

# Single-Family New Construction Economic Analysis

## 2015 RBES base code compared to 2011 requirements

- Typical home modeled using propane, natural gas, oil and electricity (heat pump)
- Weighted average annual energy savings
- Incremental costs for 2015 Prescriptive Package compared to 2011 minimum requirements
- Results for weighted average 2015 Base Code and Stretch Code

## All four benefit-cost perspectives show incremental costs offset by energy savings that accrue

- Simple Payback
- Return on Investment
- Savings to Investment Ratio
- Cash Flow

No scenarios take into account escalating fuel costs, so savings projections are likely to be conservative

# Analysis Approach

- ▶ 2015 RBES Base and Stretch Code energy savings calculated by EVT from REM/Rate modeled annual consumption estimates and converted into fuel specific units for propane, natural gas, fuel oil and electricity (heat pump).
- ▶ Annual energy costs calculated using VT PSD Fuel Report, with conservative assumption of constant fuel prices into future
- ▶ Incremental costs developed using several sources: RS Means, EPA's Cost and Savings Report, NEEP Incremental Cost Study, and PNNL Building Component Database

# Analysis Approach – (continued #1)

- ▶ Each Prescriptive Package analyzed to establish minimum requirements for 2015 Base and Stretch Codes, energy savings were determined and compared to minimum requirements in Prescriptive Package #1 listed in 2011 RBES Handbook
- ▶ For each comparison scenario, energy savings determined for 4 heating system fuel types: fuel oil, propane, natural gas, and electricity (heat pump)
- ▶ Weighted average annual energy savings calculated by weighting annual savings for each fuel type by incidence rate of each fuel as reported in 2013 VT Residential New Construction Baseline Study
- ▶ Also determined were incremental costs for each Prescriptive Package compared to minimum requirements in 2011 RBES Prescriptive Package #1, which was then reviewed by Vermont production builders

# Analysis Approach – (continued #2)

- ▶ Following are weighted energy savings across all 2015 Base and Stretch Code Prescriptive Packages, along with high and low energy cost savings scenarios based on a specific fuel type assumed for a particular Prescriptive Package
- ▶ Across the four benefit – cost perspectives, incremental costs associated with Base Code and Stretch Code, as compared to 2011 RBES requirements, are offset through significant energy savings that accrue

# Average Savings and Costs

- ▶ **Average Annual Weighted Savings**
  - Base Code = \$653
  - Stretch Code = \$1092
  
- ▶ **Average Incremental Cost**
  - Base Code = \$3470
  - Stretch Code = \$8156

# Simple Payback (SPB) – Results

- ▶ SPB = Incremental cost divided by annual energy savings
- ▶ 5.3 years for Base Code (fuel-specific scenarios range from 4.3 to 12.4 years)
- ▶ 7.4 years for Stretch Code (fuel-specific scenarios range from 6.6 to 15.8 years)

# Return on Investment (ROI) – Results

**ROI = Annual energy savings divided by incremental cost**

- ▶ **19% for Base Code** (fuel-specific scenarios range from 8% to 23%)
- ▶ **13% for Stretch Code** (fuel-specific scenarios range from 6% to 15%)

# Savings to Investment Ratio (SIR) – Results

**(SIR) – based on 25 year expected life**

- ▶ SIR = Annual energy savings divided by incremental cost times the lifetime of the energy measures
- ▶ 4.7 for Base Code (fuel-specific scenarios range from 2 to 5.8)
- ▶ 3.3 for Stretch Code (fuel-specific scenarios range from 1.6 to 3.8)



# Cash Flow (CF) – Results

CF – based on annual mortgage payment @ 4.5% interest over 30 years)

- ▶ CF = Annual energy savings minus incremental mortgage cost of the energy measures
- ▶ \$440 Annual Net Positive Savings for Base Code (fuel-specific scenarios range from \$68 to \$590)
- ▶ \$591 for Stretch Code (individual fuel-specific scenarios range from \$15 to \$730)

# Base Code Cost Assumptions

Measure	2011 RBES	2015 RBES	Inc. Unit Cost	Area	Cost Qty.	Cost Unit
Cooling Equipment	13 SEER Central AC	13 SEER Central AC				Tons
Heating Equipment	78 AFUE Gas Furnace	78 AFUE Gas Furnace				kBtu/h
Ventilation	Exhaust Fan	Exhaust Fan				each
Ceiling Insulation - Slope	R-32	R-32		368		\$/SF/R-1
Ceiling Insulation - Flat	R-49	R-49		1055		\$/SF/R-1
A-G Wall Insulation - Cavity	R-13	R-13		2350		\$/SF/R-1
A-G Wall Insulation - Exterior	R-5	R-10	\$0.19	2350	11750	\$/SF/R-1
Foundation Wall Insulation	R-15/20	R-15/20		1151		\$/SF/R-1
Slab Insulation	R-15, 4ft	R-15, 4ft		324		\$/SF/R-1
Floor Insulation	R-30	R-30		96		\$/SF/R-1
Rim & Band Joist - Cavity	R-20	R-20		272		\$/SF/R-1
Rim & Band Joist - Continuous	R-5	R-5		272		\$/SF/R-1
Infiltration	5.0 ACH 50	3.0 ACH 50	\$0.31	2576	2576	CFA (sq ft)
Windows	U-value: 0.32; SHGC: 0.40	U-value: 0.32; SHGC: 0.40			280	Window Area (sq ft)
Doors	R-3	R-3			2	each
Water Heater	0.75 EF Propane DHW, 40 Gallons	0.75 EF Propane DHW, 40 Gallons			1	each
Thermostat	Programmable	Programmable				
Duct Sealing - Total Leakage	6 CFM per 100 SF of CFA Total Leakage	4 CFM per 100 SF of CFA Total Leakage	\$0.19		2576	CFA (sq ft)
Duct Insulation	R-8 Attic, R-6 Other Uncond. Spaces	R-8 Attic, R-6 Other Uncond. Spaces			130	Duct Surface Area (sq ft)
Lighting	75% ENERGY STAR CFLs	75% ENERGY STAR CFLs				

# Base Code Assumptions (continued)

Measure	Inc. Cost	Source
Cooling Equipment	\$0	
Heating Equipment	\$0	
Ventilation	\$0	
Ceiling Insulation - Slope	\$0	
Ceiling Insulation - Flat	\$0	
A-G Wall Insulation - Cavity	\$0	
A-G Wall Insulation - Exterior	\$2,182	RMeans
Foundation Wall Insulation	\$0	
Slab Insulation	\$0	
Floor Insulation	\$0	
Rim & Band Joist - Cavity	\$0	
Rim & Band Joist - Continuous	\$0	
Infiltration	\$799	<a href="#">EPA ENERGY STAR Version 3 Cost and Savings</a>
Windows	\$0	
Doors	\$0	
Water Heater	\$0	
Thermostat		
Duct Sealing - Total Leakage	\$489	<a href="#">EPA ENERGY STAR Version 3 Cost and Savings</a>
Duct Insulation	\$0	
Lighting	\$0	
<b>Total Incremental Cost</b>	<b>\$3,470</b>	

# Stretch Code Cost Assumptions

Measure	2011 RBES	2015 RBES	Inc. Unit Cost	Area	Cost Qty.	Cost Unit
Cooling Equipment	13 SEER Central AC	14.5 SEER Central AC	\$108.00		3	Tons
Heating Equipment	78 AFUE Gas Furnace	95 AFUE Gas Furnace			100	kBtu/h
Ventilation	Exhaust Fan	Exhaust Fan				each
Ceiling Insulation - Slope	R-32	R-49	\$0.05	368	6256	\$/SF/R-1
Ceiling Insulation - Flat	R-49	R-60	\$0.05	1055	11605	\$/SF/R-1
A-G Wall Insulation - Cavity	R-13	R-13		2350		\$/SF/R-1
A-G Wall Insulation - Exterior	R-5	R-10	\$0.19	2350	11750	\$/SF/R-1
Foundation Wall Insulation	R-15	R-20 (10I+10E)	\$0.20	1151	5755	\$/SF/R-1
Slab Insulation	R-15, 4ft	R-15, 4ft		324		\$/SF/R-1
Floor Insulation	R-30	R-30		96		\$/SF/R-1
Rim & Band Joist - Cavity	R-20	R-20		272		\$/SF/R-1
Rim & Band Joist - Continuous	R-5	R-5		272		\$/SF/R-1
Infiltration	5.0 ACH 50	3.0 ACH 50	\$0.31	2576	2576	CFA (sq ft)
Windows	U-value: 0.32; SHGC: 0.40	U-value: 0.28; SHGC: 0.40	\$3.74		280	Window Area (sq ft)
Doors	R-3	R-4	\$20.59		2	each
Water Heater	0.75 EF Propane DHW, 40 Gallons	0.78 EF Propane DHW, 40 Gallons	\$0.00		1	each
Thermostat	Programmable	Programmable				
Duct Sealing - Total Leakage	6 CFM per 100 SF of CFA Total Leakage	4 CFM per 100 SF of CFA Total Leakage	\$0.19		2576	CFA (sq ft)
Duct Insulation	R-8 Attic, R-6 Other Uncond. Spaces	R-8 Attic, R-6 Other Uncond. Spaces			130	Duct Surface Area (sq ft)
Lighting	75% ENERGY STAR CFLs	75% ENERGY STAR CFLs				

# Stretch Code Assumptions (continued)

Measure	Inc. Cost	Source
Cooling Equipment	\$324	<a href="#">EPA ENERGY STAR Version 3 Cost and Savings</a>
Heating Equipment	\$1,175	<a href="#">NEEP Incremental Cost Study</a>
Ventilation	\$0	
Ceiling Insulation - Slope	\$313	RSMeans
Ceiling Insulation - Flat	\$580	RSMeans
A-G Wall Insulation - Cavity	\$0	
A-G Wall Insulation - Exterior	\$2,238	RSMeans
Foundation Wall Insulation	\$1,151	RSMeans
Slab Insulation	\$0	
Floor Insulation	\$0	
Rim & Band Joist - Cavity	\$0	
Rim & Band Joist - Continuous	\$0	
Infiltration	\$799	<a href="#">EPA ENERGY STAR Version 3 Cost and Savings</a>
Windows	\$1,046	<a href="#">Building Cost Component Database</a>
Doors	\$41	<a href="#">EPA ENERGY STAR Version 3 Cost and Savings</a>
Water Heater	\$0	
Thermostat		
Duct Sealing - Total Leakage	\$489	<a href="#">EPA ENERGY STAR Version 3 Cost and Savings</a>
Duct Insulation	\$0	
Lighting	\$0	
<b>Total Incremental Cost</b>	<b>\$8,156</b>	