

Richard Devlin
Chair
Oregon

Ted Ferrioli
Oregon

Guy Norman
Washington

Patrick Oshie
Washington



Northwest **Power** and **Conservation** Council

Bo Downen
Vice Chair
Montana

Jennifer Anders
Montana

Jim Yost
Idaho

Jeffery C. Allen
Idaho

April 7, 2020

MEMORANDUM

TO: Power Committee Members

FROM: Tina Jayaweera, Kevin Smit, Charlie Grist

SUBJECT: Incorporating Climate Change for Energy Efficiency

BACKGROUND:

Presenter: Tina Jayaweera

Summary: In the 2021 Power Plan, staff are incorporating impacts of climate change across the various inputs and analysis. For energy efficiency, climate change will influence the savings for weather-sensitive measures, such as HVAC equipment (e.g. heat pumps, air conditioners) and insulation. Staff have incorporated data from the global circulation models (GCMs) to modify the savings for these measures. Specifically, these savings are often estimated using building simulation models that rely on historical weather, and staff have modified these historical weather files to incorporate future climate. This presentation will provide an overview of the process to modify and the impacts of these changes.

Relevance: Development of inputs for the 2021 Power Plan

Workplan: Power Division A.3: Develop the 2021 Power Plan: Energy Efficiency

More Info: In November 2019, staff presented on selection of General Circulation Models for use in the 2021 Plan:
https://www.nwcouncil.org/sites/default/files/2019_1112_p1.pdf

Estimated Impact of Climate Change on Energy Efficiency Savings

Tina Jayaweera

April 14, 2020



THE 2021
NORTHWEST
POWER PLAN
FOR A SECURE & AFFORDABLE
ENERGY FUTURE

1

Using Climate Change Data for Energy Efficiency

- For EE measures that are weather sensitive, the future climate will result in differing savings than what we have seen historically
- We will want to incorporate this in the Plan savings assumptions
- Currently, use Typical Meteorological Year “TMY” weather files for energy simulation models



THE 2021
NORTHWEST
POWER PLAN

2

2

TMY

- TMY: Typical Meteorological Year
- Compiled by National Renewable Energy Lab
- Based on historical weather 1961-2005
 - Each month is selected from historical record to most represent the “typical” weather of that period
 - For example, January may be based on 1987 weather and February based on 1999 weather
- Data are hourly and contain many fields including: dry bulb temperature, relative humidity, solar radiation (direct, horizontal, diffuse), windspeed, wind direction, etc...
- These don't necessarily reflect future climate



3

FMY

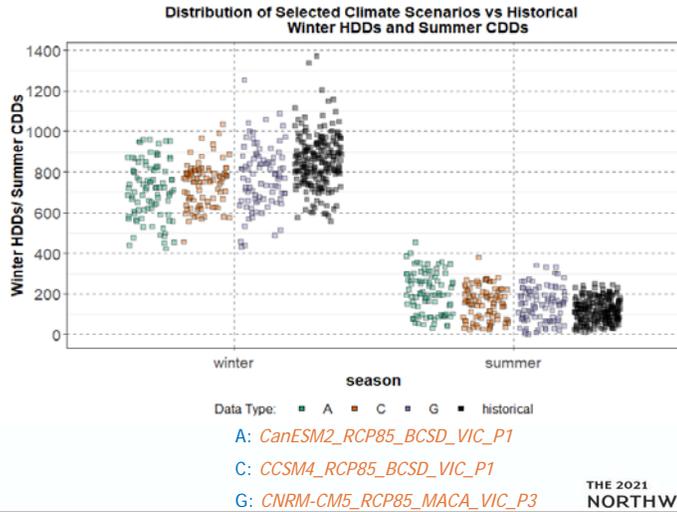
- Need similar data reflecting future years – Future Meteorological Year (FMY) using General Circulation Model data (GCM)
- Complications:
 - GCM data are daily, TMY is hourly
 - GCM don't contain all the same data fields
- Solution:
 - Modify TMY hourly data to reflect GCM trends
 - Thanks to Ecotope for their help - Paul Kintner and Ben Larson (now of Larson Energy Research)



4

GCM Selection

- Recall: For 2021 Plan, we will use *three* GCM datasets to reflect variance in climate and hydro generation
- For EE: We can only use *one* GCM given need for a single supply curve (for a given load)
- Choose “CanESM2” as it has the broadest span of HDD/CDD



THE 2021
NORTHWEST
POWER PLAN



5

5

Process to Create FMY

- Modify key TMY variables using GCM data
 - Temperature, Solar Radiance, Humidity
- Keep hourly trends in TMY
- Adjust TMY variables based on differences between GCM monthly max/mins compared to TMY max/mins



THE 2021
NORTHWEST
POWER PLAN

6

6

Converting Variables

TMY (Hourly)	GCM (Daily / Monthly)	Method for FMY
Dry Bulb Temperature	Max Temperature Min Temperature	Adjust based on differences in the monthly mean of the max and min
Relative Humidity	Max RHS Min RHS	Adjust based on differences in the monthly mean of the max and min
Dew Point	Specific Humidity	Convert to specific humidity and stretch.
Total Horizontal Solar	Average daily downward shortwave radiation at surface	Adjust by difference in monthly means
Direct Normal Solar		Adjust by difference in total solar monthly means
Diffuse Horizontal Solar		Adjust by difference in total solar monthly means



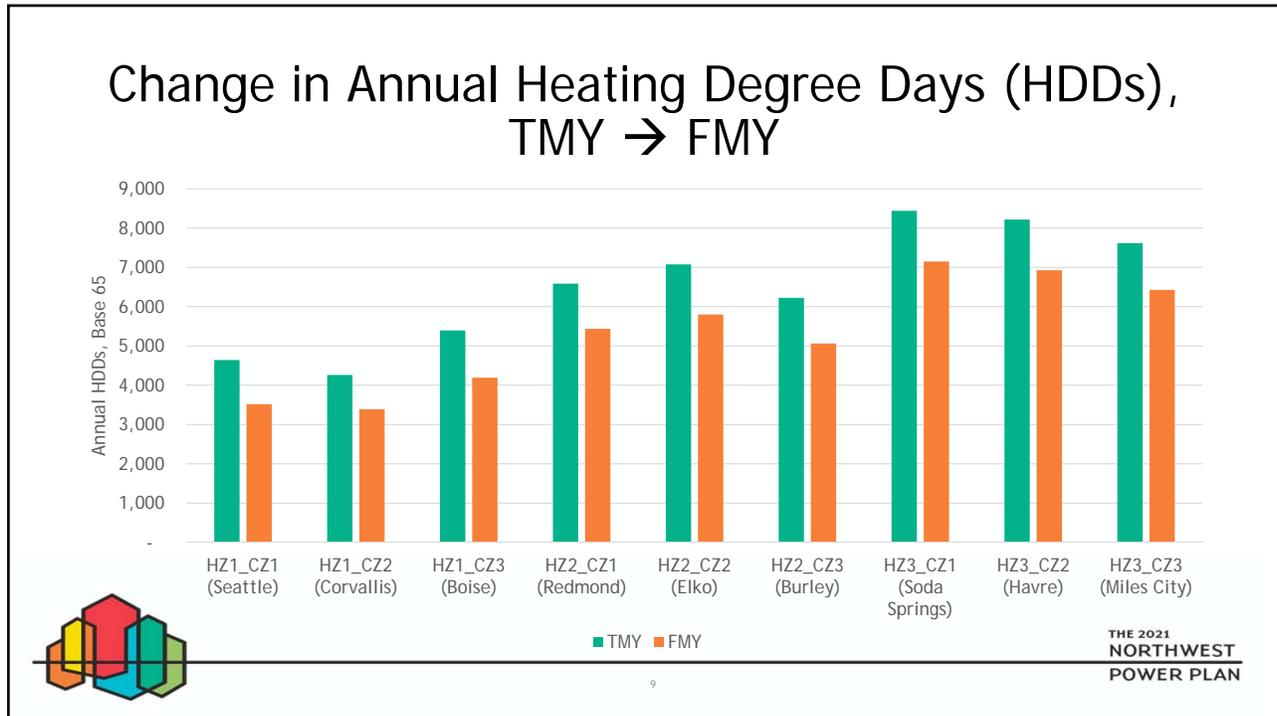
7

Comparing TMY/FMY Simulation Results

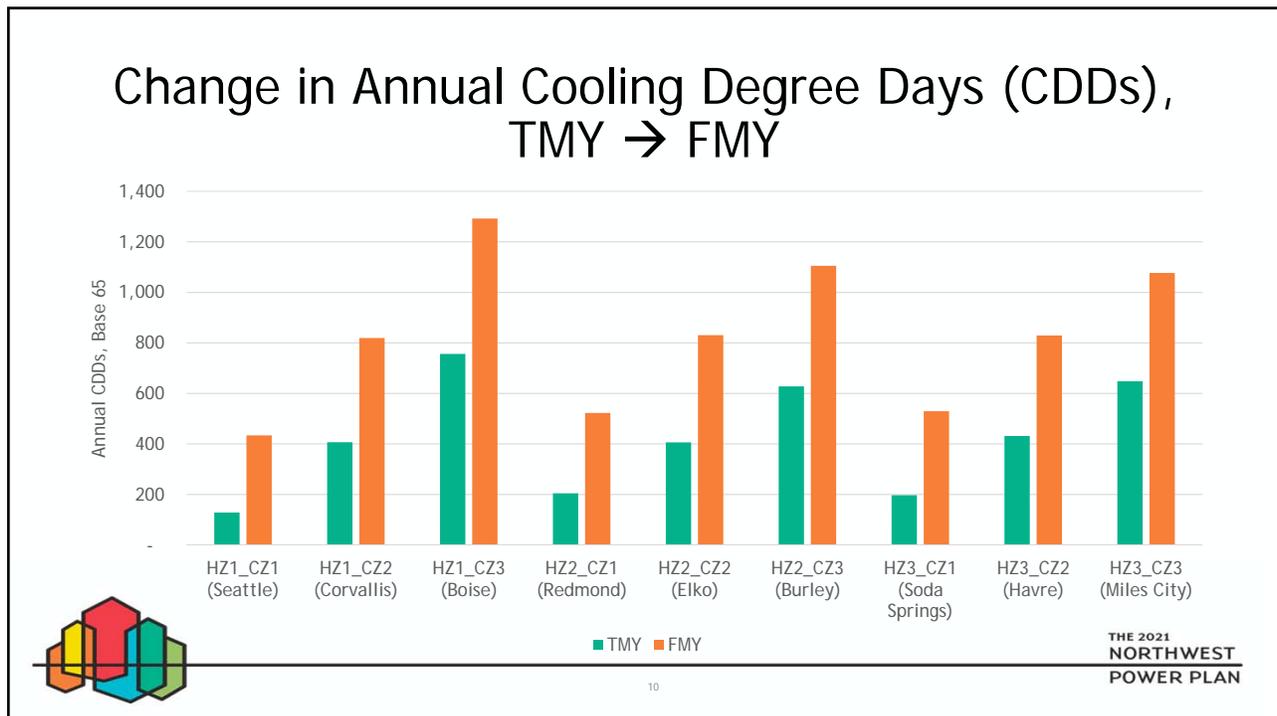
Thanks to Christian Douglass,
RTF Contract Analyst



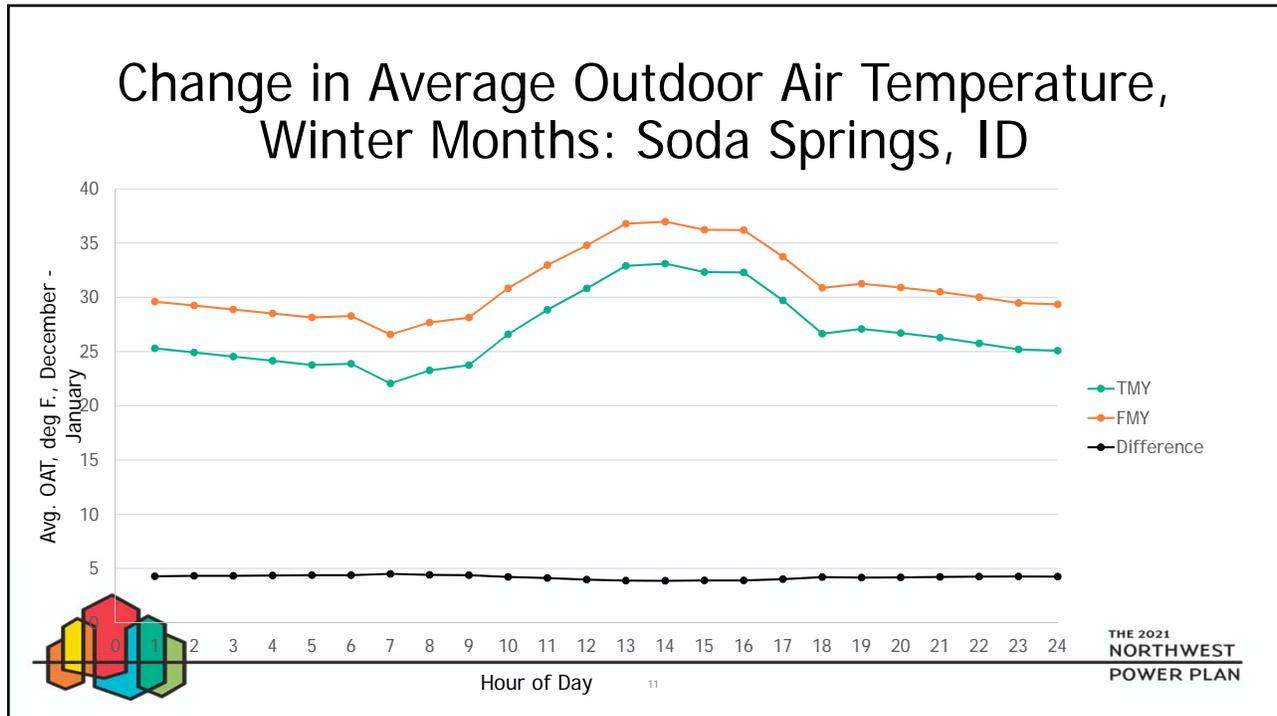
8



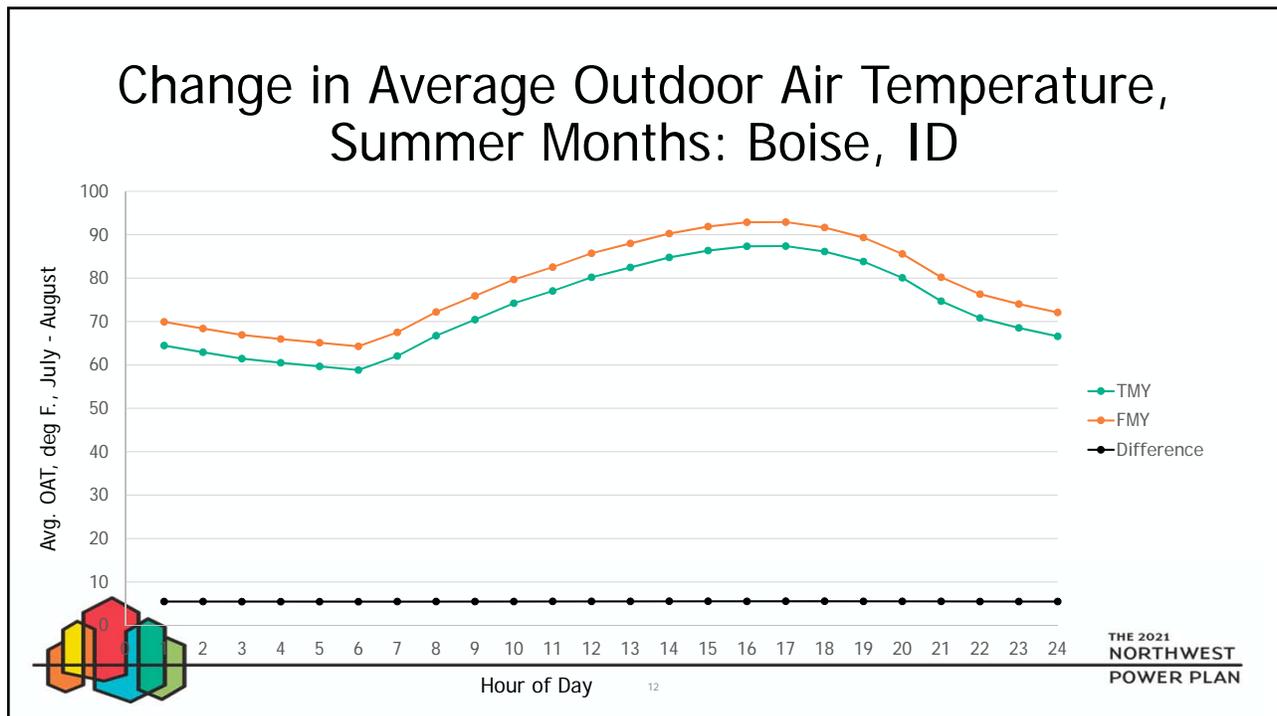
9



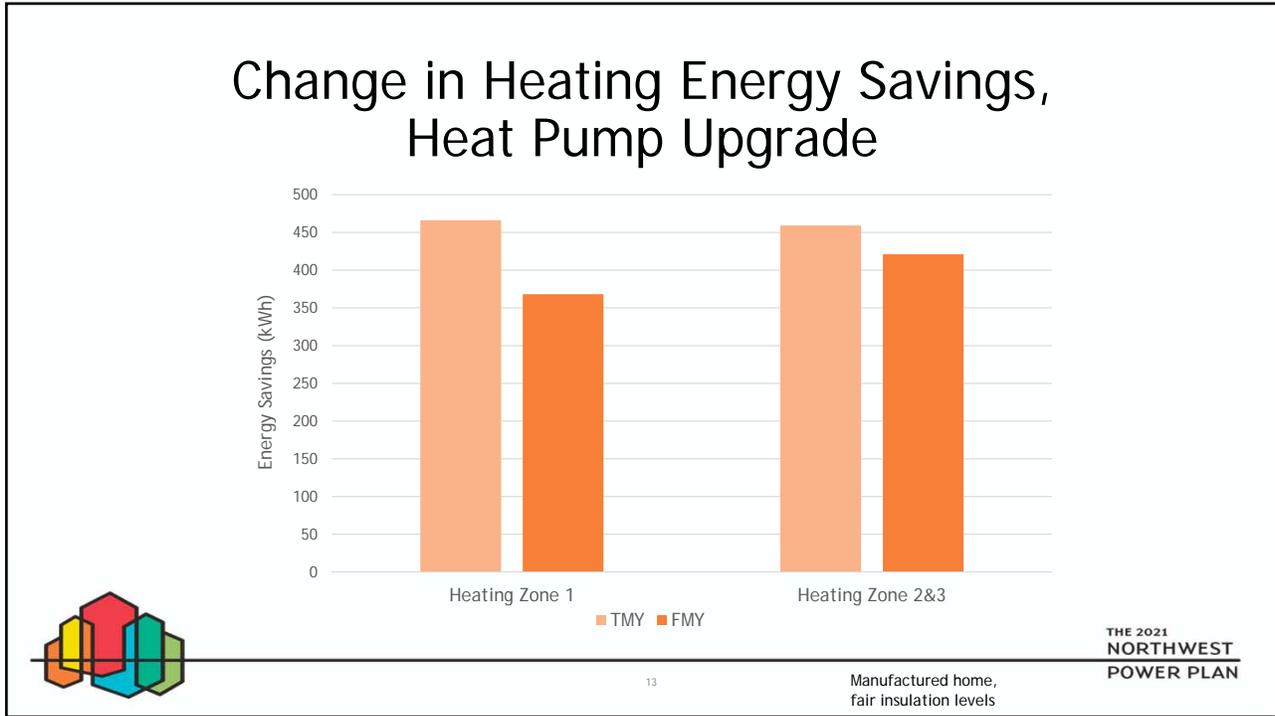
10



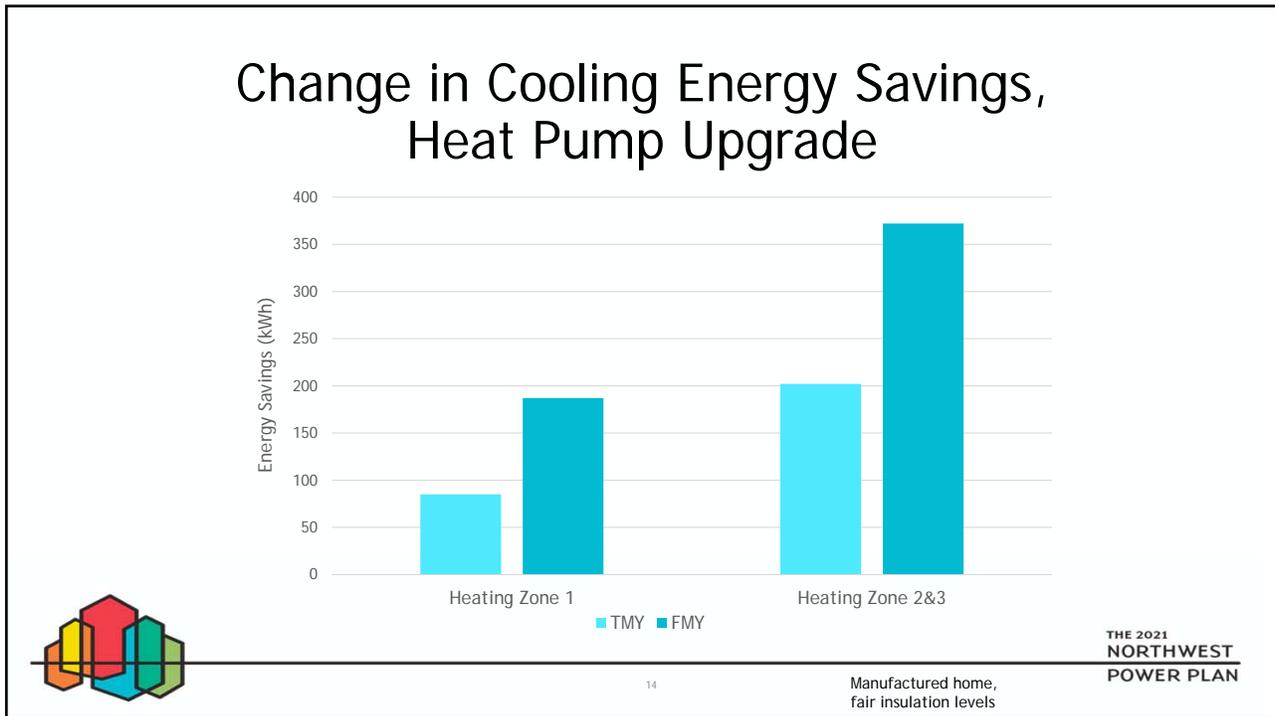
11



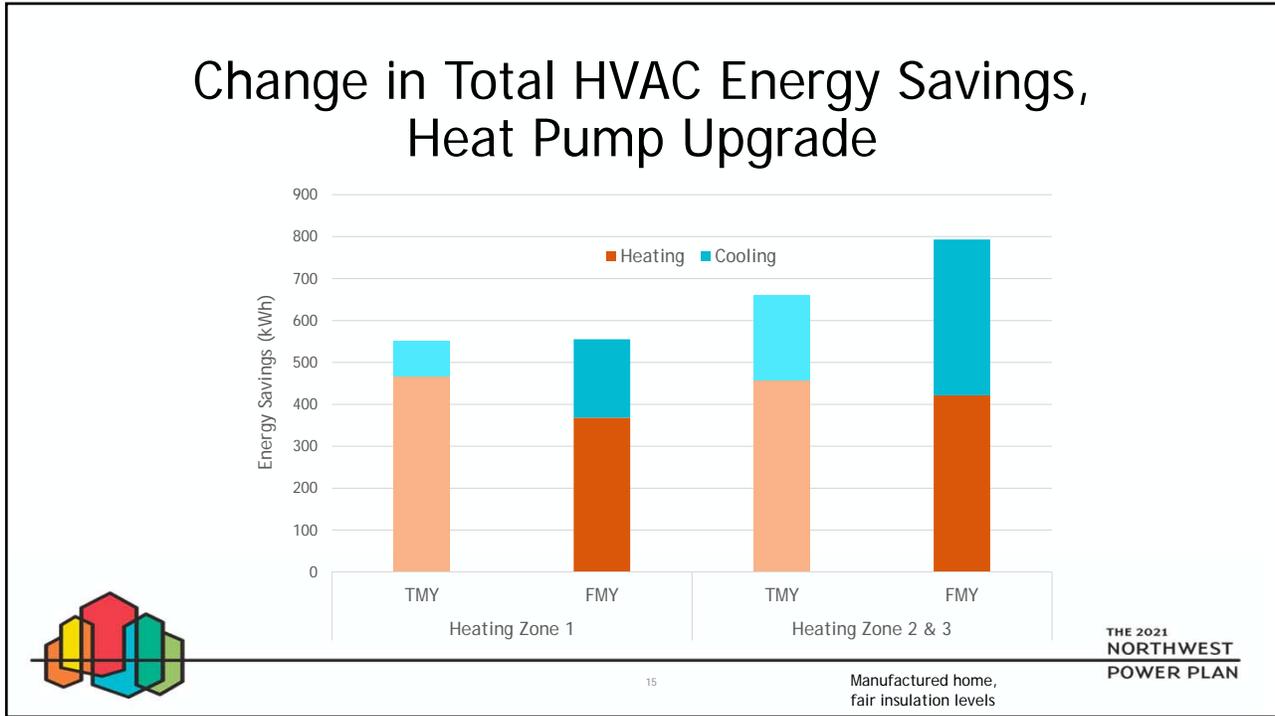
12



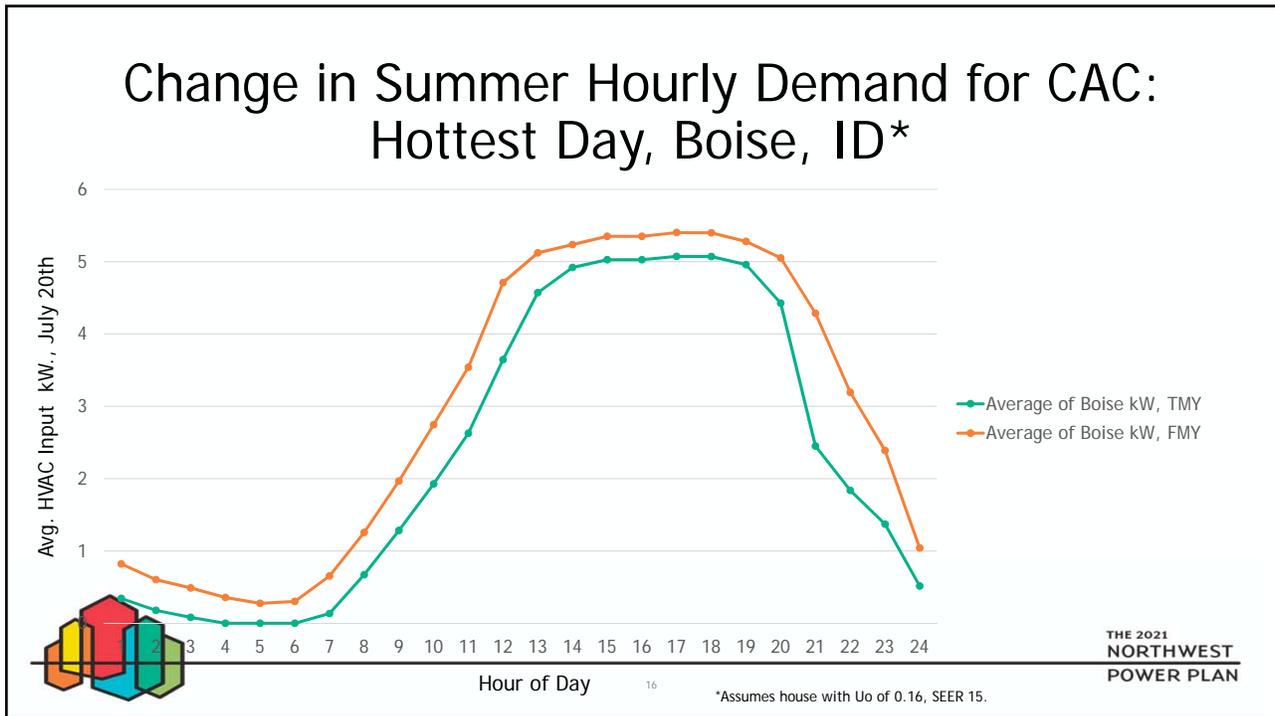
13



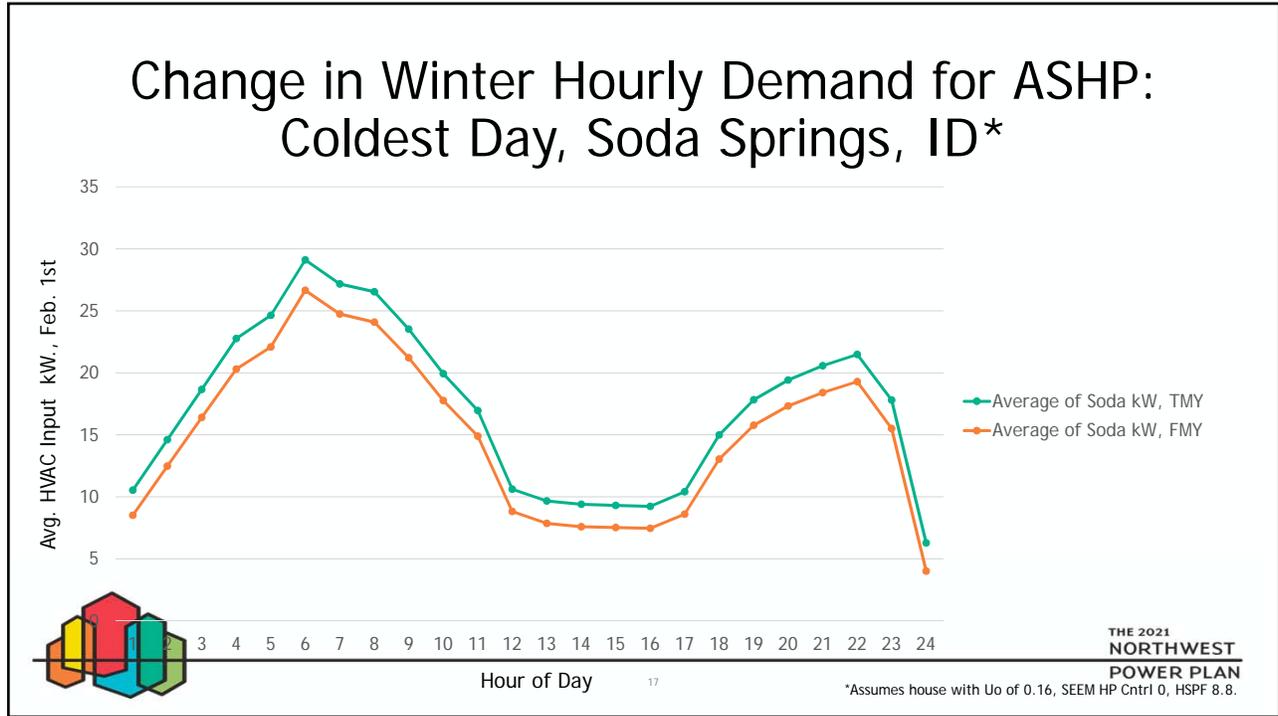
14



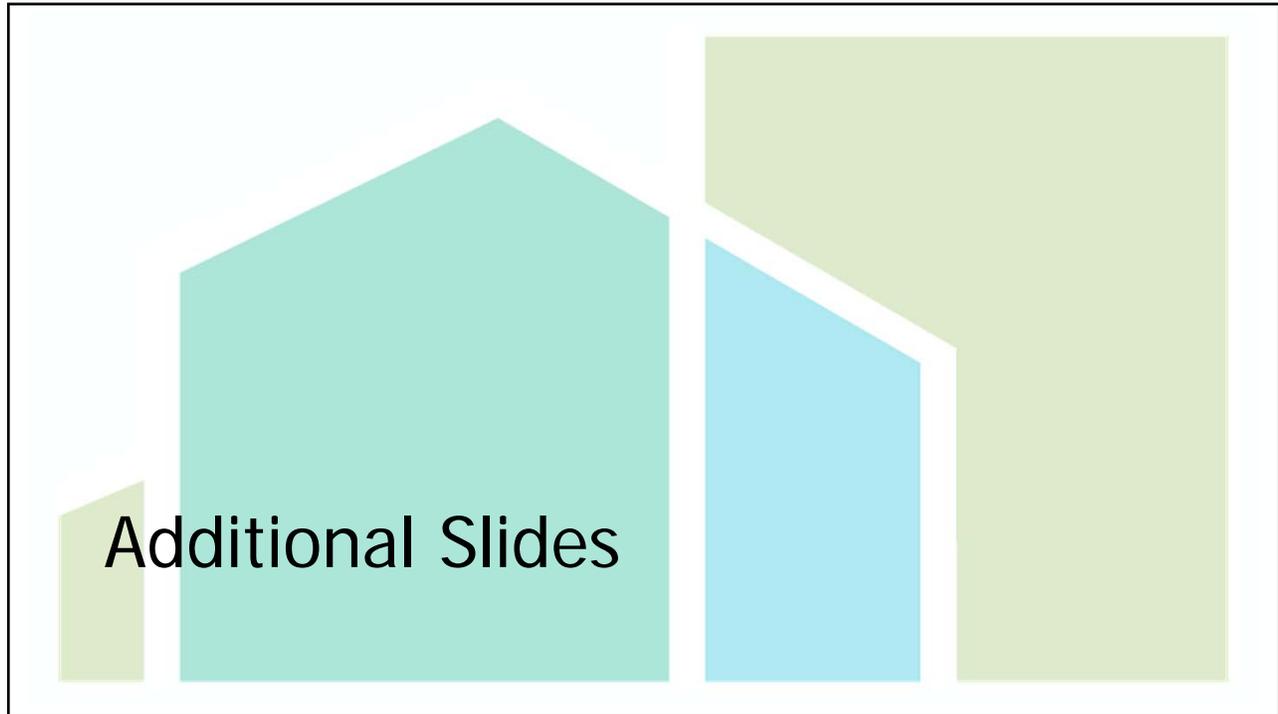
15



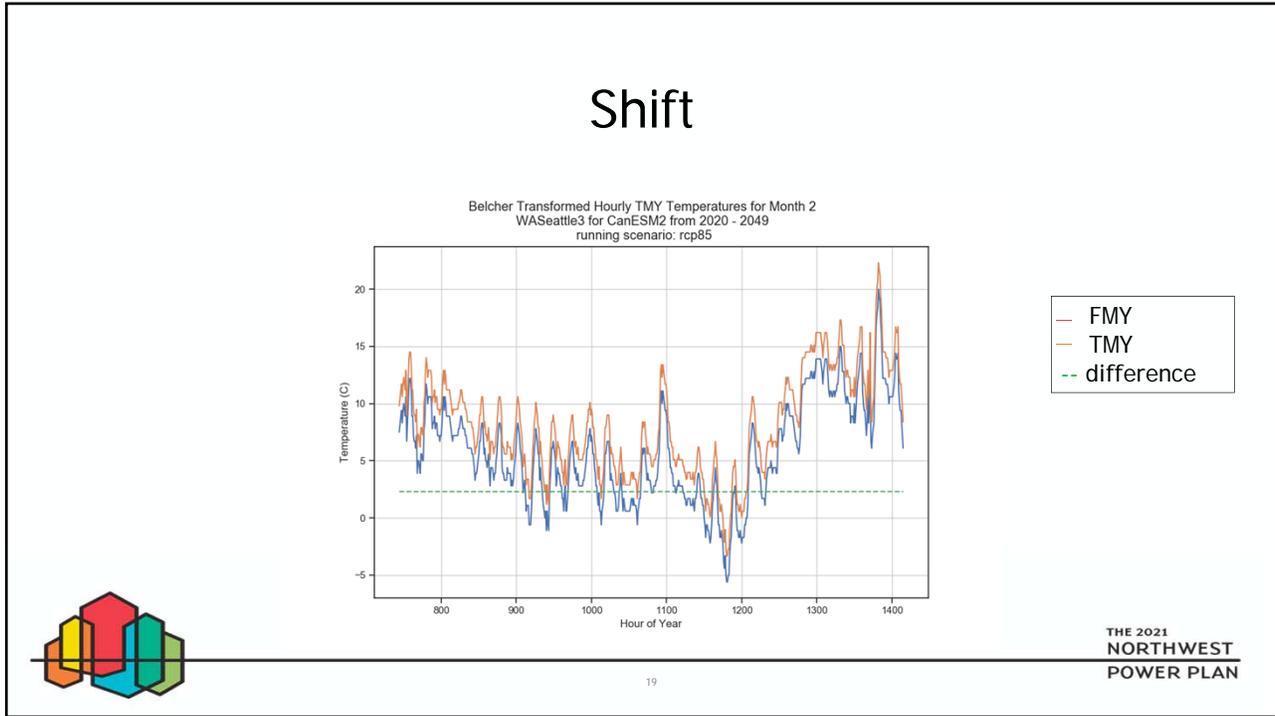
16



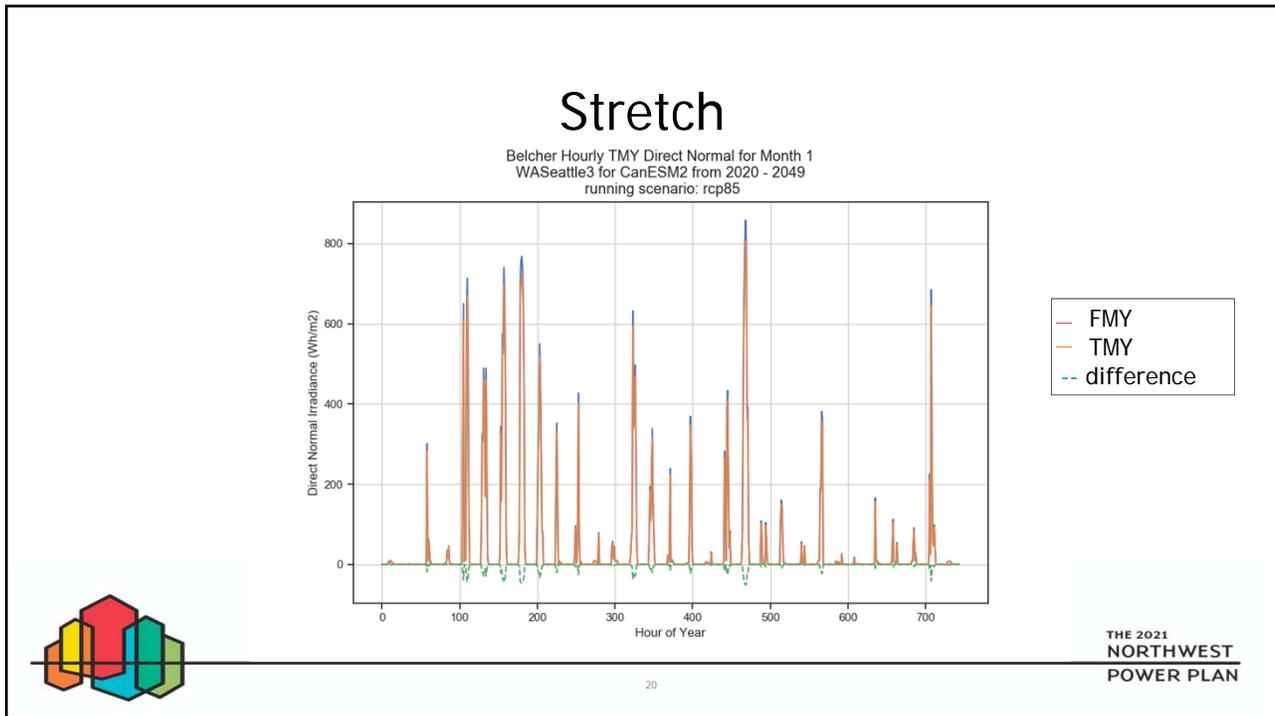
17



18



19



20

