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December 16, 2011

MEMORANDUM

TO: Power Committee

FROM: Terry Morlan

SUBJECT: Direct Use of Natural Gas Analysis

Is it better to use natural gas directly in water heaters and furnaces or to generate electricity for electrical space and water heating systems that provide these services? The Council has deliberated on this question since its inception. Over the years, the Council has performed several studies and issued papers addressing the issue. The topic has gone under different names; total-energy efficiency, fuel switching, direct use of gas, and others.

In light of changing technologies and energy prices and of growing climate concerns, in 2008 the Council was again asked to look at the direct use of natural gas issue. The analysis is called for in the Action Plan (ANLYS-16) for the Sixth Power Plan. With the financial support and cooperation of the Northwest Gas Association and Puget Sound Energy, the Council has updated its economic analyses. The Council's Regional Technical Forum oversaw the study and its scope.

This is the most detailed and complete analysis of the direct use of natural gas issue to date. The analysis found that from both a societal and individual consumer perspective that most consumers should remain with their current space and water heating fuels. There are few cost effective fuel conversions in space heating, but up to 26 percent of water heating choices could involve changes in fuels. Most of the water heating fuel conversions involve shifting to natural gas water heating away from electric resistance where natural gas is already in the home for space heating. However, there are also fewer situations where it is cost-effective to shift from natural gas water heaters to heat pump water heaters when the water heaters are greater than 55 gallons.

Two technologies no longer appear cost-effective; electric resistance water heating, and electric forced air furnace space heating. The analysis found that it is cost-effective to shift away from these technologies. Replacement technologies are quite competitive between natural gas and electricity. Gas forced air furnaces, air source heat pumps, ductless heat pumps and electric zonal are all competitive replacements for electric forced air furnaces depending on home

characteristics, climate, and fuel prices. For water heating replacements heat pump water heaters and condensing gas water heaters are very close in both first cost and life cycle cost.

The overall potential effects on gas and electricity use if all of the cost-effective conversion choices were made is small. Across all households, regional electric loads decrease around 340 average megawatts or about 1.5% of projected loads in 2030. Natural gas use by customers increases 13 trillion BTU. However, less natural gas is used by the power generation turbines that would otherwise have served those electric space and water heating systems. After netting out the 21 trillion BTU decrease of gas use by these turbines, total regional natural gas consumption falls 8 trillion BTU per year by the end of the 20-year study.

Staff has written a paper describing the analysis and findings. It has been reviewed by the RTF and the Northwest Gas Association. We will be looking for the Council's approval to release the paper for general public comment.

The draft paper is attached to the Council packet along with a decision memorandum. A PowerPoint presentation is attached to this Power Committee packet that describes the analysis and findings. We will go through that presentation for the Power Committee and have a discussion about the findings and implications for the Council's fuel choices policy.

Attachment

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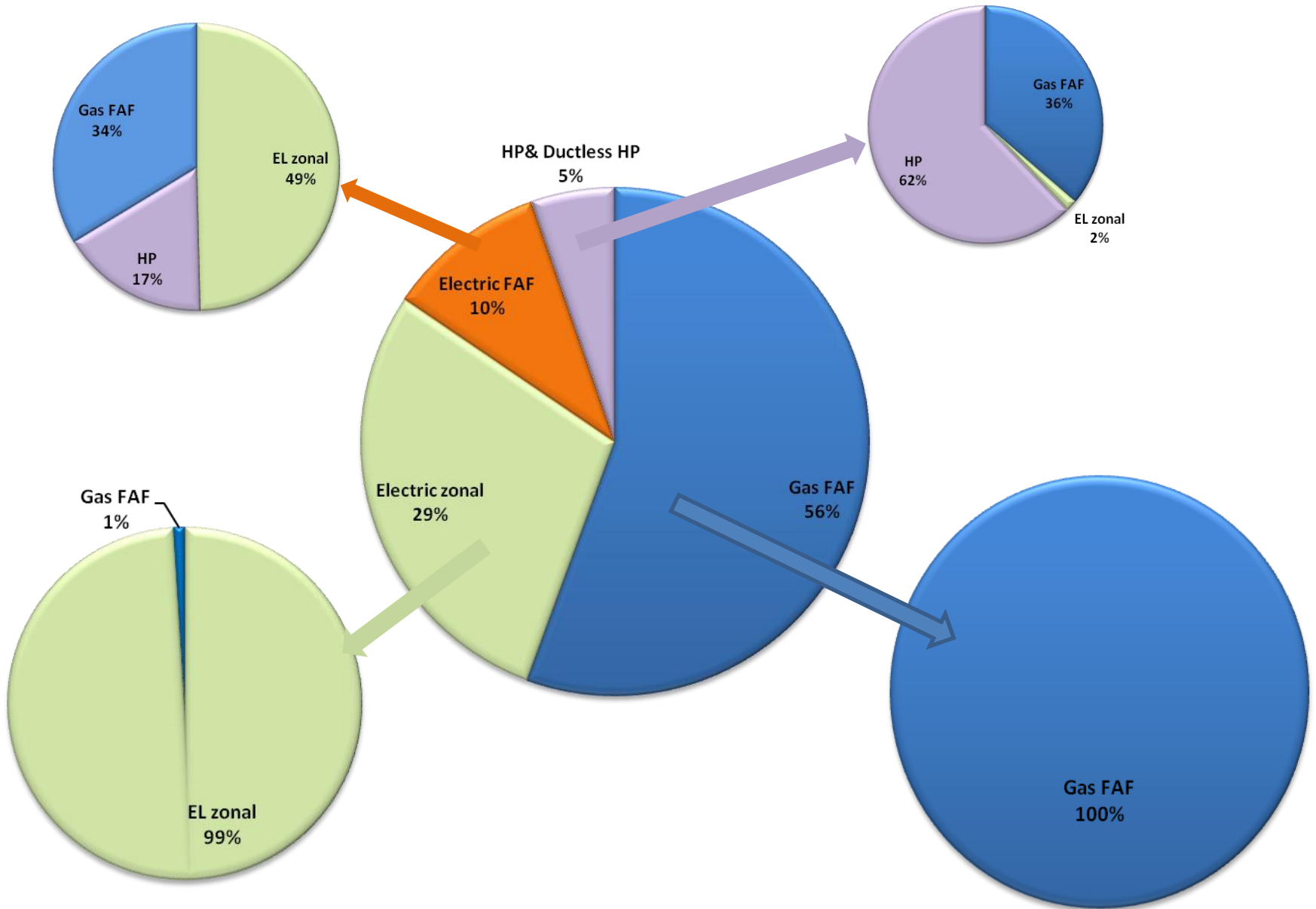
Direct Use of Natural Gas Analysis

Power Committee Meeting
January 2012

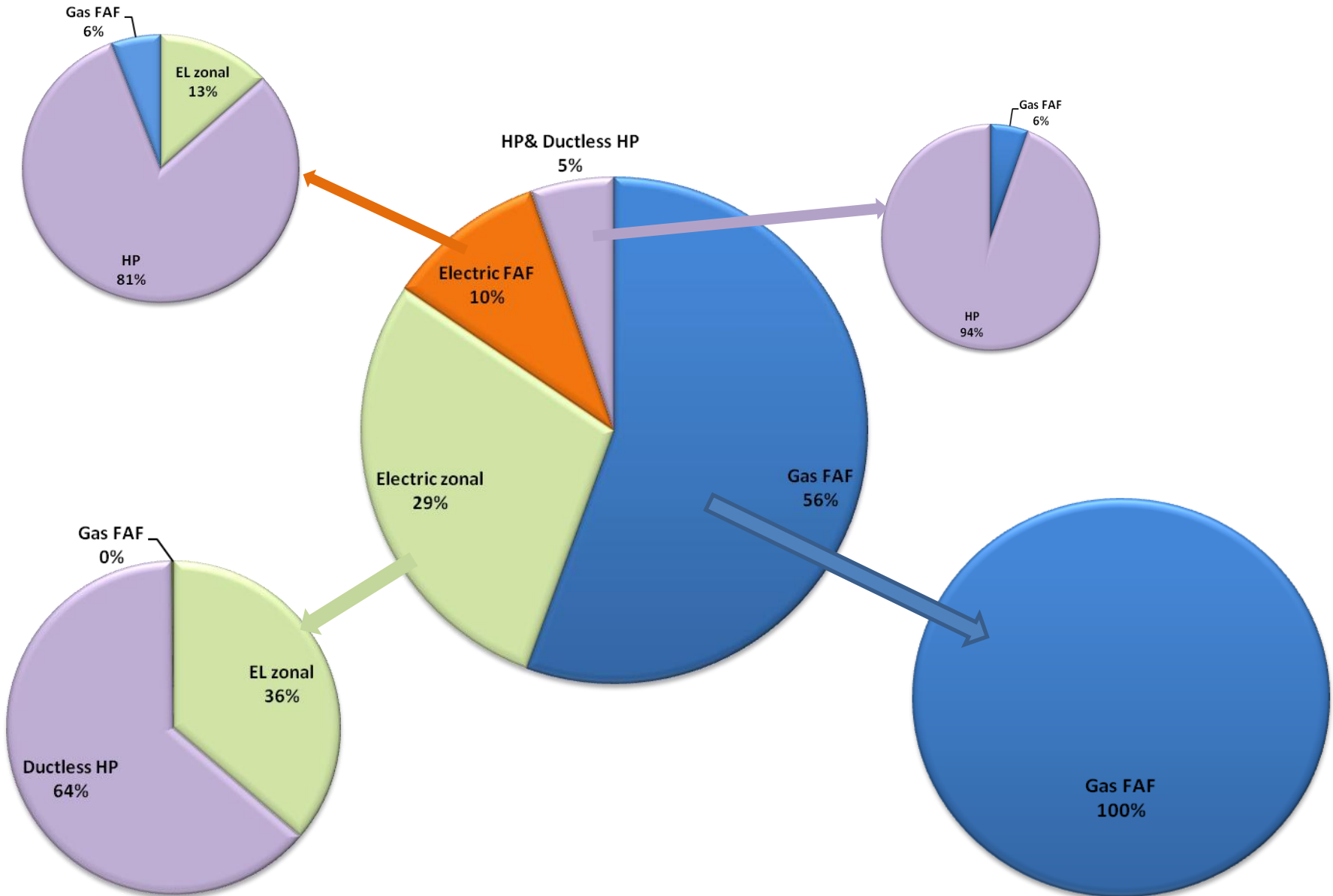
Two Perspectives

- Regional Power System
 - Space conditioning and water heating system selection based on wholesale electricity and gas prices
 - Considers total system “cost” and “risk” (i.e., *consideration of individual space and water heating conversion costs and performance alone does not account for the cumulative effects of these systems on the need for new resources*)
- Consumer Perspective
 - Space conditioning and water heating system selection based on retail electricity and gas prices
 - Does not consider for “system” level impacts

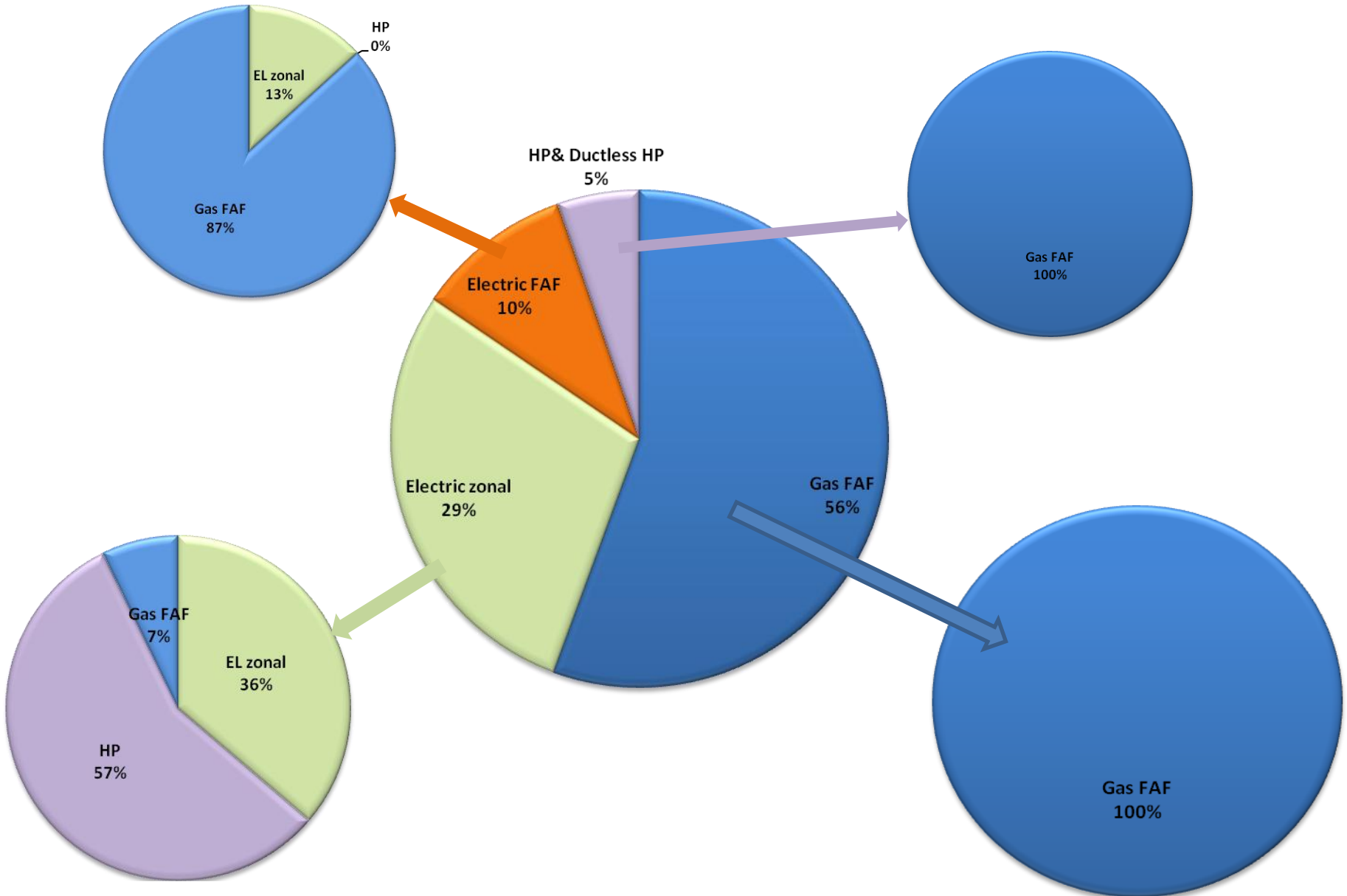
Space Heat Choices - Regional



Space Heat Choices – Consumer 1

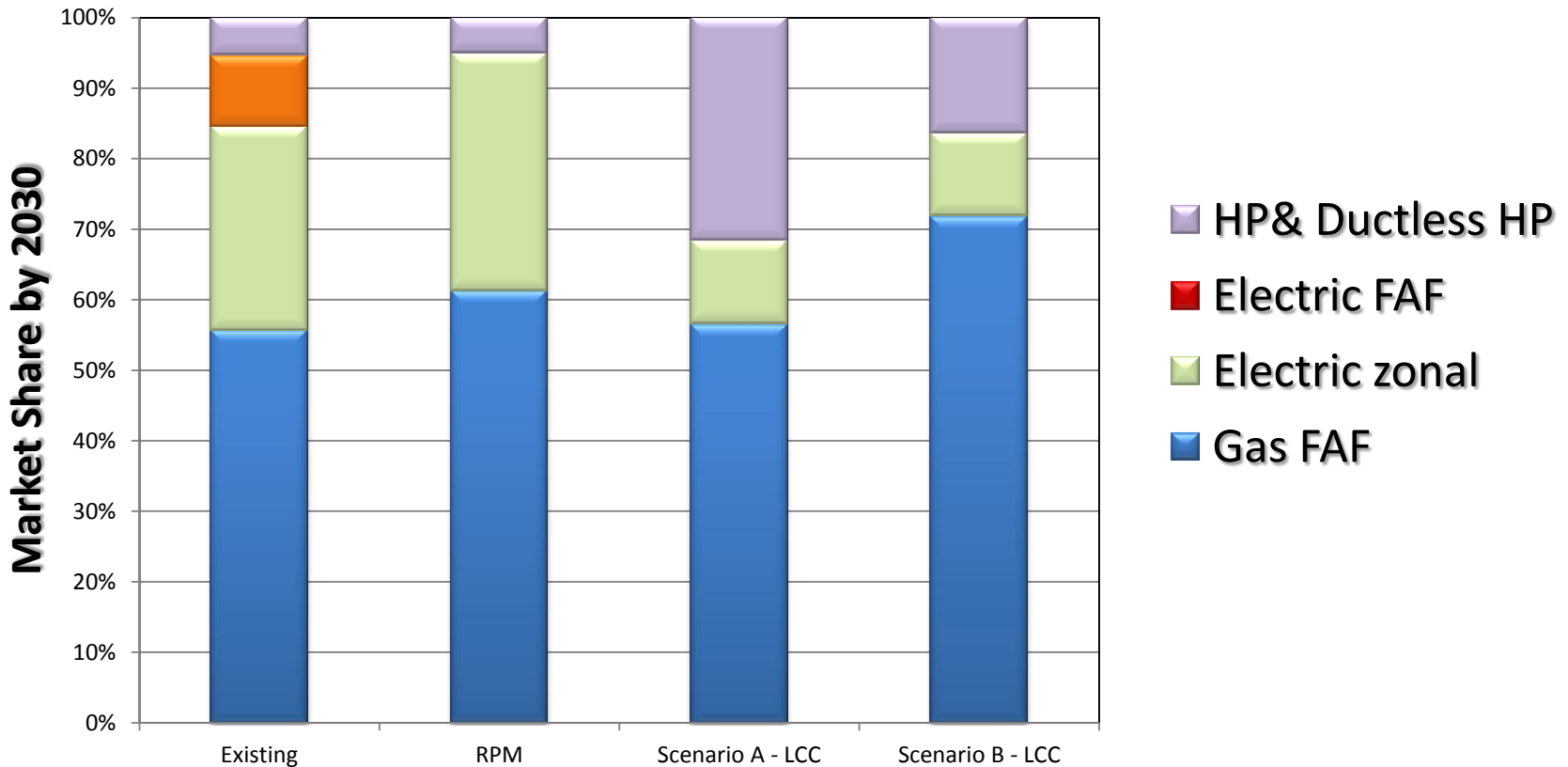


Space Heat Choices – Consumer 2



Space Conditioning System Choices

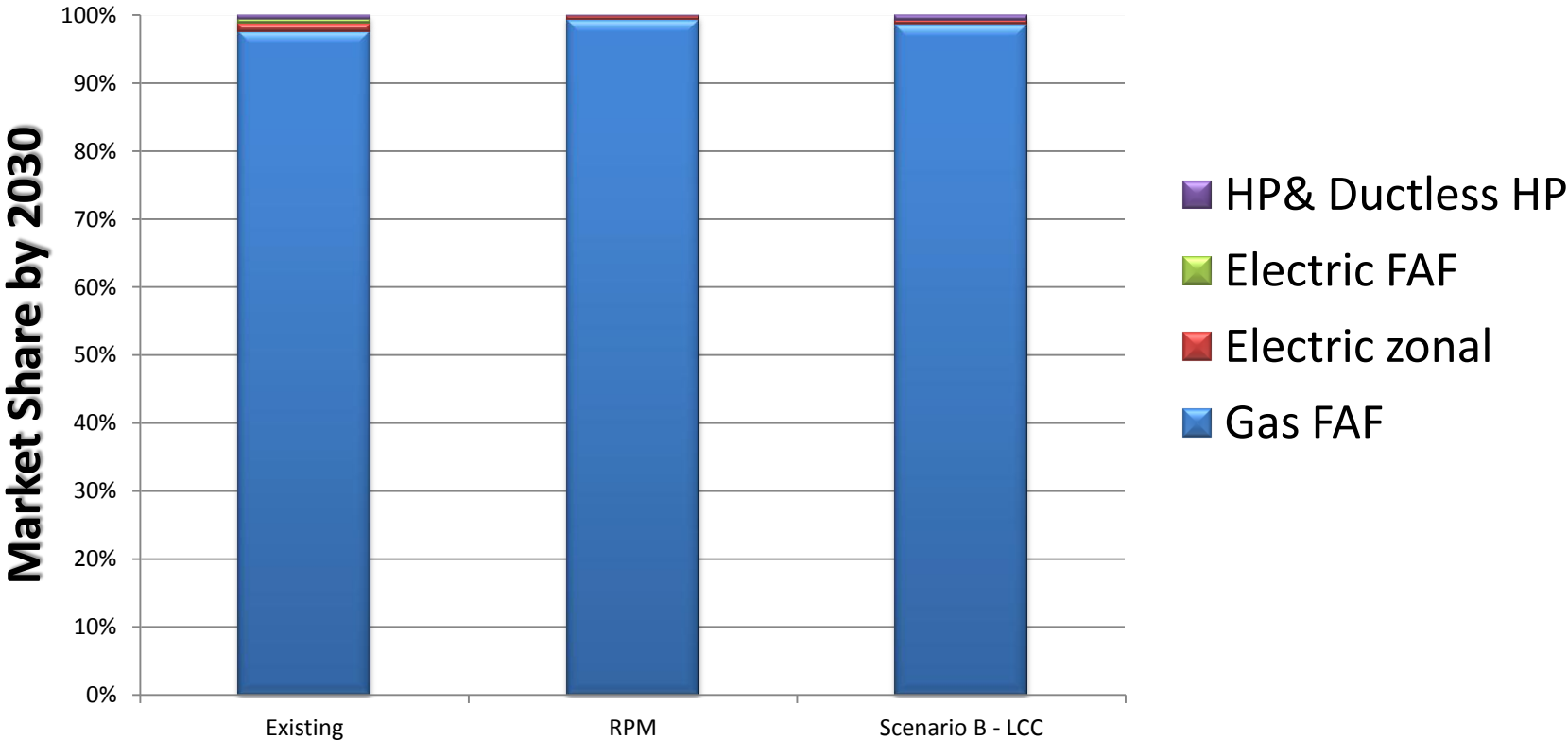
TRC vs LCC Results for All Households



LCC Scenario A assumes gas access (line or line and main extension) costs are paid directly by consumer.

LCC Scenario B assumes gas access cost are recovered in all residential retail rates.

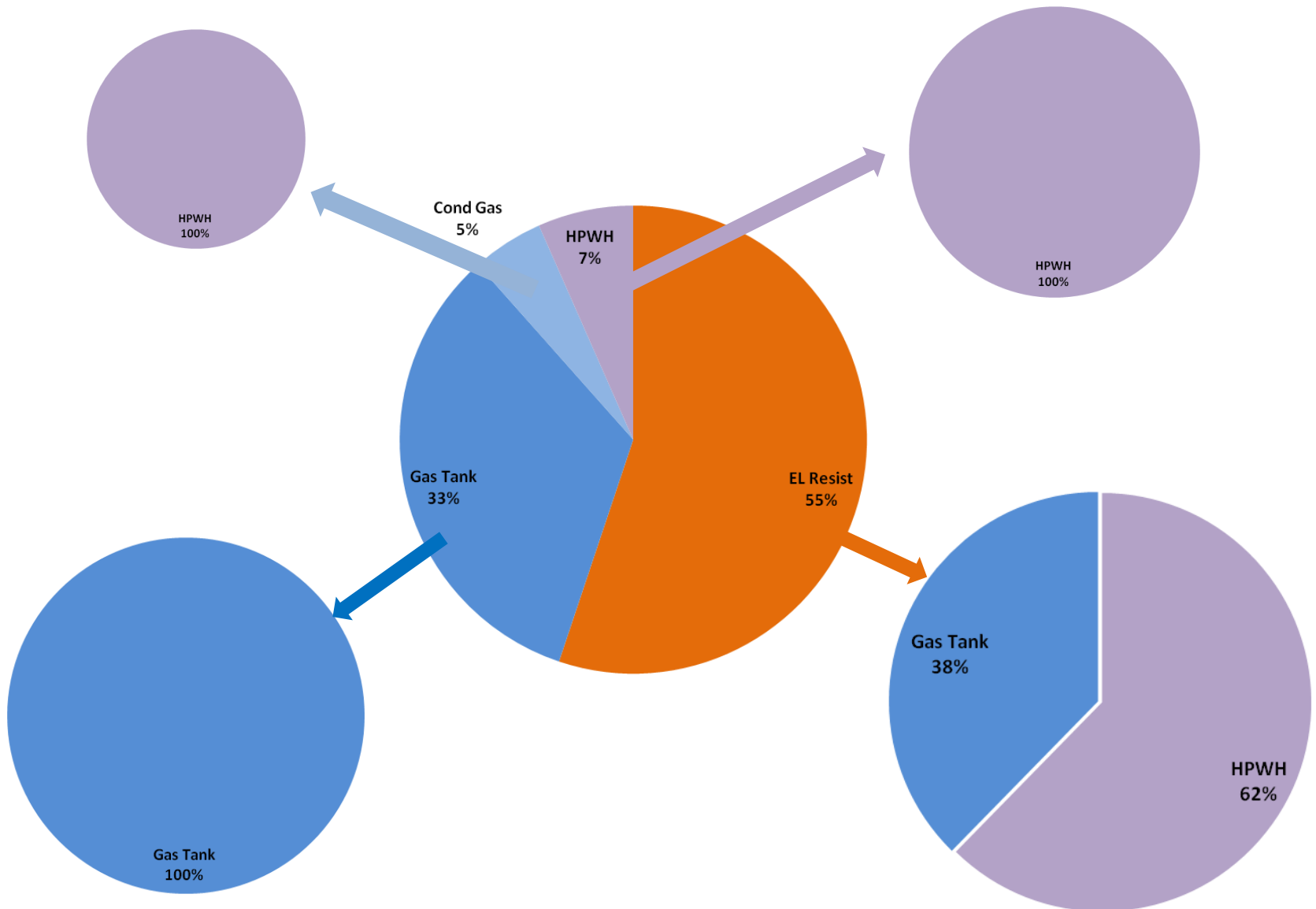
Space Conditioning System Selection RPM vs. LCC Results for Households with Existing Gas Service



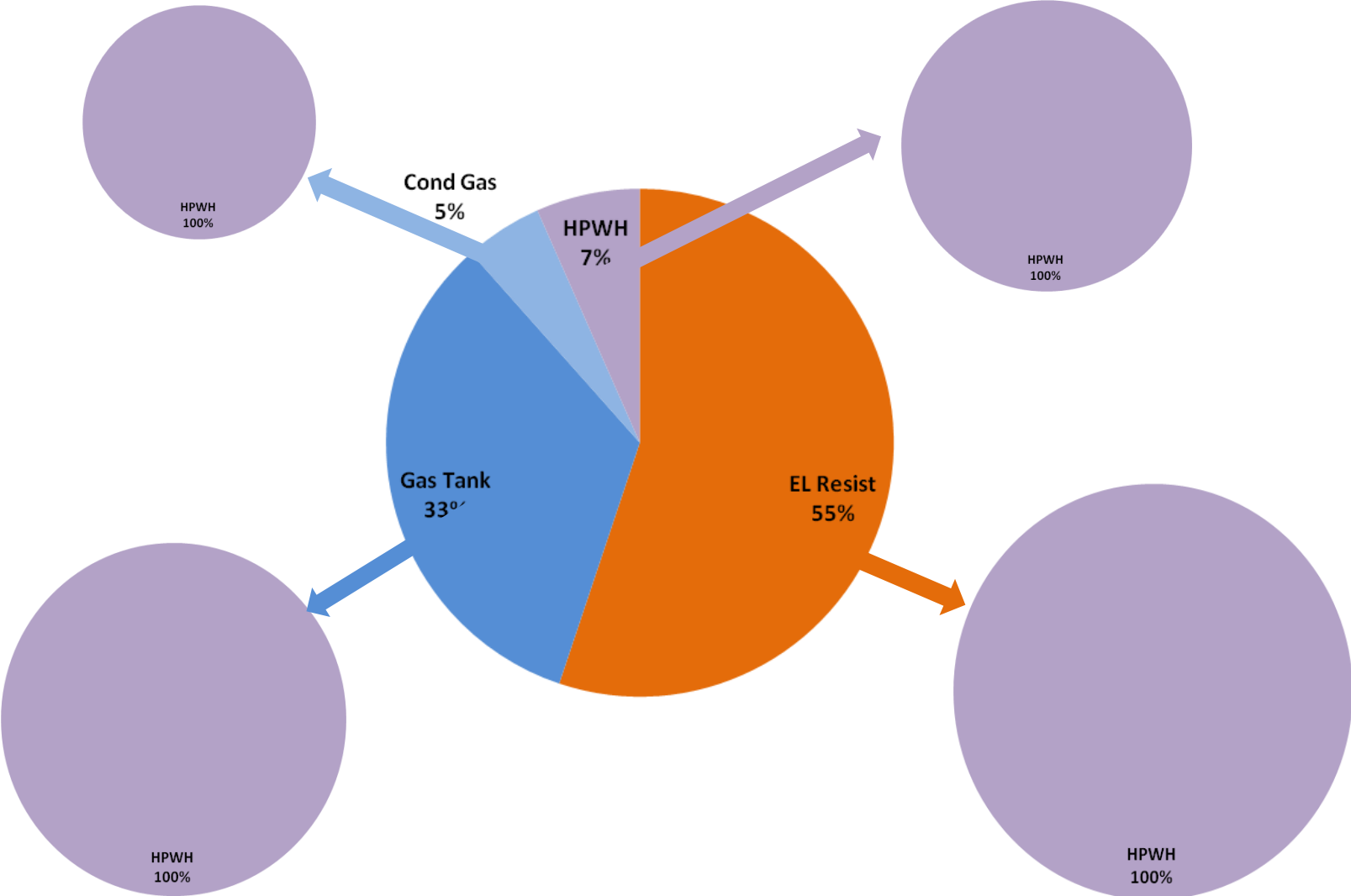
Space Heat Summary

- Most equipment replacements stay with existing fuel, only 5.6% of replacements involve a shift from electricity to natural gas
- All conversions occur in homes with natural gas already available, or that require only a hookup
- When a hookup is required only homes without A/C and with water heaters less than 55 gallons switch to natural gas
- How pipeline extension costs are recovered affects consumers choices of fuel type

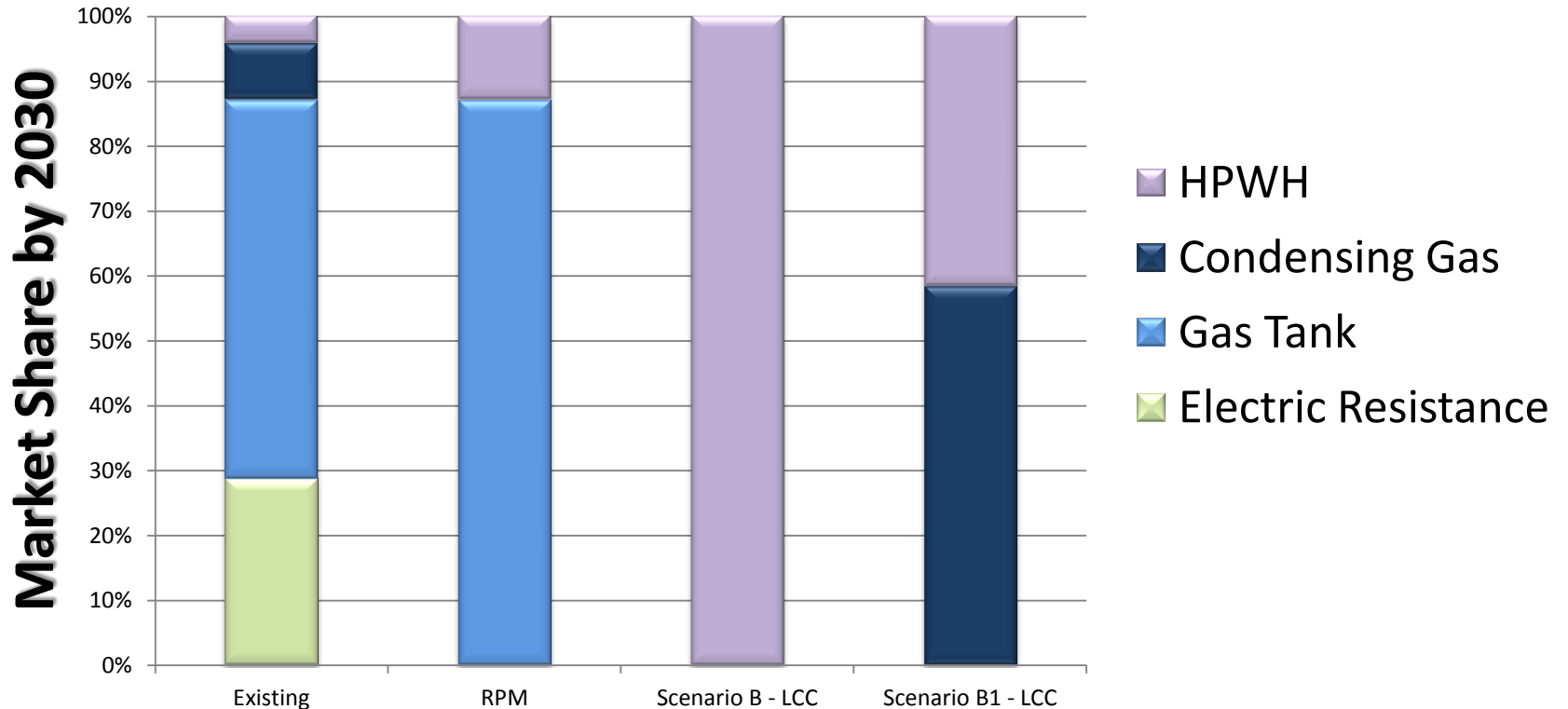
Water Heat Choices – Regional



Water Heat Choices – Consumer 1



Water Heating System Selection RPM vs. LCC Results for Homes with Existing Gas Service



LCC Scenario B assumes gas access costs are recovered in all residential retail rates.

LCC Scenario B1 is identical to Scenario B, except that water heating systems within 1% of the lowest LCC system are considered “equivalent.”

Water Heat Summary

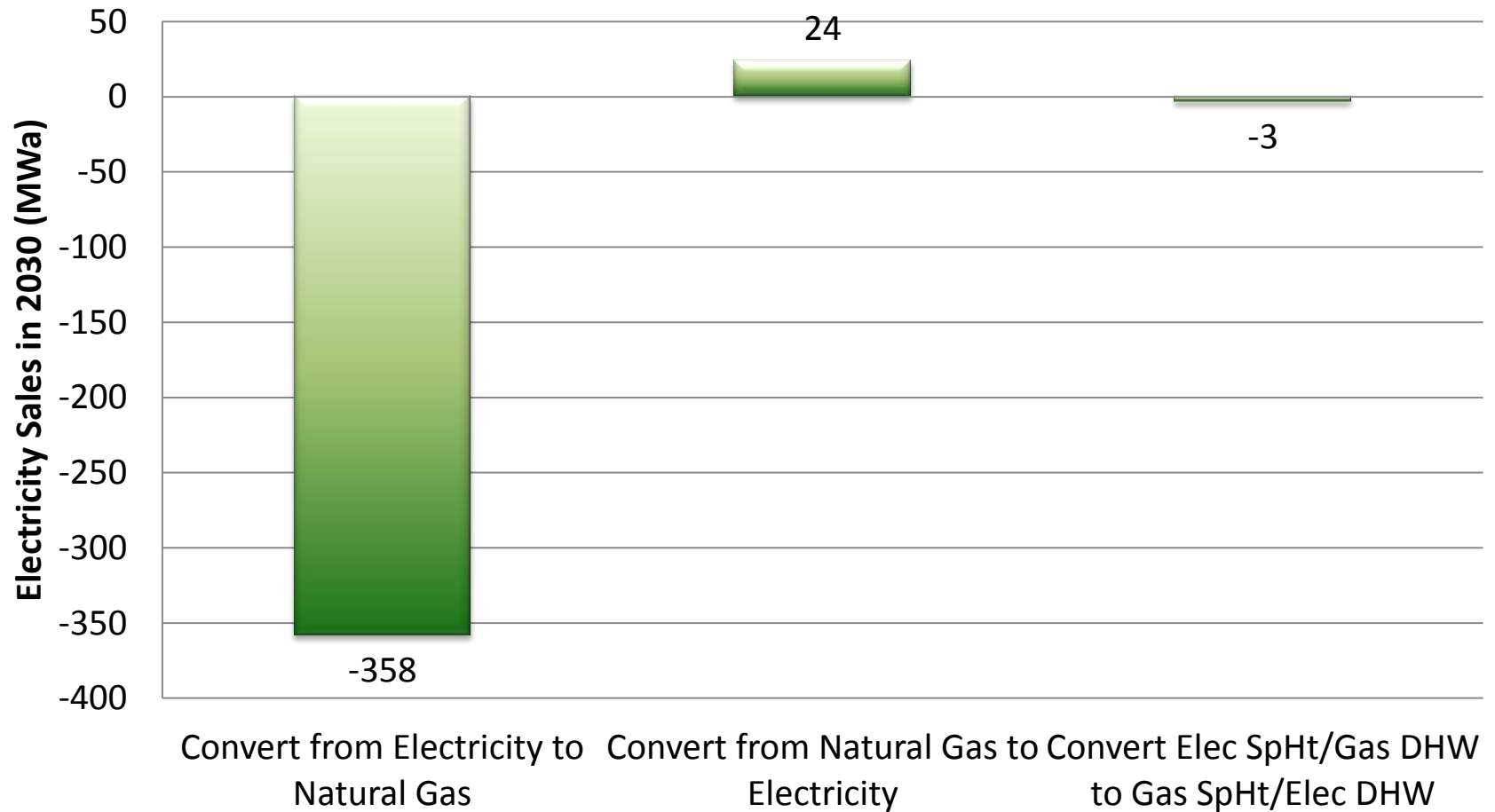
- Most fuel conversion activity is in water heating
- Only 26% of water heating equipment choices involve fuel conversion (80% of those are to gas)
- Water heaters greater than 55 gal. convert to heat pump water heaters (condensing gas would be close)
- Most conversions to gas are in homes that already have gas available, the remainder are in homes that are hooking up to gas and converting space heating
- Heat pump and condensing gas water heaters are very close in both first cost and LCC, but both are new technologies

Summary of Findings: Alignment Between Regional (TRC) and Consumer (LCC) Results

- The space heating systems found to be economically preferable from a regional (TRC) perspective are *generally* also the lowest life cycle (LCC) systems
- The high efficiency gas and electric water heating systems found to be economically preferable from consumer (LCC) perspective were also found to be economically competitive from a regional (TRC) perspective

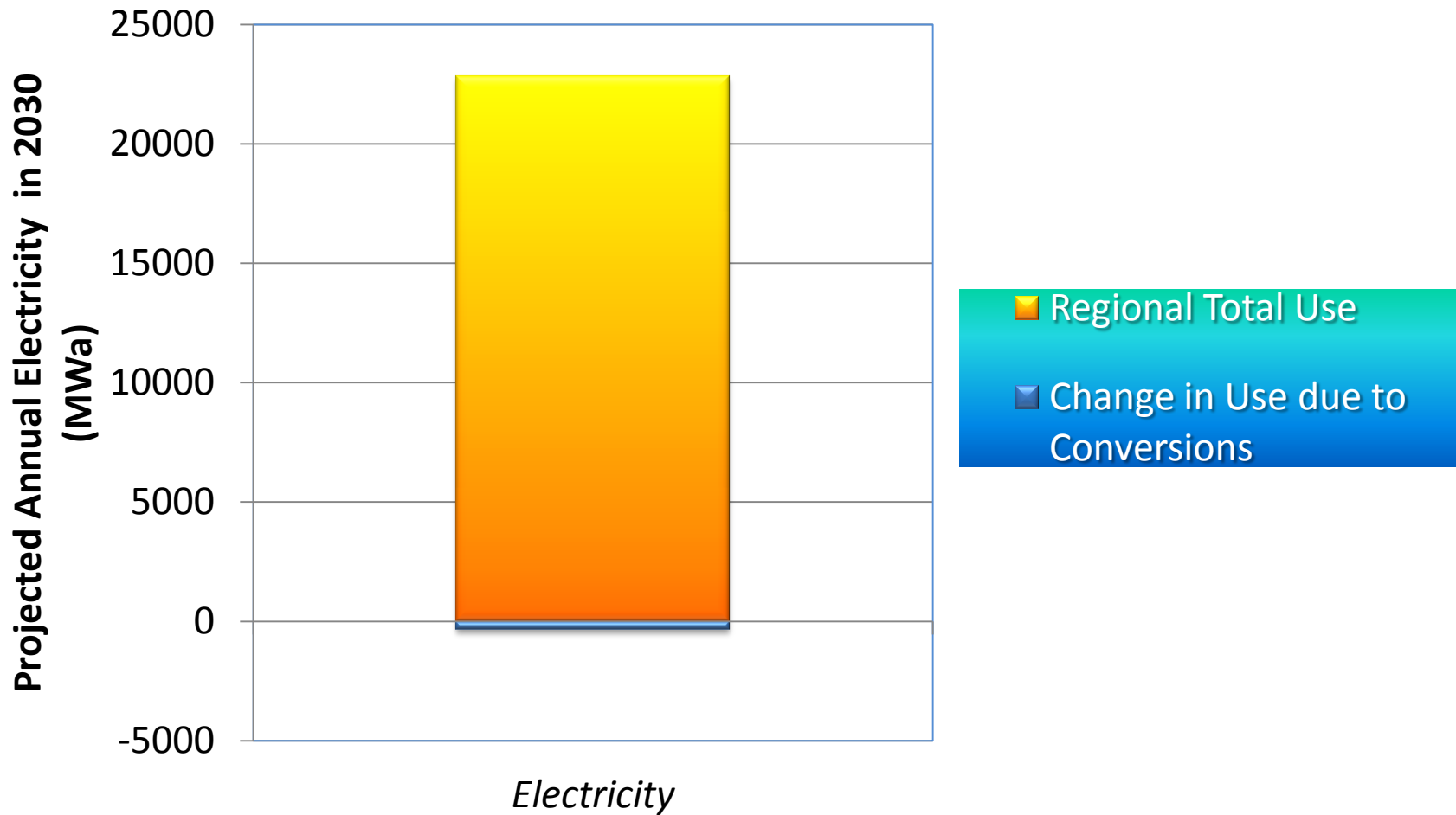
Summary of Findings

Change in Regional Electricity Use



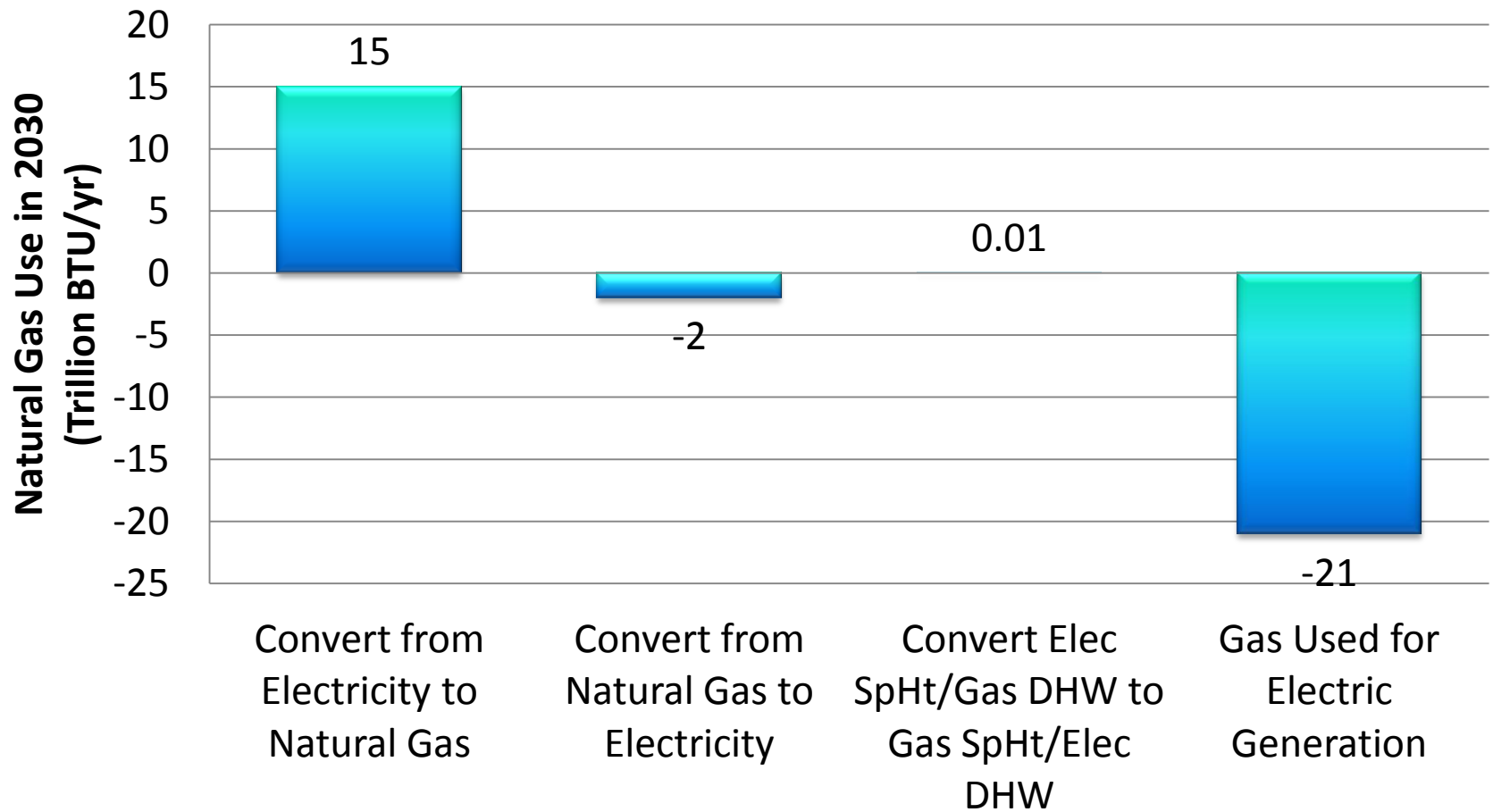
Summary of Findings

Impact on Regional Electricity Use



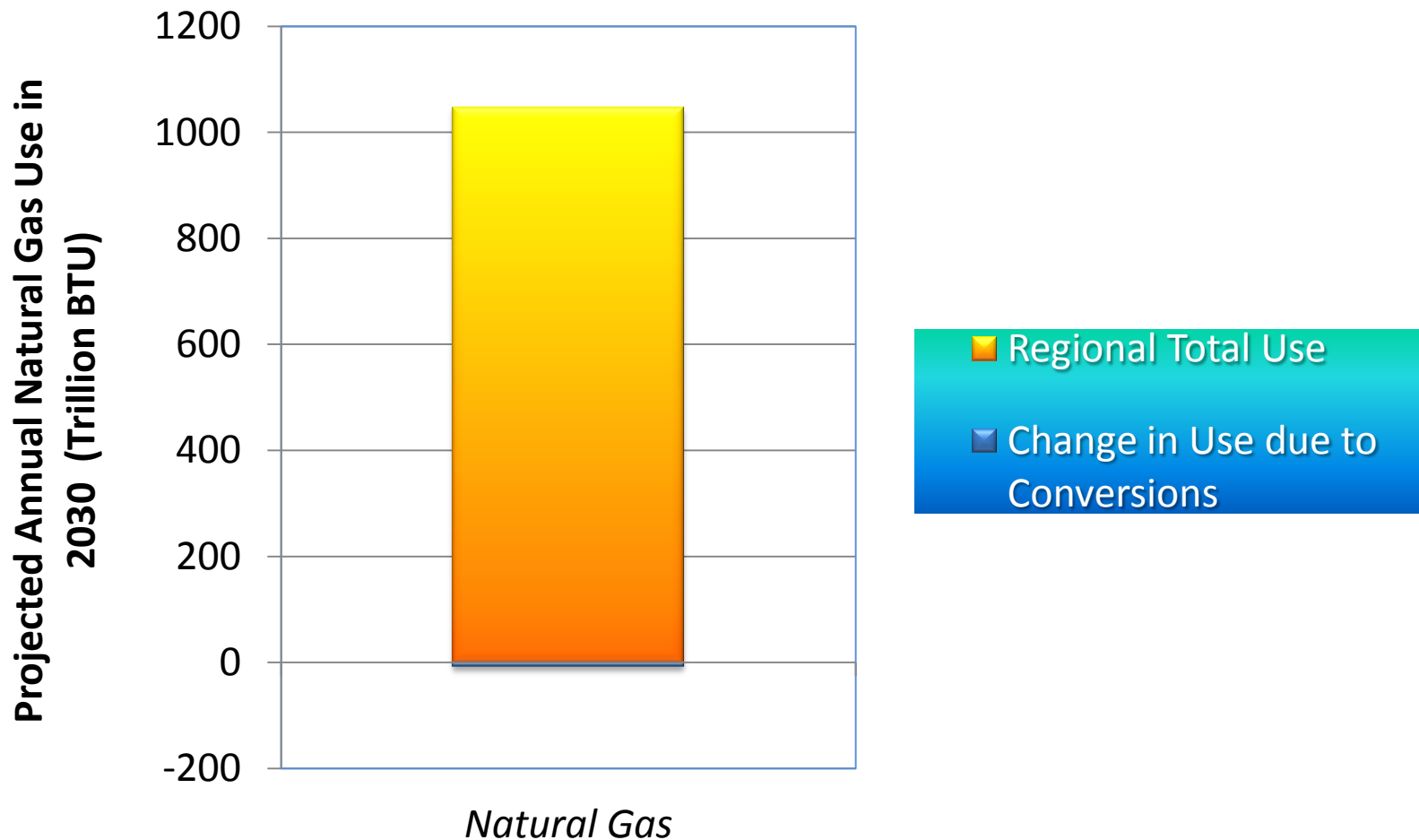
Summary of Findings

Change in Regional Natural Gas Use



Summary of Findings

Impact of Regional Natural Gas Use



Summary

- It is not cost-effective to replace electric forced air furnaces or electric resistance water heaters in kind
- If natural gas is already in the home gas space heating is the preferred choice in most cases
- Heat pump and condensing gas water heaters are competitive choices for consumers
- Costs of pipeline extension and new power plants limit the cost-effectiveness of conversions
- Fuel choice has little effect on carbon emissions