Appliance Standards Awareness Project
American Council for an Energy-Efficient Economy
California Energy Commission
National Consumer Law Center, on behalf of its low-income-clients
Natural Resources Defense Council

February 13, 2020

Dr. Stephanie Johnson
U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Building Technologies Office, EE-5B
1000 Independence Avenue SW
Washington, DC 20585

RE: Docket Number EERE–2017–BT–STD–0003: Request for Information for Energy Conservation Standards for Consumer Refrigerators, Refrigerator-Freezers, and Freezers

Dear Dr. Johnson:

This letter constitutes the comments of the Appliance Standards Awareness Project (ASAP), American Council for an Energy-Efficient Economy (ACEEE), California Energy Commission (CEC), National Consumer Law Center, on behalf of its low-income clients (NCLC), and Natural Resources Defense Council (NRDC) on the request for information (RFI) for energy conservation standards for consumer refrigerators, refrigerator-freezers, and freezers ("refrigerators and freezers"). 84 Fed. Reg. 62470 (November 15, 2019). We appreciate the opportunity to provide input to the Department.

DOE should conduct a full analysis to evaluate potential amended standards for refrigerators and freezers. The RFI suggests that DOE is specifically seeking information that would allow the Department to propose a 'no new standard' determination.[1] However, available data suggest that there is clear opportunity for large potential energy savings and associated bill savings for consumers from amended standards for refrigerators and freezers. As shown in the figures in the Appendix to these comments, for all the major product categories there are models across the range of refrigerator and freezer sizes that use significantly less energy than models just meeting the current minimum standards.[2] In the case of compact refrigerators (Product Class 11), all the available models use at least 8% less energy than what the minimum standards permit. DOE's analysis for the RFI of models in the Department's Compliance Certification Database shows that the most efficient refrigerators and freezers use up to 37% less energy than models just meeting the minimum standards.[3] Furthermore, as of 2018, 46% and 37% of refrigerators and freezers, respectively, met the ENERGY STAR levels, which represent energy savings of 10% relative to the minimum standards.[4]

[1] 84 Fed. Reg. 62481.
[2] Models in the DOE Compliance Certification Database (CCD) as of 2/7/20.
[3] 84 Fed. Reg. 62478. Table II.5.
[4] https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2018/2018%20Unit%20Shipment%20Data%20Summary%20Report%20.pdf?a6f8-5338.

There are a range of technology options that can provide significant energy savings in refrigerators and freezers. Tables II.2 and II.3 in the RFI show the technology options that were considered in the 2011 rulemaking and new technology options, respectively. We encourage DOE to thoroughly investigate each of these technology options as part of the analysis. Below we highlight several of the technology options that have the potential to provide significant energy savings:

- Variable-speed compressors: As DOE explained in the analysis for the 2011 rulemaking, variable-speed compressors can improve the efficiency of refrigerators and freezers by improving heat exchanger effectiveness and reducing cycling losses (in addition to using higher-efficiency motor technology).[5] However, as we explained in our comments on the RFI on the measurement of average use cycles or periods of use in DOE test procedures, the current test procedure may not be adequately reflecting the benefits of variable-speed compressors.[6] In particular, we would expect that a refrigerator's compressor would cycle more often at typical ambient temperatures where refrigerators and freezers are used (e.g. 72°F) than at 90°F (which is the ambient temperature at which the current test is conducted) and, therefore, that the benefits of variable-speed compressors would be greater at 72°F. We encouraged DOE to evaluate the IEC test procedure, IEC-62552:2015, which may be more representative than the current DOE test procedure without imposing an undue test burden.

- Vacuum-insulated panels (VIPs): An experimental study published in 2016 found that a VIP coverage area of 56% reduces refrigerator energy use by 21%.[7] Significant advances have been made in VIP technology since the 2011 rulemaking including in nanoporous core materials and 3D VIPs. An EU-funded project developed new nanoporous materials for VIPs which demonstrated energy savings of up to 30% while reducing cost by about 70%.[8] And the EU's ELATION project developed 3D VIPs described as "an innovative, ultra-high performance, low-cost, lightweight insulation material for refrigerators and refrigerated vehicles" that "has the same insulation properties as VIPs but is more cost comparable to conventional insulation."[9] We understand that at least one supplier is manufacturing 3D VIPs.[10]

- Alternative refrigerants: Most refrigerators and freezers sold in the U.S. today use HFC-134a as the refrigerant. Isobutane (R-600a), which is widely used globally, can significantly improve the efficiency of consumer refrigerators and freezers relative to HFC-134a and will likely soon become the refrigerant of choice in the U.S. According to a representative from the Association of Home Appliance Manufacturers (AHAM), full-size refrigerators using isobutane will be widely available "no later than 2022," which is the year when HFC-134a will become unacceptable in California in new standard-size refrigerators and freezers.[11] For the 2011 rulemaking, DOE analysis found that the use of isobutane compressors can reduce energy use by 5% compared to

[5] https://www.regulations.gov/document?D=EERE-2008-BT-STD-0012-0128, pp. 5-67.
[6] https://www.regulations.gov/document?D=EERE-2018-BT-TP-0020-0009.
[7] https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=2584&context=iracc.
[8] https://cordis.europa.eu/article/id/190833-insulation-nanomaterials-for-energyefficient-refrigerators.
[9] https://cordis.europa.eu/article/id/90828-cool-solutions-for-energyefficient-refrigeration.
[10] https://va-q-tec.com/en/technology/vacuum-insulation-panels/materials-shapes/.
[11] https://hydrocarbons21.com/articles/8806/gradual_u_s_rollout_seen_for_isobutane_home_refrigerators.

HFC-134a compressors,[12] and Samsung reports that using isobutane can reduce energy use by 6.5%.[13] Isobutane is also less expensive than HFC-134a.[14]

- Improved blowing agents: Typical blowing agents for refrigerators and freezers have included HFC-245fa and cyclopentane. Alternative blowing agents, such as Honeywell's Solstice Liquid Blowing Agent (HFO-1233zd(E)), can provide efficiency gains of about 2% to 12% relative to conventional blowing agents at a relatively low cost.[15]

A range of market failures prevent the market outcome for refrigerators and freezers from maximizing societal welfare. In the RFI, DOE requests comment on market failures, and particularly those in the context of refrigerators and freezers.[16] There are both demand-side and supply-side market failures that prevent the market outcome for refrigerators and freezers from maximizing societal welfare. Demand-side market failures include the split incentive problem, panic purchases, and lack of information:

- Split incentive problem: The split incentive problem refers to instances in which the purchaser of a product does not pay the utility bills to operate that product. For example, in the case of rental properties, the landlord purchases the appliances, including refrigerators and freezers, but the tenant typically pays the utility bills. The landlord has no incentive to purchase even slightly more expensive efficient products since the utility bill savings would accrue to the tenant. Energy conservation standards for refrigerators and freezers ensure that the products purchased by landlords meet a minimum level of efficiency, thereby lowering monthly bills for tenants.
- Panic purchases: When a consumer's refrigerator or freezer has failed, their top priority will most likely be to replace the product as soon as possible. In these situations, consumers often are stuck with purchasing whatever product they can get most quickly. With standards for refrigerators and freezers, all products, including those in stock at stores, meet a minimum level of efficiency.
- Lack of information: Consumers typically do not have sufficient information to make an informed decision about purchasing a more-efficient refrigerator or freezer. It is very difficult for a consumer to estimate the life-cycle costs of different products, and in many cases, consumers may not even know that different models can use different amounts of energy.

Supply-side barriers include limited stocking of efficient products and the bundling of efficiency into premium products only:

- Limited stocking of efficient products: Retail stores have only limited space to store and display products. If efficient refrigerators and freezers are not in stock, they require a special order. Standards for refrigerators and freezers ensure that all products stocked by retail stores meet a minimum level of efficiency.

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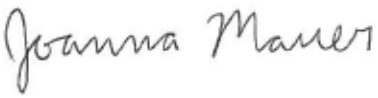
[12] https://www.regulations.gov/document?D=EERE-2008-BT-STD-0012-0128, pp. 5-62, 5-63.
[13] https://news.samsung.com/us/samsung-earns-energy-star-emerging-technology-award-for-20-refrigeration-models-in-2017/.
[14] http://www.ahrinet.org/App_Content/ahri/files/RESOURCES/Consumer_Costs_Inforum.pdf. p. 28.
[15] https://www.fluorineproducts-honeywell.com/blowingagents/wp-content/uploads/2017/03/Solstice-Refrigerator-Insulation-Sell-Sheet-US-1.pdf.
[16] 84 Fed. Reg. 62481.

- Bundling of efficiency into premium products only: Manufacturers may often choose to bundle efficiency with other features in premium products only. In these cases, consumers may not have the option to purchase a value-priced efficient refrigerator or freezer. With standards for refrigerators and freezers, efficiency is available on all models, rather than on just the most expensive ones.

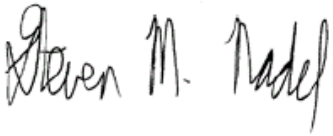
Energy conservation standards for refrigerators and freezers overcome both demand-side and supply-side barriers to efficiency, ensuring that all products meet a minimum level of efficiency. By shifting purchases to a range of choices that save consumers money, standards also achieve public benefits derived from cutting energy waste including improved electric system reliability, reduced need for new energy infrastructure, and reductions in air pollutant emissions.

Thank you for considering these comments.

Sincerely,

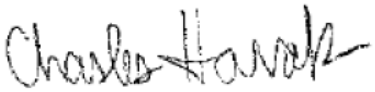


Joanna Mauer
Technical Advocacy Manager
Appliance Standards Awareness Project



Steve Nadel
Executive Director
American Council for an Energy-Efficient Economy

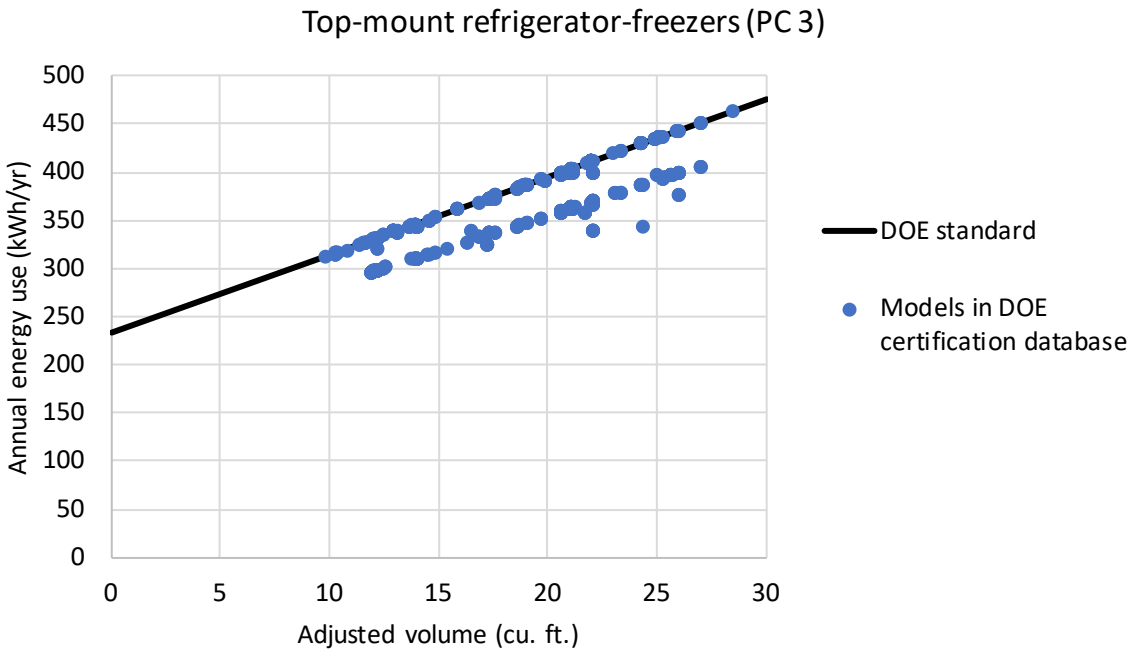
David Hochschild
Chair
California Energy Commission

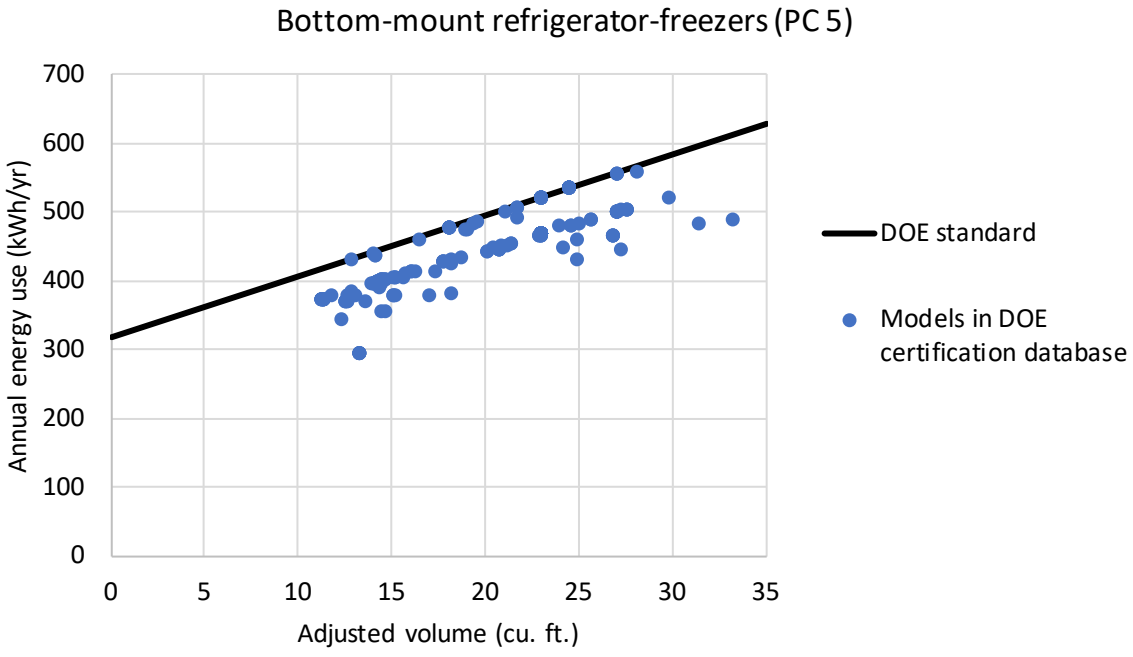


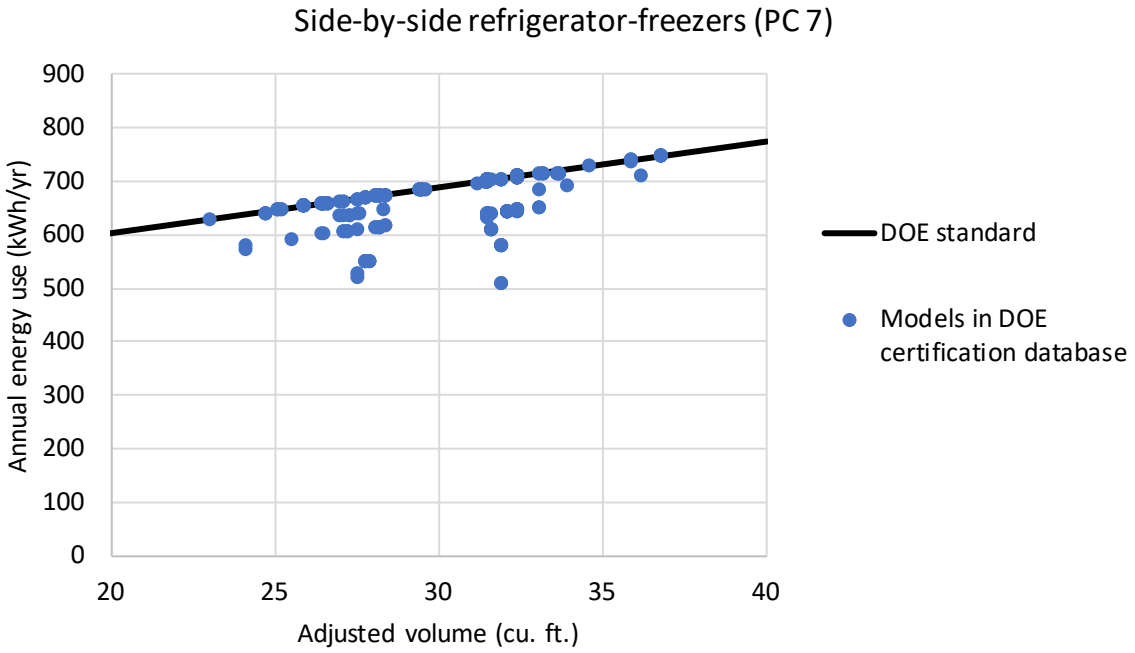
Charles Harak, Esq.
National Consumer Law Center
(On behalf of its low-income clients)

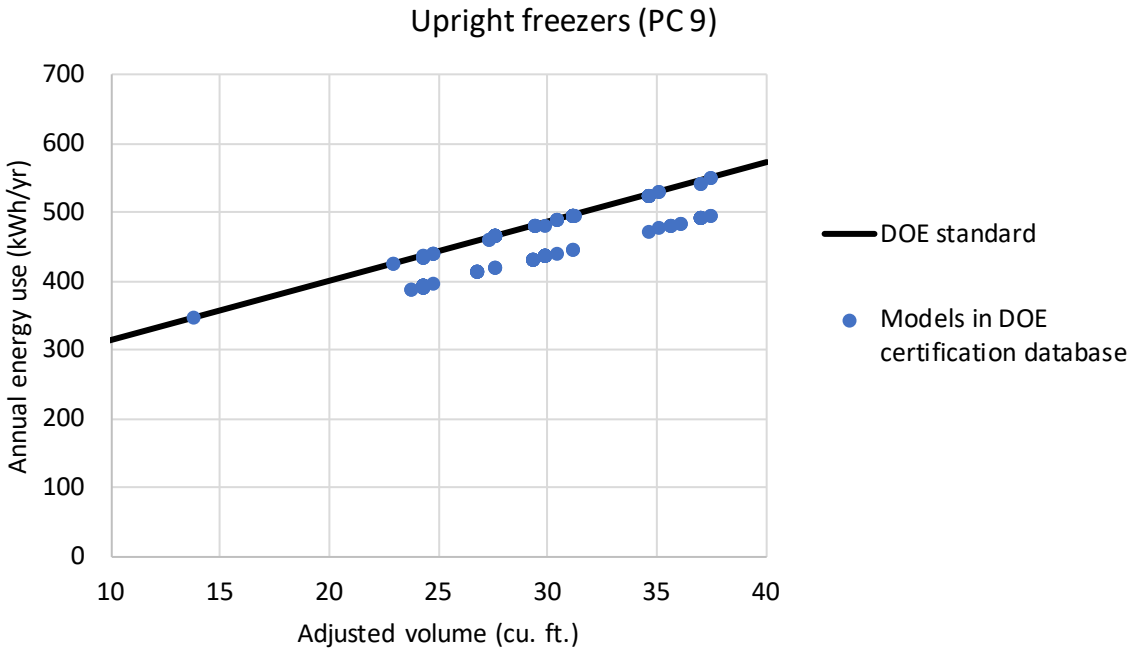
Lauren Urbanek
Senior Energy Policy Advocate
Natural Resources Defense Council

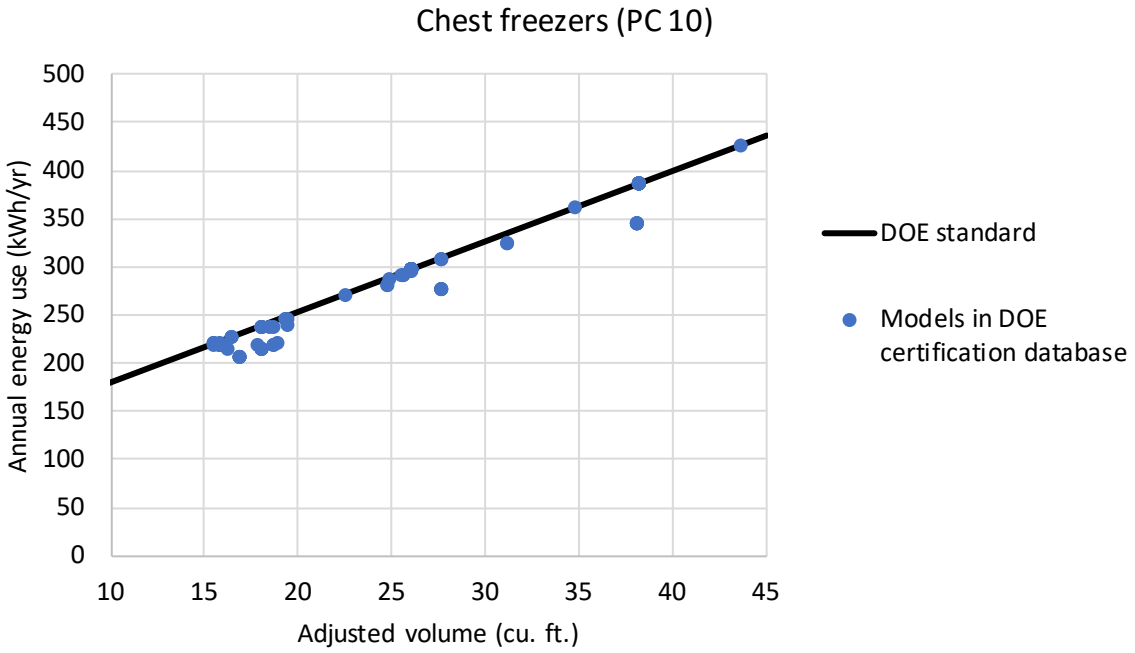
Appendix

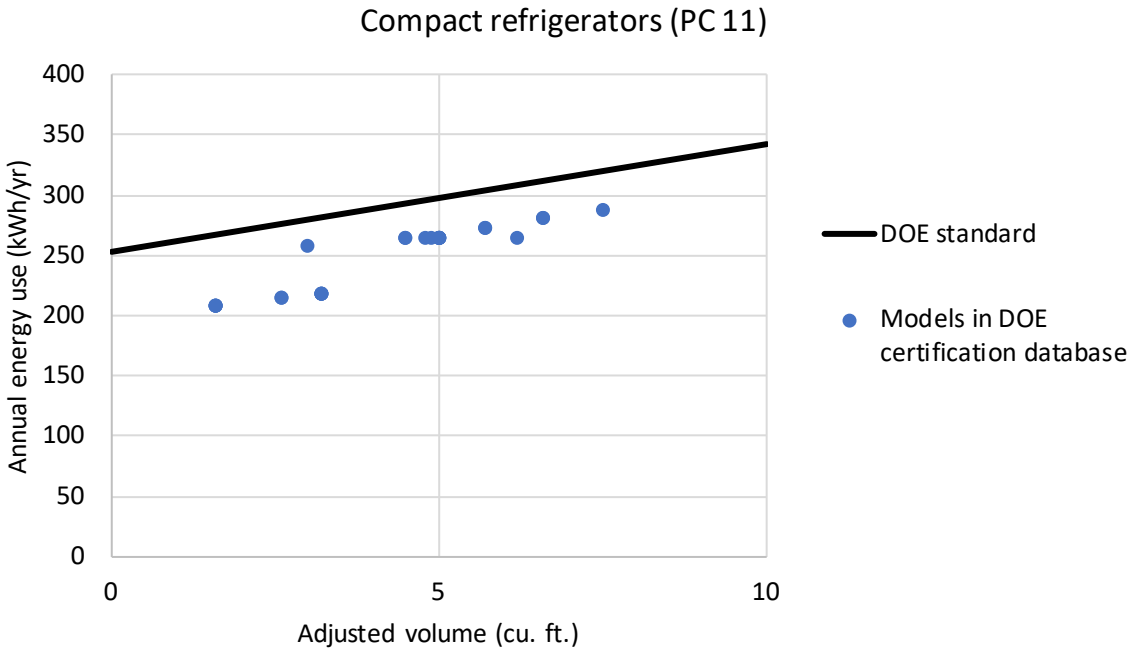

Top-mount refrigerator-freezers (PC 3)
Annual energy use (kWh/yr)
500
450
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25
30
Adjusted volume (cu. ft.)
DOE standard
Models in DOE certification database

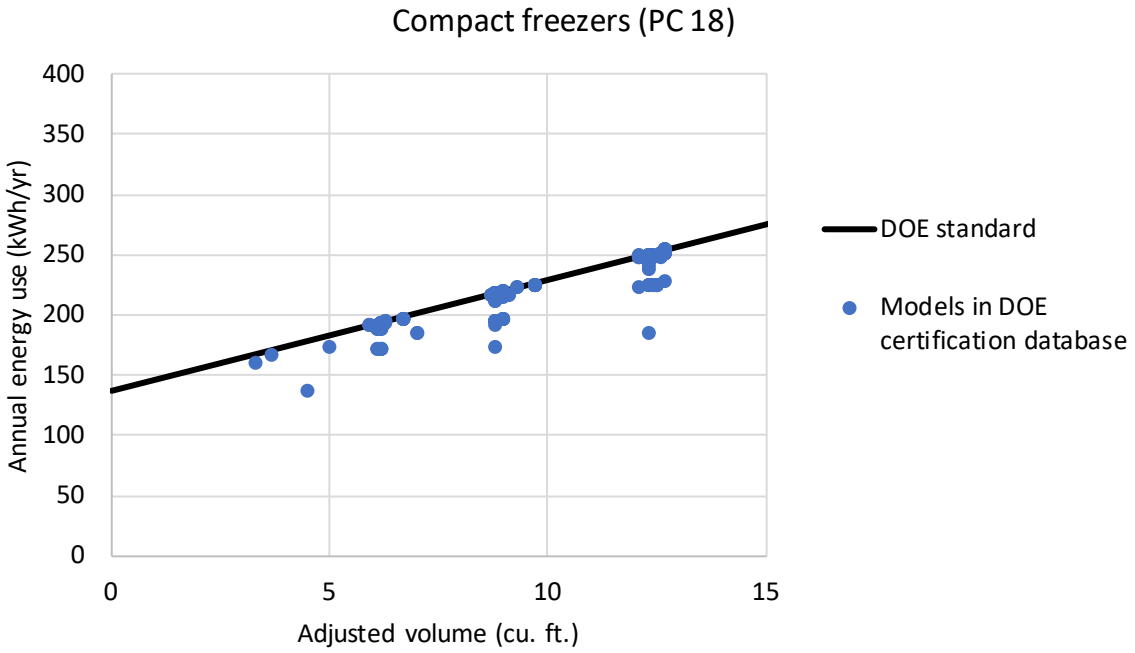

Bottom-mount refrigerator-freezers (PC 5)
Annual energy use (kWh/yr)
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
Adjusted volume (cu. ft.)
DOE standard
Models in DOE certification database


Side-by-side refrigerator-freezers (PC 7)
Annual energy use (kWh/yr)
900
800
700
600
500
400
300
200
100
0
20
25
30
35
40
Adjusted volume (cu. ft.)
DOE standard
Models in DOE certification database


Upright freezers (PC 9)
Annual energy use (kWh/yr)
700
600
500
400
300
200
100
0
10
15
20
25
30
35
40
Adjusted volume (cu. ft.)
DOE standard
Models in DOE certification database


Chest freezers (PC 10)
Annual energy use (kWh/yr)
500
450
400
350
300
250
200
150
100
50
0
10
15
20
25
30
35
40
45
Adjusted volume (cu. ft.)
DOE standard
Models in DOE certification database


Compact refrigerators (PC 11)
Annual energy use (kWh/yr)
400
350
300
250
200
150
100
50
0
0
5
10
Adjusted volume (cu. ft.)
DOE standard
Models in DOE certification database


Compact freezers (PC 18)
Annual energy use (kWh/yr)
400
350
300
250
200
150
100
50
0
0
5
10
15
Adjusted volume (cu. ft.)
DOE standard
Models in DOE certification database