BONNEVILLE POWER ADMINISTRATION

Impact Evaluation of Ductless Heat Pumps and Prescriptive Duct Sealing

September 2018

NAVIGANT

THANK Y♥U!

BIG THANKS to the **UTILITIES & SMEs** who **PROVIDED UTILITY DATA** (we know it's hard work to gather) & **REVIEW** (on the programs, methodology, and initial findings, you've done a lot of work to get us here)

Agenda

Overarching Drivers and Context

Ductless Heat Pumps (DHP) replacing Electric Forced Air Furnaces (eFAF) or Electric Zonal Heating

Prescriptive Duct Sealing

Evaluation Next Steps

Why Evaluation?

What do we all want?

Energy efficiency programs that save customers money and energy.

To be trustworthy stewards of their money.

Evaluation

What did we achieve?

&

How do we improve?

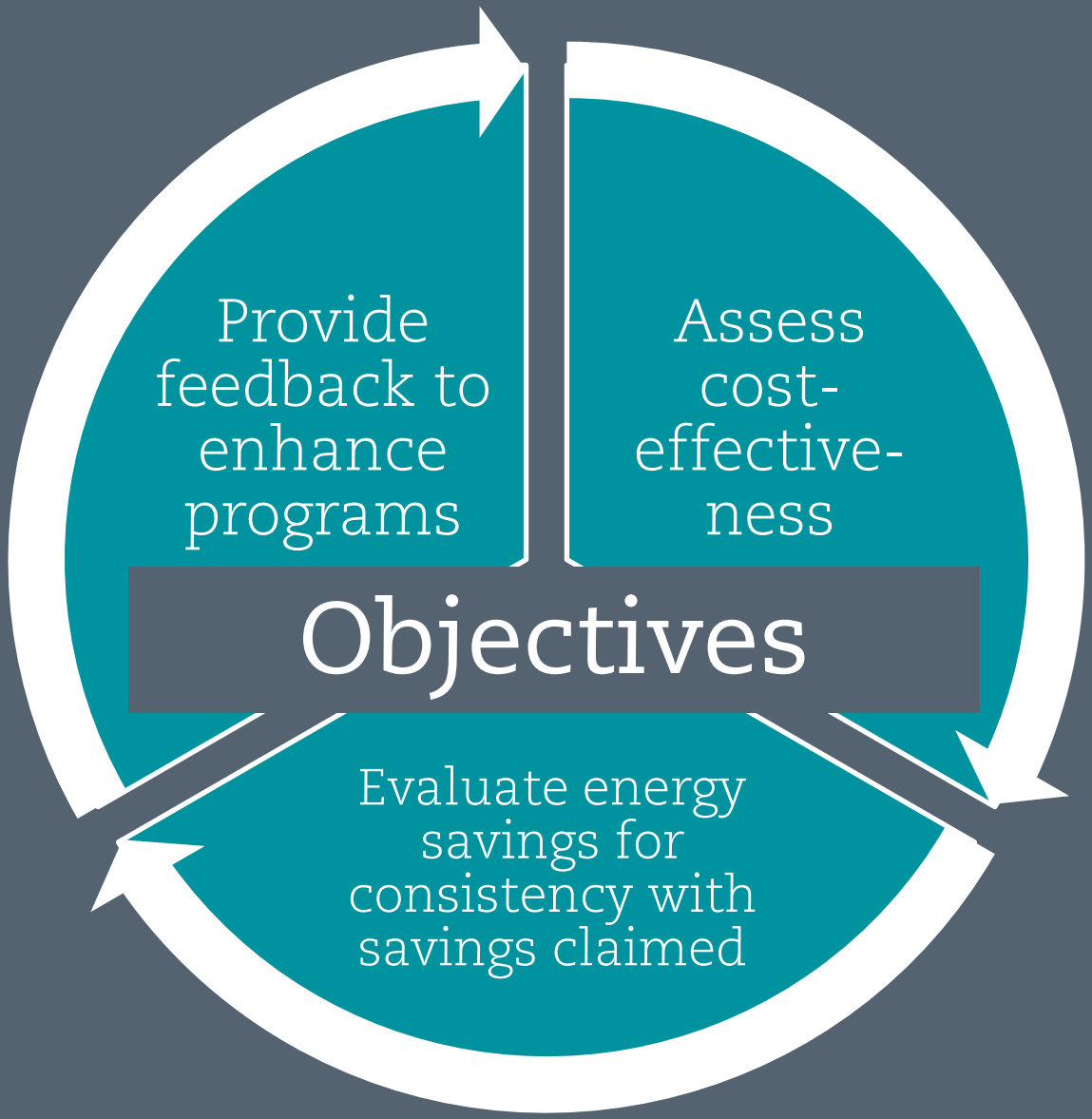
Impact Evaluation

Savings reliability with independent verification

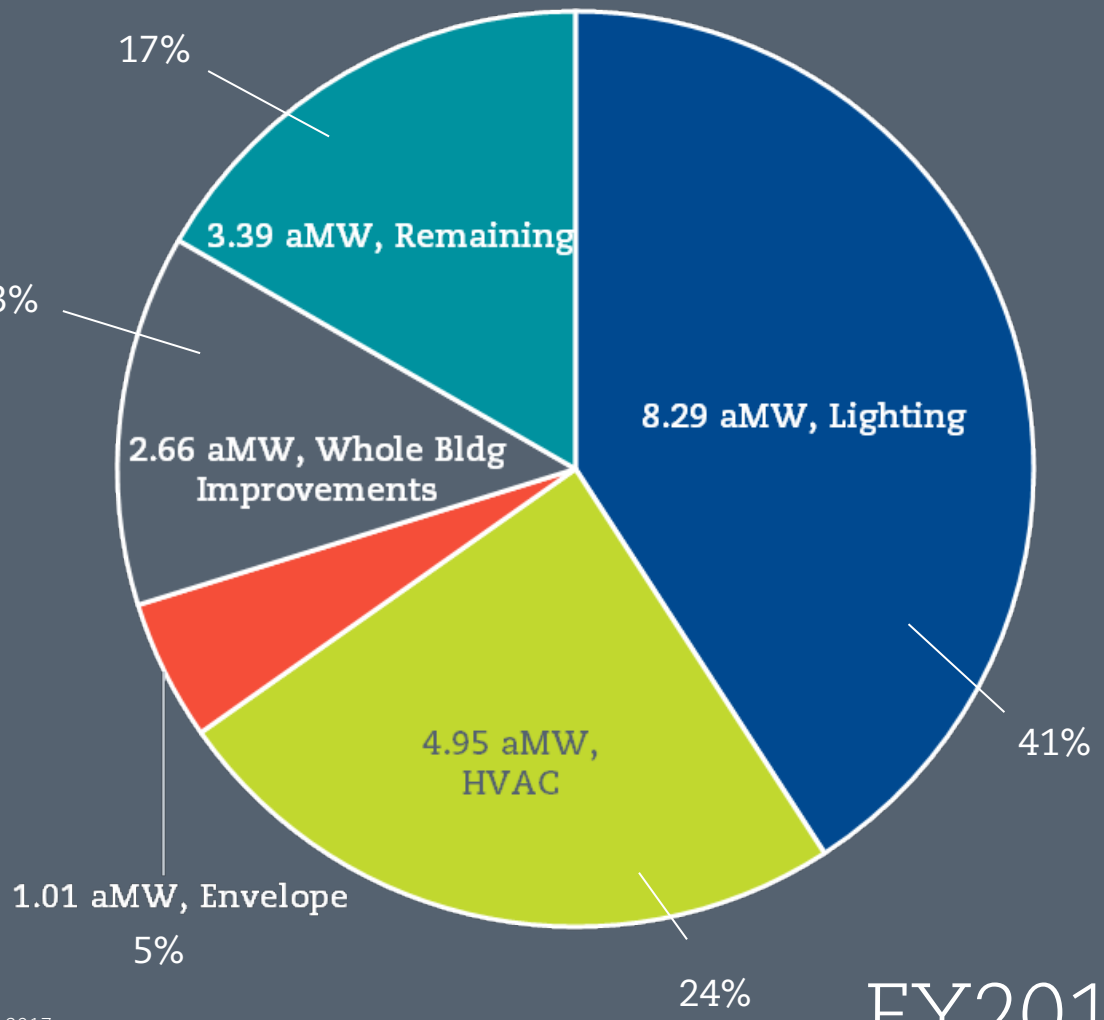
+

Program improvement opportunities

Residential Impact Evaluation Background


Provide feedback to enhance programs
Assess cost-effective-ness
Objectives
Evaluate energy savings for consistency with savings claimed

HVAC makes up a consistent 24% of the UES contribution



20.30 aMW, Residential

FY2016

Source: Summarized from BPA's IS2.0 database, accessed Dec 2017

How Did We Get Here?

Measure Selection

Navigant and BPA systematically identify measures to include in a new billing analysis in 2016 evaluation plan.

Impact Evaluation (Phase I)

Request billing data & perform billing analysis for residential windows and insulation measures (FY14/15 data). Analyze Heat Pump conversions and performance DS using PTCS dataset (FY09-11 data).

Early 2015

Late 2015

2016

2017-2018

Methods Development

Navigant and BPA develop an approach through collaboration with stakeholders and pilot approach using 2013 PTCS dataset.

Impact Eval (Phase II)

Perform billing analysis on Prescriptive Duct Sealing, Ductless Heat Pump eFAF & DHP Zonal measures using FY14/15 data, opt-in data, installation forms and participant surveys.

Evaluation Activities by Measure Group

Impact Evaluation Study	Measure Group		Billing Analysis			
			Base Models & Exploratory Models	Install Forms	Survey	Utility Specific Results
Phase I (Winter 2017/2018)	PTCS	Performance DS	✓	-	-	-
		HP Conversions	✓	-	-	-
	Wx	Insulation	✓	-	-	✓
		Windows	✓	-	-	✓
Phase II (September 2018)	Res. HVAC	Prescriptive DS	✓	-	-	✓
		DHP Zonal	✓	✓	-	✓
		DHP eFAF	✓	✓	✓	✓

Where do we go from here?

If there are any updates as a result of the RTF process made before January 2019, **then updates may come into effect in October 2019**.

If there are updates after January 2019, **then nothing will change to existing measures until October 2021**.

Where do we go from here?

Programs

- Program managers review findings and strategize on possible changes

UES

- RTF reviews findings and combines with regional research and updates UES as needed
- BPA adopts most recent UES before each program year

Research Support

- Identify areas for additional research to support programs
- Identify promising new or adjusted measures

Replacing eFAF and Zonal with DHP

DHP survey & site information

Sampled Utilities
Central Electric
Clallam
Clark
Columbia River
Inland
Mason
Peninsula
Port Angeles
Seattle
Snohomish
Tacoma
Central Lincoln
Cowlitz
Eugene
Flathead
Grays Harbor
Lewis
Lincoln
Midstate
Northern Wasco
Tillamook

Count of Sites Included in Final Results			
Home Type	Heat Zone	DHP eFAF	DHP zonal
Single Family	1	266	1708
	2	38	17
	3	8	1
Manufactured Homes	1	240	2
	2	37	1
	3	14	0

Major Findings: DHP survey (replacing eFAF)

Customers use DHPs such that savings may be lower than current UES

This is the case if customers:

- Continue to use eFAF
- Displace non-electric heating
- Increase AC use
- Switch from programmable to manual thermostats

Life changes and major renovations do not often coincide with DHP installations (about 8% of respondents for each)

Major Findings: DHP installation forms (replacing eFAF and Zonal)

More than half of units were installed in homes smaller than 1,500 sq. ft.

1

Most installations were single-head units

2

3+

but there were many units with two or more heads

Major Findings: DHP billing analysis (replacing eFAF and Zonal)

Ductless Heat Pumps replacing eFAF

- Savings are 50% of current UES
- Findings appear to be driven by:
  - Use of eFAF after DHP installation
  - Displacement of non-electric heat

Ductless Heat Pumps replacing Zonal

- Savings are 84% of current UES
- There is no clear driver of findings

Main Findings: DHP replacing eFAF

Evaluation Activities by Measure Group

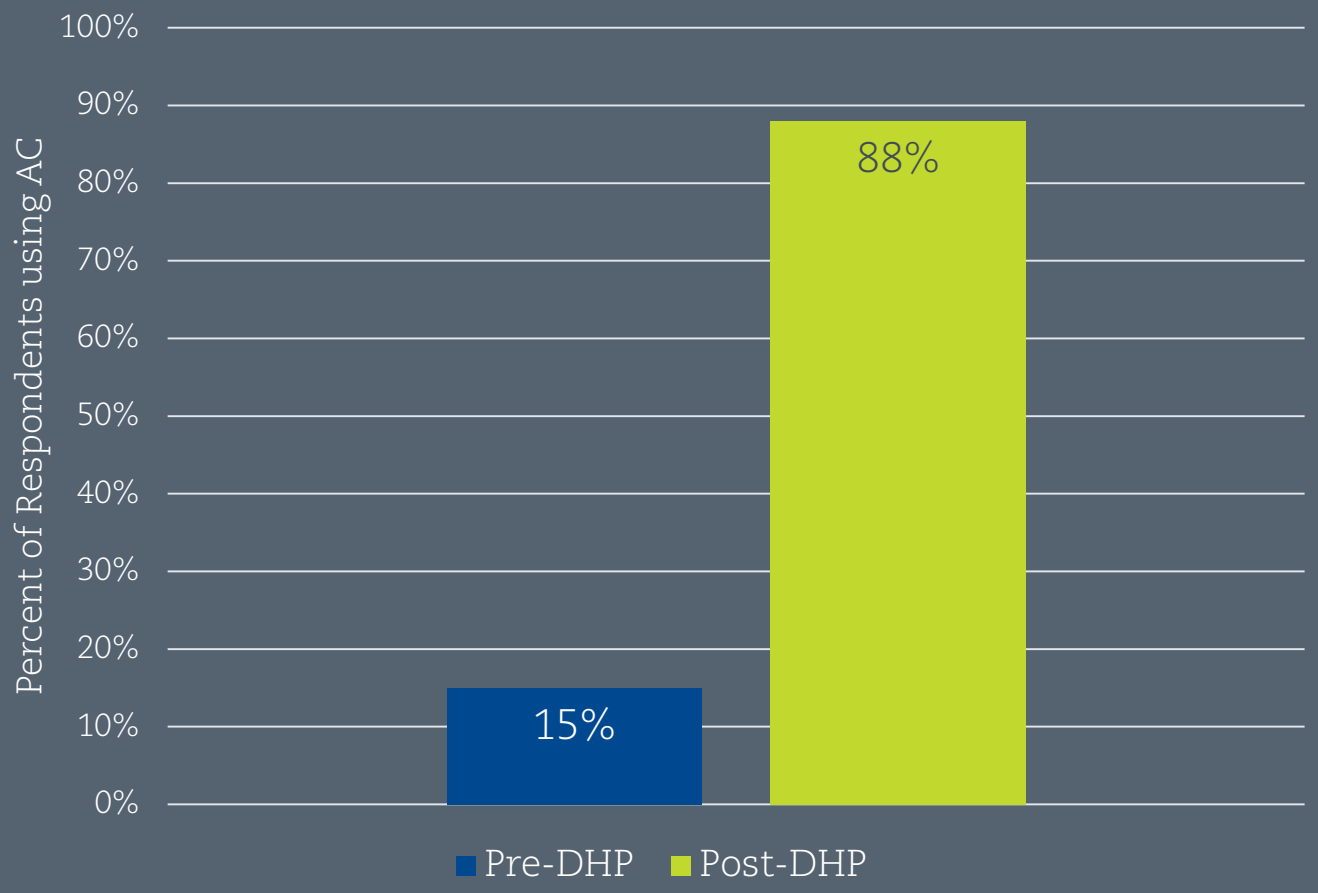
	Billing Analysis Activities			
Measure Group	Base Models	Exploratory Models	Install Forms	Survey
DHP eFAF	✓	✓	✓	✓
DHP zonal	✓	✓	✓	

Data: FY14/15 data, opt-in data, installation forms and participant surveys

eFAF to DHP: Survey results on AC Use

Installing a DHP led to an increase in AC use

Note that 85% of sites did not have AC before installing the DHP

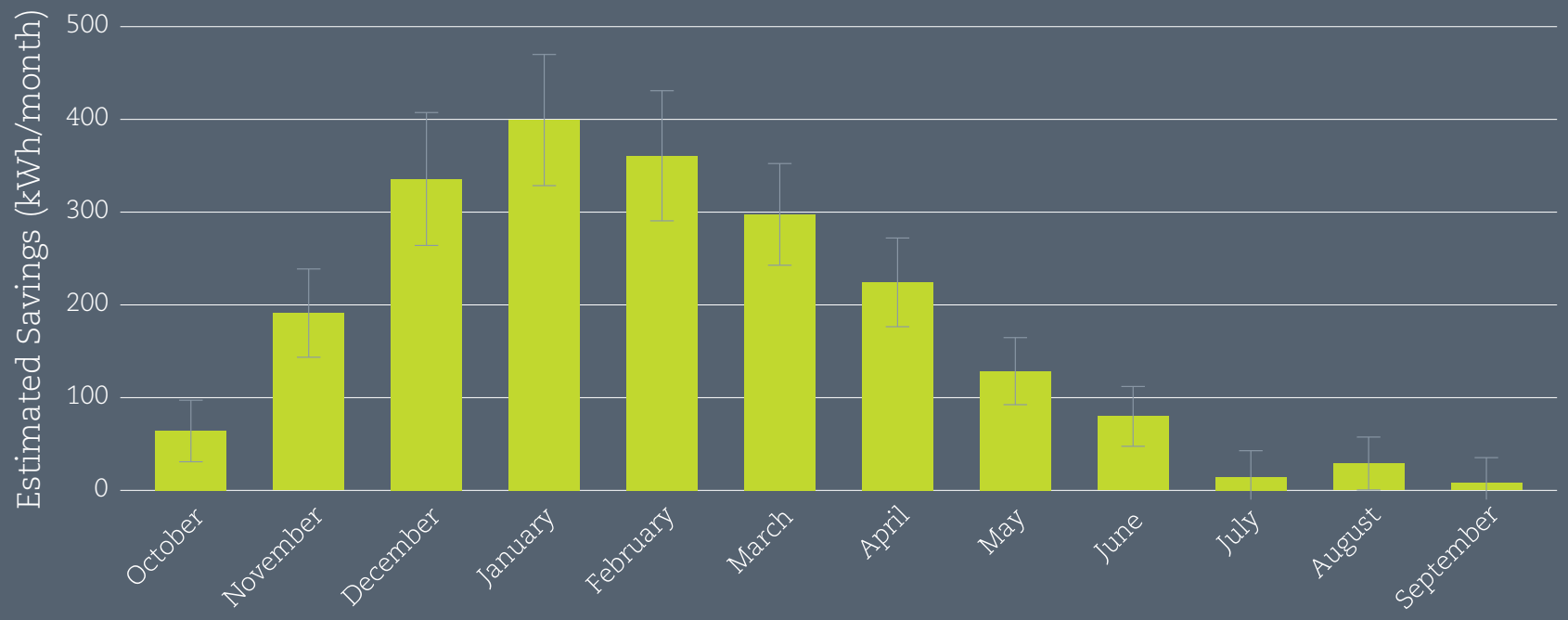


eFAF to DHP: Savings related to AC

Contrary to the survey results, billing analysis suggests no cooling load increases on average

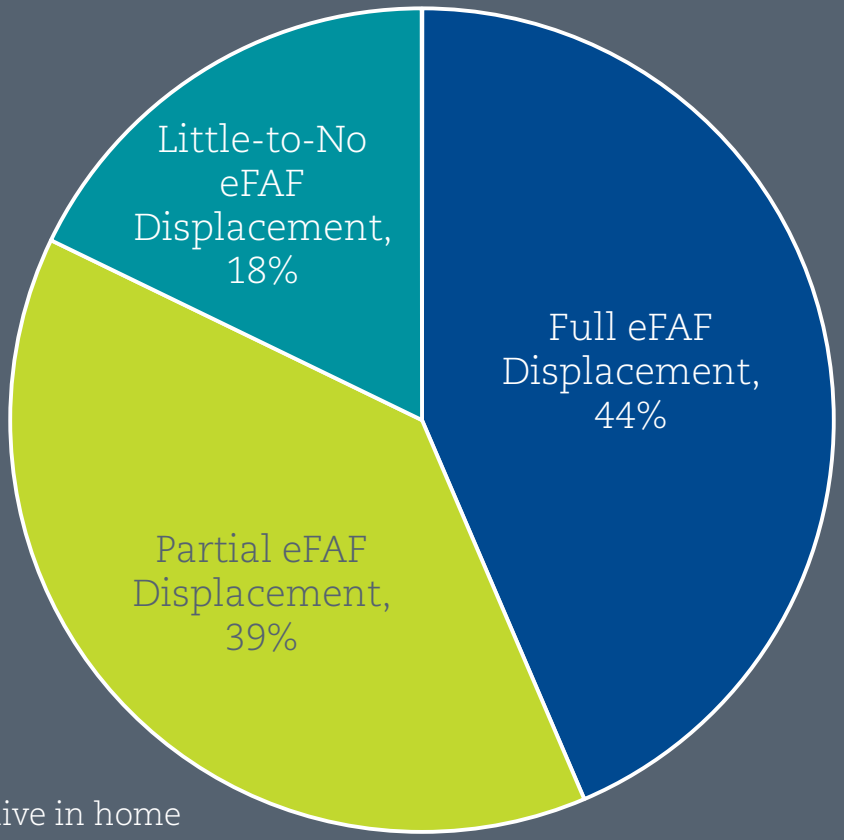
Savings are highest in the winter months and savings in summer are not statically different than 0kWh

Increased AC use is not a clear driver of lower savings and whether cooling impacts are negative or positive, they appear to be small relative to heating



eFAF to DHP: Survey results

Full eFAF displacement is defined as customers who previously used an electric furnace as their primary heating source and completely stopped using the furnace after the DHP was installed



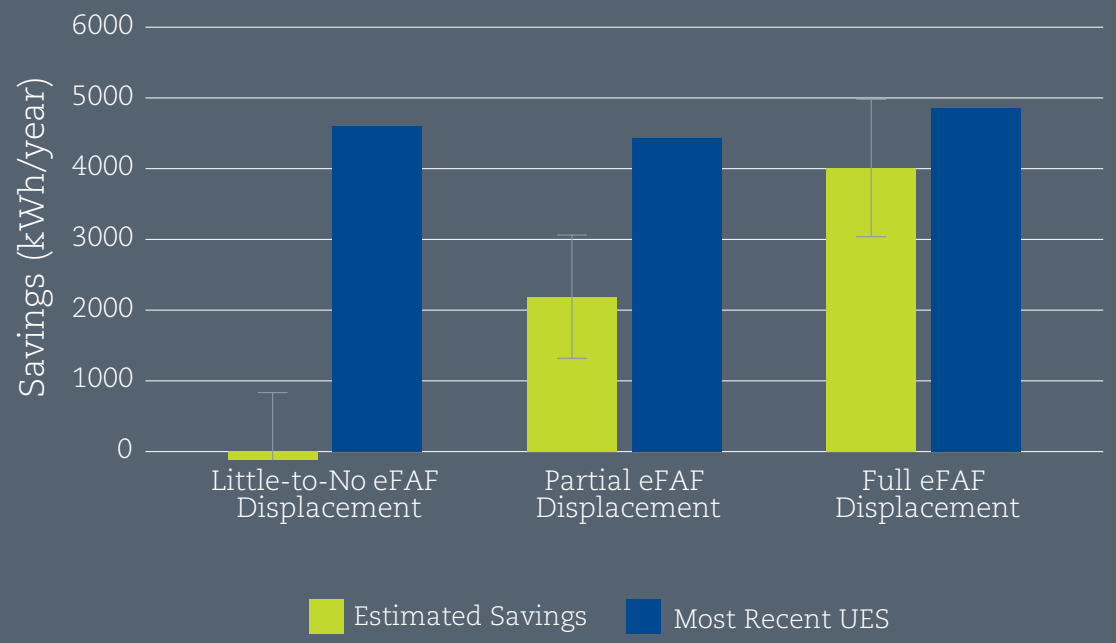
% of all respondents who still live in home

eFAF to DHP: Savings related to displacement

Savings vary by survey savings groups

Savings are highest when eFAF is fully displaced

Displacement of non-electric heat may play a large role in driving savings down, use of eFAF after DHP installation may play a large role in driving savings down

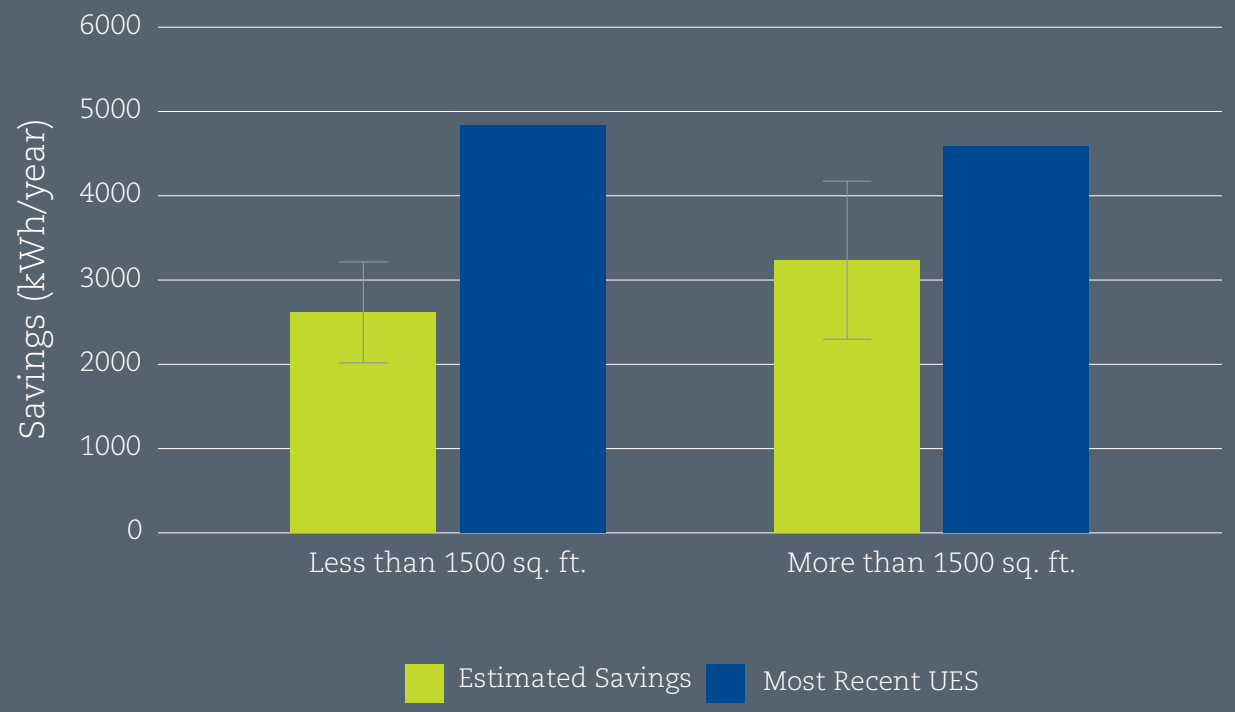


eFAF to DHP: Savings related to size of home

Savings may vary by home size

Savings in homes larger than 1500 sq ft are slightly higher than smaller homes

Home size may not be driving savings

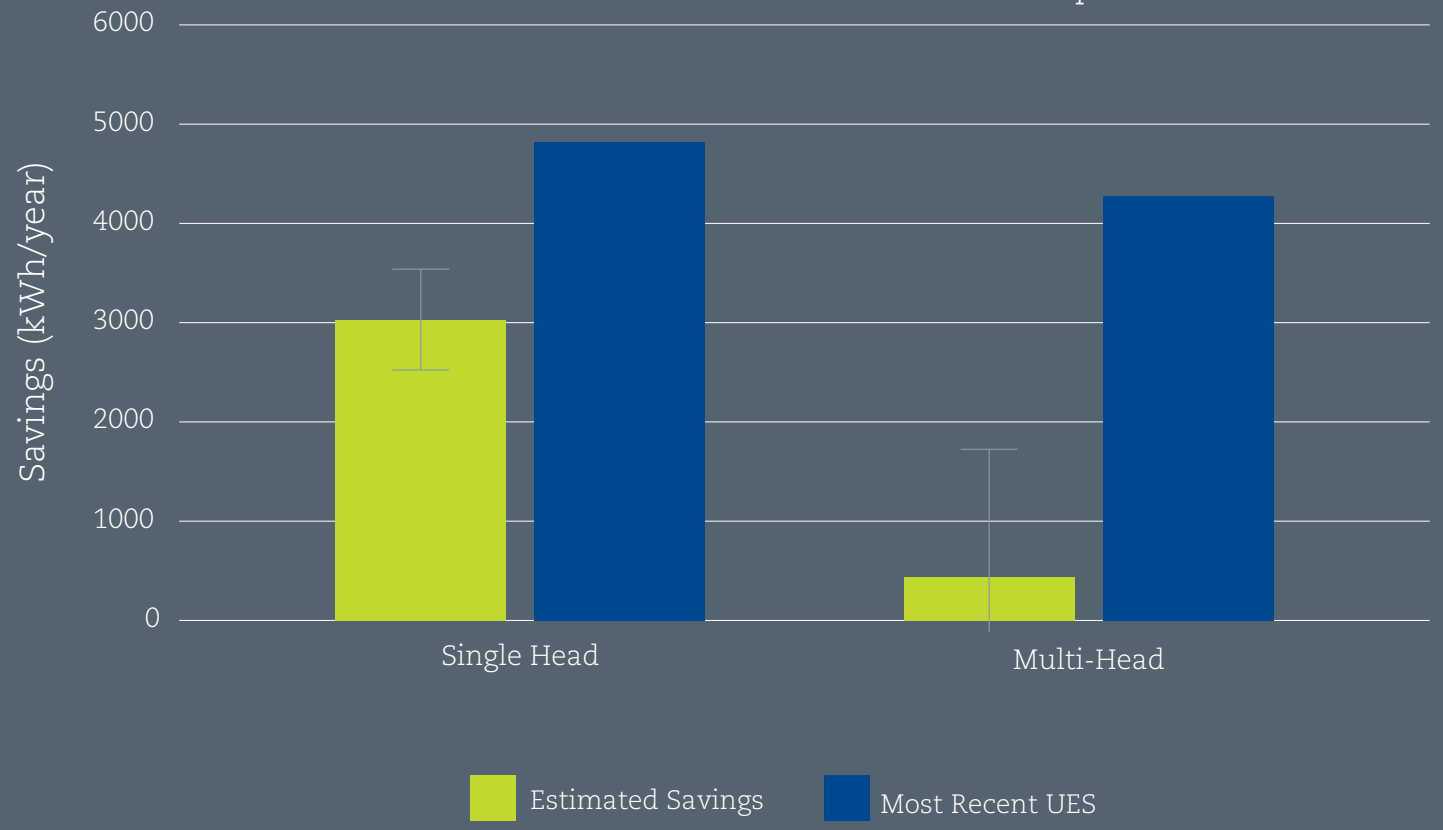


eFAF to DHP: Savings related to number of heads

It's unclear if savings vary by the number of heads

In agreement with UES, savings from single head units are higher than from multi-head units

It does not appear that multi-head systems save more than single head, however this may be a result of a small multi-head sample size



Main Findings: DHP replacing Zonal

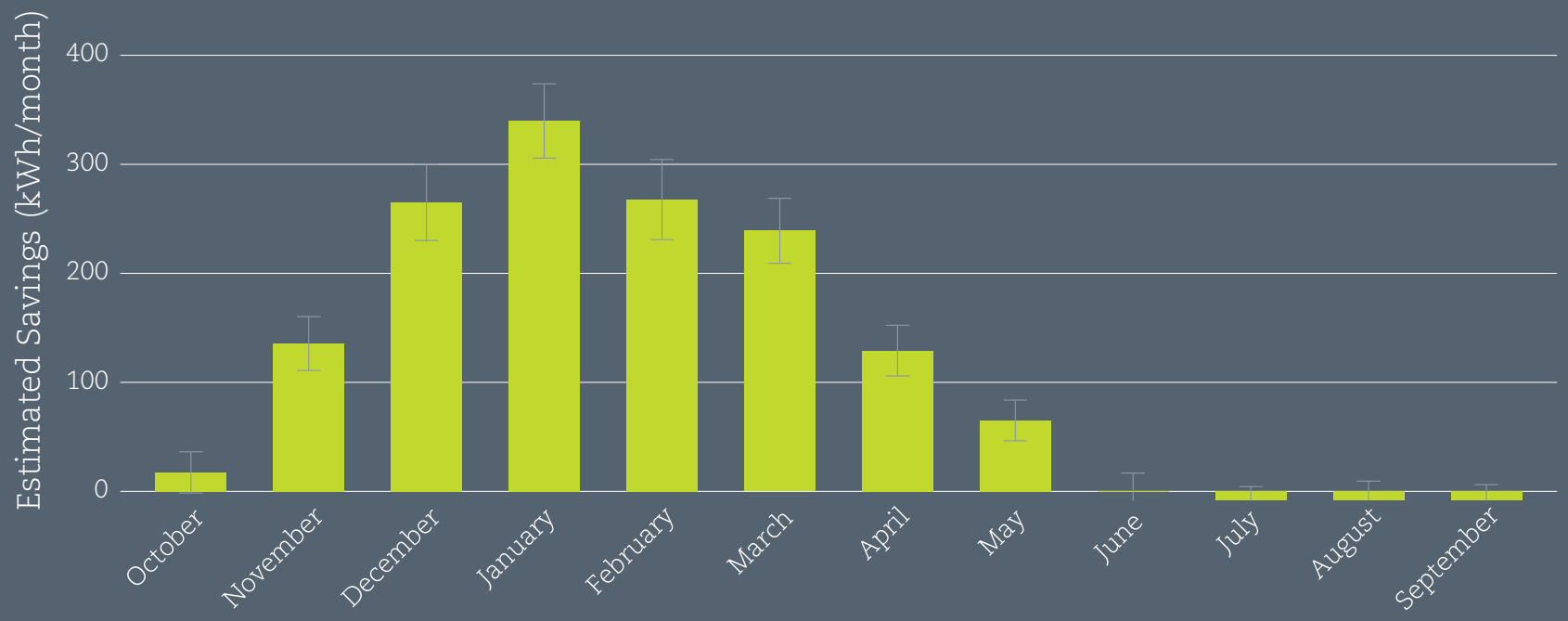
Evaluation Activities by Measure Group

	Billing Analysis Activities			
Measure Group	Base Models	Exploratory Models	Install Forms	Survey
DHP eFAF	✓	✓	✓	✓
DHP zonal	✓	✓	✓	

Data: FY14/15 data, opt-in data, installation forms, and participant surveys

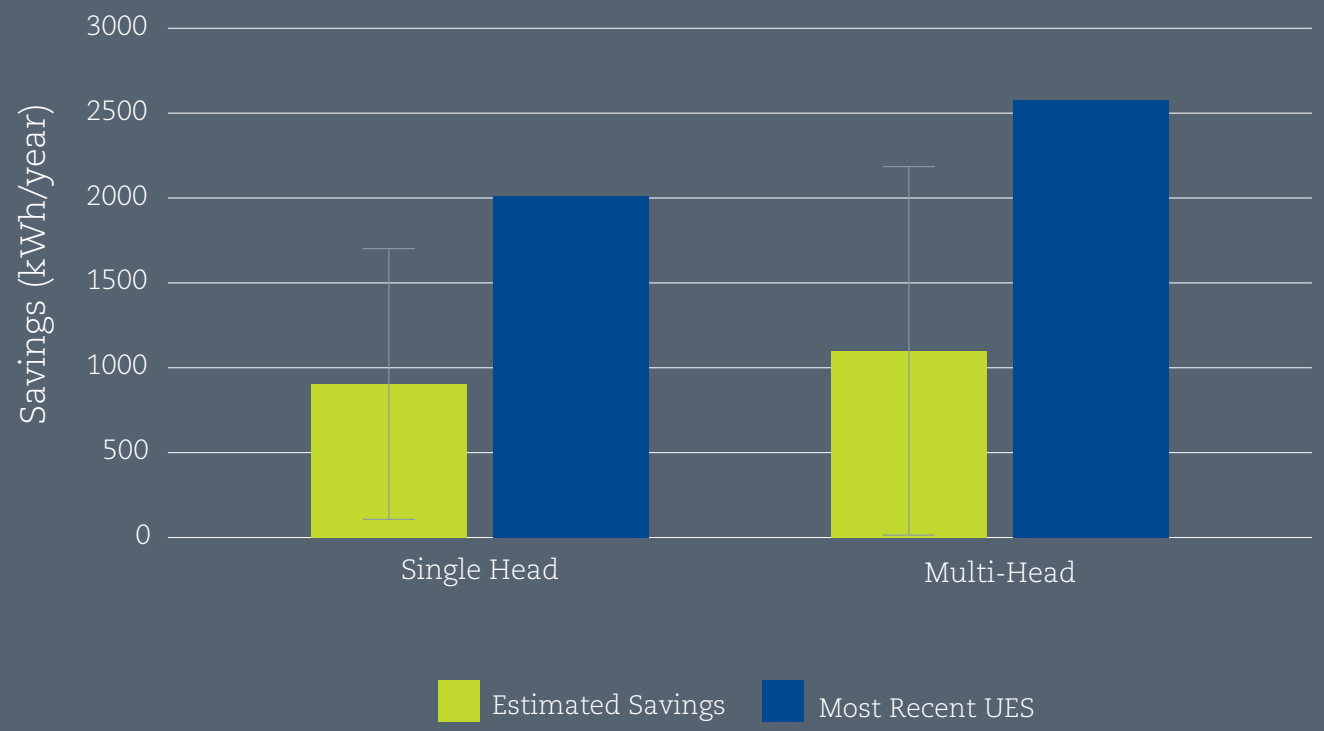
DHP Zonal:
Billing analysis results related to AC

Cooling impacts and total cooling load are low



DHP Zonal: Savings related to Number of Heads

Savings may vary by number of heads



DHP Next Steps

DHP Next Steps

BPA will be working with the RTF to provide these results for use in measure updates.

BPA will consider these evaluation results in our future residential HVAC program strategy and measure offerings.

BPA will engage utility customers on the results and future strategy.

Main Findings: Prescriptive Duct Sealing

Evaluation Activities by Measure Group

Billing Analysis Activities		
Measure Group	Base Models	Exploratory Models
Prescriptive Duct Sealing	✓	✓

Data: FY14/15 Billing Data, Opt-In Data (FY14/15/16)

Prescriptive Duct Sealing survey & site information

Sampled Utilities
Clark
Columbia River
Inland
Tacoma
Blachly-Lane
Central Electric
Central Lincoln
Clallam
Eugene
Flathead
Glacier
Grays Harbor
Klickitat
Tillamook
Snohomish

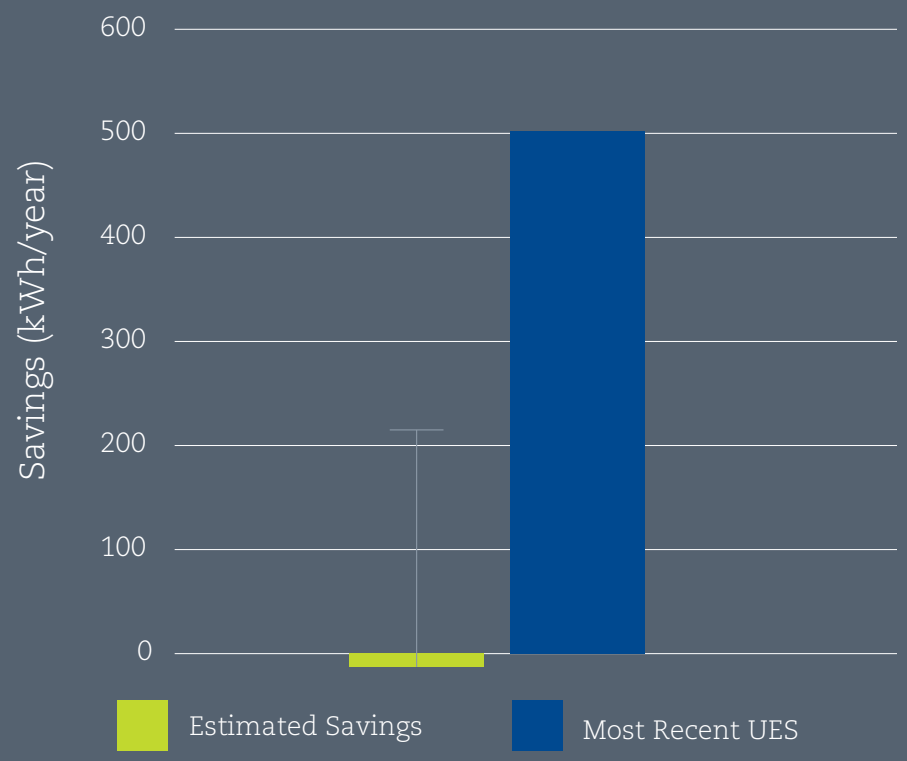
Count of Sites Included in Final Results		
Home Type	Heat Zone	Prescriptive Duct Sealing
Single Family	1	20
	2	5
	3	0
Manufactured Homes	1	453
	2	4
	3	3

Main Findings: Prescriptive Duct Sealing

Results are variable and unclear

The available information does indicate that additional research is warranted

Navigant suggests site visits for future impact research, which could include pre/post sub-metering, site testing, or ride-alongs



Prescriptive Duct Sealing next steps

Prescriptive Duct Sealing Next Steps

The RTF will consider this information in an update to duct sealing measures in September.

BPA will document our findings to inform methodological decisions for any future prescriptive duct sealing studies in the region.

BPA will engage utility customers on any future activity around this measure.

What’s next?

Navigant's DHP & Prescriptive Duct Sealing Evaluation

Bonneville's Programs

RTF Reviews Measures

Sep 2018

Bonneville Starts Tracking Measures Using UES (including any updates)

Oct 2019

Apr 2019

Bonneville Notification of UES Measure List to Take Effect in October 2019

Looking Forward

Bonneville is taking several actions for **ductless heat pumps** that we believe will improve the reliability of these measures:

1. **Researching control methodologies** to ensure that the DHP is the primary heating source where a FAF is retained in the home

2. **Creating parity for incentives for DHPs and air source heat pumps**. We hope that with an aligned incentive structure, homeowners will focus on the best solution for their home – which may be an air source heat pump when a forced air system already exists

3. Considering whether we need to **align incentives for single and multi-head DHP installations**

Bonneville will continue to monitor evaluation results for **prescriptive duct sealing** and look for opportunities to improve the measure (e.g., tighten criteria and specifications to include only sites with higher savings potential).

Thank you!

www.bpa.gov/goto/evaluation

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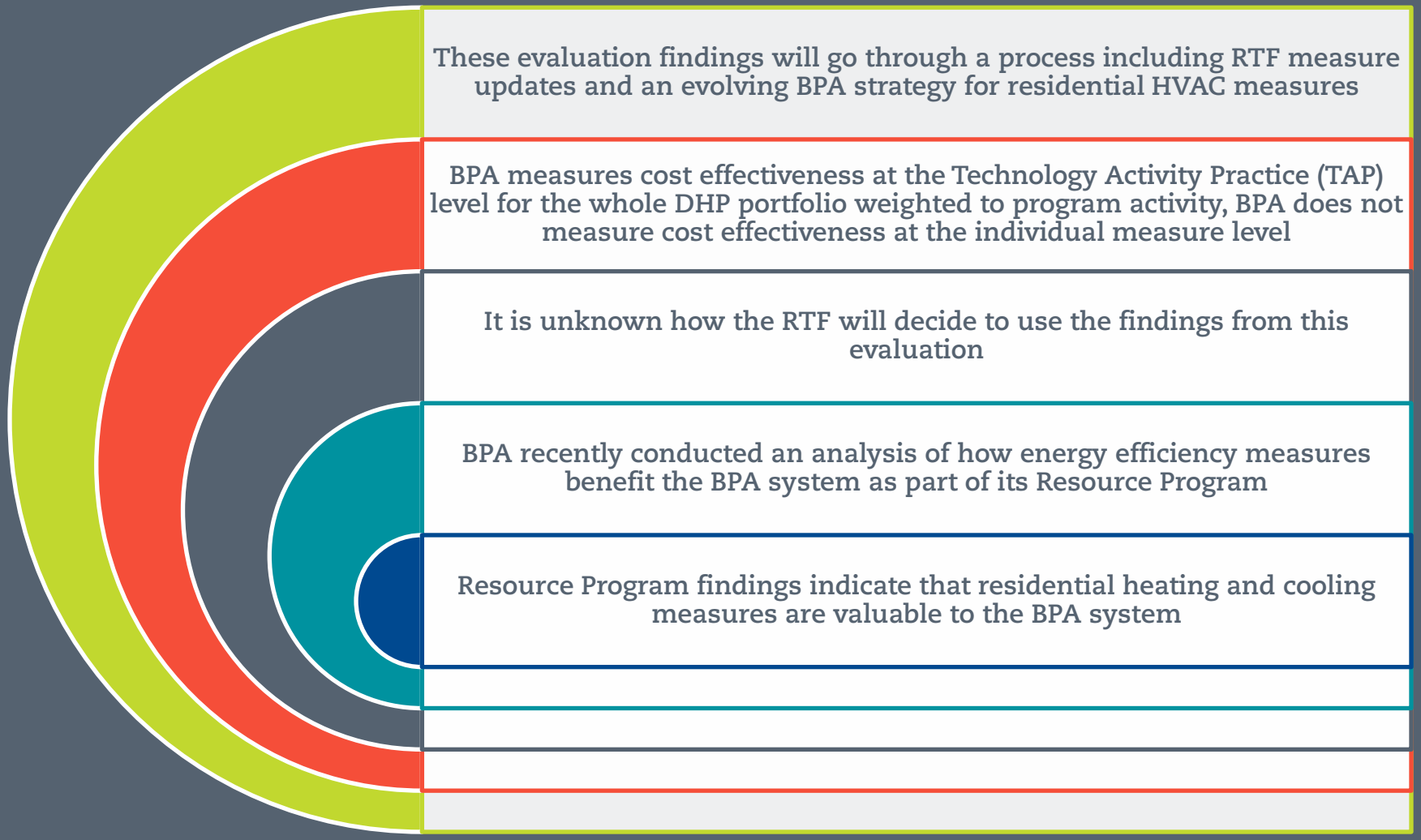
Cost Effectiveness