High Performance Windows: Natural Market Baseline

SAG Market Transformation Working Group
June 10, 2024
Randy Opdyke

Nicor Gas | Energy Efficiency Program

Agenda

- Background and Development
- Methodology, Data Sources, Assumptions
- NMB
- Next Steps
- Appendix
  - References
  - Sources

NMB Purpose

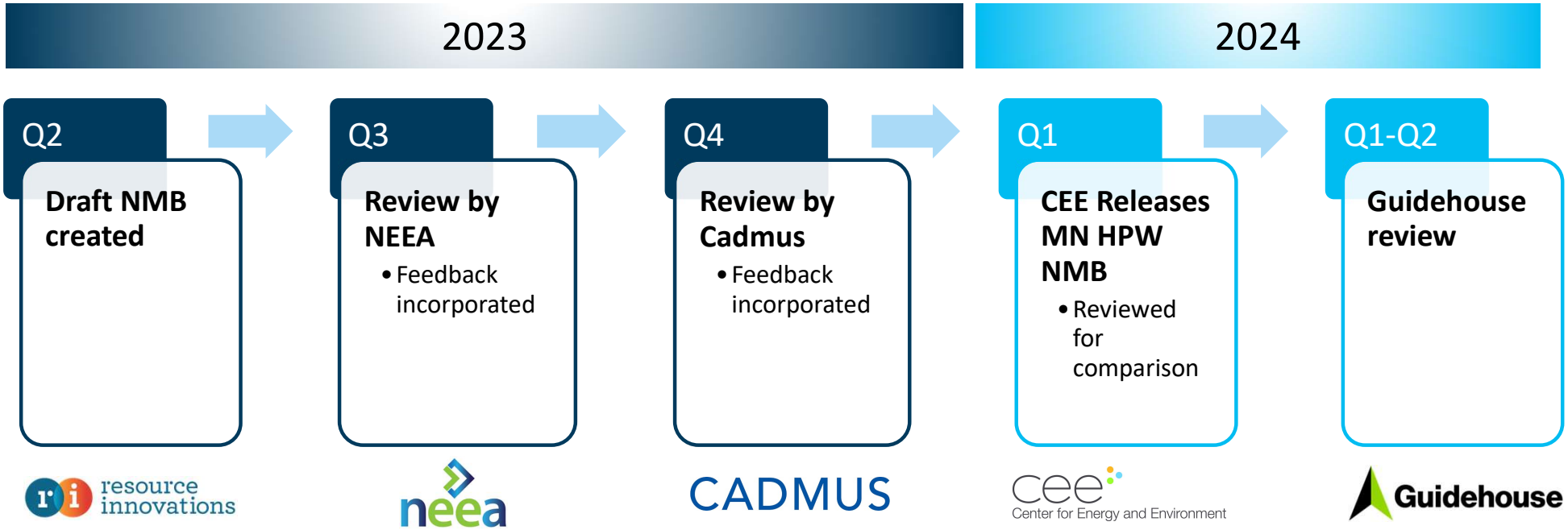
"…a forecast of the future in which no utility-funded energy-efficiency programmatic intervention exists."

Nicor Gas through collaboration, developed the following:

- ✓ Methodology
- ✓ Data Sources
- ✓ Assumptions

The Natural Market Baseline (NMB) will be revised over time (on a schedule determined in the Theory Based Evaluation plan) based on new data.

Development & Review Timeline



Guidehouse Natural Market Baseline Review

Data Sources Review

- Guidehouse evaluated the data sources provided by RI for the NMB, regarding their scope and accuracy, and checked for more recent updated versions
- Guidehouse identified three sources with version updates which did not have an explicit impact on the initial NMB; these will be tracked for future NMB reviews

Variables Review

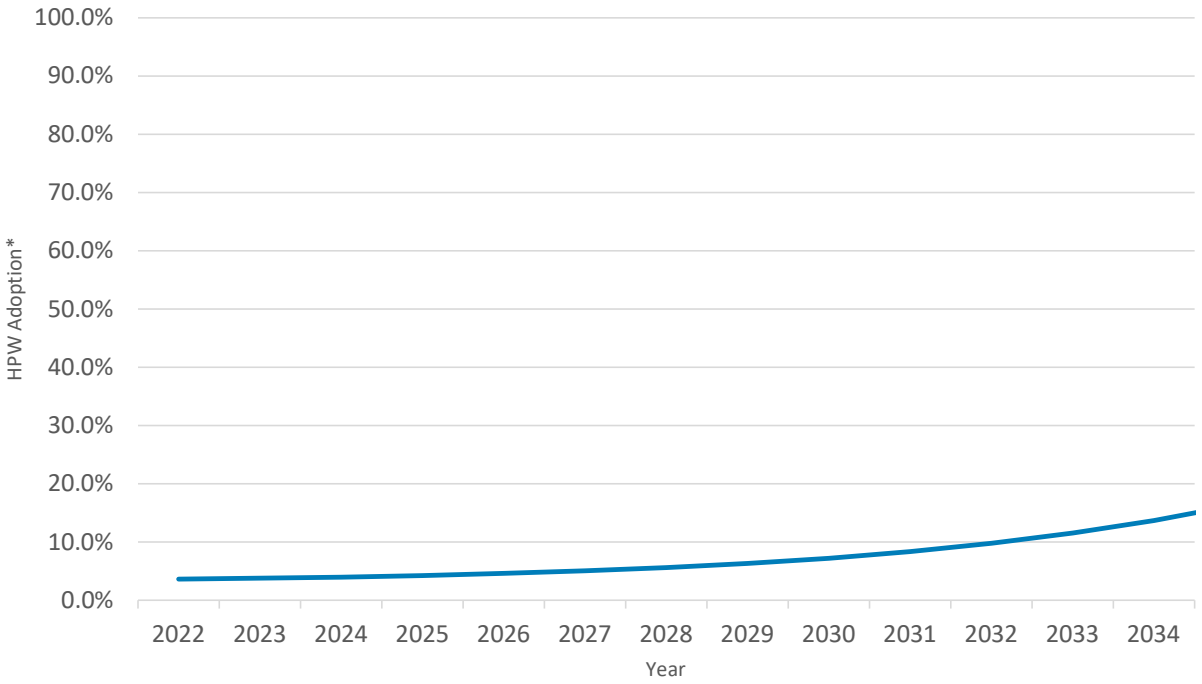
- Guidehouse conducted an in-depth review of RI's methodology for determining NMB variables
- This included analyzing given sources and researching market trends
- Guidehouse found that all variables chosen are well defined and appropriate, with minor comments on how RI may better describe the select "start of hypergrowth"

Internal SME Review

- Guidehouse engaged with its internal window and building envelope SMEs to identify any additional data sources or market identifiers that might be used to improve the NMB
- No additional resources were identified, but Guidehouse will engage its SMEs to promote future collaborations and as part of the evaluation plan

HPW NMB

High Performance Windows: Natural Market Baseline



*HPW sales as % of total window sales

Year	HPW Adoption*
2022	3.60%
2023	3.76%
2024	3.97%
2025	4.24%
2026	4.59%
2027	5.03%
2028	5.59%
2029	6.31%
2030	7.21%
2031	8.35%
2032	9.77%
2033	11.53%
2034	13.69%
2035	16.30%

Methodology

Nicor Gas used a simple S-Curve:

$$\textbf{Market Penetration} = \frac{\textbf{Maximum Market Share}}{1 + \textbf{Factor}\,\wedge\left(\frac{\textbf{Start of Hypergrowth} + \left(\frac{\textbf{Ramp Period}}{2}\right) - \textbf{Current Year}}{\textbf{Ramp Period}}\right)}$$

This curve is estimating **unit market share**: HPW sales as a percent of total window sales in any given year. It is *not* estimating the cumulative installed stock of HPW.

Curve terminology is in the appendix.

Methodology

The curve has four main inputs to consider:

1. **Maximum Market Share:** The maximum level of market saturation
2. **Start of Hypergrowth:** The point at which a product's market share begins to rapidly accelerate
3. **Ramp Period:** The period between the start of hypergrowth and takeover point
4. **Factor:** A factor based on the estimated upper and lower limits of the ramp period

For further explanation, see appendix.

Sources

Nine unique sources were used to triangulate a NMB unique to Nicor Gas' service territory.

Sources have more information in the appendix.

Document	Author	Date
Market Baseline for Triple Pane Windows	Stephen Selkowitz	May 2021
High-Performance Windows: Illinois Market Characterization	Resource Innovations	May 2023
ENERGY STAR® v7.0 Data Package	ENERGY STAR	October 2022
ENERGY STAR Draft 1 Version 7 Stakeholder Webinar	ENERGY STAR	July 2021
LBNL Webinar	LBNL	May 2022
RESNET HERS Data	RESNET	May 2023/Jan 2024
HPW Energy Savings and Market Evaluation Plan	CEE	November 2023
NEEA HPW NMB and Cadmus Review	NEEA	October 2023
Cadmus Review	Cadmus	December 2023

Assumptions

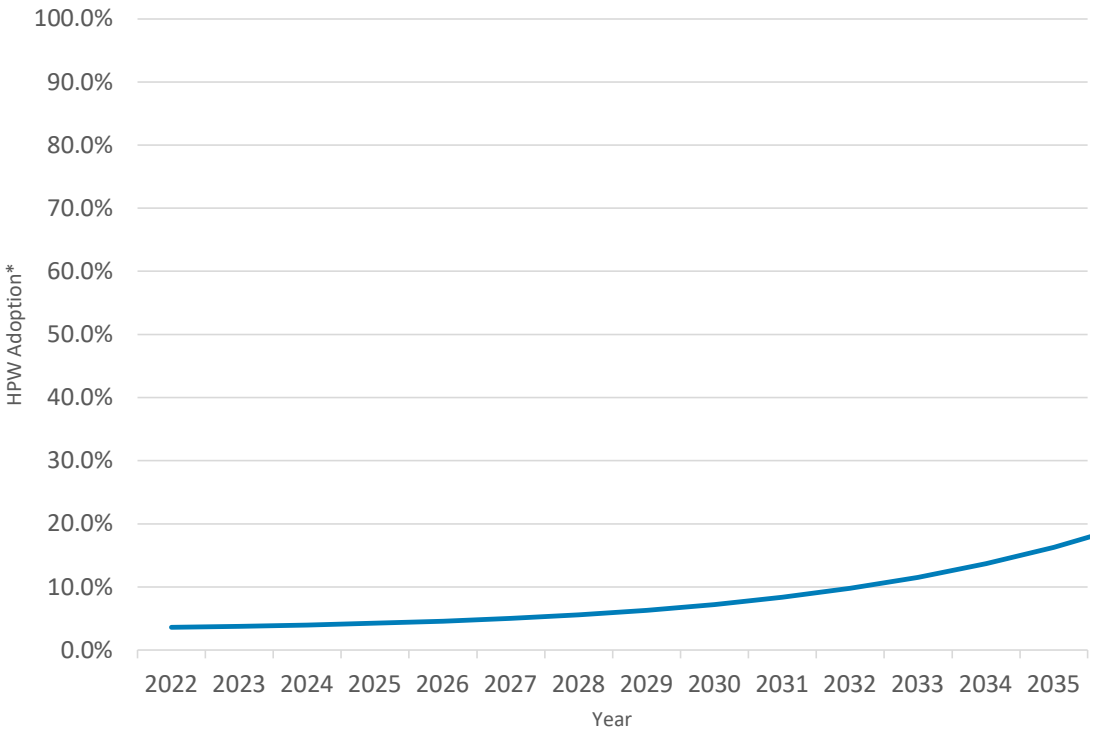
The data drove several main assumptions:

- HPW sales have been relatively flat for decades, remaining around 2% for the last 15-20 years.
  - With “business as usual”, this market share will double in approximately 10 years.
- Illinois has factors that may drive estimates higher than national sales estimates.
  - Colder, northern state with increased need to save energy and improve comfort.
  - High retrofit opportunity, where greater benefits are felt by homeowners in older homes
- Nicor Gas survey data indicates modest growth above national estimates.
- ENERGY STAR v7 was the largest efficiency jump for windows since before 2010.
- HPW will likely reach max market share faster than the adoption of double glazing or Low-E glazing largely due to ENERGY STAR’s role in the market.

Variable Summary and Natural Market Baseline

Variable (Inputs in orange)	Value
Initial Market Share*	3.6%
Start of Hypergrowth	2033
Ramp Period	17.25
Takeover Point**	2050
Maximum Market Share	85%
Factor	81

** In 2022*
*** This is a calculated value = start of hypergrowth + ramp period*



*HPW sales as % of total window sales

Note: Larger graph and % values are located in appendix.

Comparison with NEEA and MN CEE NMBs

Both the NEEA and CEE NMBs represent valuable comparisons for Nicor Gas.

Overall, **all NMBs estimate slow growth with annual market share in the single digits until beyond 2030**.

The biggest unknown across the board is the impact of ENERGY STAR. Nicor Gas' NMB may be more optimistic due to the historically high market share enjoyed by ENERGY STAR qualified windows.

Figure 4: HPW natural market baseline over the 20 year program life

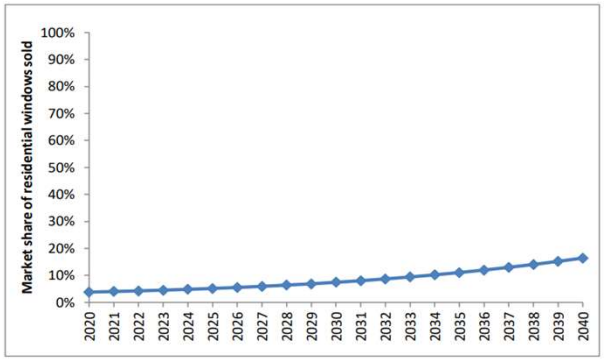
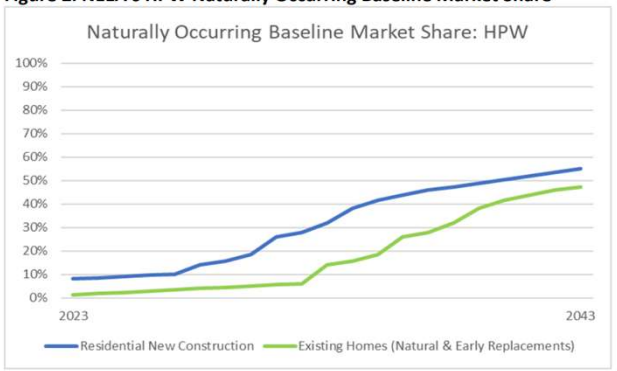


Figure 2. NEEA's HPW Naturally Occurring Baseline Market Share



Next Steps for HPW

1. **SAG Feedback on NMB**
   - A two-week feedback period for comments –
     please send to Celia Johnson (celia@celiajohnsonconsulting.com) and
     Randy Opdyke (RWOPDYKE@SOUTHERNCO.COM)

2. **Theory Based Evaluation**
   - Presenting at Q3 SAG meeting (7/8)
   - Includes NMB revision schedule

Questions?

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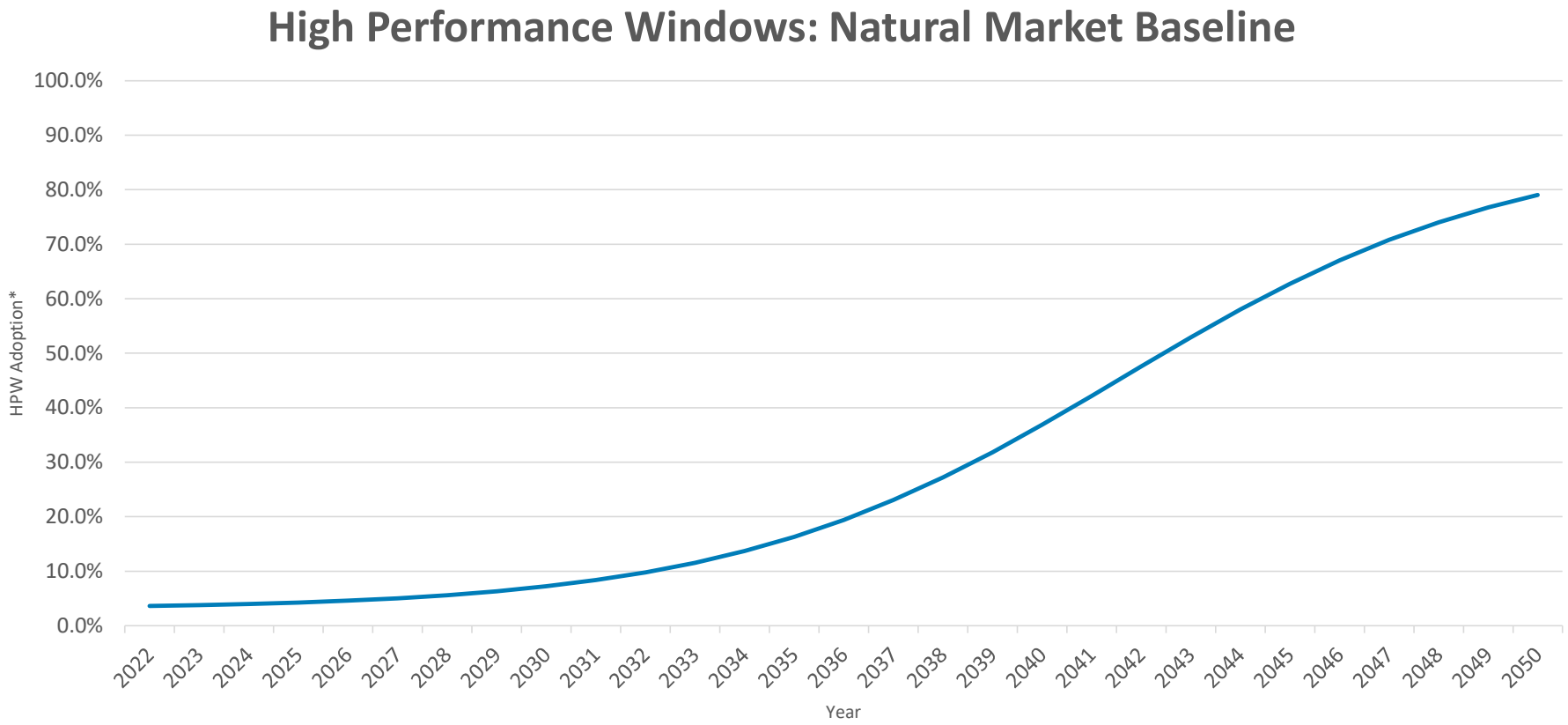
Appendix

HPW NMB



*HPW sales as % of total window sales

HPW NMB

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2033	11.53%
2034	13.69%
2035	16.30%
2036	19.40%

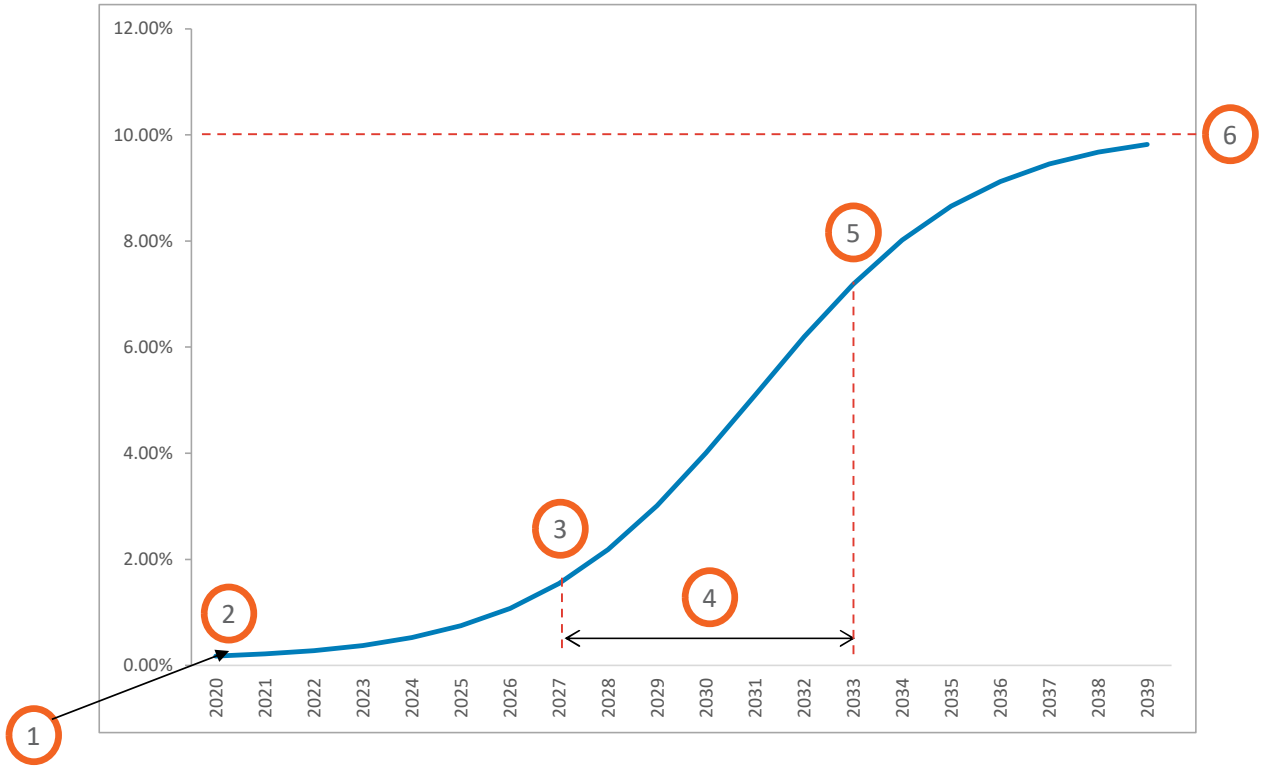
Year	HPW Adoption*
2037	23.04%
2038	27.19%
2039	31.83%
2040	36.86%
2041	42.15%
2042	47.56%
2043	52.90%
2044	58.01%
2045	62.75%
2046	67.03%
2047	70.80%
2048	74.04%
2049	76.77%
2050	79.03%

*HPW sales as % of total window sales

NMB Terminology Breakdown

1. Adoption Curve Shape
2. Initial Market Share
3. Start of Hypergrowth*
4. Ramp Period*
5. Takeover Point
6. Maximum Market Share*

**main input*



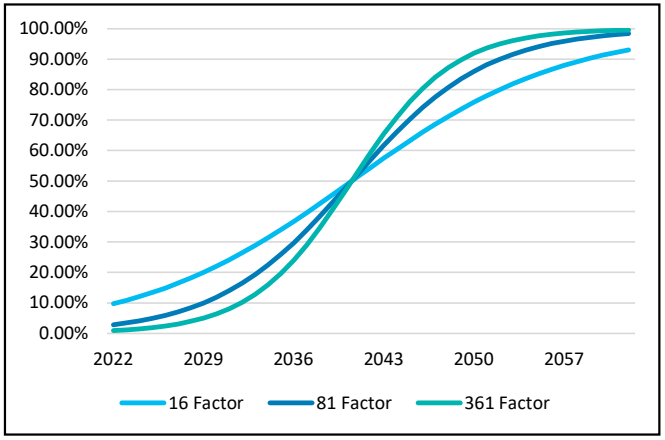
“Factor” Explained

Factor is a result of defining the upper and lower limits of the ramp period in the s-curve. The equation is as follows, where the upper and lower limits are the percent of total market penetration.

$$\boldsymbol{Factor = \frac{Upper\ Limit^{2}}{Lower\ Limit^{2}}}$$

For example, a common factor used in s-curve modeling is 81: $\boldsymbol{81 = \frac{90^{2}}{10^{2}}}$

This indicates that the hypergrowth phase starts at 10% of *maximum market penetration* and ends at 90%. The factor affects the angle of the slope, with a lower factor having a lesser slope. See examples below:



IL TRM v12/ENERGY STAR v7 HPW Specification

Table 1: Key Product Criteria for High Performance Windows[1594]

IL Degree-Day Zone	ENERGY STAR Climate Zone	U-Value	SHGC	Prescriptive or Performance-Based
1 – Rockford 2 – Chicago 3 – Springfield	Northern	≤ 0.22	≥ 0.17	Prescriptive
		= 0.23	≥ 0.35	Equivalent Energy Performance
		= 0.24		
		= 0.25	≥ 0.40	
		= 0.26		
4 – Belleville	North-Central	≤ 0.25	≤ 0.40	Prescriptive
5 – Marion				Prescriptive

ENERGY STAR: ENERGY STAR Residential Windows, Doors, and Skylights Version 7.0 Specification

IL TRM: 2024 IL-TRM Version 12.0 Volume 3: Residential Measures

Appendix: Sources

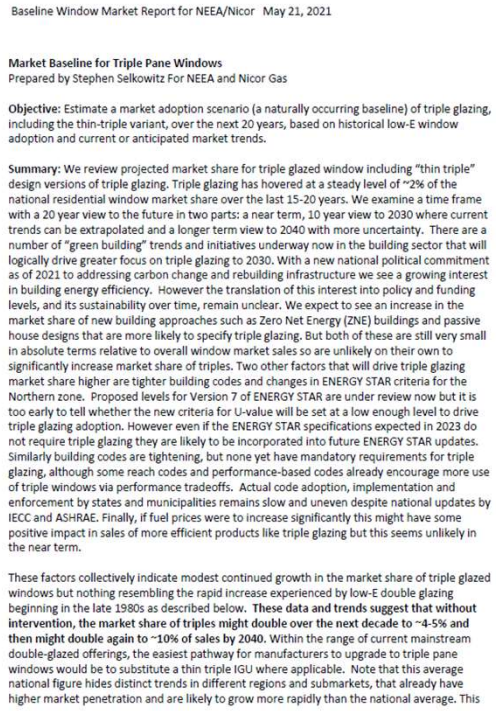
Market Baseline for Triple Pane Windows

What:

Paper written by Stephen Selkowitz for NEEA and Nicor Gas to estimate natural market adoption of triple glazed windows

Date:

May 2021



Baseline Window Market Report for NEEA/Nicor May 21, 2021

Market Baseline for Triple Pane Windows
Prepared by Stephen Selkowitz For NEEA and Nicor Gas

Objective: Estimate a market adoption scenario (a naturally occurring baseline) of triple glazing, including the thin-triple variant, over the next 20 years, based on historical low-E window adoption and current or anticipated market trends.

Summary: We review projected market share for triple glazed window including "thin triple" design versions of triple glazing. Triple glazing has hovered at a steady level of ~2% of the national residential window market share over the last 15-20 years. We examine a time frame with a 20 year view to the future in two parts: a near term, 10 year view to 2030 where current trends can be extrapolated and a longer term view to 2040 with more uncertainty. There are a number of "green building" trends and initiatives underway now in the building sector that will logically drive greater focus on triple glazing to 2030. With a new national political commitment as of 2021 to addressing carbon change and rebuilding infrastructure we see a growing interest in building energy efficiency. However the translation of this interest into policy and funding levels, and its sustainability over time, remain unclear. We expect to see an increase in the market share of new building approaches such as Zero Net Energy (ZNE) buildings and passive house designs that are more likely to specify triple glazing. But both of these are still very small in absolute terms relative to overall window market sales so are unlikely on their own to significantly increase market share of triples. Two other factors that will drive triple glazing market share higher are tighter building codes and changes in ENERGY STAR criteria for the Northern zone. Proposed levels for Version 7 of ENERGY STAR are under review now but it is too early to tell whether the new criteria for U-value will be set at a low enough level to drive triple glazing adoption. However even if the ENERGY STAR specifications expected in 2023 do not require triple glazing they are likely to be incorporated into future ENERGY STAR updates. Similarly building codes are tightening, but none yet have mandatory requirements for triple glazing, although some reach codes and performance-based codes already encourage more use of triple windows via performance tradeoffs. Actual code adoption, implementation and enforcement by states and municipalities remains slow and uneven despite national updates by IECC and ASHRAE. Finally, if fuel prices were to increase significantly this might have some positive impact in sales of more efficient products like triple glazing but this seems unlikely in the near term.

These factors collectively indicate modest continued growth in the market share of triple glazed windows but nothing resembling the rapid increase experienced by low-E double glazing beginning in the late 1980s as described below. **These data and trends suggest that without intervention, the market share of triples might double over the next decade to ~4-5% and then might double again to ~10% of sales by 2040.** Within the range of current mainstream double-glazed offerings, the easiest pathway for manufacturers to upgrade to triple pane windows would be to substitute a thin triple IGU where applicable. Note that this average national figure hides distinct trends in different regions and submarkets, that already have higher market penetration and are likely to grow more rapidly than the national average. This

High Performance Windows: Illinois Market Characterization.

What:

Survey conducted by Resource Innovations (on behalf of Ameren IL, ComEd, and Nicor Gas) to nearly 6,000 residential customers in Illinois to characterize the current window market in the state.

Date:

May 2023

High Performance Windows

Illinois Market Characterization

Prepared by: Resource Innovations

Date: May 1, 2023

ENERGY STAR v7.0 Data Package

What:

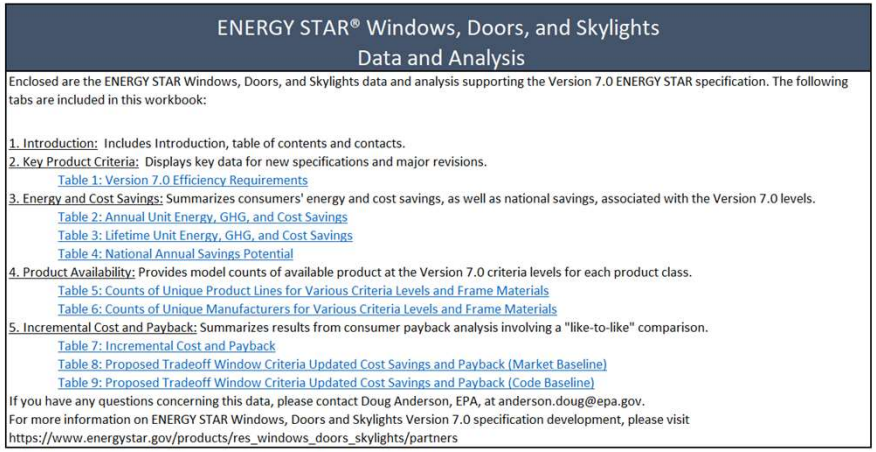
Data and analysis provided by DOE alongside the release of the final ENERGY STAR v7.0 Specifications for Windows, Doors, and Skylights.

Date:

October 2022

Link:

ENERGY STAR Version 7.0 Residential Windows, Doors, and Skylights Data Package



ENERGY STAR® Windows, Doors, and Skylights
Data and Analysis

Enclosed are the ENERGY STAR Windows, Doors, and Skylights data and analysis supporting the Version 7.0 ENERGY STAR specification. The following tabs are included in this workbook:

1. Introduction: Includes Introduction, table of contents and contacts.
2. Key Product Criteria: Displays key data for new specifications and major revisions.
   - Table 1: Version 7.0 Efficiency Requirements
3. Energy and Cost Savings: Summarizes consumers' energy and cost savings, as well as national savings, associated with the Version 7.0 levels.
   - Table 2: Annual Unit Energy, GHG, and Cost Savings
   - Table 3: Lifetime Unit Energy, GHG, and Cost Savings
   - Table 4: National Annual Savings Potential
4. Product Availability: Provides model counts of available product at the Version 7.0 criteria levels for each product class.
   - Table 5: Counts of Unique Product Lines for Various Criteria Levels and Frame Materials
   - Table 6: Counts of Unique Manufacturers for Various Criteria Levels and Frame Materials
5. Incremental Cost and Payback: Summarizes results from consumer payback analysis involving a "like-to-like" comparison.
   - Table 7: Incremental Cost and Payback
   - Table 8: Proposed Tradeoff Window Criteria Updated Cost Savings and Payback (Market Baseline)
   - Table 9: Proposed Tradeoff Window Criteria Updated Cost Savings and Payback (Code Baseline)

If you have any questions concerning this data, please contact Doug Anderson, EPA, at anderson.doug@epa.gov.
For more information on ENERGY STAR Windows, Doors and Skylights Version 7.0 specification development, please visit https://www.energystar.gov/products/res_windows_doors_skylights/partners

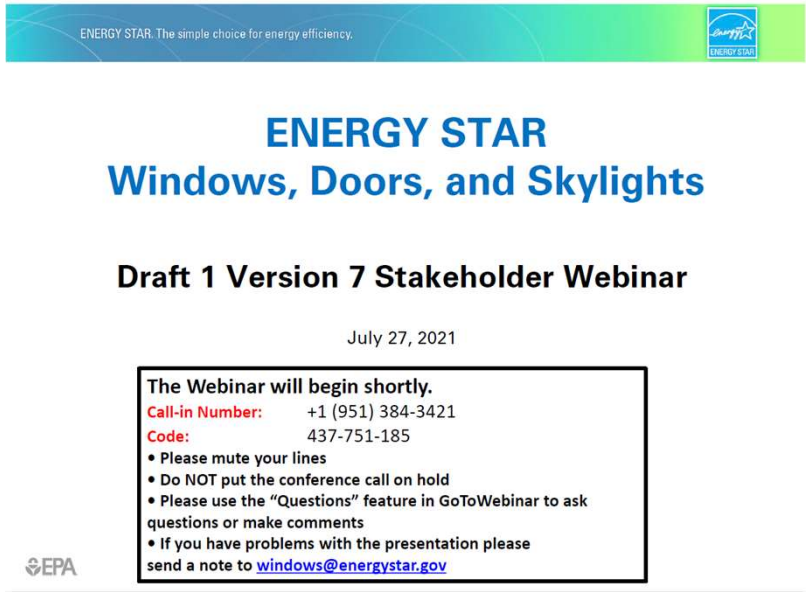
ENERGY STAR Draft 1 Version 7 Stakeholder Webinar

What:

Stakeholder webinar slides from DOE, released as part of the process to create ENERGY STAR v7.0 Specifications for Windows, Doors, and Skylights.

Date:

July 2021



LBNL Webinar

What:

Robert Hart of LBNL presented analysis of ENERGY STAR's product database and reviewed how windows might meet the version 7 requirements from a technical perspective.

Analysis (starting on pg. 39) confirmed that for the Northern climate zone, double-pane and triple-pane can be a useful proxy to distinguish HPW in absence of detailed u-value/SHGC information.

Date:

May 2022

RESNET HERS Data

What:

Two different sets of RESNET HERS data were reviewed:

1. An annual report (link below) showing trends in HERS rated homes from around the United States.
2. A purchased data set specific to Illinois. Data looks at HERS ratings conducted from 2013-2023 with a total of over 27,000 homes' window specifications detailed.

Date:

May 2023
Data collected January 2024

Link:

2023 Data Trends Report of HERS Rated Homes

CEE: HPW Energy Savings and Market Evaluation Plan

What:

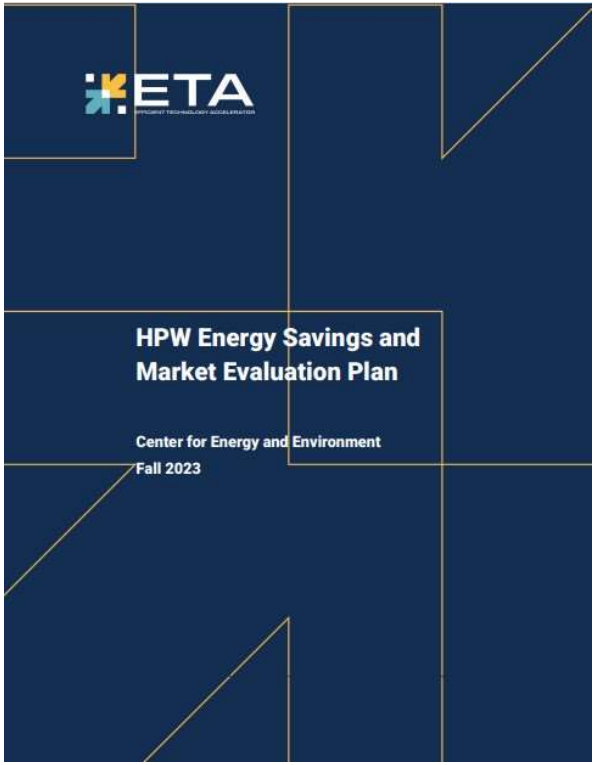
CEE has also chosen HPW as a MT initiative in Minnesota. The Energy Savings and Market Evaluation Plan contains their NMB for the MN market (pg. 19). While they define HPW by u-value only (≤ 0.22), they are functionally the same.

Date:

November 2023 (publicly available January 2024)

Link:

HPW Energy Savings and Market Evaluation Plan



NEEA HPW NMB (and Cadmus Review)

What:

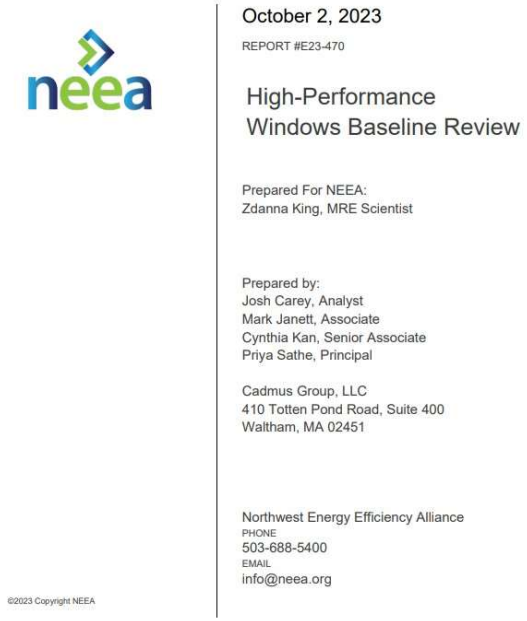
NEEA asked Cadmus to review their Natural Market Baseline. Like MN CEE, they define HPW by u-value only (≤ 0.22), which is functionally the same as ENERGY STAR v7.

Date:

October 2023

Link:

HPW Baseline Review



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October 2, 2023

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High-Performance Windows Baseline Review

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503-688-5400
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Cadmus Review

What:

Cadmus was asked to review RI's NMB. RI has already incorporated feedback from this review into the NMB.

Date:

December 2023