Estimating Residential Cooling Utility Overpayment From Existing SEER/SEER2 Efficiency

A simple comparison model against current federal-minimum, ENERGY STAR, and higher-efficiency reference systems

Purpose. This paper provides a simple mathematical method for estimating how much more cooling electricity an existing residential air-conditioning system may use relative to a modern reference system while delivering the same seasonal cooling load. The result is expressed as an estimated percentage utility overpayment attributable to cooling efficiency.

1. Core Efficiency Relationship

SEER2 is seasonal cooling output divided by electrical energy input. For approximately equal seasonal cooling loads, electrical energy use is therefore inversely proportional to SEER2. If **X** is the existing system efficiency and **S** is the comparison-system efficiency, the relative energy-use multiplier is:

$$\text{Relative Cooling Energy Use} = S / X$$

The estimated percentage by which the existing unit's cooling electricity exceeds the comparison system is:

$$\text{Estimated Utility Overpayment \%} = \max(0, (S / X - 1) \times 100)$$

This is a cooling-energy comparison, not a claim that the homeowner's entire electric bill is overpaid by that percentage. Lighting, appliances, water heating, heating fuel, plug loads, and other non-cooling consumption must be excluded or treated separately.

2. Selecting Today's Comparison Standard

There is no single universal 2026 SEER2 minimum for every residential central-air installation. DOE requirements depend on equipment type, capacity, and region. A useful report should therefore identify the reference being used rather than simply calling one number 'today's standard.'

Reference	SEER2	How to use it
DOE less-efficient comparison	13.4	Useful baseline in DOE/FEMP current cost examples
ENERGY STAR central AC	15.2	Modern efficiency benchmark for split and packaged CAC
Federal tax-credit qualifying split AC*	17.0	Higher-efficiency benchmark (effective 2025 criteria)
DOE/FEMP best-available example	23.5	Illustrative premium-efficiency comparison

*Tax-credit eligibility is not the same thing as the federal minimum efficiency standard. It is included only as a useful modern high-efficiency comparison point.

3. Quick Customer-Facing Formula

For a simple modern-efficiency comparison using ENERGY STAR's 15.2 SEER2 criterion:

$$\text{Estimated Cooling Utility Overpayment \%} = \max(0, (15.2 / X - 1) \times 100)$$

where **X** is the existing system's comparable seasonal efficiency rating. If X is an older SEER rating rather than SEER2, the comparison is only approximate because SEER and SEER2 use different test procedures. For a

defensible customer report, use matched SEER2 data when available or clearly label an older-SEER calculation as an estimate.

4. Estimated Cooling-Energy Overpayment Table

Existing rating X	vs 13.4	vs 15.2 ENERGY STAR	vs 17.0
8	67.5%	90.0%	112.5%
9	48.9%	68.9%	88.9%
10	34.0%	52.0%	70.0%
11	21.8%	38.2%	54.5%
12	11.7%	26.7%	41.7%
13	3.1%	16.9%	30.8%
13.4	0.0%	13.4%	26.9%
14	0.0%	8.6%	21.4%
15	0.0%	1.3%	13.3%
15.2	0.0%	0.0%	11.8%
16	0.0%	0.0%	6.2%

Values represent additional cooling energy used by the existing unit relative to the selected reference for the same delivered seasonal cooling load. A zero means the existing rating equals or exceeds the selected reference.

5. Worked Example

Suppose the existing unit is rated at X = 10 and the comparison is an ENERGY STAR 15.2 SEER2 system:

$$(15.2 / 10 - 1) \times 100 = 52\%$$

Under the simplified equal-load model, the 10-rated system requires approximately **52% more cooling electricity** than the 15.2-rated reference to provide the same seasonal cooling output.

If the home's cooling portion of the annual utility bill is known, the percentage can be converted to dollars. If **Cnew** represents what cooling would cost at the reference efficiency:

$$\text{Existing Cooling Cost} = Cnew \times (S / X)$$

If instead the homeowner's **existing annual cooling cost, Cold**, is known, the estimated savings from moving to the reference efficiency are:

$$\text{Estimated Annual Savings} = Cold \times (1 - X / S)$$

Example: if the existing 10-rated system costs $1,000/year to operate for cooling, replacing it with an otherwise equivalent 15.2-rated system gives a theoretical efficiency-only cooling cost of approximately $658/year and savings of approximately $342/year, before installation, degradation, weather, duct, sizing, and behavioral effects.

6. Adding the Undersizing Screen

The earlier undersizing model can be reported alongside the efficiency comparison, but the two penalties should **not simply be added**. Efficiency and runtime interact. A useful two-factor screening model is:

Combined Relative Cost Multiplier ~= (S / X) x [1 + P x max(0, L / C - 1)]

where **L** is design load, **C** is available installed capacity, and **P** is the previously proposed screening coefficient (0.35 default). The combined estimated overpayment is then:

Combined Estimated Overpayment % ~= (Multiplier - 1) x 100

This combined equation is a screening model, not an adopted DOE/ENERGY STAR calculation. It deliberately keeps the measured/rated SEER2 relationship separate from the assumed undersizing penalty.

7. Important Field Corrections

Actual utility impact can differ substantially from the theoretical SEER2 ratio because of refrigerant charge, airflow, dirty coils/filters, duct leakage, static pressure, thermostat strategy, equipment degradation, climate, humidity, cycling, staging, and installation quality. DOE/FEMP specifically notes that improper charging, oversizing, and leaky ducts cause efficiency losses. Therefore, this model is most useful for estimating the *efficiency opportunity* after obvious system faults are accounted for.

8. Recommended Report Language

Estimated cooling utility overpayment versus today's selected efficiency benchmark: ____%. This estimate compares the existing system's seasonal efficiency rating (X = ____) with a reference rating (S = ____) under an equal-cooling-load assumption. It applies to the cooling portion of energy consumption, not the entire utility bill, and does not constitute a guaranteed savings estimate.

Sources

U.S. Department of Energy, Federal Energy Management Program, *Purchasing Energy-Efficient Residential Central Air Conditioners*. DOE/FEMP comparison tables use 13.4 SEER2 as the less-efficient example, 15.2 SEER2 for ENERGY STAR, and 23.5 SEER2 as a best-available example; the page also explains the 2023 transition from SEER to SEER2.

ENERGY STAR, *Version 6.2 Central Air Conditioners and Air Source Heat Pumps Final Specification*. Residential central AC split systems and single-package equipment require at least 15.2 SEER2 for ENERGY STAR certification.

ENERGY STAR, *Central Air Conditioners Tax Credit*. Effective January 1, 2025, qualifying split-system central air conditioners require at least 17.0 SEER2 and 12.0 EER2; packaged central AC requires at least 16.0 SEER2 and 11.5 EER2.

U.S. Department of Energy, *Energy Conservation Standards for Residential Central Air Conditioners and Heat Pumps*. Regional minimum requirements vary by product class, capacity, and installation region.