



Energy Efficiency
PROGRAM

High Performance Windows: LM + MPIs, NMB

SAG Market Transformation Working Group

August 29, 2024


Tim Dickison, AIC

Brady Nemeth, Resource Innovations

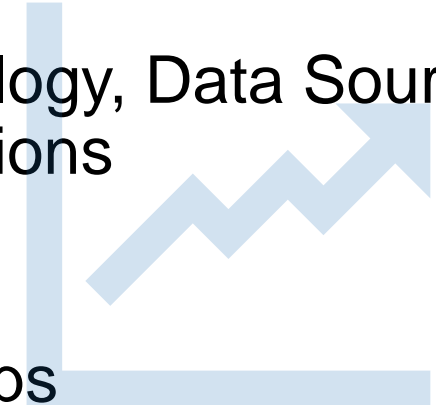


Agendas

Logic Model + Market Progress Indicators

1. The Process
 2. Logic Model
 3. Market Progress Indicators
 4. Next Steps
- 

Natural Market Baseline

1. Background and Development
 2. Methodology, Data Sources, Key Assumptions
 3. NMB
 4. Next Steps
 5. Appendix
- 

The Process

Per the [Market Transformation Savings Protocol Process Recommendation](#), creating a logic model includes the following:

1. Conducting market research
2. Drafting MT theory
3. Drafting intervention strategies
4. Developing market progress indicators
5. Refining and finalizing

SAG's role is to “review revised logic model.”



The Process

AIC formally launched the HPW MTI in 2023. The AIC Logic Model (LM) was created in 2024 and has been reviewed by AIC's evaluator, Opinion Dynamics (ODC).

This is the first MTI in IL to have multiple IOUs (Nicor Gas and AIC) incorporating it into their respective MT portfolios.

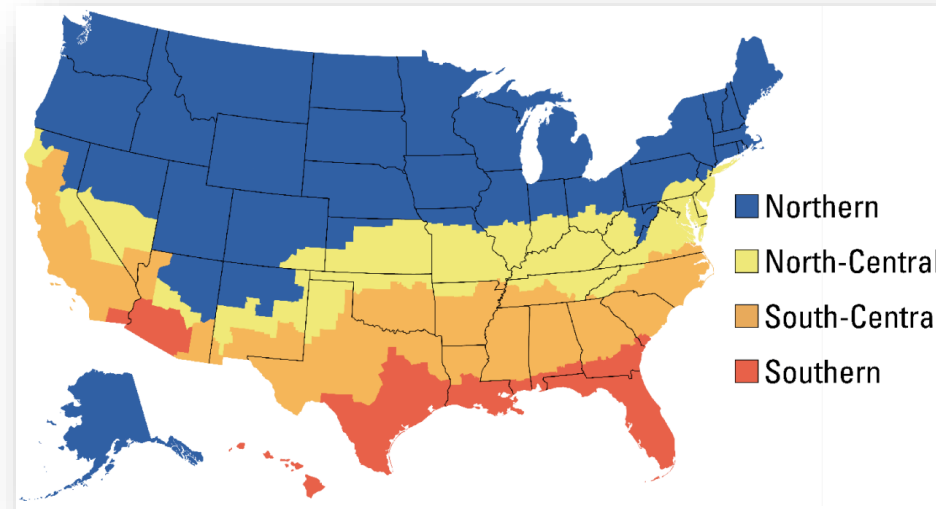
Nicor Gas LM and MPIs:

- Were created in 2021 and finalized through 2022
- Had input from NEEA based on their experience in the NW
- Had inputs from Market Characterization reports in 2022
- Was reviewed by SAG in 2023

The Process

While several overarching themes are present in both, there are purposeful differences between the two:

- › The market has moved in the 2 years since finalization of Nicor Gas'
 - ENERGY STAR v7
- › The service territories between the two utilities differ
 - Dense Chicago suburbs vs. rural Illinois
- › Different climate zones can affect savings and value proposition



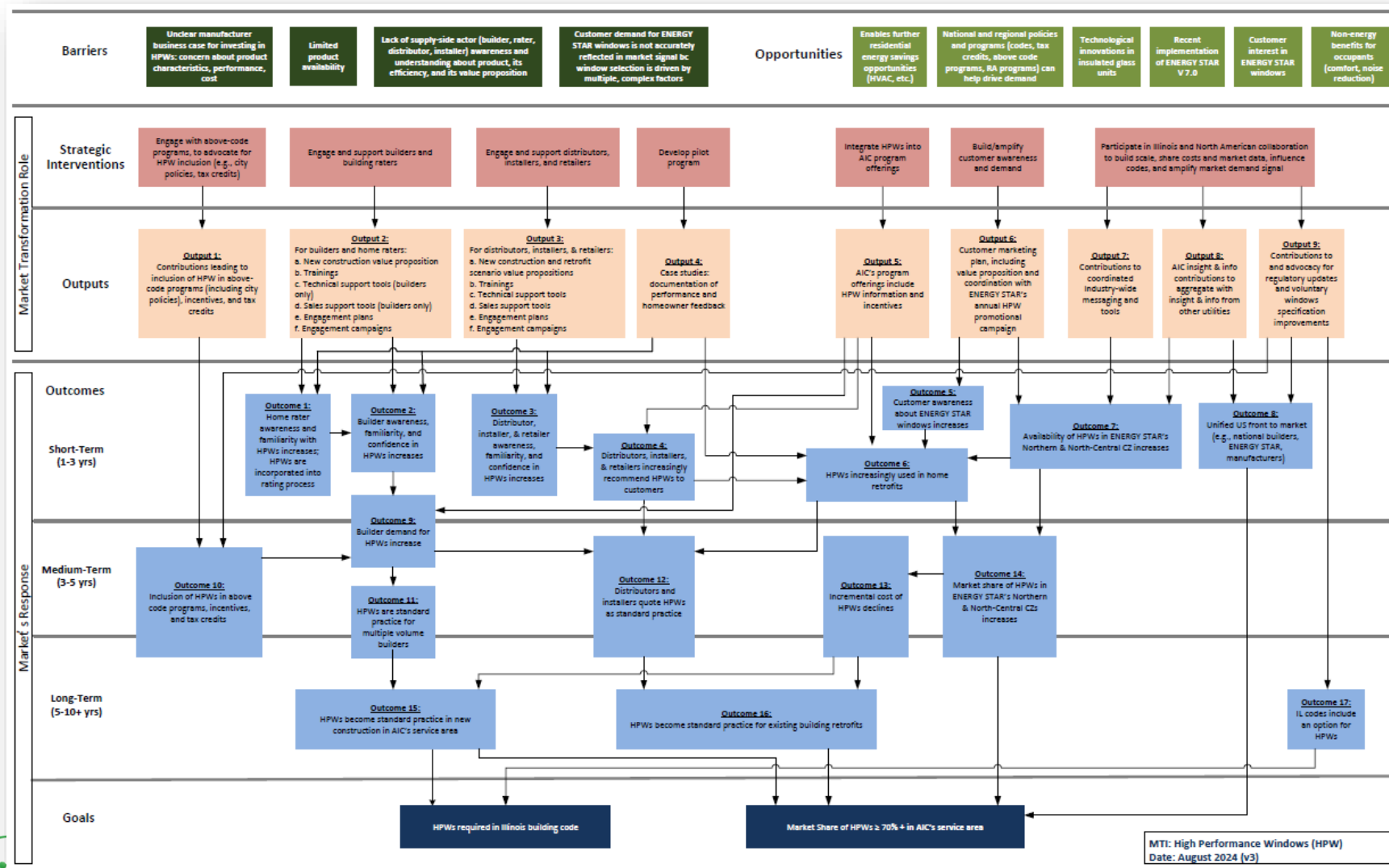
ENERGY STAR Climate Zones

Table 1: Key Product Criteria for High Performance Windows¹⁵⁹⁴

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		
	= 0.26	≥ 0.40		
4 – Belleville	North-Central	≤ 0.25	≤ 0.40	Prescriptive
5 – Marion				Prescriptive

IL TRM Degree-Day Zones

The Logic Model



Logic Model: Barriers

Unclear manufacturer business case for investing in HPWs: concern about product characteristics, performance, cost

Limited product availability

Lack of supply-side actor (builder, rater, distributor, installer) awareness and understanding about product, its efficiency, and its value proposition

Customer demand for ENERGY STAR windows is not accurately reflected in market signal because window selection is driven by multiple, complex factors

Several barriers exist outside of just the buy down of the measure's incremental cost:

1. Unclear manufacturer business case

- › Manufacturing w/ thin glass, additional cost concerns.

2. Limited product availability

- › Historic jump in ENERGY STAR requirements. Made-to-order product.

3. Lack of supply chain awareness

- › Little familiarity with efficiency benefits across all levels – including within windows manufacturers themselves.

4. Complex supply chain distorts market signals

- › Consumers love windows, but frequently purchase through third parties (distributors, retailers, homebuilders).

Logic Model: Strategic Interventions

Engage with above-code programs, to advocate for HPW inclusion (e.g., city policies, tax credits)

Engage and support builders and building raters

Engage and support distributors, installers, and retailers

Develop pilot program

Integrate HPWs into AIC program offerings

Build/amplify customer awareness and demand

Participate in Illinois and North American collaboration to build scale, share costs and market data, influence codes, and amplify market demand

Strategic Interventions can be categorized into several groups:

1. Supply chain engagement

- › Make it easier for builders, raters, retailers, etc. to pick HPW for winning bids.

2. Incorporation of HPW measure(s) into program offerings

- › Create the carrot to point the supply chain's enthusiasm towards.

3. Collaborate efforts to amplify demand

- › Use industry groups, such as PAWS, to amplify messaging and signals to the market.

4. Calibrate customer demand

- › Connect the dots between homeowners love of windows and the supply chain who provides them.

Logic Model: Expected Outcomes

Short/Mid/Long-term highlights:

HPWs increasingly used
in home retrofits

Distributors and installers
quote HPWs as a
standard practice

HPWs become standard
practice (new
construction and retrofit)

HPWs required
in IL building
code

Market Share of
HPWs $\geq 70\%$
in AIC's service
area

Market Progress Indicators

17 Total MPIs:

- › Connects every outcome to an MPI, measurable metric, and potential data source

Metric Examples:

- › Awareness rate
- › Recommendation rate
- › Product cost

Data Source Examples:

- › Surveys
 - Builder, rater, distributor, installer, etc.
- › ENERGY STAR shipment data report
- › HERS data

AIC HPW MPI Table					
Outcome #	Term	Logic Model Outcome	Market Progress Indicator	Metric	Data Source
1	Short	Home rater awareness and familiarity with HPWs increases; HPWs are incorporated into rating process	a) Increases in home rater awareness of HPWs b) Increases in home rater familiarity with HPWs c) Inclusion of HPWs (or HPW specifications) in home rater tools	a) % of home raters aware of HPWs b) Level of home rater familiarity with HPWs c) Window specification options in home rater tools	Home rater survey
2	Short	Builder awareness, familiarity, and confidence in HPWs increases	a) Increases in builder awareness of HPWs b) Increases in builder familiarity with HPWs c) Increases in builder confidence in HPWs	a) % of builders aware of HPWs b) Level of builder familiarity with HPWs c) Level of builder confidence in HPWs	Builder survey
3	Short	Distributor, installer, and retailer awareness, familiarity, and confidence in HPWs increases	a) Increases in distributor awareness of HPWs b) Increases in distributor familiarity with HPWs c) Increases in distributor confidence in HPWs d) Increases in installer awareness of HPWs e) Increases in installer familiarity with HPWs f) Increases in installer confidence in HPWs g) Increases in retailer awareness of HPWs h) Increases in retailer familiarity with HPWs i) Increases in retailer confidence in HPWs	a) % of distributors aware of HPWs b) Level of distributor familiarity with HPWs c) Level of distributor confidence in HPWs d) % of installers aware of HPWs e) Level of installer familiarity with HPWs f) Level of installer confidence in HPWs g) % of retailers aware of HPWs h) Level of retailer familiarity with HPWs i) Level of retailer confidence in HPWs	a) Distributor survey b) Installer survey c) Retailer survey
4	Short	Distributors, installers, and retailers increasingly recommend HPWs to customers	a) Increases in % of distributors recommending HPWs to customers b) Increases in frequency of distributor HPW recommendations to customers c) Increases in % of installers recommending HPWs to customers d) Increases in frequency of installer HPW recommendations to customers e) Increases in % of retailers recommending HPWs to customers f) Increases in frequency of retailer HPW recommendations to customers	a) % of distributors recommending HPWs to customers b) % of customers to who distributors recommend HPWs c) % of installers recommending HPWs to customers d) % of customers to who installers recommend HPWs e) % of retailers recommending HPWs to customers f) % of customers to who retailers recommend HPWs	a) Distributor survey b) Installer survey c) Retailer survey d) Customer survey
5	Short	Customer awareness about ENERGY STAR windows increases	Increases in % of customers aware of ENERGY STAR windows	% of customers aware of ENERGY STAR windows	Customer survey

Questions?



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Artwork by Brenda Pagan, member of the Peoria Guild of Black Artists



Next Steps

The Logic Model and Market Progress Indicators are complete, aside from SAG comment period.

Revisions will be made as required, as determined by AIC in conjunction with Opinion Dynamics.

Up Next:

Natural Market Baseline

Presented today

Theory Based Evaluation

2025

HPW Pilot

Starting 2024



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High Performance Windows: Natural Market Baseline

SAG Market Transformation Working Group

August 29, 2024

Tim Dickison, AIC

Brady Nemeth, Resource Innovations



NMB Purpose and Development

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

Ameren has had the following developed and reviewed by Opinion Dynamics:

- ✓ Methodology
- ✓ Data Sources
- ✓ Assumptions

Like the LM + MPI work, Ameren is now the second IL IOU to create a HPW natural market baseline. While the high-level methodology remains consistent, values unique to Ameren Illinois service territory have been used to create a different NMB.

NMB Development Process



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Nicor Gas

- Draft development by RI
- Third-party review and feedback
- **SAG Presentation: Q2 2024**



CADMUS



cee
Center for Energy and Environment



Ameren Illinois

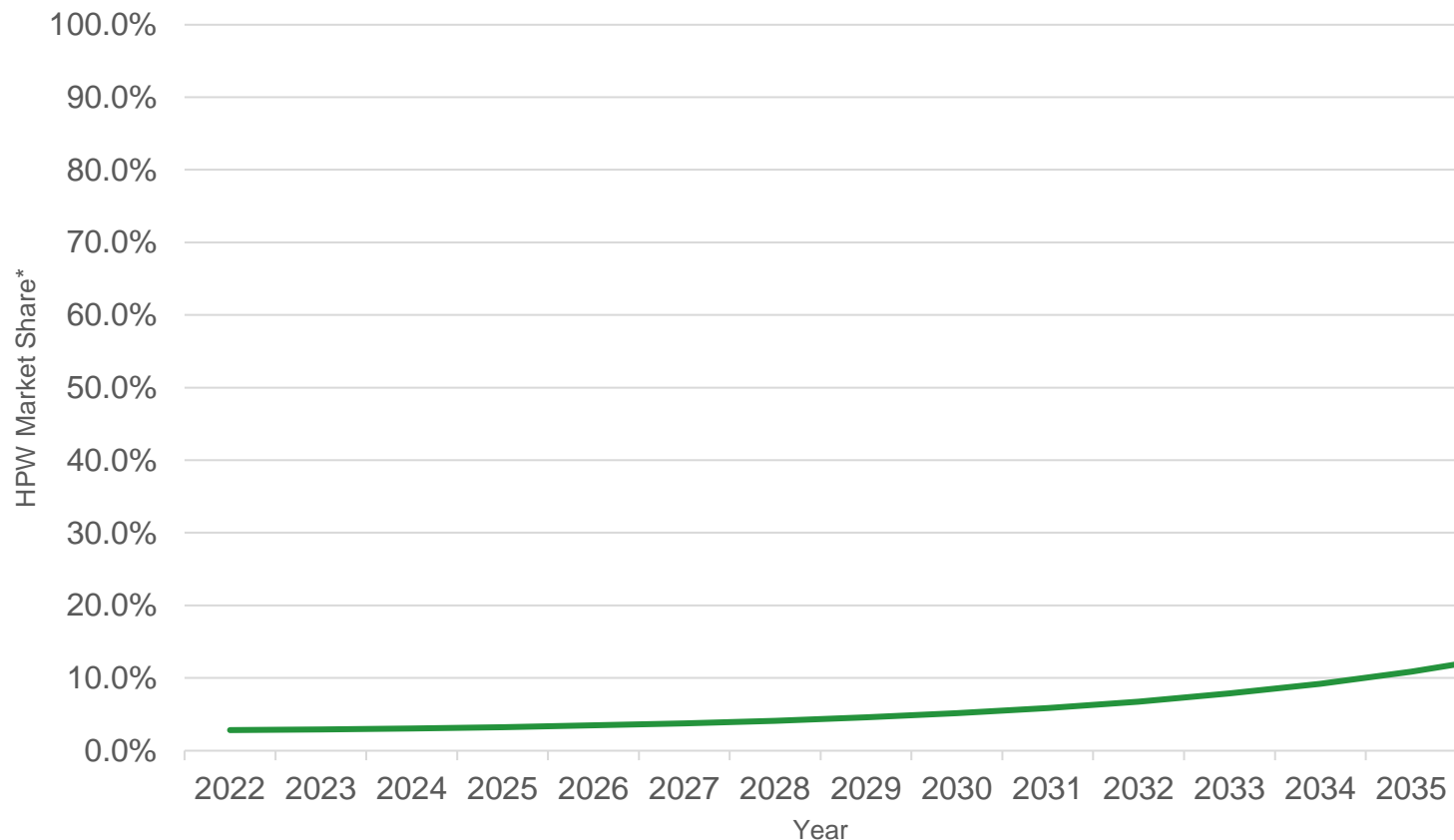
- Same overall methodology by RI
- Adjustments unique to AIC territory
- Evaluator review
- **SAG Presentation: Q3 2024**



HPW NMB



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Year	HPW Adoption*
2022	2.80%
2023	2.91%
2024	3.06%
2025	3.24%
2026	3.47%
2027	3.75%
2028	4.12%
2029	4.57%
2030	5.15%
2031	5.86%
2032	6.75%
2033	7.86%
2034	9.22%
2035	10.88%

*HPW sales as % of total window sales

Methodology

Ameren has used a simple S-Curve:

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

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 4 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 numerical value which defines the 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 Ameren’s 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
HPW Energy Savings and Market Evaluation Plan	CEE	November 2023
NEEA HPW NMB and Cadmus Review	NEEA	October 2023
MN CEE HPW NMB	MN CEE	Jan 2024

Key Assumptions

The data drove several main assumptions:

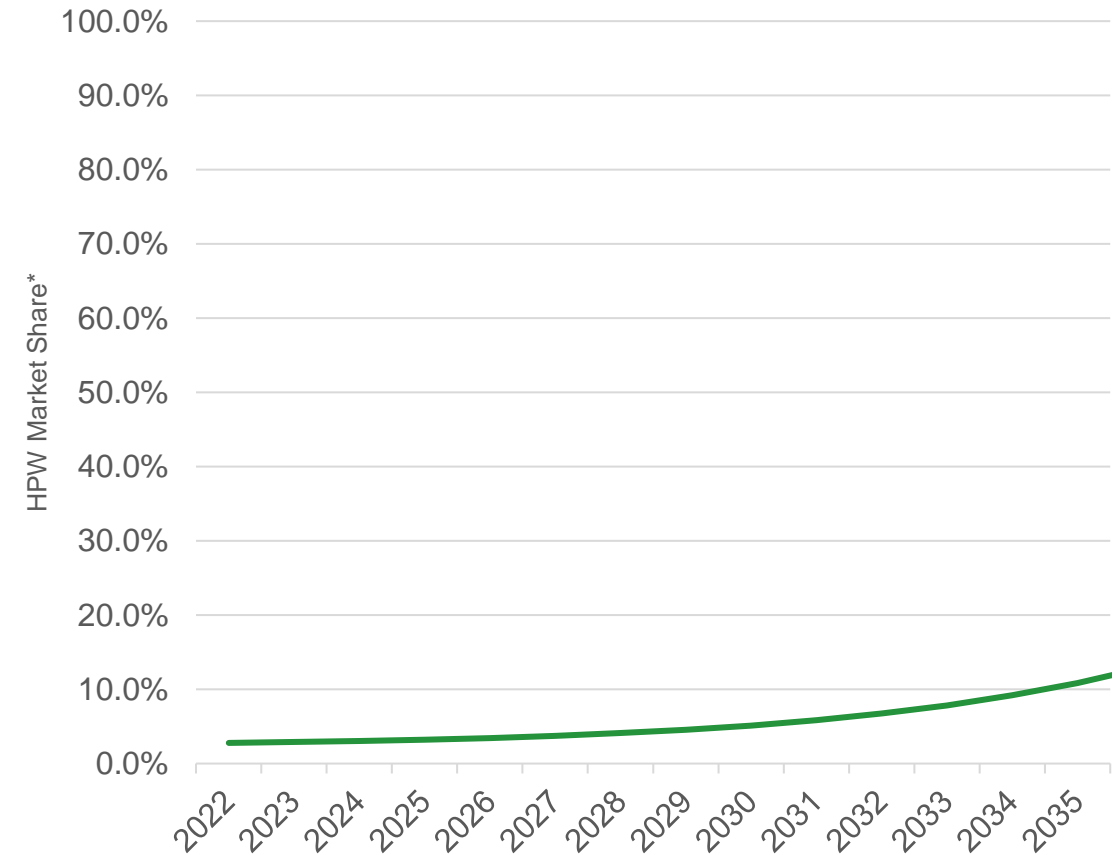
- HPW sales have been relatively flat for decades, remaining around 2% for the last 15-20 years.
 - With “business as usual”, this market share will double in approximately ten years.
- Illinois has factors that may drive estimates higher than national sales estimates.
 - Colder, northern state with increased need to save energy and improve comfort.
 - High retrofit opportunity, where greater benefits are felt by homeowners in older homes.
- 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.

Unique to Ameren

- *Ameren survey data indicates modest growth above historic norms.*
- *Fewer households in Ameren territory (compared to Nicor Gas) currently have or have recently replaced their windows with HPW.*
- *Almost double the rate of customers purchasing through a retailer in Ameren territory as opposed to a distributor or installer.*

Variable Summary and NMB

Variable (Inputs in red)	Value
Initial Market Share*	2.8%
Start of Hypergrowth	2035
Ramp Period	18.4
Takeover Point**	2053
Maximum Market Share	85%
Factor	81



Note: Larger graph and % values are located in [the appendix](#).

* In 2022

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

Comparison with Other NMBs

NEEA, CEE and Nicor Gas NMBs represent valuable comparisons for Ameren.

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. Updates to the NMB will be expected to be called out in the forthcoming (2025) theory based evaluation plan developed in conjunction with ODC.

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

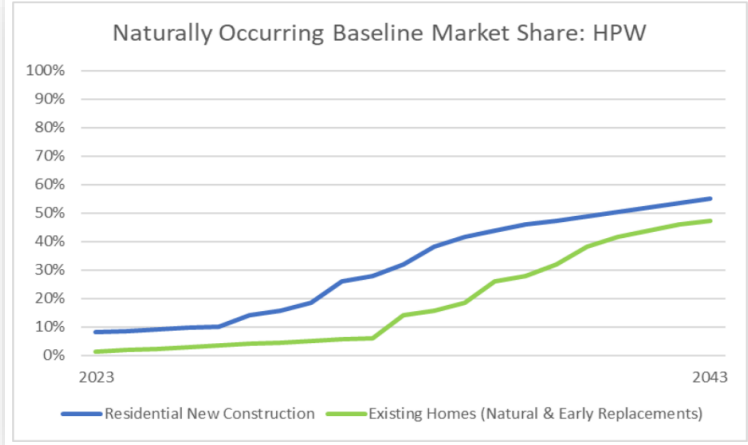
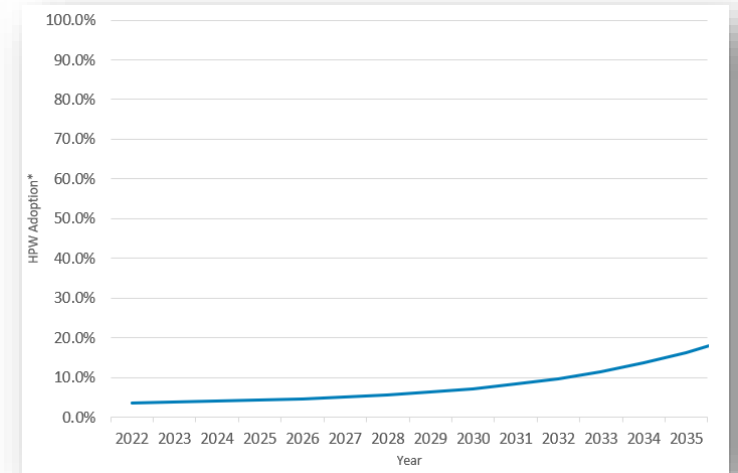
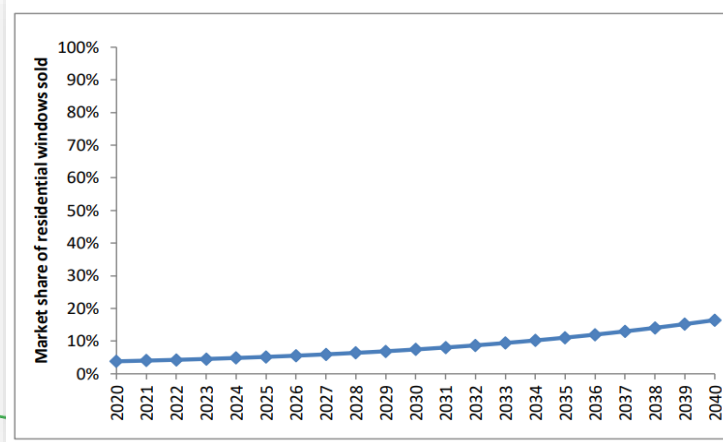


Figure 4: HPW natural market baseline over the 20 year program life



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 Tim Dickison (tdickison@ameren.com)

2. HPW Pilot Implementation

3. Theory Based Evaluation

Appendix



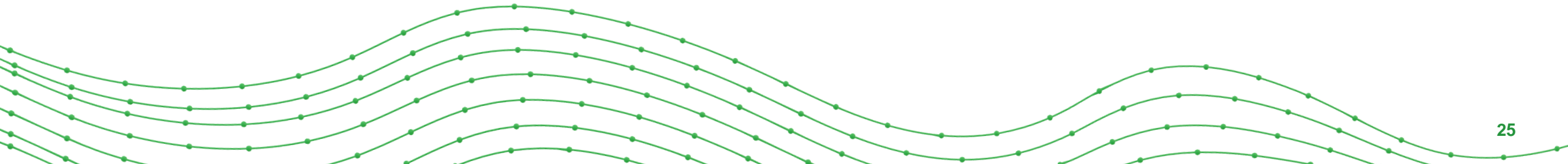
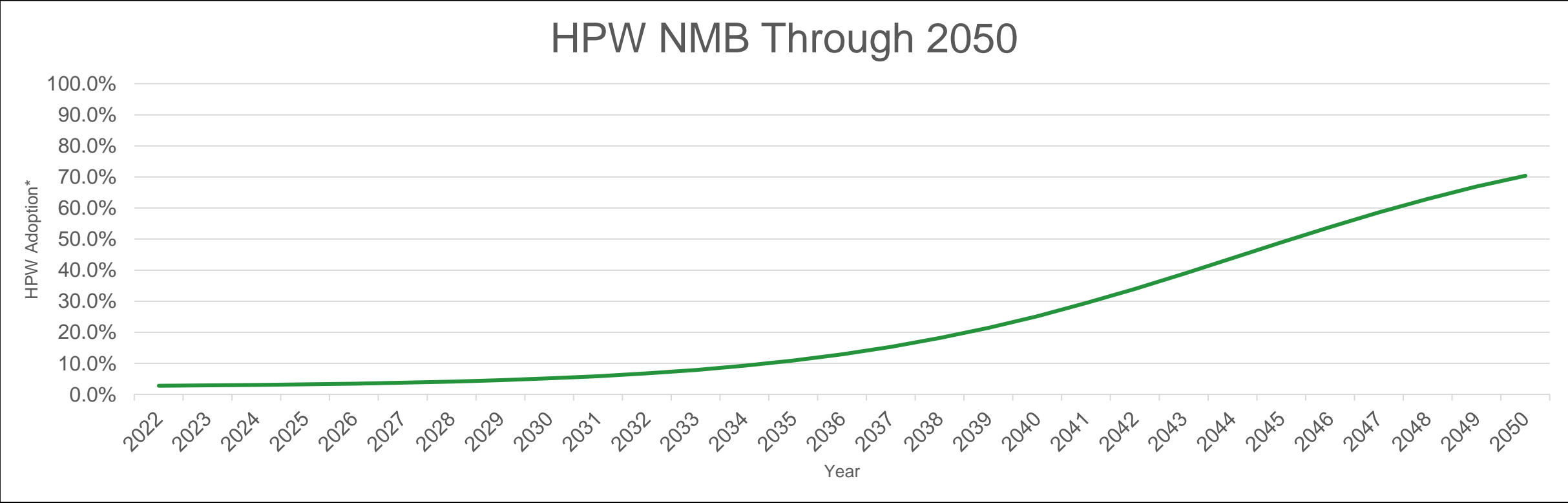
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High Performance Windows: Natural Market Baseline



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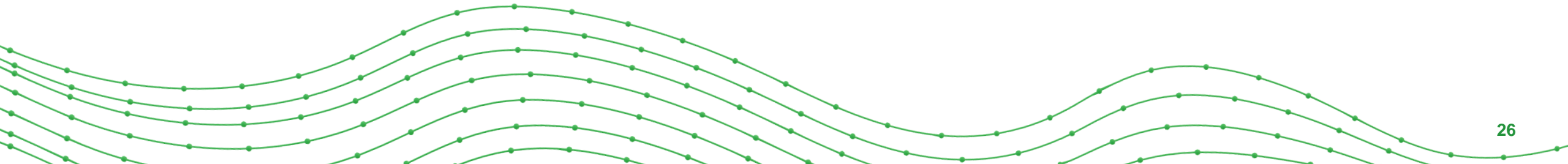
Natural Market Baseline: High Performance Windows



Year	HPW Adoption*
2022	2.80%
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2025	3.24%
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2027	3.75%
2028	4.12%
2029	4.57%
2030	5.15%
2031	5.86%
2032	6.75%
2033	7.86%
2034	9.22%
2035	10.88%
2036	12.89%

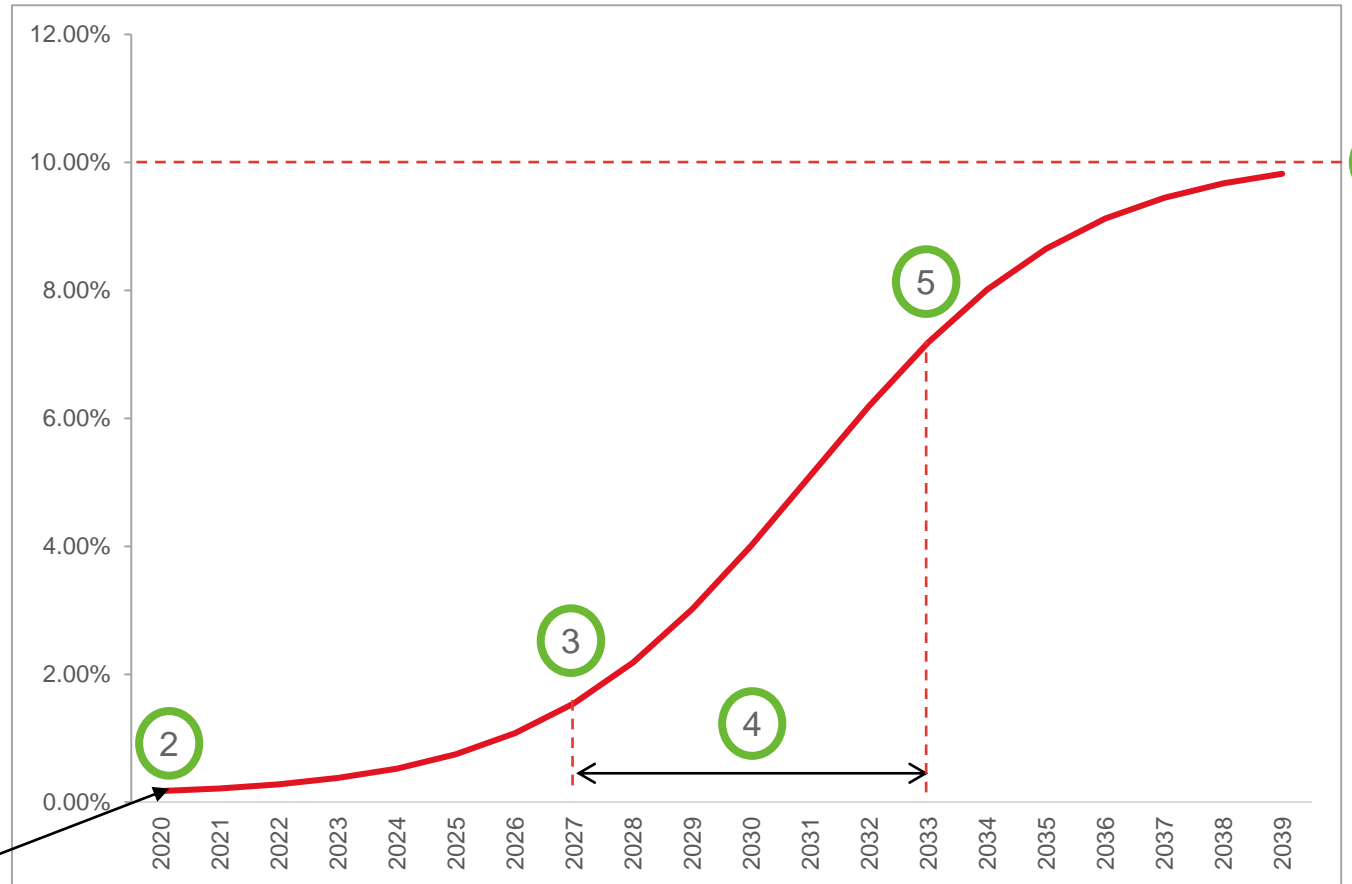
Year	HPW Adoption*
2037	15.29%
2038	18.13%
2039	21.43%
2040	25.19%
2041	29.39%
2042	33.96%
2043	38.83%
2044	43.86%
2045	48.93%
2046	53.88%
2047	58.58%
2048	62.94%
2049	66.88%
2050	70.36%

*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*



①

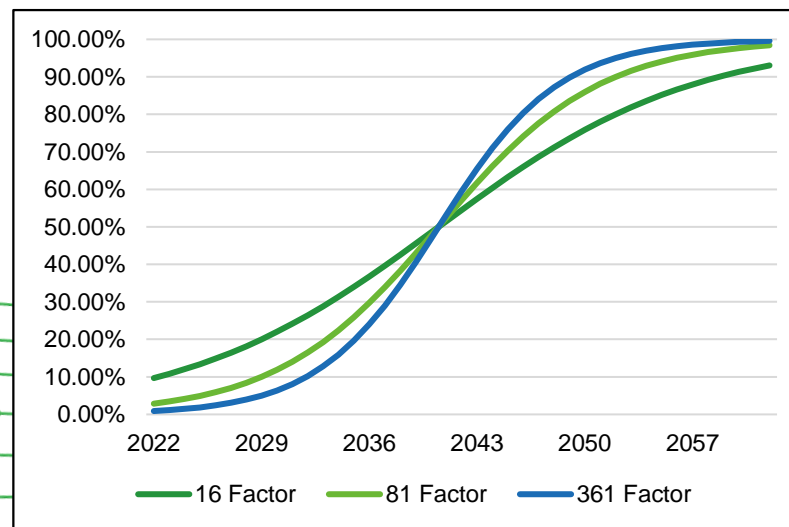
“Factor” Explained

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.

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

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

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 Windows¹⁵⁹⁴

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

Sources



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Market Baseline for Triple Pane Windows



What:

Paper written by Stephen Selkowitz 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.



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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

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ENERGY STAR v7.0 Data Package



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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](https://www.energystar.gov/products/res_windows_doors_skylights/partners)

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




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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



ENERGY STAR. The simple choice for energy efficiency.

ENERGY STAR Windows, Doors, and Skylights


Draft 1 Version 7 Stakeholder Webinar

July 27, 2021

The Webinar will begin shortly.

Call-in Number: +1 (951) 384-3421
Code: 437-751-185

- Please mute your lines
- Do NOT put the conference call on hold
- Please use the "Questions" feature in GoToWebinar to ask questions or make comments
- If you have problems with the presentation please send a note to windows@energystar.gov



Lawrence Berkeley National Lab (LBNL) Webinar



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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 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



Residential Energy Services Network (RESNET) Home Energy Rating System (HERS) Data



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What:

An annual report (link below) showing trends in HERS rated homes from around the United States.

Date:

May 2023

Link:

[2023 Data Trends Report of HERS Rated Homes](#)



Center for Energy and Environment (CEE): HPW Energy Savings and Market Evaluation Plan



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What:

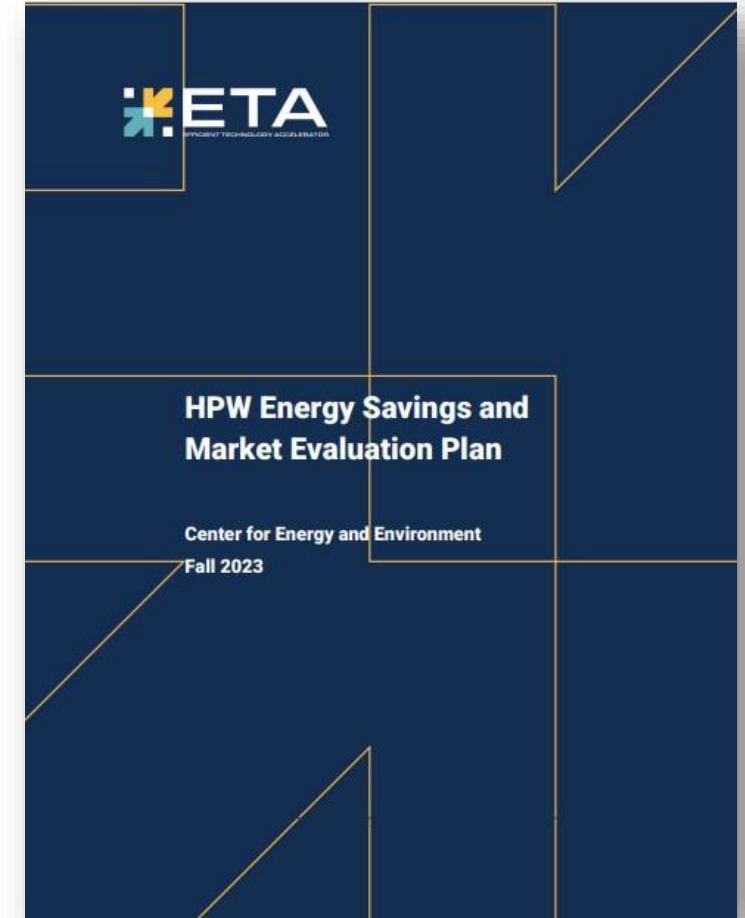
CEE has also chosen HPW as a MT initiative in Minnesota. The Energy Savings and Market Evaluation Plan contains their NMB for the MN market (pg. 19).

Date:

November 2023 (publicly available January 2024)

Link:

[HPW Energy Savings and Market Evaluation Plan](#)



Northwest Energy Efficiency Alliance (NEEA) HPW NMB with Cadmus Review



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What:

Cadmus' review of NEEA's Natural Market Baseline.

Date:

October 2023

Link:

[HPW Baseline Review](#)

