVAC)

*Applies to all base runs and all measures

The initial option table proposal required that each single family home include provisions to achieve three "points" beyond compliance with the prescriptive requirements. In addition, an extra point was required for homes above 5000 square feet of conditioned area and one less point was required for homes with less than 1500 square feet of conditioned area. These modifications made the demands on smaller homes more tractable. The justification was based on the simulation for the smaller prototype that suggested that very significant reductions were actually available from the lighting, air tightness and DHW provisions, with fewer measures from the option table.

The effect of this package of proposals was to reduce the overall energy requirements of the home by about 30%. This figure was derived from the combination of measures drawn from the matrix including the impacts of lighting and air tightness. The assumption was that the existing homes built to the current standards averaged 7 ACH50 in envelope tightness. Thus a small savings would be available by a mandatory blower door test with a target of 6 ACH50.

The final report from the Technical Advisory Group (TAG) to the SBCC included improvements to the mandatory envelope section of the code as well as a requirement for 50% high efficacy lamps, improvements in heat pump controls and a mandatory duct tightness testing protocol and standard. The final standard was then reviewed and set by the SBCC.

This process took into account the technical work done but also accommodated the various interests including the construction industry and the home builders association. The proposal was amended to reduce the number of points in the final code proposal from three points to one point. While this reduced the impact of the code overall it also cemented the option structure into the WSEC.

Table 4: 2009 Options table (abbreviated)

Option	Description	Credit(s)
1a	HIGH EFFICIENCY HVAC EQUIPMENT 1: Gas, propane or oil-fired furnace or boiler with minimum AFUE of 92%, or Air-source heat pump with minimum HSPF of 8.5.	1.0
1b	HIGH EFFICIENCY HVAC EQUIPMENT 2: Closed-loop ground source heat pump; with a minimum COP of 3.3.	2.0
1c	HIGH EFFICIENCY HVAC EQUIPMENT 3: DUCTLESS SPLIT SYSTEM HEAT PUMPS, ZONAL CONTROL: In home where the primary space heating system is zonal electric heating, a ductless heat pump system shall be installed and provide heating to at least one zone of the housing unit.	1.0
2	HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM 1: All heating and cooling system components installed inside the conditioned space. All combustion equipment shall be direct vent or sealed combustion.	1.0
3a	EFFICIENT BUILDING ENVELOPE 1: Component performance compliance: Reduce the Target UA from Table 5-1 by 5%, as determined using EQUATION 1.1	0.5
3b	EFFICIENT BUILDING ENVELOPE 2: Reduce the Target UA from Table 5.1 by 15%, as determined using EQUATION 1.1	1.0
3c	SUPER-EFFICIENT BUILDING ENVELOPE 3: Reduce the Target UA from Table 5.1 by 30%, as determined using EQUATION 1.1	2.0
4a	AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION: Envelope leakage reduced to 4 ACH50. Whole house ventilation requirements as determined by Section M1508 of the Washington State Residential Code heat recovery ventilation system.	0.5
4b	ADDITIONAL AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION: Envelope leakage reduced to 3 ACH50. All whole house ventilation requirements as determined by Section M1508 shall be met with a ducted heat recovery ventilation system.	1.0
5a	EFFICIENT WATER HEATING 1: Gas, propane or oil water heater with a minimum EF of 0.62. or Electric Water Heater with a minimum EF of 0.93. All showerhead shall be rated at 1.75 GPM or less. All other lavatory faucets shall be rated at 1.0 GPM or less.2	0.5
5b	HIGH EFFICIENCY WATER HEATING 1: Water heating system shall include one of the following: Gas, propane or oil water heater with a minimum EF of 0.82. or Solar water heating supplementing a minimum standard water heater or Electric heat pump water heater with a minimum EF of 2.0.	1.5
6	SMALL DWELLING UNIT 1: Dwelling units less than 1500 square feet in floor area with less than 300 square feet of window + door area.	1.0
7	LARGE DWELLING UNIT 1: Dwelling units exceeding 5000 square feet of floor area shall be assessed a deduction	-1.0
8	RENEWABLE ELECTRIC ENERGY: For each 1200 kWh of electrical generation provided annually by on-site wind or solar equipment a 0.5 credit shall be allowed, up to 3 credits.	0.5

Implementation and Legal Challenge

The energy code implementation process in Washington includes a final step where the State Legislature is given an opportunity to reject the code proposal from the SBCC. In that process the code implementation date is delayed 6 months so that there is ample time for the legislature to review the changes proposed. While the legislature did not act on the code, the economic recession spread to the home building industry and the Governor delayed the implementation of the residential energy code an additional ten months. In this period the Building Industry Association of Washington (BIAW) sued in federal court (on behalf of the home builders) to strike down the options table on the theory that such a table had to meet a much higher standard than regular energy code amendments since it sought to provide a regulatory mechanism for equipment to surpass the federal standards and thus violated the federal preemption for equipment included in the original EPAC 1992 legislation.

This approach emphasized the facts that the federal preemption included both equivalent energy options and equivalent cost options. Since some of the options were much more costly than the equipment improvements required by the equipment options, the builders would have no choice but to select the efficient equipment and would thus be mandated to select such equipment by the economic imperatives in the structure of the option tables. Such a mandate would constitute a violation of the preemption clauses of the EPAC.

The defense of the option tables was handled by the Washington State Attorney General (AG). There were several interveners including the National Resources Defense Council (NRDC) and other local environmental and energy policy advocates. The defense mounted by the AG (in consultation with the interveners) was that the EPAC provided a path to include higher efficiency equipment in state regulations. This process included seven criteria that together would make an acceptable condition to allow the state policy to require higher efficiency in preempted equipment:

1. The builder will have overall performance goals that could be met with “covered equipment” but would not be required to use such equipment in complying with the standard.
2. No language can require the use of such equipment in meeting the performance standard in the code.
3. Other equivalent options (not “covered equipment”) must be available to the builder to meet the performance standards set by the code.
4. The basic mandatory provision of the code cannot require any efficiency standard beyond the standards set by federal mandate.
5. At least one option path must be available that does not require the use of covered equipment beyond the standards set by federal rule.
6. An energy consumption standard (or energy cost standard) shall be equivalent for all options proposed.
7. The energy consumption standards of any covered equipment used in the code must use the federal standards to arrive at the rated performance.

The key issue before the court as the BIAW presented its case was that the “energy cost standard” was violated since the cost of the non-equipment options exceeded the cost of the equipment that was otherwise covered by the federal standards. Since the builders had to make a cost effective judgment to build the homes the effect of these options was to mandate the more efficient equipment. This should be interpreted as a violation of the federal preemption.

The State's defense was centered on the definition of equivalent energy use. In the language of the EPAC it was clear that the intent of Congress was to provide equivalent energy use or energy costs *to the building occupant*. The builder's decisions were not the issue, only the final efficiency of the building using either the covered equipment or the other options provided. To establish this equivalence the final option tables were evaluated using the same procedure that was used in their development. In this case, however, the base case was revised to include the changes to the prescriptive paths included in the basic code. Table 5 shows the results of this analysis for the final option table. Each option was evaluated against the same prototype homes used in the initial analysis and the results were combined based on a population weighted assignment for the prototypes and fuel choices typical in new residential construction (RLW, 2007).

Table 5 represents the relative savings per point assigned in the option table. The savings percentage in Table 5 is the result of the weighted average of the four prototypes and the fuel choices for those prototypes. The use of site energy as one of the criteria is consistent with the performance language in the WSEC which emphasized site energy for all performance runs in both commercial and residential sectors. The cost basis was designed to mimic the ASHRAE 90.1 standard which uses modeled energy cost to assess individual designs. Only one option (4a) is outside the savings range of the remaining options. This option was modified significantly when two of the original options were combined in the SBCC's final editing process.

The defense of the option table in the federal court was based on the results of the simulation estimates summarized in Table 5. The plaintiffs filed for summary judgment arguing that the central assumption that the options were inherently equivalent was flawed as the builder would see much different costs depending on the options selected. In issuing a final decision denying the petition, the Judge ruled that the State had met the requirements of the EPAC. In effect the consumer would see equivalent energy savings and/or equivalent energy costs regardless of the option selected. Thus, the court dismissed the suit in summary judgment in February, 2011 about two months before the new code was to take effect[8].

[8] Robert J. Bryon, U.S. District Judge, February 7, 2011, Document 63, Case No. C09-5633RGB, Building Industry Association of Washington, et al vs. Washington State Building Code Council before U.S. District Court, Western District of Washington.

Table 5: Savings per Option Point

Option	Description	Points	Site Energy Basis Savings per Point	**Consumer Cost Basis** Savings per Point
1a	High efficiency furnace or heat pump*	1	8%	**6%**
1b	Ground source heat pump*	2	6%	**6%**
1c	Ductless split system heat pump (zonal)*	1	7%	**7%**
2	Interior duct placement	1	6%	**5%**
3a	Efficient envelope 1	0.5	7%	**5%**
3b	Efficient envelope 2	1	8%	**6%**
3c	Super-efficient envelope	2	7%	**5%**
4a	Air leakage control and heat recovery ventilation	0.5	10%	**10%**
4b	Added leakage control and heat recovery ventilation	1	9%	**8%**
5a	Tank water heater upgrade and lower-flow fixtures*	0.5	9%	**8%**
5b	Gas tankless or elec. Heat pump water heater*	1.5	6%	**5%**
5bsol	Solar thermal water heating	1.5	7%	**6%**
6	Small dwelling, <1500ft^2, credit	1	†	†
7	Large dwelling, >5000ft^2, deduction	-1	†	†
8	Renewable electric energy, 1200kwh/yr	0.5	11%	10%

*Includes Covered Equipment
†Savings not calculated for house size credits

Energy Saving Estimates

Upon the implementation of the 2009 WSEC a savings estimate was developed for homes built under this code. Table 6 summarizes the results of this analysis. This analysis employed the same prototypes used in the original matrix development and weighted the results by the incidence of heating system and house size and climate zone across the state (Larson, et al, 2011).

As can be seen the overall savings impact of the code changes and option table was about 14% of total consumption. Only the small fraction of zonal electric homes in the state did not show that level of savings. This is the result of the small home provision (option 6). Homes under 1500 sf were required to have only a single option point but are awarded the “small dwelling” credit which meets that requirement. This provision obviates the need for any additional options for small homes. The vast majority of the prototypes using the electric resistance heating systems were these smaller homes. They were, however, required to use the prescriptive additions to the code such as blower door tests and high efficacy lighting. The savings in this group only reflects those changes. About 83% of all new construction in Washington is heated with gas furnaces. Thus, in the remaining prototypes the savings are dominated by the use of high efficiency furnaces (AFUE >.92).

At this writing the homes built under this option table and the subsequent revisions in 2012 are dominated by only a few options. The 2012 code only required an additional half point over the 2009 code. An informal survey of people involved in code support suggested that the options selected tended to be the more efficient gas furnaces (1a), the most modest envelope measure (3a), and the instantaneous DHW option (5b). For the electrically heated homes the high efficiency heat pump (1a) is usually selected. In the 2015 revisions two additional points were added. It is likely that some of the more aggressive options will be seen in this coming code cycle.

Table 6: Energy Use and Savings 2006-2009 WSEC (Modeled)

	2006 WSEC		2009 WSEC		Savings (from 2006 code)		
System	Therms	kWh	Therms	kWh	Therms	kWh	%
Gas furnace, with AC	669	7474	560	6641	109	833	14.9%
Gas furnace, no AC	663	6512	553	5884	110	628	14.8%
Heat pump		16472		14537		1935	9.5%
Electric zonal no AC		17108		16467		641	3.7%
All systems, all prototypes							13.8%

Conclusions:

The development of the option table in Washington was designed to accommodate the rulings of the federal court in previous cases involving the pre-emption clause in the EPAC. The main goal, however, was to provide a near term road map for future energy efficiency advances in Washington State. With the ambitious goal of a 70% reduction in total energy use by 2031, it became imperative that the SBCC have a guideline to press forward with code actions. While the options proposed in the final version would probably not meet the goal of 70% total savings in the residential sector it was designed to provide measures that would provide most of the savings required through the 2024 code cycle or a reduction of more than 50%. Since the 2009 code deliberations, advances in LED lighting and heat pump water heaters have suggested that this goal may be achievable. Moreover, with cost reductions of 50 to 60 percent, the addition of solar PVs could bridge the gap to the legislative goals for the residential sector.

In the two code cycles that have occurred since the passage of the 2009 code the option tables have been revised. The water heating measures, especially high performance water heating, have been expanded. The SBCC has tried to anticipate federal standards and adjust the option tables accordingly. This approach proved problematic when the anticipated improvement in gas furnace AFUE was rolled back at the beginning of 2013 after the approval of a revised option table that reduced the impact of the higher efficiency gas furnace. In the subsequent code cycle this option was revised to be consistent with the savings from the original federal standard for gas furnace efficiency.

In the next two code cycles (2012 and 2015) the SBCC increased the number of points required for a standard size home to 3.5. This change (over the two code cycles), in conjunction with additional mandatory code changes resulted in a decrease in the total energy use in new single family homes in Washington of an additional 15 to 20 percent over the final 2009 code with option tables. The overall impact of these three code cycles resulted in decrease in total energy of the 2006 benchmark code by more than 30%, This progress is consistent with the goals of the legislature and the governor and provides a significant validation of the option table approach to the problem of significantly improving overall performance from energy codes.

The WSEC residential energy code has been a prescriptive code for virtually all of the last twenty years. The infrastructure for a performance code on the model of Title 24 in California was abandoned in the late 90s and the performance path largely ignored by subsequent code cycles. The performance path as a code tool requires infrastructure that allows building departments to check the results of simulations using a standardized package of inputs in a standardized computer simulation. The State of Washington has not developed that infrastructure and indeed there is little demand from either the builders or code officials. The option table allows flexibility for builders of increasingly efficient homes and provides paths that give credit for high efficiency equipment employed in the compliance of these homes. The performance path is already able to make that adjustment. The option tables provide a path to make that same flexibility available in the prescriptive codes.

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