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# Heat Pump Deployment in Alaska: Analysis and Policy Brief

Prepared by the University of Alaska Center for Economic Development

CED
Center for Economic Development
UAA Business Enterprise Institute

# Executive Summary

Given the adoption rates forecasted by the University of Alaska Center for Economic Development (UA CED), heat pumps could reduce natural gas consumption by 1.84 Bcf between 2025 and 2045, but high electricity costs (compared to areas with significant adoption of heat pumps), lower than average retail natural gas cost, and market barriers currently limit adoption. This brief explores what it would take for air source heat pumps (ASHPs) to become a viable, widespread alternative to natural gas furnaces or boilers. UA CED undertook a two-part analysis. First, we developed a quantitative model to estimate household heating costs, natural gas savings, and the economic feasibility of switching from natural gas furnaces or boilers to heat pumps under a range of scenarios. Second, we conducted stakeholder interviews with energy experts, utilities, policymakers, and housing professionals to identify barriers to deployment and develop policy recommendations to support heat pump adoption if they become financially viable for Anchorage households.

## Key Findings from Quantitative Analysis

- **Energy Efficiency and Gas Savings:** Heat pumps reduce natural gas use by approximately 24% compared to furnaces or boilers. Widespread heat pump adoption would extend the life of Cook Inlet natural gas supplies and offset the importation of a significant amount of natural gas.
- **Cost Barriers:** At current rates, heat pump heating costs are approximately $2,300 higher per year for an average home than natural gas due to lower gas prices (26% below the national average) and high electric rates (27% above the national average).
- **Feasibility Thresholds:**
    - Retail natural gas prices would need to rise 69% from current levels to make heat pumps cost-effective with current electricity rate structures.
    - Electric rates would need to fall by 41% to achieve cost parity under today's gas prices.
- **Rate Design Solutions:** Adopting a specialized heat pump rate structure, like ones in use in other regions including Juneau, could reduce annual heat pump costs by $1,570 per household, making them 28% cheaper to use than with current electric rate structures.
- **Climate Impact:** With 25% household adoption by 2045, heat pumps could avoid over one million tons of $CO_2$, roughly equivalent to removing all the cars in Anchorage from the road for one year.

## Policy Recommendations

In section 2, UA CED puts forward several policy recommendations that will support heat pump adoption in Anchorage and across Alaska. Even if heat pumps become cost-competitive, adoption will lag if key barriers are not addressed. These include:

- Workforce Development: Expanding training programs and addressing labor shortages.
- Licensure, Permitting, and Inspection: Streamlining regulatory processes and clarifying standards.
- Incentives and Financing: Increasing affordability and addressing initial adoption costs.
- Grid and Infrastructure: Ensuring the electric grid, especially in rural areas, can support demand.
- Public Awareness and Education: Building knowledge and trust among homeowners and contractors.

## Cold Climate Heat Pump Deployment: Analysis and Considerations

While heat pump technology is now cold-climate capable, Anchorage's low natural gas prices and high electricity rates have suppressed adoption. Heat pumps are widely used in the southeastern U.S. for both heating and cooling, and about 14% of U.S. households use them as their primary heat source. Recent advances have improved their performance in cold climates, leading to increased adoption in states like Maine and Vermont. In Alaska, heat pumps are gaining traction in Southeast communities like Juneau, where winters are milder, and electricity is cheaper. But in Anchorage, where natural gas costs are 26% below[1] the national average and electricity costs are 27% above[2], switching from furnaces or boilers to heat pumps remains economically challenging, even with their improved efficiency.

To better understand the potential for heat pump adoption in Anchorage, UA CED developed a model estimating natural gas savings, household heating costs, and financial feasibility under various energy price scenarios. The model also explores broader implications, such as emissions reductions, utility impacts, and likely adoption rates, assuming Alaska reaches levels seen in other cold-climate states. This analysis is especially timely given declining Cook Inlet gas production and the region's impending need for gas imports or a new pipeline to meet future demand.

### Heating Efficiency: How Heat Pumps Compare to Gas Furnaces or Boilers

While the heating efficiency of a furnace or boiler is typically represented as a percentage of the energy of the fuel which is converted to useful heat, a heat pump's efficiency is expressed as a coefficient of performance (COP). Unlike a furnace or boiler, this efficiency changes dramatically based on the operating conditions of the heat pump and, importantly, the temperature of the outside air. A typical efficiency rating for a non-condensing furnace or boiler is 80% regardless of exterior temperatures, which equivalent to a COP of 0.8.

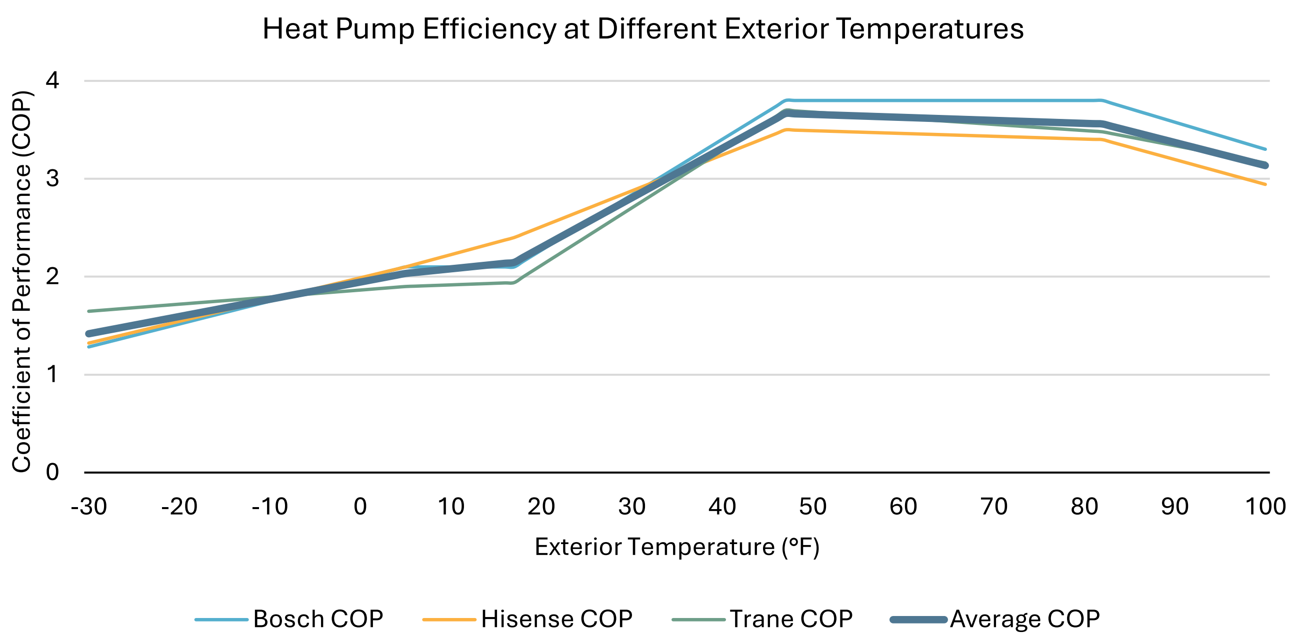


*Figure 1: Heat Pump Efficiency at Different Exterior Temperatures*

[1] Energy Information Agency (EIA), Monthly Residential Natural Gas Prices
[2] EIA, Average Price of Electricity to Ultimate Customers – Residential Sector

UA CED evaluated the performance of several heat pump models by examining their Coefficient of Performance (COP) across a range of temperatures. COP measures how efficiently a heat pump delivers heat relative to its electricity use. While efficiency declines as temperatures drop, cold-climate models remain more efficient than natural gas furnaces or boilers, even in Anchorage's coldest conditions. This is significant because both systems rely on natural gas: furnaces and boilers burn it directly, while heat pumps use electricity generated from a mix of natural gas, hydroelectric, and wind at CEA's power plants.

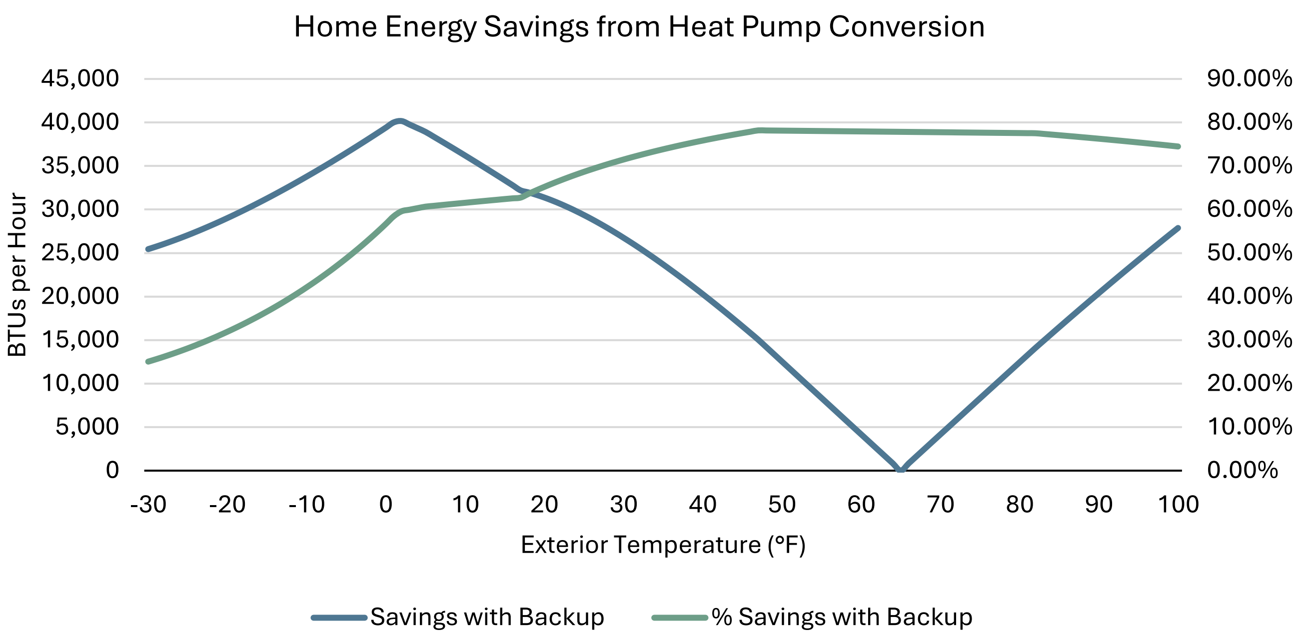


*Figure 2: Home Energy Savings from Heat Pump Conversion*

Due to their higher efficiency, heat pumps consume less natural gas to heat the same space. This translates into meaningful natural gas savings at every temperature, even if 100% of the electricity is generated from natural gas. One consideration, however, is that most homes in Anchorage do not currently have central air conditioning, so the energy consumption of the heat pump at higher temperatures, while very efficient, represents additional consumption. This additional demand comprises less than 0.2% of the total energy consumption for a household in Anchorage. An unfortunate reality of heat pump technology is that due to limitations of the refrigerants used in the systems, their capacity to provide heat decreases noticeably as temperatures drop. This means that in extremely cold conditions, supplemental heat is needed to keep the structure at a comfortable temperature. The need for backup heat was accounted for in the calculation of total energy consumption and savings. For the purposes of these estimates, it was assumed that electric resistance heaters would be installed in the existing ducts of the home that could be automatically activated when the heat output demanded by the thermostat exceeds the capacity of the heat pump. This is common in homes which fully replace their furnace or boiler with an ASHP but in some cases it may be possible to retain the furnace or boiler in a home for use as backup heat when the heat pump would not be capable of supplying sufficient heat based on environmental conditions. This was not modeled but would result in cost-savings to consumers on cold days. The downside to this hybrid heating solution is increased complexity and installation cost.

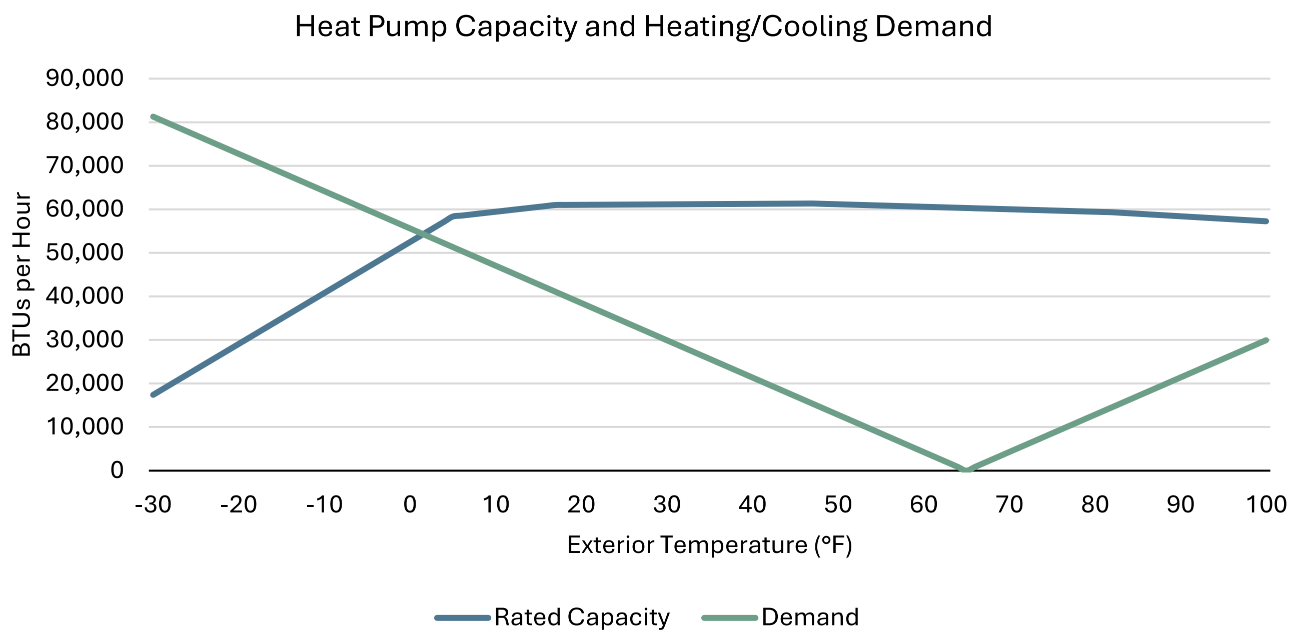


*Figure 3: Heat Pump Capacity and Heating/Cooling Demand*

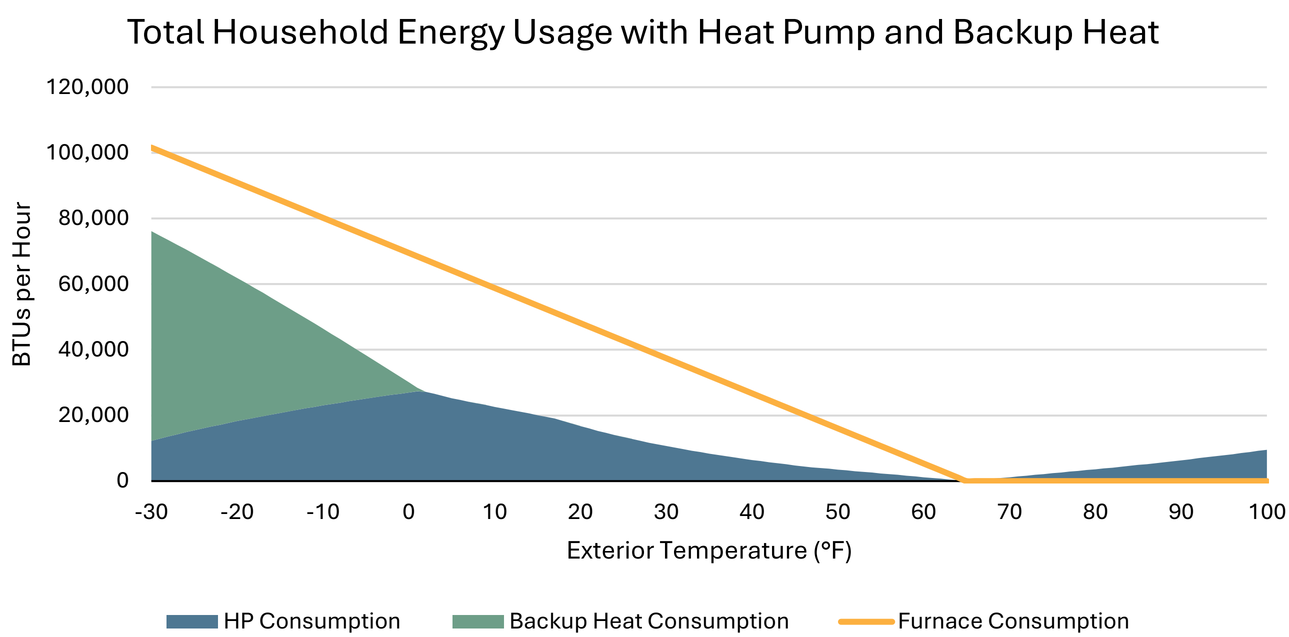


*Figure 4: Total Household Energy Usage with Heat Pump and Backup Heat*

At very cold temperatures, resistance heating contributes most of the heat energy. It is important to note that even the electrical resistance heat is more energy efficient than a furnace or boiler but is more expensive due to the current prices of electricity and natural gas. In the current utility rate environment, there is no temperature where heat pumps are cheaper to operate than a furnace or boiler. The hourly difference in cost between the two systems is low when temperatures are moderate, and much higher at more extreme temperatures.

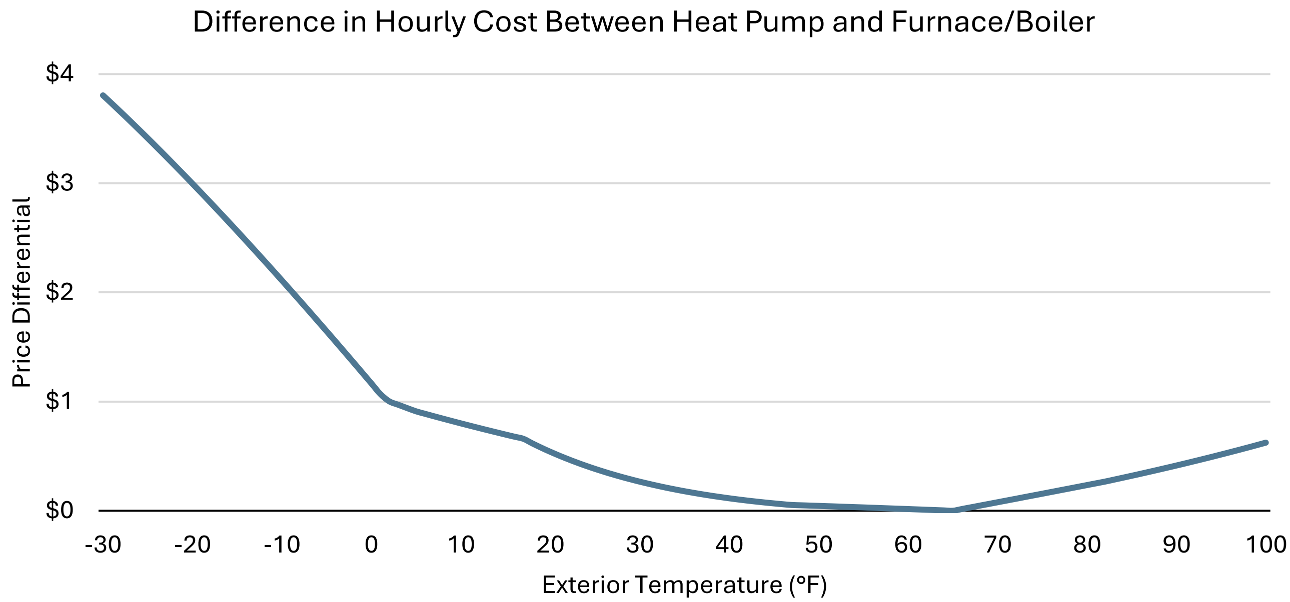


*Figure 5: Difference in Hourly Cost Between Heat Pump and Furnace/Boiler*

## Modeling the Impact of Heat Pump Adoption on Anchorage Natural Gas Usage

UA CED modeled two scenarios: one where all homes use natural gas furnaces or boilers, and another where all use heat pumps. The analysis found that switching entirely to heat pumps would reduce natural gas use by 24.33%. This corresponds to a decrease from 250 Mcf to 189 Mcf annually, per household.

While full adoption is unlikely, this scenario highlights the significant gas savings potential of heat pumps, an important consideration given declining Cook Inlet production. The model incorporates appliance efficiency, electricity generation losses, historical temperature data, and indoor heating needs. It also accounts for cooling loads and the need for backup electrical resistance heating during periods of extreme cold. One limitation is that the model uses 30-year average daily temperatures, which may understate peak demand during cold snaps or heat spells.

## Evaluating Household Costs of Heat Pump Conversion

UA CED's analysis shows that heat pumps, while more energy-efficient than natural gas furnaces or boilers, are significantly more expensive to operate under current Anchorage energy prices. The average annual cost to operate a heat pump, including backup heat, is $5,554.90, compared to $3,233.00 for a natural gas furnace or boiler, an annual difference of roughly $2,300.

This cost gap is primarily due to Anchorage's unique energy pricing. Residential natural gas in Anchorage averages $11.96 per thousand cubic feet, 26% below the national average and cheaper than gas in all but five states. Meanwhile, electricity costs 22.3 cents per kilowatt-hour on average, 27% higher than the national average and higher than all but nine states.

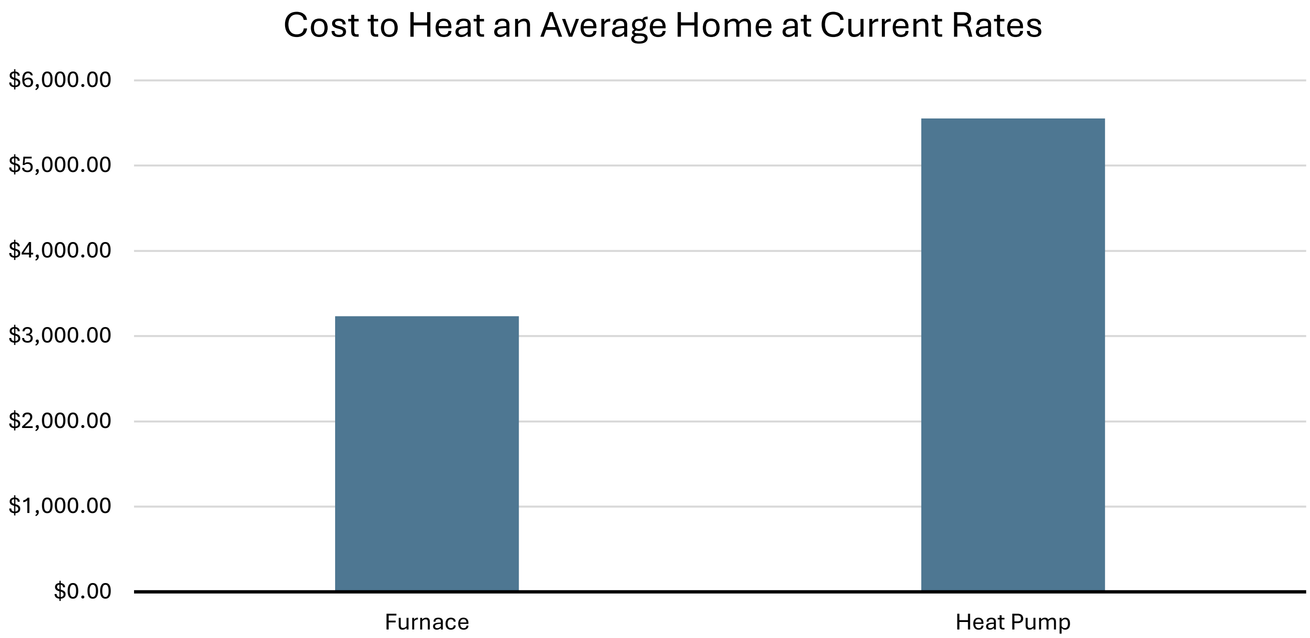


*Figure 6: Cost to Heat an Average Home at Current Rates*

These conditions negate the efficiency advantage of heat pumps and represent a major barrier to household adoption unless offset by policy changes, incentives, or shifts in energy markets.

## When Does it Pay Off? Scenarios for Cost Effective Heat Pump Conversion

Although heat pumps operate efficiently in Anchorage's climate, UA CED's analysis found they are not financially viable under current energy prices. To evaluate when they might become cost-effective, two key variables were modeled:

- Natural Gas Imports: Rising costs from Cook Inlet depletion and gas imports could increase the price of heating with natural gas, narrowing the gap between gas and electric systems.
- Electric Rate Design: Utilities could adopt specialized rate structures for heat pump users, lowering operating costs and improving long-term affordability.

UA CED used Wood Mackenzie's[3] wholesale natural gas estimates to project future household rates in Anchorage. The analysis assumes natural gas makes up 80% of Enstar's current retail rate and 12% of Chugach Electric's, reflecting Chugach's higher fixed costs. As a result, natural gas price increases have a much greater impact on natural gas rates than on electricity rates.

[3] Wood Mackenzie. (2024). *Economic Viability of Alaska LNG – Phase 1 Final Report*. Prepared for the Alaska Gasline Development Corporation. October 2024. https://agdc.us/wp-content/uploads/2024/11/2024.10-WM-AGDC-Alaska-LNG-Phase-1-Final-2.pdf

## Natural Gas Price Increases

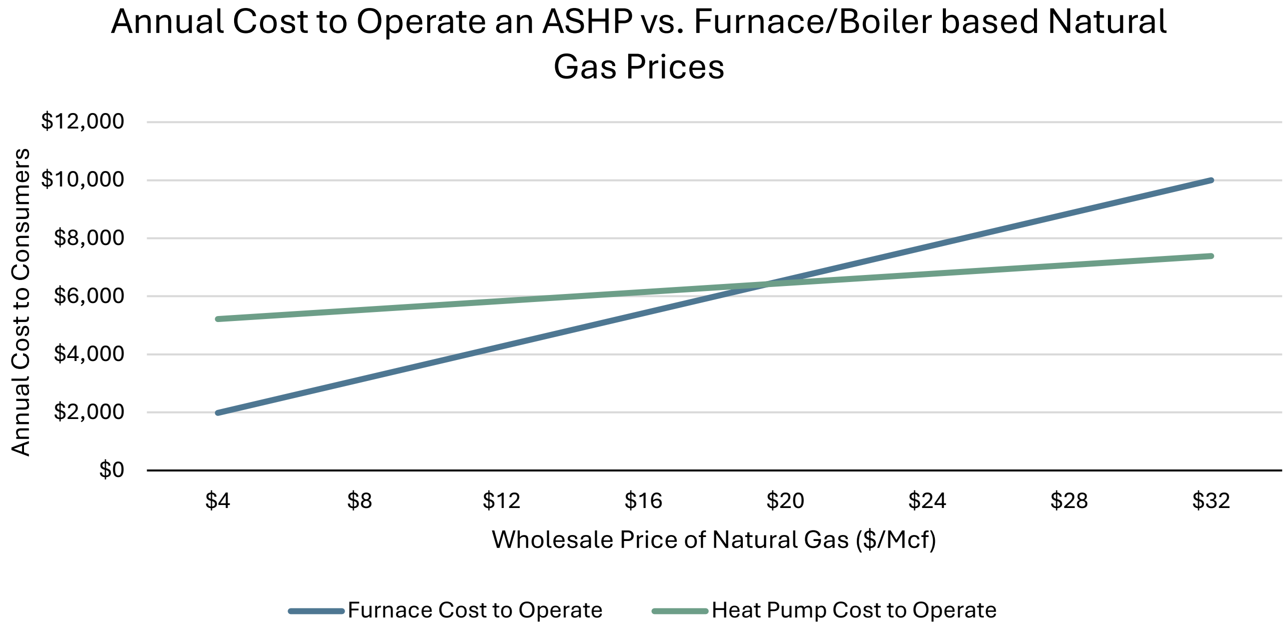


*Figure 7: Annual Cost to Operate an ASHP vs. Furnace/Boiler based on Natural Gas Prices*

When Cook Inlet production declines and imports become necessary, natural gas prices could rise. UA CED's model shows that for heat pumps to match the cost of gas furnaces or boilers, retail gas prices would need to reach $20.24 per thousand cubic feet—a 69% increase over current prices. While prices are likely to rise under import scenarios, they are not expected to reach this threshold. Wood Mackenzie projects wholesale prices between $10.20 and $13.70, plus delivery costs, suggesting retail prices will remain well below the break-even point. This scenario highlights the challenge: even substantial increases in gas costs alone are unlikely to make heat pumps financially attractive without complementary measures like electric rate reform or incentives.

## Electric Rate Design

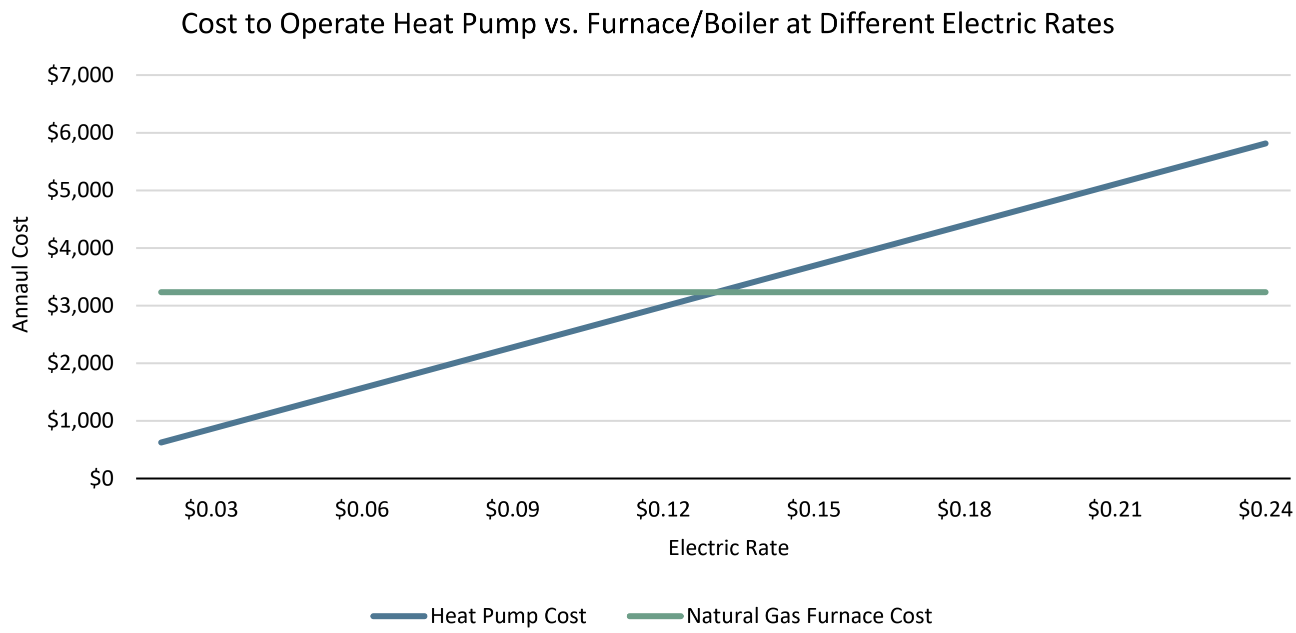


*Figure 8: Cost to Operate Heat Pump vs. Furnace/Boiler at Different Electric Rates*

Electric rates are a more flexible and impactful lever for improving heat pump economics. At current gas prices, electricity would need to fall from $0.223 to $0.131/kWh, a 41% reduction, for heat pumps to be cost-competitive. However, if gas prices rise to $13.70/MMBtu, cost parity could be achieved at a more attainable rate of $0.189/kWh.

Some Alaska utilities already offer specialized rates for heat pump users. Juneau's Alaska Electric Light & Power (AEL&P) provides a sharply reduced energy charge paired with a demand charge:

| | General Residential | Heat Pump Residential |
|---|---|---|
| **Energy Charge per kWh** | $ 0.1229 | $ 0.0527 |
| **Customer charge per month** | $ 10.08 | $ 11.46 |
| **Demand Charge per KW** | - | $ 10.20 |

*Table 1: AEL&P Rate Comparison – General Residential vs. Heat Pump Residential*

If Chugach Electric adopted a proportionally similar rate structure, Anchorage homeowners could see a 28% annual savings on heat pump operation, equivalent to $1,570:

| | General Residential | Heat Pump Residential |
|---|---|---|
| **Energy Charge** | $ 5,398.25 | $ 2,314.79 |
| **Monthly Customer Charge** | $ 153.48 | $ 174.49 |
| **Annual Demand Charge** | - | $ 1,492.40 |
| **Total Annual Cost** | $ 5,551.73 | 3,981.69 |
| **Annual Savings** | | **$ 1,570.05** |

*Table 2: CEA Rate Comparison – General Residential vs. Conceptual Heat Pump Residential*

While rate design varies widely and direct replication is not always feasible, this example shows that strategic pricing could significantly reduce household costs and improve heat pump adoption.

## The Benefits of Heat Pump Adoption

Beyond household savings, heat pumps offer broader system and environmental benefits. Increased electrification can improve grid efficiency and potentially lower long-term electricity rates. Unlike gas furnaces or boilers, heat pumps also provide summer cooling and can enhance indoor air quality and comfort.

UA CED's model estimates that if 1,438 homes in Anchorage install heat pumps annually from 2026 to 2045, reaching 25% of households, the city would avoid approximately 1.08 million tons of $CO_2$ emissions by 2045. That is equivalent to[4]:

- Removing 229,365 gasoline-powered cars from the road for one year
- Avoiding the consumption of 110.6 million gallons of gasoline
- Offsetting carbon through 986,328 acres of forest over one year

Even partial adoption can yield meaningful climate benefits.

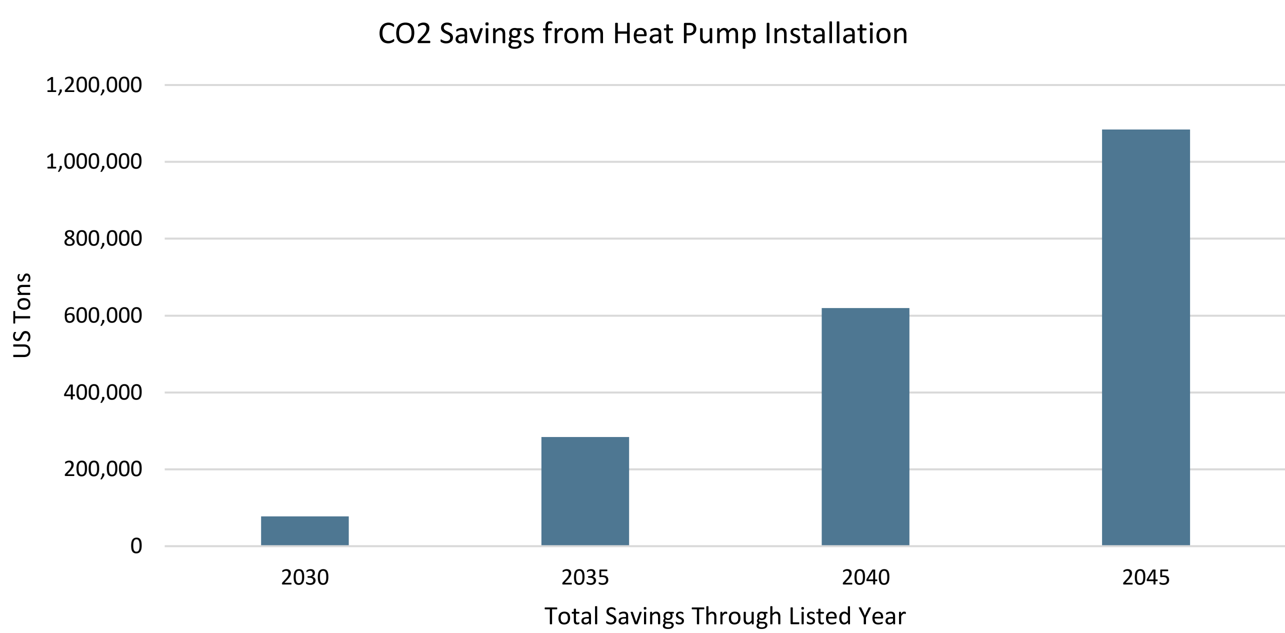


*Figure 9: Natural Gas and CO2 Savings from Heat Pump Installation*

[4] U.S. Environmental Protection Agency. (2024, November). *Greenhouse Gas Equivalencies Calculator*, from EPA website: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

# Policy Recommendations to Accelerate Heat Pump Adoption in Alaska

To complement its modeling, UA CED conducted interviews with energy experts, utilities, installers, housing organizations, and program managers to understand the practical and policy barriers to heat pump adoption. Even if operating costs become competitive, widespread adoption will not follow without action. Usual challenges include limited workforce capacity, permitting complexity, consumer skepticism, and inconsistent regulations. The following recommendations are based on both the model findings and stakeholder insights:

## Workforce Development

Alaska lacks sufficient trained professionals to support large-scale heat pump deployment, particularly in rural communities. Technical design and performance issues are often the result of undertrained installers or poorly configured systems.

- Invest in HVAC and electrical training programs focused on cold-climate heat pump installation and hybrid system design.
- Develop rural training cohorts to reduce geographic barriers.
- Establish apprenticeships and certifications in partnership with unions, technical colleges, and utilities.
- Support ongoing training for existing HVAC techs to build familiarity with evolving heat pump technologies and installation.
- Support ongoing education on system design, controls, and backup integration

## Licensure, Permitting, and Inspection

Inconsistent licensing requirements and a challenging permitting process is creating confusion and delay for installers and projects.

- Standardize contractor licensing requirements across state agencies, with specialized endorsements for cold-climate systems.
- Simplify and streamline permitting requirements, particularly for retrofits in existing homes.
- Create a centralized registry of permitted installations and installers to increase awareness and build homeowner confidence.
- Incentive most-efficient cost-climate systems, with proper design, commissioning, and maintenance.

## Incentives and Financing

Even where heat pump operating expenses are cost-effective, high upfront costs slow adoption. CED's analysis focused on operating costs, but the focus of many state programs is to defray startup costs for homeowners and lower the barrier to adoption.

- Expand and streamline rebate and tax credit programs.
- Create tiered incentives that reward performance and target low-income households, multi-family housing, and rural areas.
- Promote local inventory for cold-climate system, incentivize installers, and distributors.
- Consider local tax credits for heat pump installations and modifications for whole-home electrification.

## Grid and Infrastructure

Although there are significant benefits to electrification, there are concerns that heat pump adoption will increase winter peak loads and may strain smaller utility systems in rural areas of Alaska.

- Fund grid impact studies and planning support for rural cooperative utilities anticipating demand increases.
- Support utility-led pilot projects to evaluate rate designs, load management, and demand response.
- Pair heat pump deployment with grid upgrades in areas with aging or undersized infrastructure.
- Promote hybrid systems that can be integrated with existing gas heating system for backup.

## Public Awareness and Education

Stakeholder interviews highlight widespread misunderstanding, with both consumers and installers, about how heat pumps work and where they are effective.

- Develop and coordinate public awareness campaigns highlighting cost savings, air conditioning benefits, air improvements, and cold-climate performance. Encourage all air conditioning systems to be heat pumps and encourage distributors and retailers to carry heat pumps.
- Focus messaging on comfort, resilience, and long-term savings, rather than climate framing.
- Train installers to educate customers.
- Promote local success stories and support pilot projects to build trust, especially in communities with low adoption rates.
- Scale community-based home heat assessments to provide households with personalized evaluations of their heating systems, upgrade recommendations, and information on incentives.

## Fuel Supply and Decarbonization

Large-scale heat pump adoption requires a coordinated transition in Alaska's energy supply. Shifting from direct-use natural gas to electricity can reduce fuel costs, improve resilience, and extend existing gas resources. Strategic electrification planning will maximize benefits and minimize disruptions.

- Support utility- and community-scale renewable projects, such as hydro, wind, and solar to reduce reliance on Cook Inlet natural gas.
- Plan for winter peak load impacts and transition flexible gas demand to electric systems to ease deliverability constraints.
- Reduce building-level gas use to preserve limited gas resources for backup and essential uses.
- Integrate heat pump adoption with transportation and industrial electrification to maximize infrastructure benefits.
- Reduce household exposure to rising or unstable natural gas prices through long-term electrification.