Economic & Consumer Impacts of HFC Phasedown

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INFORUM Interindustry Forecasting at the University of Maryland | JMS Consulting | The Alliance for Responsible Atmospheric Policy | AHRI we make life better™

HFC Phasedown Background

- With regulatory certainty, the technology transition to low-GWP next-generation technology is underway in all major developed countries and is gathering momentum in most major developing countries including India, China, Korea, and Indonesia.
- The transition path in the U.S. is uncertain with no federal action to date However, a dozen states have started a patchwork of legislation or regulation creating an unpredictable state-based HFC phasedown.
- Investment decisions are being made now on implementation of these next-generation technologies, but under the current circumstances the U.S. market will be fractured and less efficiently served, increasing consumer costs and diminishing U.S. global technology leadership.
- A predictable federal U.S. HFC phasedown positions industry to maintain global technology leadership, create additional manufacturing jobs, and cost-effectively produce these new technologies that benefit consumers.
- The Kigali Amendment to the Montreal Protocol has been ratified by 91 countries and went into effect on Jan 19. 2019, initiating a broad-based orderly phasedown of HFCs.

Economic Analysis

- Inforum and JMS Consulting previously:
  - Assessed fluorocarbon industry size
  - Conducted scenario analysis, focusing on HVACR, the largest segment
  - Examined consumer costs in residential/commercial air conditioning, the largest uses
- Scenarios compared ratification and implementation of global HFC phasedown requirements in the U.S. versus a "business as usual" case with no mandated U.S. phasedown. The "consistent with global HFC phasedown" case assumes U.S. action, with or without formal ratification by the Senate.
- Analysis incorporated public data, estimates from Inforum models, and industry interviews, using conservative assumptions.
- U.S. HFC phasedown implementation adds American jobs, increases exports, decreases imports, and supports American technology leadership.
- Delays in implementation or ongoing uncertainty due to state actions will inhibit or eliminate the opportunity to achieve the forecast gains
- Life-cycle cost analysis of air conditioning applications shows the transition during HFC phasedown is expected to further reduce consumer costs.

U.S. Industry Segments (Fluorocarbons)

- Fluorocarbon-using products impact how we live on a daily basis.
- Fluorocarbons are used in commercial HVAC, residential HVAC, commercial refrigeration, household appliances, and motor vehicle air conditioning
- Insulating foams, medical metered-dose inhalers, aerosols, and several other applications make up the remainder of the manufacturing sector

American-made products that preserve the health, safety and comfort of our daily lives

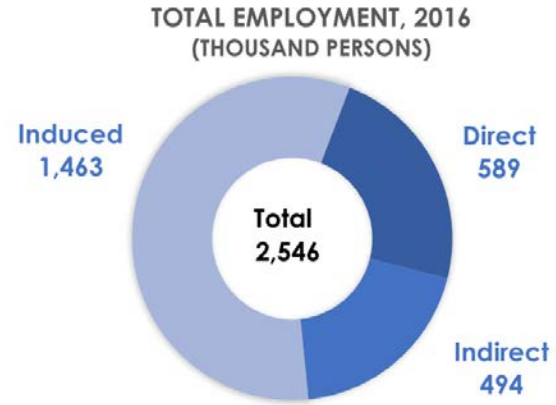
U.S. Industry Objective

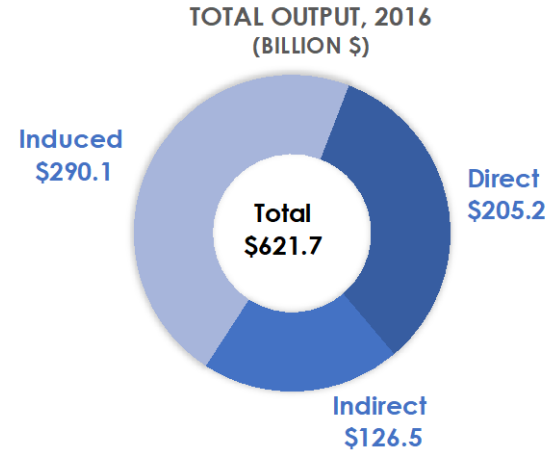
- U.S. industry strongly supports domestic phasedown of HFCs consistent with the Montreal Protocol.
- Heating Ventilation Air Conditioning and Refrigeration (HVACR) and Fluorocarbon technologies are signature American technologies.
- The phasedown being implemented globally under the Montreal Protocol provides a platform for gradual introduction and commercialization of next generation technologies.
- An HFC phasedown in the U.S. opens the door for domestic production to serve the rapidly expanding global market without harming U.S. consumers.
- Implementation of the HFC phasedown is good for American jobs, the balance of trade, and continued American technology leadership.
- The transition during HFC phasedown is expected to reduce consumer costs in the air conditioning industry.

We urge Congress to implement a U.S. HFC phasedown.

U.S. Manufacturing Impact
Fluorocarbons in the American Economy

- **Jobs**
  - **589K** direct employment
  - **$39B** in payroll
  - **$205B** in sales
  - **2.5M** total employment impact
- **Output**
  - **$621B** in economic output, including manufacturing, distribution, service & installation (includes supply chain and induced demand)
- **Manufacturing**
  - **$178B** contribution
  - **671K** jobs, dominated by HVACR equipment
  - Downstream contracting, wholesale, and service make up the rest



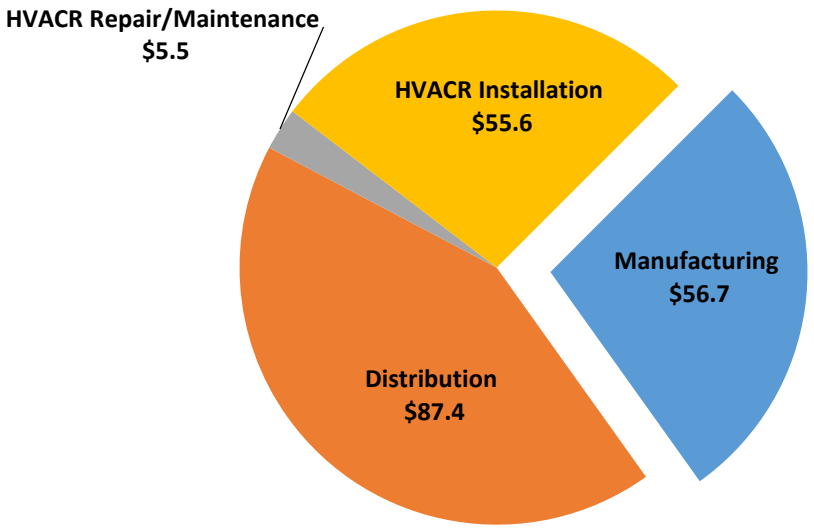


This industry is a significant contributor to American jobs, trade & economic output

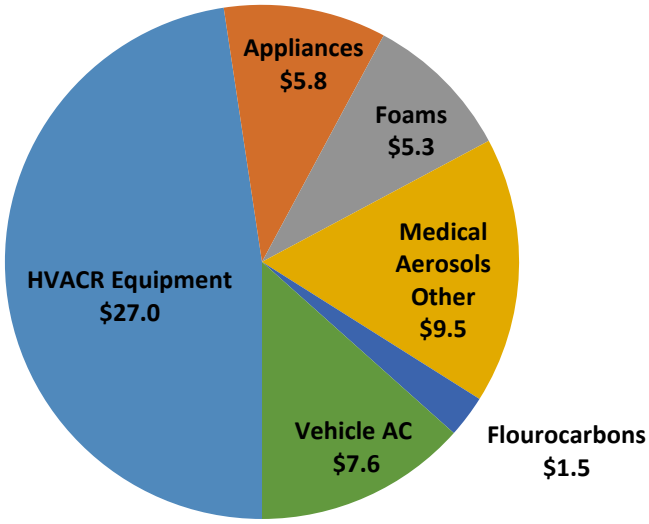
U.S. Industry Segments
Manufacturing and Downstream Output

- Current manufacturing output is $56.7B
- Downstream output in the wholesale, contracting, and repair and maintenance sectors is almost 3X that of manufacturing

Manufacturing + Downstream (Billions $)



Manufacturing Shipments (Billions $)

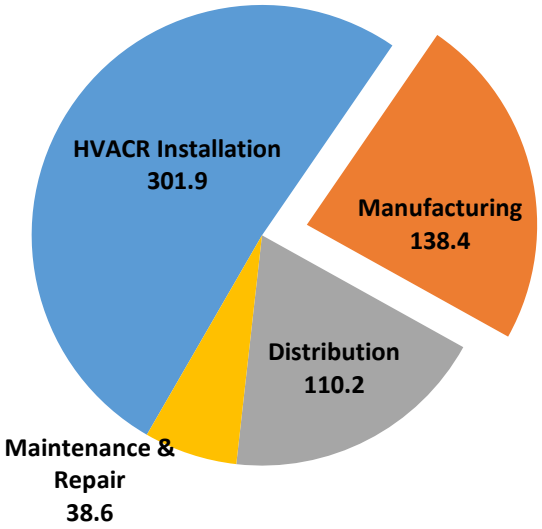


Downstream output is almost 3X the size of the manufacturing output

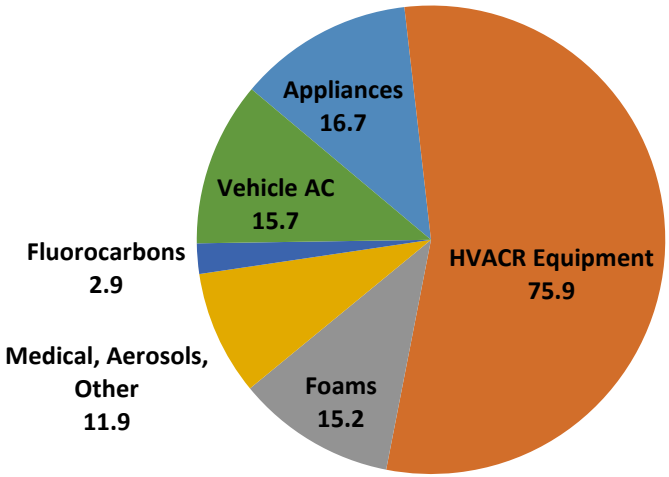
U.S. Industry Segments Employment

- Current manufacturing impact is 138.4K jobs

Direct Industry Employment - 2016 (Thousands)



Manufacturing Employment 2016 (Thousands)



Downstream employment is over 3X the size of the manufacturing employment

U.S. Industry Growth Prospects

- Over the next 10 years…
  - International HVACR market expected to more than double
  - The cumulative global market will be over $1 trillion
  - Developed countries are already transitioning to new technologies
  - Developing countries will transition away from ozone-depleting substances and this transition is at its apex between now and 2047
  - Foams, medical applications and aerosols also have large global growth opportunities
- American Innovation
  - Commercialization of next generation technology is essential at this point in the Montreal Protocol transition
  - The U.S. HVACR industry has traditionally led these transitions and it is vital they lead this transition
  - Typical design cycle for the industry is 5-10 years, decisions being made now

American industry must lead the transition to new technologies to be competitive

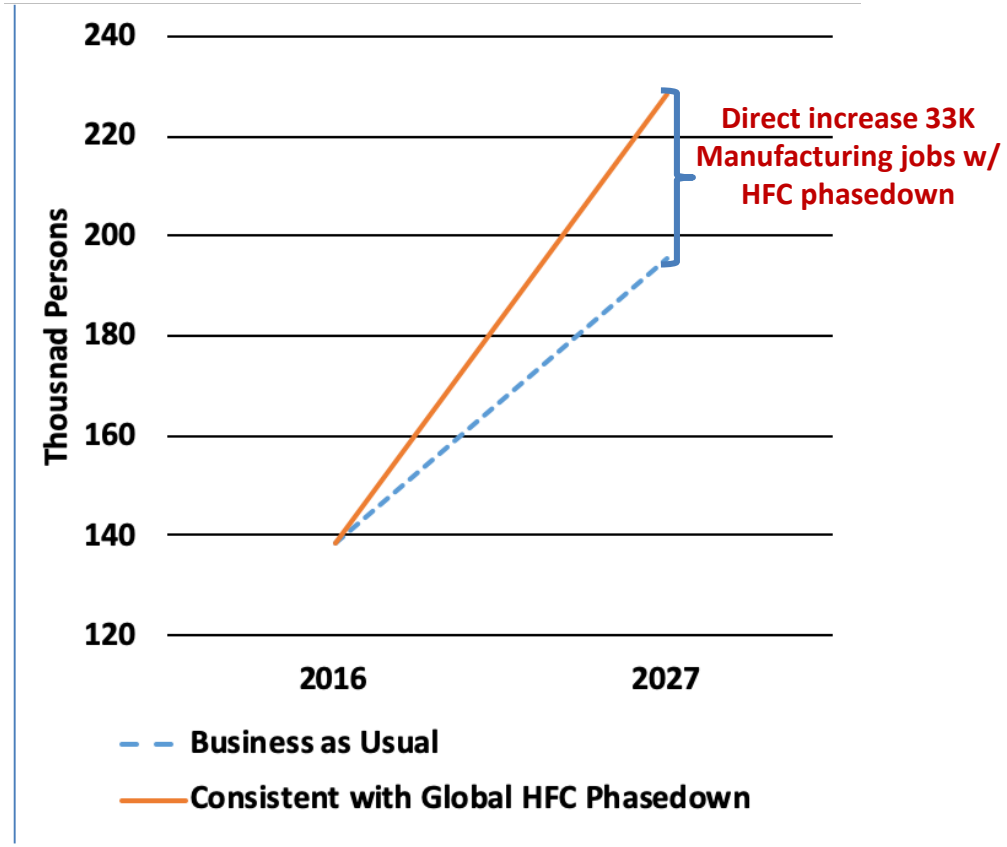
HFC Phasedown Impact 2027

Scenarios Compared:

"Consistent with Global HFC Phasedown" – U.S. implements HFC phasedown on Montreal Protocol schedule

"Business as Usual" – No U.S. phasedown

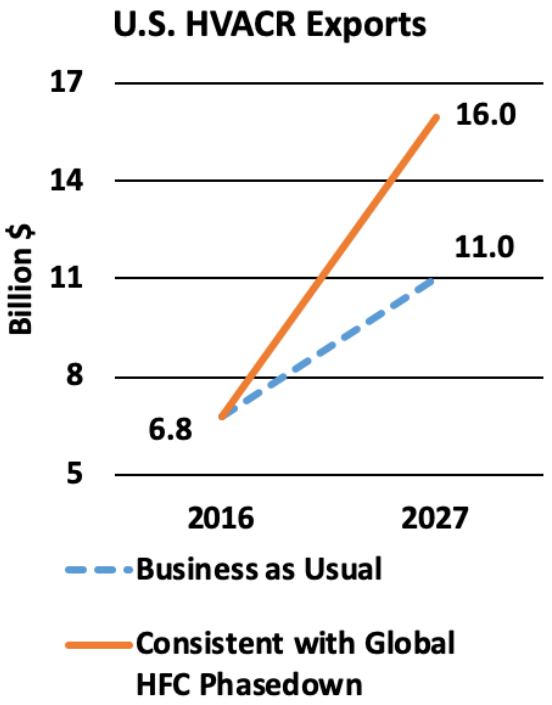
- **Manufacturing Jobs**
  - Current manufacturing impact is **138.4K** jobs
  - HFC phasedown increases direct manufacturing jobs by **33K**
  - Manufacturing growth translates into an incremental **150K** jobs economy-wide
- **Direct Economic Output**
  - HFC phasedown improves direct manufacturing output by **$12.5B**
  - Total increased output of **$38.8B** versus no-phasedown scenario
- **Trade Balance**
  - Positive impact on balance of trade
  - Manufacturing impacted directly

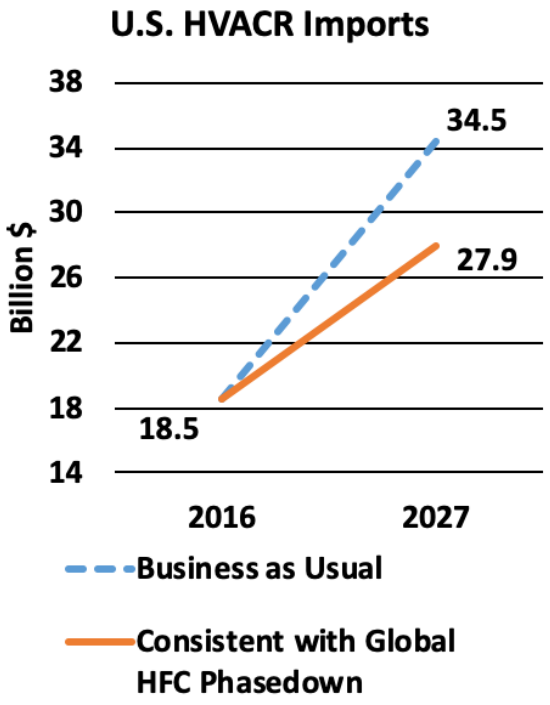


U.S. HFC phasedown essential to jobs growth, industry growth, trade balance

HFC Phasedown Impact
Global Trade

- **Global Trade Impacts**
  - U.S. HFC phasedown will increase U.S. supply to global HVACR markets by $5.0B
  - Phasedown will inhibit growth of old technology HVACR imports by $6.5B
  - Fluorocarbon manufacture adds $1 billion in net trade benefit

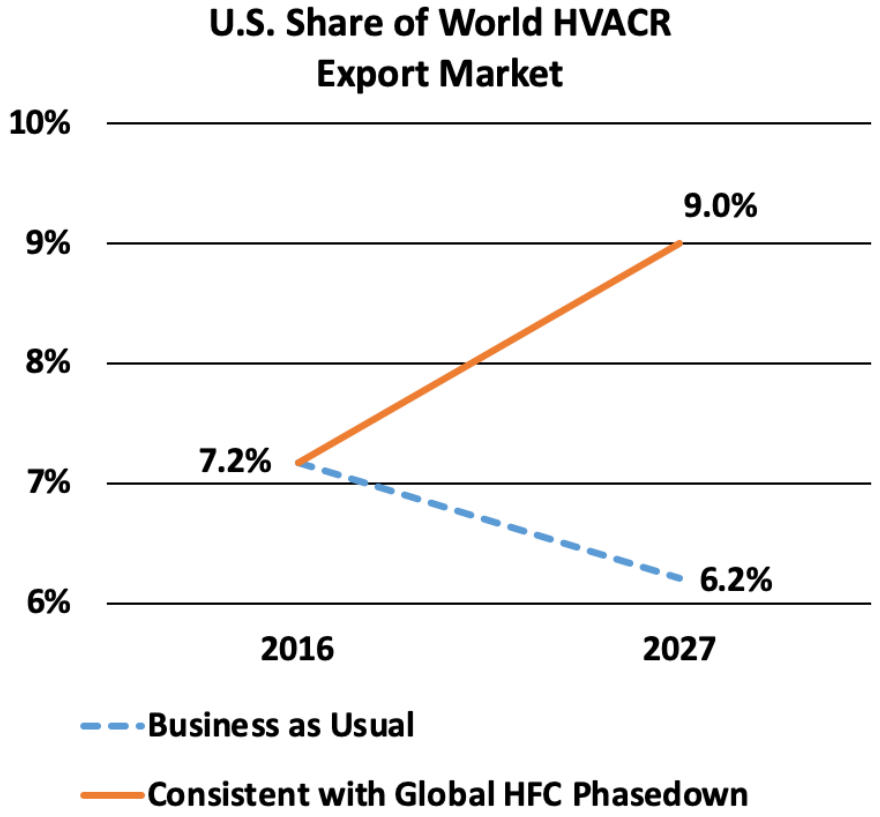




U.S. HFC Phasedown will grow U.S. exports and improve balance of trade

HFC Phasedown Impact
HVACR Global Export Market

- The HVACR global export market will grow by 6% per year to meet needs of China, India, Latin America, and Africa
- With HFC phasedown, U.S. exports will outperform, increasing U.S. share of global market from 7.2% to 9.0%
- Without HFC phasedown, exports will underperform



U.S. is a net importer, but gains share of global market with a U.S. HFC phasedown

HFC Phasedown Impact
Refrigerant Production & Reclaim

- Fluorocarbon manufacturing would benefit from increased exports if HFC phasedown is enacted and suffer from imports of older refrigerants if not
- $1B net benefit included in analysis
- Reclaimed HFCs with a U.S. HFC phasedown are estimated to increase reclaim sales by $0.8 billion and add almost 4,000 jobs. (not included in totals)

HVACR Technology & Investment

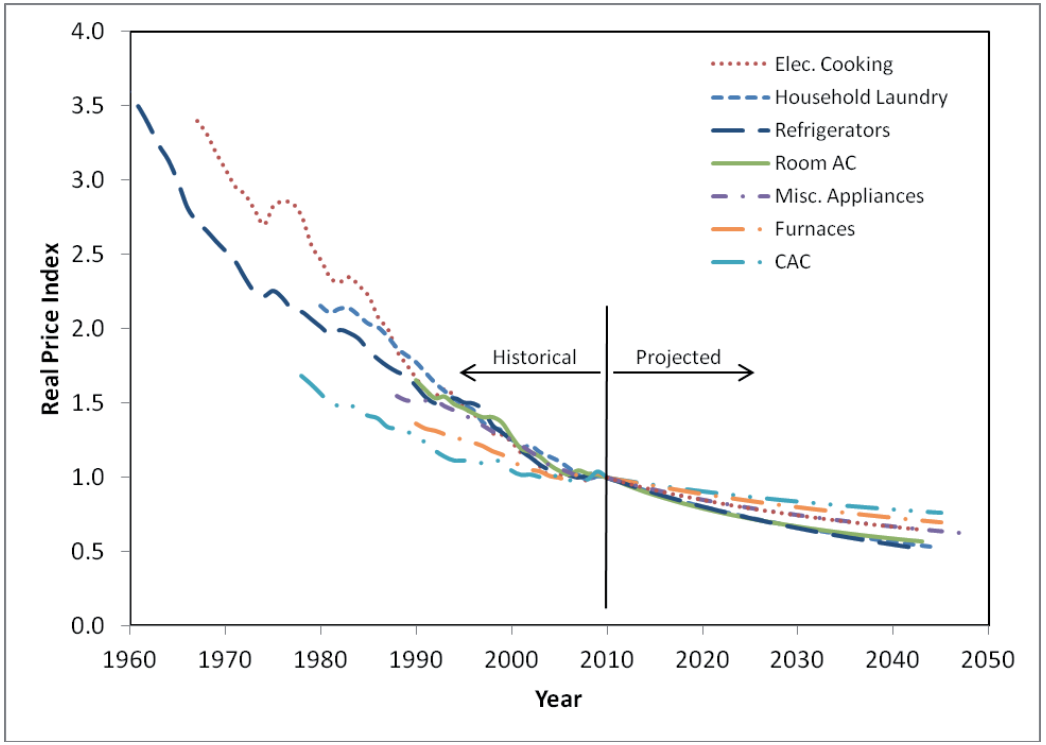
- The American HVACR industry led global innovation, which is driven by domestic demand
- Investments in next generation refrigerants and equipment technologies are already underway
  - In 2015, AHRI members representing 90% of U.S. HVACR manufacturing committed $5B through 2025 in R&D and capital investment to commercialize high efficiency equipment using next generation refrigerants
  - American investments in R&D and capacity for HFC phasedown-related growth will generate 1,400 additional jobs and $1B in capital investment if a U.S. HFC phasedown is implemented
  - Without U.S. HFC phasedown, manufacturing and R&D for new technologies will move to international markets to meet local demand for new technologies

U.S. HFC phasedown essential to maintain and expand American leadership

Key Consumer Costs Continue to Decline

- The 30-year history of the Montreal Protocol shows the industry has used innovations, new technologies, and more sustainable compounds to drive continued reduction of consumer costs.
- Industry innovation, gradual transition schedules, and avoiding impacts on existing equipment owners allowed the industry to accommodate major transition costs over time, minimizing impact on consumer prices.
- U.S. appliance prices have declined over time and are expected to continue to do so.
- Room air conditioners, refrigerators, and central air conditioners have all seen real price declines through two technology transitions under the Montreal Protocol.

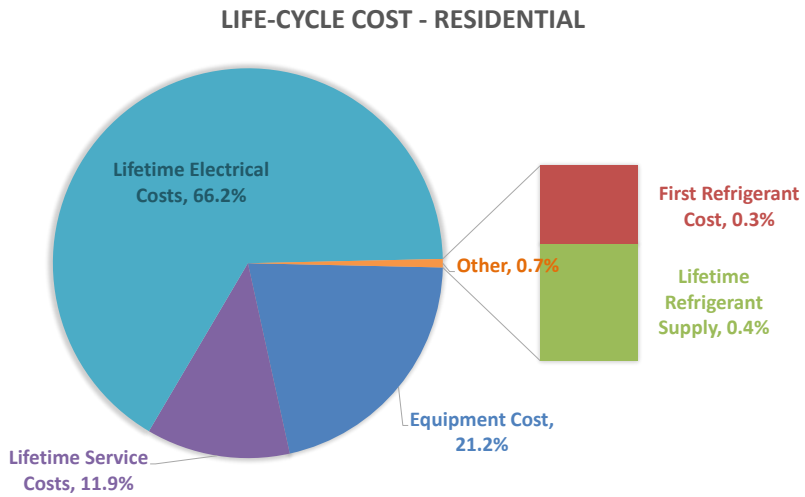
Historical & Projected Real Price Indices for U.S. Major Appliance Categories

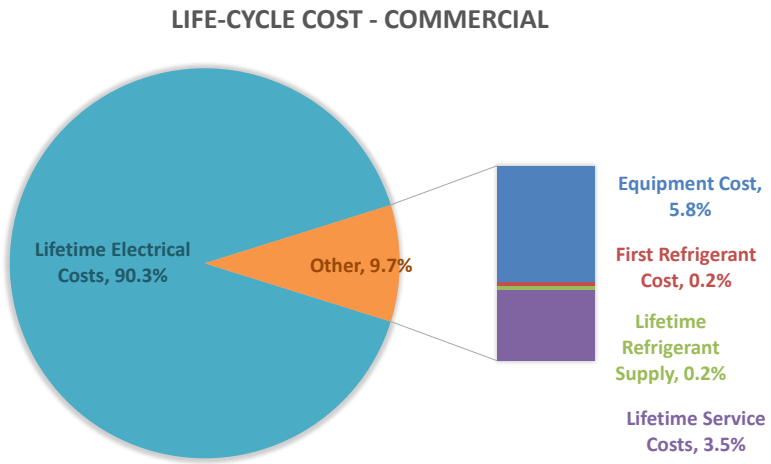


See Desroches, et al. (2018). Historical trends based on the PPI published by the U.S. Bureau of Labor Statistics. Projected trends are experience curve fits to the historical data.

Innovation and planning minimized costs of conversion under the Montreal Protocol.

Life-Cycle Costs of Air Conditioning





- Electricity dominates lifetime costs for both residential and commercial air conditioning.
- Refrigerant Supply is less than 1% of lifetime costs.
- Cost projections of each element were made for a new equipment purchase in 2029, with and without U.S. HFC phasedown.

Energy cost dominates even equipment cost, and refrigerant is a minor contributor.

U.S. Consumers Benefit from HFC Phasedown

- Total costs were estimated over 15-year lifetime for average 2.5 ton residential and 15 ton commercial U.S. air conditioning units.
- Equipment with HFC phasedown (”Consistent with HFC Global Phasedown”) is conservatively assumed to be 10% more costly, but on average slightly more efficient, with lower leak rates and smaller charge sizes.
- The average price among all refrigerants is expected to equilibrate and continue to average ~$7/lb.
- Driven by energy, total costs decline slightly with HFC phasedown. There are no significant consumer cost impacts even if refrigerant prices were 5x higher.

Total Cost of Ownership for 2029 Purchase

RESIDENTIAL AIR CONDITIONING	Business as Usual	Consistent with Global HFC Phasedown
Equipment Cost	$4,000	$4,400
First Refrigerant Cost	$53	$49
Lifetime Refrigerant Supply	$79	$37
Lifetime Service Costs	$2,250	$1,950
Lifetime Electrical Costs	$11,585	$11,434
TOTAL OWNERSHIP COSTS	$17,966	$17,869
ANNUAL AVERAGE COSTS	$1,197.74	$1,191.29

COMMERCIAL AIR CONDITIONING	Business as Usual	Consistent with Global HFC Phasedown
Equipment Cost	$25,000	$27,500
First Refrigerant Cost	$700	$653
Lifetime Refrigerant Supply	$1,050	$490
Lifetime Service Costs	$15,000	$13,000
Lifetime Electrical Costs	$351,285	$346,697
TOTAL OWNERSHIP COSTS	$393,035	$388,340
ANNUAL AVERAGE COSTS	$26,202.34	$25,889.34

HFC phasedown will not increase consumers’ cost of air conditioning.

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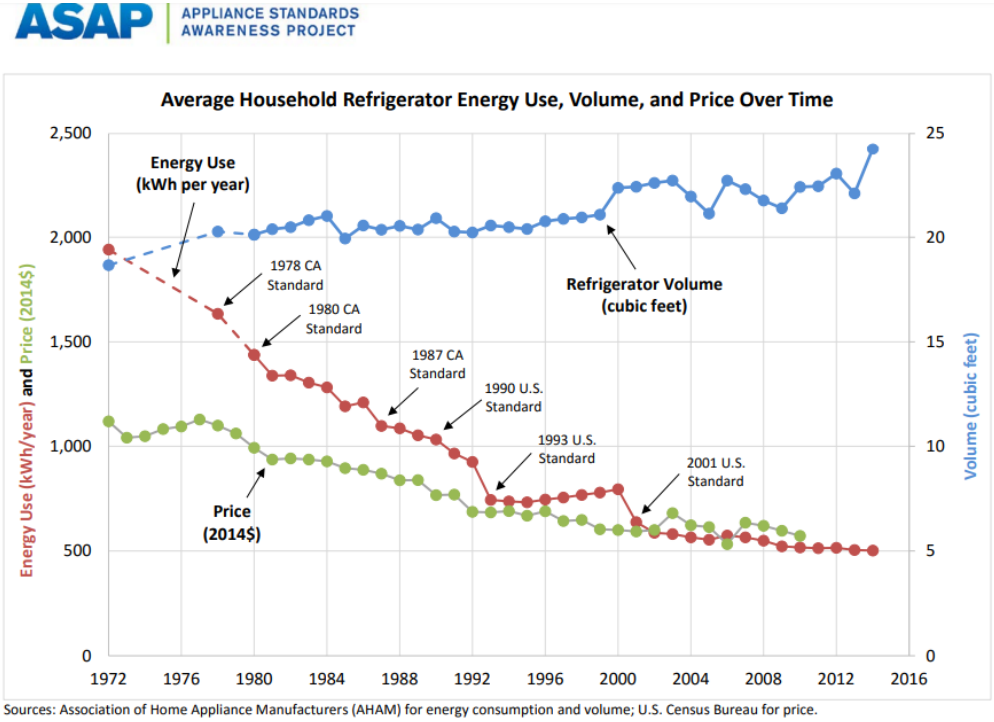
Refrigerators Add Value at Lower Cost

- Refrigerators today are larger, lower-priced, and more energy-efficient than ever.
- The trend has been persistent despite 30 years of transitions under the Montreal Protocol.
- Similarly, other applications have already begun to transition to new compounds and can benefit further from the clarity of the HFC phasedown schedule.



No reason to expect consumer impacts of HFC phasedown to differ from earlier transitions.

Summary of HFC Phasedown Impacts

- U.S. Industry needs certainty about transition timing to win globally
  - The global HVACR market will double in ten years
  - U.S. industry must be cost competitive to expand global market share
  - Phasedown timing certainty reduces transition costs
- U.S. Economic Benefits
  - Increase American manufacturing jobs
  - Grow U.S. share of the global market
  - Improve the U.S. balance of trade
  - Phasedown timing certainty delivers economic benefits
- American Consumer Impact
  - AC continues to be more efficient
  - AC continues to be more affordable for American consumers
  - Phasedown timing certainty reduces the cost to consumers

U.S. HFC phasedown benefits industry, the economy, and consumers