Super-Efficient Dryers: Counter-Factual Baseline Forecast Validation

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NORTHWEST ENERGY EFFICIENCY ALLIANCE

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Presentation Objective

Validate/invalidate NEEA's 20-year (2015-2034) counter-factual naturally-occurring baseline adoption forecast for super-efficient dryers (SEDs)

Project Overview and Background

Project Overview

Project Objective

- Review the inputs and assumptions, and validate/invalidate NEEA's 20-year (2015-2034) counter-factual naturally-occurring baseline adoption forecast for super-efficient dryers (SEDs)

Definitions

- Super-efficient dryers are clothes dryers that incorporate heat pump technology
  - Heat pump-electric resistance hybrid dryers
  - Pure heat pump dryers
- Counter-factual baseline
  - The naturally-occurring market adoption forecast of what would have happened without any involvement or market influence from NEEA, its stakeholders, or its regional or national partners, including SEDI, EPA, and DOE.

Background

NEEA was a co-founder of SEDI

- Partnership launched in 2010
- Promotes the introduction of advanced clothes dryers in the North America
- Is the only entity advocating for more efficient dryer technology in North America

Prior to NEEA's involvement

- No manufacturer sold or planned to sell heat pump dryers in the US
- Federal test procedure did not accurately measure the energy use of clothes dryers
- Manufacturers had no financial incentive to introduce products that are more energy efficient, but risked cannibalizing their existing high-margin dryer product lines

Background (cont'd.)

ENERGY STAR® Emerging Technology Award for dryers

- Did not exist prior to 2012
- Was initiated as a result of NEEA's provision of data to DOE to support revisions to their dryer testing protocol

ENERGY STAR® v1.0 specification for dryers took effect on Jan. 1, 2015

The test procedure is still under discussion: no Energy Guide (yellow) label exists for dryers today

SEDs are substantially more expensive than conventional dryers

A standard S-curve for product adoption applies

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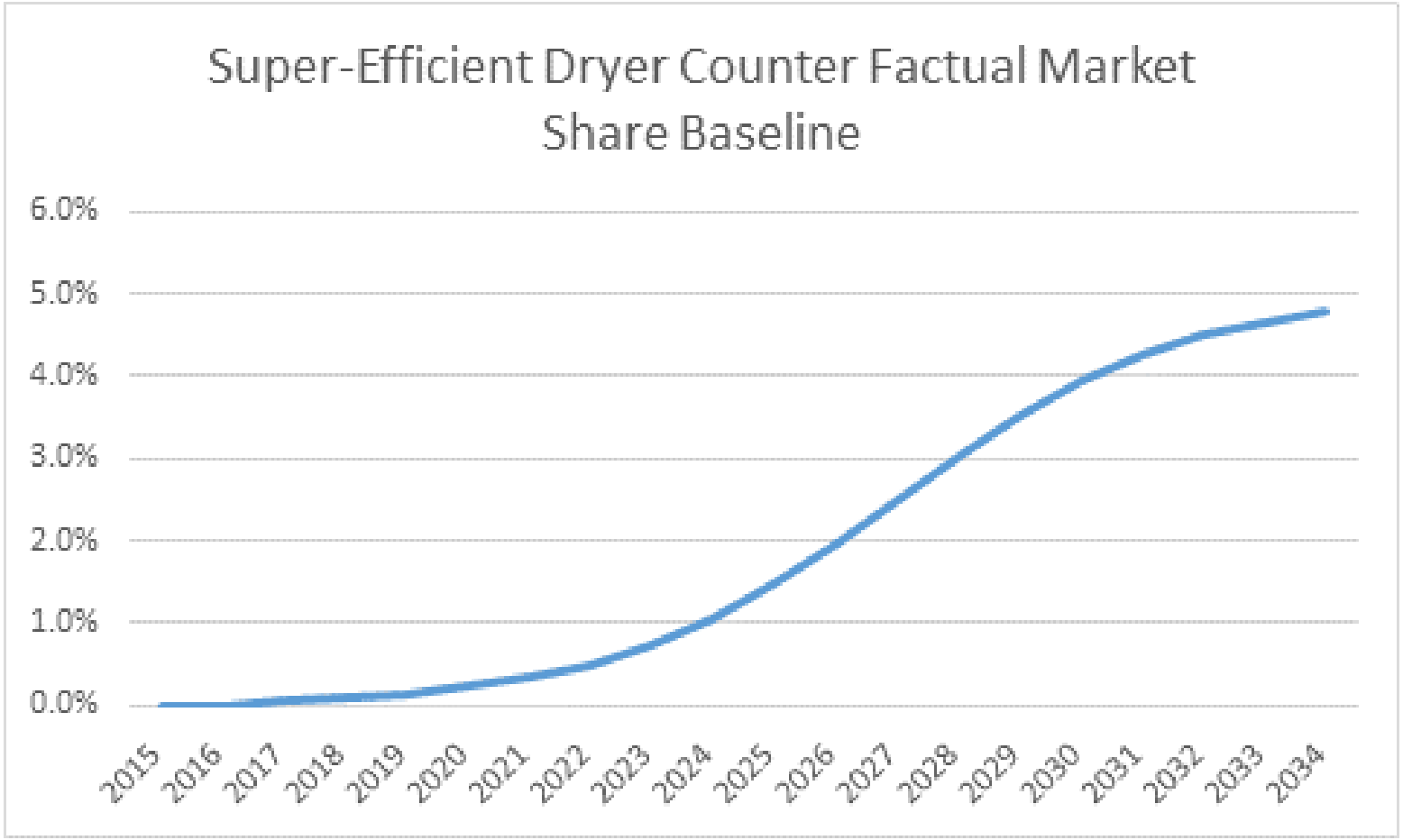
NEEA's SED Baseline Adoption Forecast



NEEA's SED Forecast is Driven by Pricing

Variable	Value	Rationale
Forecast start year	2015	NEEA launched the SED Initiative in 2015
Adoption prior to initiative	0%	Discussions with manufacturers and market observations
Year SEDs enter the market	2017	Prior to NEEA's involvement in 2010: • No SEDs sold or planned for sale in the US • Test procedure did not accurately measure performance • Manufacturers had no financial incentive; in fact, they had a financial disincentive ES v1.0 Tier 1 took effect on Jan. 1, 2015
Near-term adoption rate (3-9 yrs)	<1%	Traqline data--in 2013, <1% of dryers sold in the Northwest cost ≥$1,600
Long-term maximum adoption (10-20 yrs)	4.8% in 2034	Traqline data--in 2013, only 5.8% of dryers sold cost > $1,000

Methodology

Validating the Baseline: Methodology

Conducted a document review

- NEEA-produced and commissioned documents
- Industry literature

Interviewed SED experts*

- 3 NEEA staff
- 1 EPA staff
- 1 LBNL staff
- 2 manufacturers

* Throughout these slides, statements made by interview respondents are identified by respondent number. For example, "(#1)" means the statement was made by respondent #1.

Validating the Baseline: Methodology (cont'd.)

Interview questions covered

- Respondent roles and responsibilities
- Organization's approach to developing baseline market adoption forecasts
- Feedback about the inputs and assumptions NEEA used in its SED baseline forecast
- Identification of
  - Products with similar characteristics
  - Products in markets with similar characteristics
- Recent changes in the SED market

Baseline Forecast

Adoption Curves for New Products Are Challenging

- Manufacturers unlikely to share projections for new products where relationship with NEEA does not yet exist (#2)
- Once the product is nearly commercialized, manufacturers are likely to say they were always planning to offer it (#2)
- There is no prior track record so, "…you can't take the sales data when that product appears and say that's the counter-factual…" (#2)

Year SEDs Enter the Market

Prior to NEEA's involvement in 2010:

- No SEDs sold or were planned for sale in the US
- Test procedure did not accurately measure performance
- Financial disincentive to manufacturers

ES v1.0 Tier 1 took effect on Jan. 1, 2015

Validating 2017

- In 2013 & 2014, SEDs were an ES emerging tech: < 5% of available models in the US
- Energy Star "most efficient" dryer category starting in 2017
- "I think it really has been a partnership of efforts that's driving it forward more quickly."(#3)
- "Inevitably we'd see products enter the marketplace if for no other reason than Europe was finding commercial success with them. And many manufacturers <made> both for the European market and the US market. So, 2017 feels like a rational starting point." (#5)

Year SEDs Enter the Market (cont'd.)

Year of market entrance could be later than 2017

- "We haven't found a reason to justify mass manufacturing of that technology <in the US>" (#6)
- "I'm not as optimistic now as I was a year or two ago…I think there might be other opportunities for energy savings in dryers." (#6)
- One manufacturer will likely develop SEDs for the US market to keep up with the competition (#7)
- "It could've been later…in large part because <without the change in testing protocols> those machines…would not get any differentiation in terms of energy efficiency." (#5, #1)
- It's "…a market that had a pretty status quo mentality…I think it could be a lot longer than that." (#2)
- "It will never come to market unless you engage." (#2)
- "There was no product intervention in dryers that we could detect until Energy Star added it as a category…within that year… three new technologies just sprung up." (#2)
- Utility rebates are a driver (which may not exist w/o Energy Star, etc.): consumers who are informed about SEDs ask about rebates (#3)

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Year SEDs Enter the Market (cont'd.)

And on the other hand…

- A limited number of utilities set criteria and offered rebates prior to 2015 (#3)

Near-Term Adoption Rate (3-9 years)

Value <1% Rationale

In 2013, <1% of dryers sold in the US cost ≥$1,600

Validating <1%

- "Certainly seems rational to me...there is no benefit for a manufacturer to bring a product that costs more to manufacture." (#5)
- "There's a case to be made that the naturally-occurring baseline for these products is nothing…it would never come to the US." (#1)
- "Is the implication here that now there has been some penetration of this kind of equipment (chuckle)?...My assumption would be that the…penetration of this type of equipment in the US is tiny." (#4)
- Manufacturers are unlikely to discount SEDs because they do not see a wide market and they don't "…know how to make a product in the $600 range." (#2)
- Manufacturers are "…fighting to gain any retail position, and the volume is so low that no retailer wants to offer it." (#2)
- "I think it really has been a partnership of efforts that's driving it forward more quickly." (#3)

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Near-Term Adoption Rate (cont'd.)

And on the other hand

- In 2016, about 5% of currently available models are SEDs (and 15% of currently available models are Energy Star.) (#3)

Long-Term Maximum Adoption Rate (10-20 years)

Value	4.8% in 2034	Rationale	In 2013, only 5.8% of dryers sold cost > $1,000

Validating 4.8% in 2034

- Without interventions it would take, “a longer time, significantly longer” to reach market adoption of 5%. (#3)
- “…even without <NEEA’s> efforts, there would be policy pushes <after the 3-9 year short-term forecast window> I can’t foresee.” (#5)
- There are big macros forces such as, “carbon savings, climate change…environmental ethos that’s moving through the nation.” (#5)
- “There just isn’t a lot of interest <among> the manufacturers…It might happen faster but not on its own.” (#2)

Long-Term Maximum Adoption Rate (cont'd.)

Adoption rate in 2034 could be less than 4.8%

- "…once it's in the market, it's gonna' go nowhere unless it's promoted…unless the trusted brand of the utilities comes to bear...and encourages people to make the purchase." (#2)
- "Unless you tap into an NEB…that can attract the market to it, it's up to utilities to make it so attractive to people to adopt it." (#2)
- "Outside of big macro forces, there is no reason this product would ever make it to the US market…it would be 0% forever." (#5)
- Testing has not validated manufacturers' claims that SEDs are gentler on clothes (non-energy benefit) (#5)

Adoption Curve Driven by SED Price

Validating price as key driver

- Price is “one of the real key barriers…” (#1)
- “The general approach seems sound to me.” (#4)
- <You would use> “…some sort of cost-benefit ratio as a driver of that adoption…but…in my experience…there just hasn’t been enough data and analysis to really predict how adoption of high-efficiency is gonna’ go.” (#4)
- “..the critical, key, characteristic is it’s expensive…” (#4)

Pricing data used to develop the forecast is from the end of 2013

- The price for the first SED introduced in the US has not changed. (#1)
- Newer SEDs on the market, which are priced a little lower, have somewhat stripped-down features. (#1)

Expectations about the timing and extent of expected SED price decreases

- Baseline counter-factual forecast assumes a large incremental cost over the first 10 years, with price dropping to about $1,000 after that (#1)

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Other Product or Market Characteristics that May Affect Adoption

Unfamiliar technology to consumers:

- No EnergyGuide label
- Lack of consumer education—people not knowing what the technology is, not knowing they should want it (#3)
- "We're…trying to force feed some deeper thinking…about dryer energy use." (#1)
- Technology new to the market / technology discontinuity (#2, #4)

Lack of market push:

- The supply chain is satisfied with the status quo. (#1, #2)
- Importance to manufacturers of pairing low-margin washers with high-margin dryers; momentum of continuing "business as usual" (#1, #5)
- A lot of European manufacturers have products that would qualify but have not introduced them in the US (#5)
- Retailers reluctant to devote much/any floor space since sales are so low. (#1, #2)

Lack of market pull:

- "…a clothes dryer…is about as perfect a product as you get. It's cheap, it works, and it does the job. Period." (#5)
- "People just want their dryer to work. They don't care that much about it." (#1)

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Other Product or Market Characteristics that May Affect Adoption (cont'd.)

Competition

- Are there any good substitutes for the product—is it competing with other new entrants (#1)

Importance of Non-Energy Benefits

- Ventless

Unique Characteristics

- Pairing with clothes washers
  - Manufacturer perspective: dryers as a high-margin companion product to low-margin washers
  - Consumer perspective: purchase decisions focus on washer features
- Less convenient than conventional option—longer drying time (≥ 15 minutes longer)

Other Considerations

Market Segmentation

- Multi-family market (#3)
  - Often desire smaller appliances
  - Ventless feature enables dryer use in broader range of spaces
- Builders of high-end and/or “green” new homes

Borrowing adoption curves from products or markets with similar characteristics

- Requires a lot of data: even with 3-4 years of historic data, NEEA’s ductless HP forecast had a very large error band

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Products with Similar Characteristics or in Similar Markets

Characteristic	Technology						
	Innovative Refrigerants	HP Water Heaters	CFLs	H-axis Washers (historically)	Pre- 1993 Refrigerators	Ductless HPs*	Combination Washer-Dryers*
Used in other countries; needs US investment	1	1		1			
Needs consumer education	1						
Needs manufacturer education	1						
Major technology change/ disruptor	1	2			1		
Conventional technology is cheap, works well, meets needs		2	1				
Large energy savings		2		1	1		
Large price difference		3					
Per-household energy savings are small (& aggregated savings are large)		1		1			
Influence of EPRI or other broad reaching orgs*							

* Added based on facilitated discussion feedback

Conclusions

Validation of Forecast Inputs

Variable	Value in Forecast	Valid?	Comments/Suggestions for Further Research
Adoption prior to initiative	0%	√	
Year SEDs enter market	2017	√	• Validated with an error band of +/- 1 year*
Near-term adoption period	3-9 years	√	
Near-term adoption rate (3-9 yrs)	<1%	√	
Long-term adoption period	10-20 years	√	• While validated, the counter-factual adoption period could be extended to 2044 (rather than 2034)
Long-term maximum adoption rate (10-20 yrs)	4.8% in 2034	√	• Validated with this refined definition: 4.8% of all electric dryers sold in the Pacific NW in any price bracket, based on current pricing levels† • While validated, 4.8% could be on the high side†

* ASKO introduced a $3,400 heat pump dryer to the US market in 2016 and has not sought ENERGY STAR or other energy-efficiency certification.

† NEEA's research showed that 5.8% of dryers sold in the US cost more than $1,000. NEEA's baseline counter-factual adoption forecast assumed that most consumers purchasing dryers costing more than $1,000 (that is, 4.8% of 5.8%, or 83%) would purchase SEDs in 2034. The discussion group concluded:

- It likely that fewer than 83% of those purchasing expensive dryers will purchase SEDs, and
- It is likely that some of the 4.8% SED purchasers will be consumers who otherwise would have bought a dryer costing less than $1,000.

Validation of Forecast Approach

Recommendations for other approaches/equations to explore:

- Scan for other potentially disruptive technologies by reviewing patent applications
- Define SEDs explicitly by performance, not by technology

Recommendations for adoption curves of other products/services to explore:

- Other technologies for which energy-efficiency is the only/primary benefit
  - Condensing gas furnace (has inflection point at 14 years; adoption levels off at 40 years)
  - CFL adoption curve 20 years ago
  - Refrigerators, using historic (1980s) adoption curves
- Adoption curves for SEDs in specific market segments--such as multi-family or commercial sector (e.g., hotels)—though those segments have specific drivers
- Note, however, that adoption forecasts for other products were often developed using historic data for that product. No comparable historic data exists for SEDs since they are new to the US market

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Memorandum

High-Performance Clothes Dryers Naturally Occurring Baseline Review

May 26, 2016

TO: Market Research and Evaluation

FROM: Ryan Brown, NEEA Market Planning Analyst
Christopher Dymond, NEEA Product Manager

SUBJECT: NEEA-Developed Baseline for Super-Efficient (Tier 2) Dryers

NEEA has developed a counter-factual naturally-occurring baseline market share projection for super-efficient dryers (SEDs). This estimate starts in 2015 and forecasts the market share for 20 years to 2034. This memo explains the rationale for the baseline and presents the results to be evaluated by a third party.

Definition of product
The market baseline of interest is for dyers that meet the 2nd Tier of NEEA's dryer specification. These "super-efficient dryers" are roughly 35% more efficient than conventional dryers.

Market Conditions Prior to NEEA's Involvement

- No manufacturer sold or planned to sell dryers with heat pump technology in the USA
- Federal test procedures did not accurately measure the energy use of clothes dryers
- Manufacturers had no financial incentive to introduce products that while more energy efficient, risked cannibalizing their existing high-margin dryer product lines

NEEA's Involvement Prior to Initiative Start
While super-efficient dryers officially entered the NEEA portfolio as an initiative in 2015, NEEA had been active in the efficient dryer space since 2010. This involvement included:

- Co-founding the Super-Efficient Dryers Initiative (SEDI), which was launched in 2010 and brings together various market players to promote the introduction of advanced clothes dryers in the North American Market
- Conducting lab and field tests of washers and dryers.
- Using data to advocate for DOE to revise its test protocol, which allowed for the development of the ENERGY STAR® 2012 Emerging Technology Award for dryers
- Engaging with manufacturers with the goal of bringing products like those available in Europe and Asia to the US
- Establishing a test protocol and multi-tiered specification for dryers

Initial Entrance of Super-Efficient Dryers in the US Market (Baseline years 1 & 2)

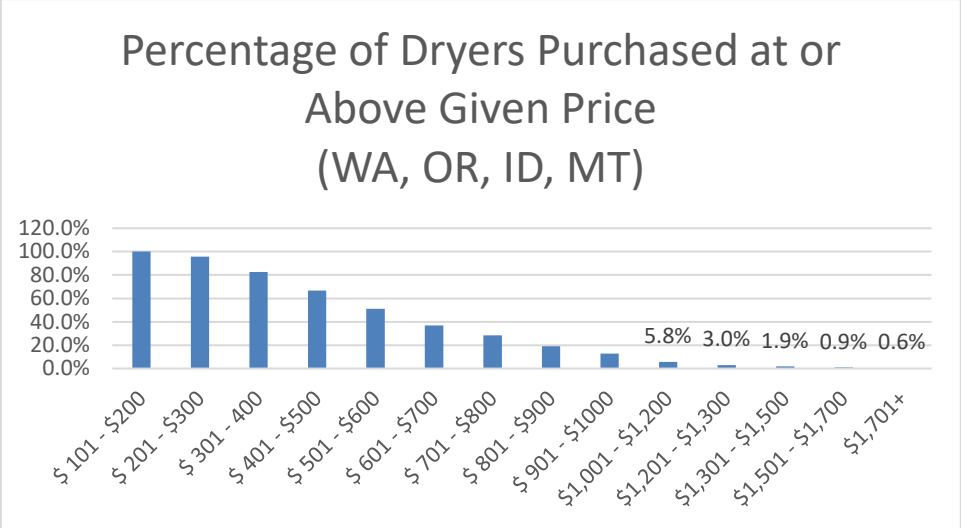
Northwest Energy Efficiency Alliance
421 SW Sixth Avenue, Suite 600, Portland, OR 97204
503.688.5400 | Fax 503.688.5447
neea.org | info@neea.org

This naturally-occurring baseline reflects our estimate of what would have happened ***without any*** of this involvement from NEEA, our stakeholders, or our partners (both regional and national). NEEA believes this involvement advanced adoption of super-efficient clothes dryers in the market and that they would not have been available on the market until some years after 2015. This assumption leads our baseline to be zero until 2017.

Near-term adoption (years 3-9)
There are several barriers to the adoption of super-efficient dryers. One of the most significant is that appliance manufacturers were unlikely to bring super-efficient products to the market place if they cannibalized sales from higher profit margin products. Without the promise of future utility incentives and marketing support NEEA feels it is unlikely that many manufacturers would develop and support super-efficient dryer products.

Additionally, the first few models of super-efficient dryers are entering the market at about $1,600, a price premium of approximately $600 over a conventional dryer with a similar feature set. As shown in figure 1, less than 1% of all dryers sold in 2013 cost this much.

Figure 1:



Source: Traqline Data Q3 2014. Consumer-reported dryer purchases in Q3 2013.

For this reason NEEA is holding the baseline market share below 1% until year 10.

Long-term maximum market share (years 10-20)
Given the barriers described above, NEEA believes the market share for these products would have remained very low. It is likely that eventually some manufacturer would see high efficiency dryers as a competitive advantage and bring product to the US market. That said, a niche product such as this would likely carry a high price premium and capture only a small amount of the market.

Even if SEDs captured 100% of all sales with a price greater than $1001, it would only represent 5.8% as shown above. Therefore NEEA assumes super-efficient dryers would have achieved a maximum market share of roughly 5% in this counter-factual baseline.

Results
The growth in the naturally-occurring baseline follows a standard product adoption “S-curve” that is fit to the parameters described above:

YEAR	Super-Efficient Dryer Market Share
2015	0.0%
2016	0.0%
2017	0.1%
2018	0.1%
2019	0.1%
2020	0.2%
2021	0.3%
2022	0.5%
2023	0.7%
2024	1.1%
2025	1.5%
2026	2.0%
2027	2.5%
2028	3.0%
2029	3.5%
2030	3.9%
2031	4.3%
2032	4.5%
2033	4.7%
2034	4.8%