April 2, 2019

MEMORANDUM

TO: **Power Committee**

FROM: **Massoud Jourabchi, Manager of Economic Analysis**

SUBJECT: **Economic Drivers For 2021 (8th) Power Plan – part 1**

BACKGROUND:

Presenter: Massoud Jourabchi

Summary: For the 2021 plan we are extending the scope of economic drivers to include impact of climate change. In the part one of the discussion we will present key economic drivers such as population, residential and commercial floorspace, output of industrial sectors. We then present an overview of impact of Climate Change in the Council's load forecast. Part two of this presentation, scheduled for later in the year, will bring to Council recommendations on selection of climate change model to use, the methodology for incorporating impacts, short and longer-term trends as well as direct and indirect impact of climate change in the Northwest and Western United States.

Relevance: Developing a range of economic drivers for the load forecast is one of the first tasks that needs to be completed.

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Economic Drivers of the 2021 (8th) Power Plan

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ENERGY FUTURE

In today's presentation

- Load forecast and council's analytical processes
- Building blocks of load forecast
- Key Economic Drivers
  - Population
  - Residential building
  - Commercial square footage
  - Industrial employment
  - Retail electric and natural gas prices
- Range of Forecast of Drivers

Next steps

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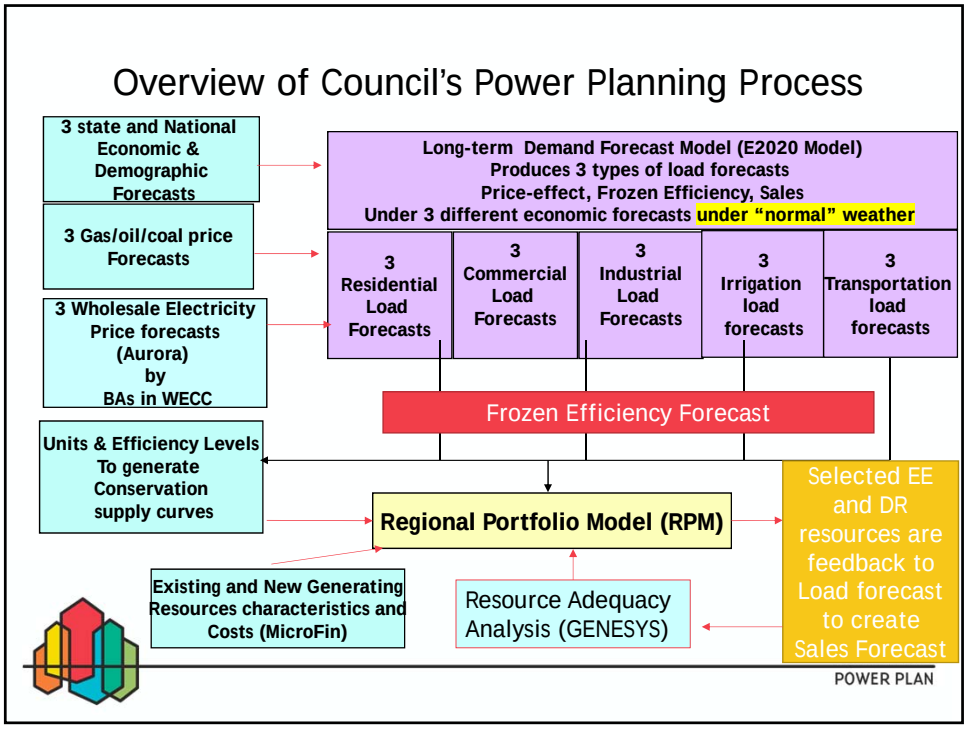
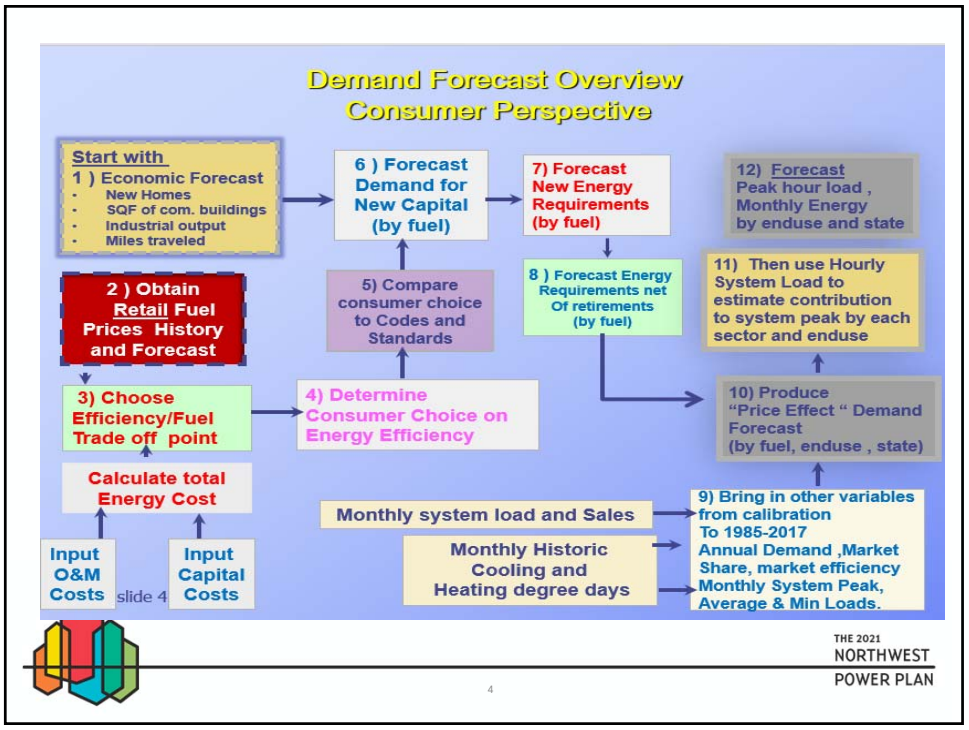

Overview of Council's Power Planning Process
3 state and National Economic & Demographic Forecasts
3 Gas/oil/coal price Forecasts
3 Wholesale Electricity Price forecasts (Aurora) by BAs in WECC
Long-term Demand Forecast Model (E2020 Model)
Produces 3 types of load forecasts
Price-effect, Frozen Efficiency, Sales
Under 3 different economic forecasts under "normal" weather
3 Residential Load Forecasts
3 Commercial Load Forecasts
3 Industrial Load Forecasts
3 Irrigation load forecasts
3 Transportation load forecasts
Frozen Efficiency Forecast
Units & Efficiency Levels To generate Conservation supply curves
Regional Portfolio Model (RPM)
Selected EE and DR resources are feedback to Load forecast to create Sales Forecast
Existing and New Generating Resources characteristics and Costs (MicroFin)
Resource Adequacy Analysis (GENESYS)
POWER PLAN


Demand Forecast Overview
Consumer Perspective
Start with
1) Economic Forecast
New Homes
SQF of com. buildings
Industrial output
Miles traveled
6) Forecast Demand for New Capital (by fuel)
7) Forecast New Energy Requirements (by fuel)
12) Forecast Peak hour load , Monthly Energy by enduse and state
2) Obtain Retail Fuel Prices History and Forecast
5) Compare consumer choice to Codes and Standards
8) Forecast Energy Requirements net Of retirements (by fuel)
11) Then use Hourly System Load to estimate contribution to system peak by each sector and enduse
3) Choose Efficiency/Fuel Trade off point
4) Determine Consumer Choice on Energy Efficiency
10) Produce "Price Effect " Demand Forecast (by fuel, enduse , state)
Calculate total Energy Cost
Monthly system load and Sales
9) Bring in other variables from calibration To 1985-2017 Annual Demand ,Market Share, market efficiency Monthly System Peak, Average & Min Loads.
Monthly Historic Cooling and Heating degree days
Input O&M Costs
slide 4
Input Capital Costs
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Overview of Basic Building Blocks of Long-term Forecasting Model

For each end-use in each sector consumption is determined in part by:

- **Number of Units (A)**
- **Fuel efficiency choices (B)**
- **Fuel choice (C)**

Energy use by an end-use = A * B * C

In today's presentation we will focus on A-Economic Drivers.

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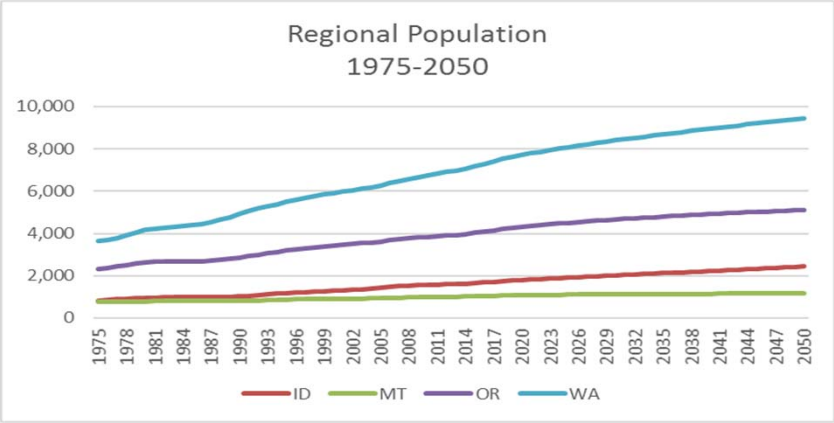
Regional Population



	2017	2020	2040	2050
Population (1000s)	14,343	14,905	17,240	18,166

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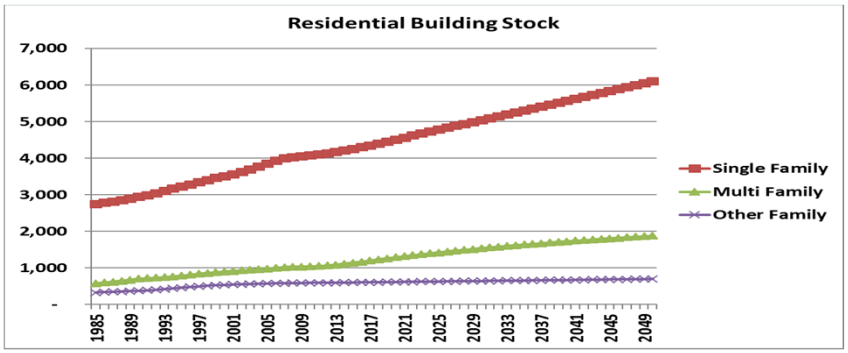
Regional Growth in Residential Building Stock



Number of residences (1000)	1985	2017	2020	2040	2050
Single Family	2,753	4,352	4,510	5,572	6,112
Multi Family	578	1,198	1,290	1,727	1,880
Other Family	329	607	615	669	697

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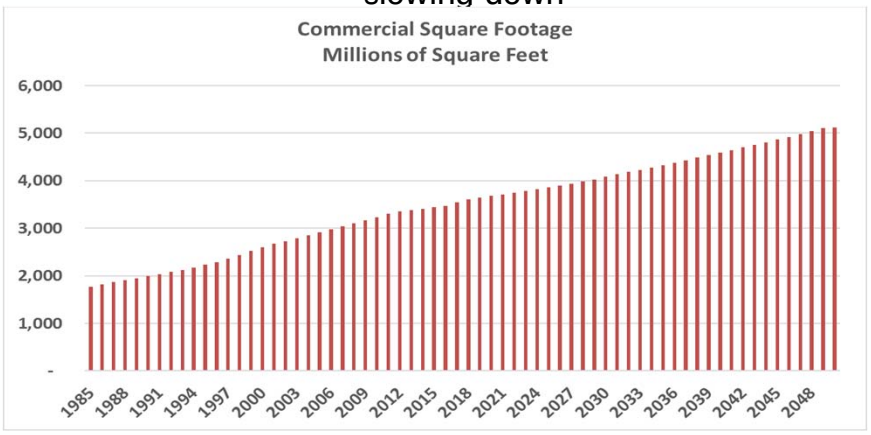
Other Family is referring to Manufactured housing

Annual Growth in Commercial SQF slowing down



	6th Plan	7th Plan	8th Plan (draft)
AAGR	2010-2030	2015-2035	2020-2040
Commercial	1.25%	1.20%	1.11%

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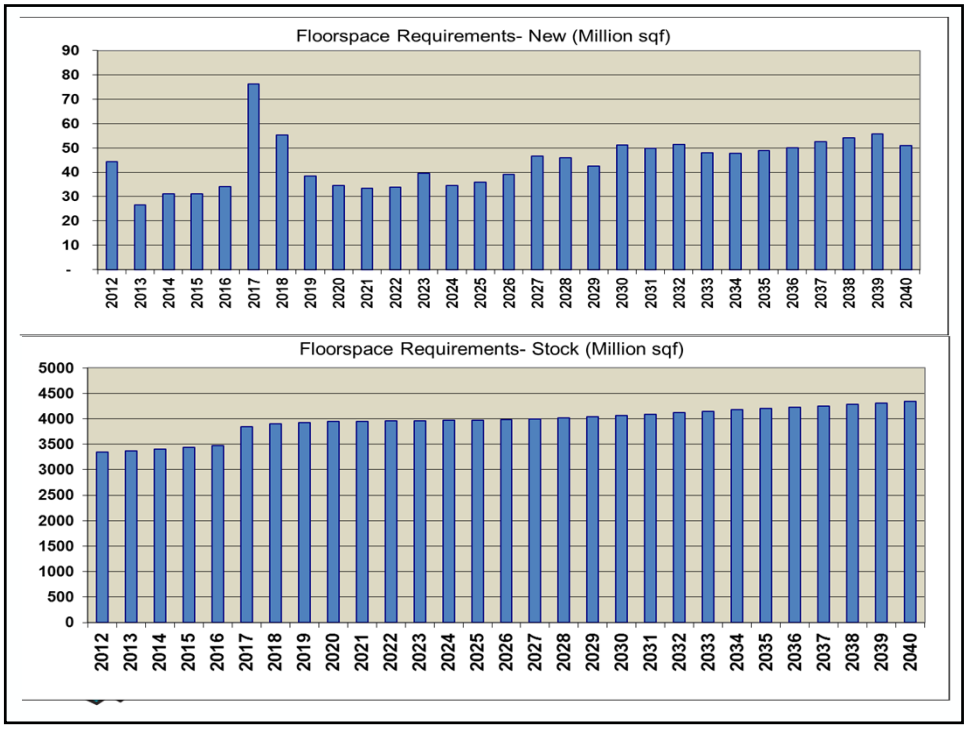
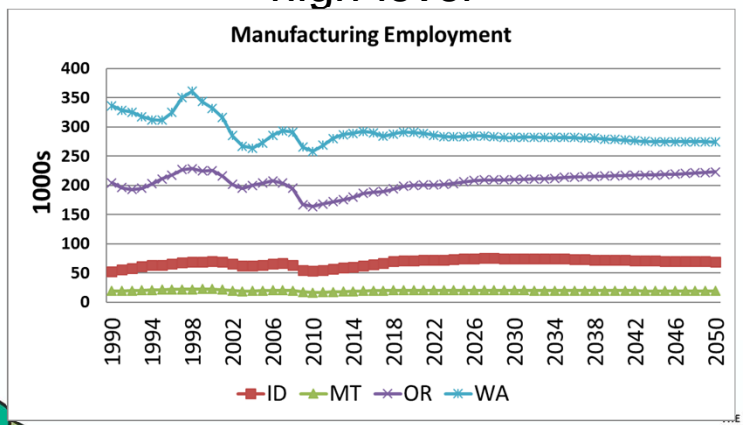
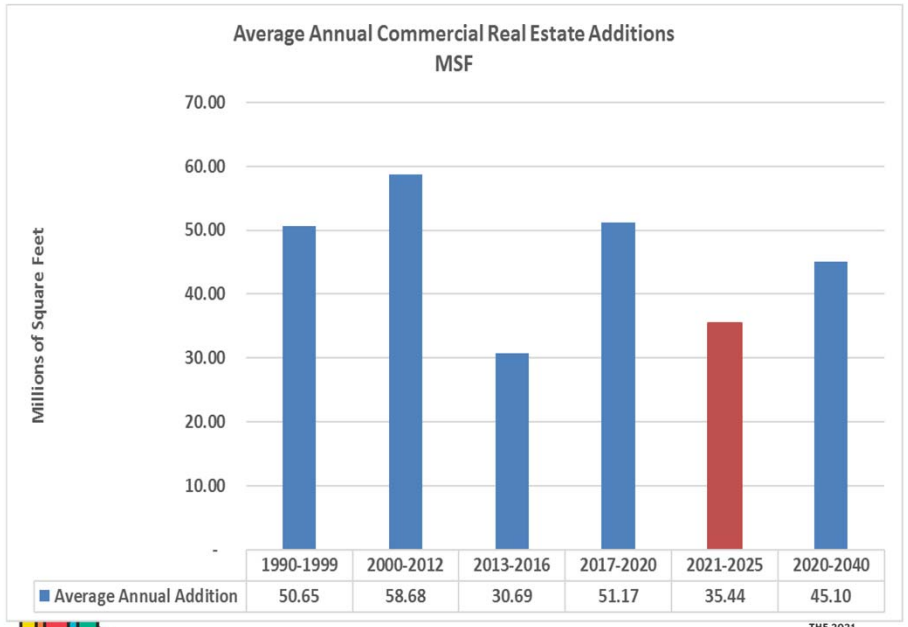


Manufacturing Employment is recovering but does not regain 1990s high level





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Summary of Major Drivers

	2017	2020	2021	2025	2040	2050
Population (1000s)	14,343	14,905	15,060	15,605	17,240	18,166
Residential stock (1000)	6,157	6,414	6,501	6,833	7,968	8,689
Commercial (Million Sqf)	3,548	3,677	3,710	3,854	4,589	5,120
Industrial (billions $2005)	117	122	122	127	141	150
Agricultural output (Billions $2005)	18	19	19	21	25	29

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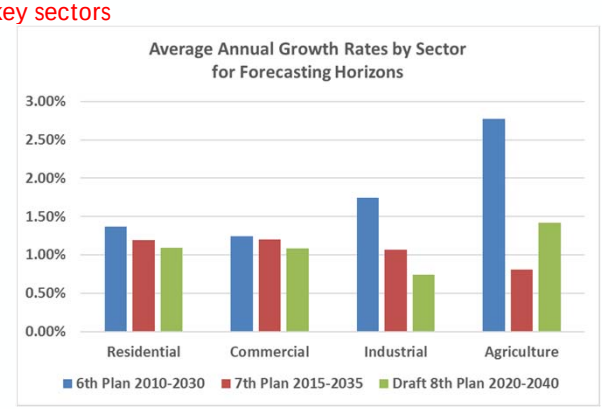
In summary current expectations are for slower overall growth in economic drivers in key sectors



	6th Plan	7th Plan	8th Plan (draft)
Average Annual Growth Rate	2010-2030	2015-2035	2020-2040
Residential	1.37%	1.19%	1.09%
Commercial	1.25%	1.20%	1.08%
Industrial	1.74%	1.06%	0.74%
Agriculture	2.78%	0.81%	1.41%

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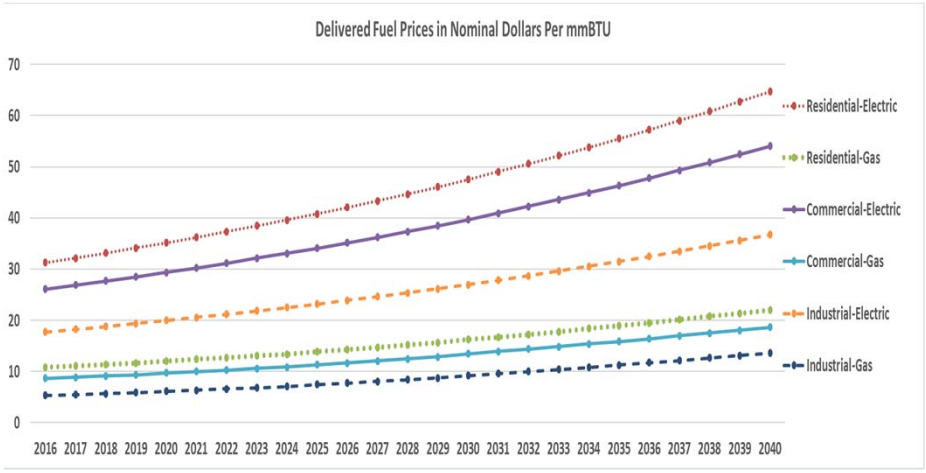
Delivered Electricity and Natural Gas prices



AAGR 2020-2040	
Residential-Electric	3.1%
Residential-Gas	3.1%
Commercial-Electric	3.1%
Commercial-Gas	3.3%
Industrial-Electric	3.1%
Industrial-Gas	4.0%

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Range of Population

	2020-2050			Population in 2020	population in 2050		Increase in Population	2020-2050	
Population (Thous.)	Trend	optimistic	pessimistic	Trend	Optimistic	Pessimistic	Trend	Optimistic	Pessimistic
ID	1.01%	1.14%	0.89%	1,803	2530	2350	633	728	547
MT	0.25%	0.38%	0.13%	1,076	1204	1118	83	129	42
OR	0.57%	0.70%	0.45%	4,313	5310	4930	797	997	617
WA	0.68%	0.81%	0.56%	7,714	9831	9128	1,747	2,117	1,414
4 states	0.66%	0.79%	0.54%	14,905	18876	17526	3,261	3,970	2,621

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Range of Economic Drivers

Optimistic	2017	2021	2022	2023	2024	2025	2040	2050
Residential Units	6,157	7,524	7,709	7,836	7,681	7,612	8,972	9,781
Commercial Floor space	3,634	4,032	4,122	4,213	4,294	4,378	6,054	7,411
Industrial output	122	151	158	167	176	185	353	547
Agricultural output	18	21	22	22	23	24	34	45
Pessimistic	2017	2021	2022	2023	2024	2025	2040	2050
Residential Units	6,157	5,312	5,484	5,640	5,654	5,629	7,019	7,529
Commercial Floor space	3,516	3,482	3,493	3,513	3,528	3,545	4,064	4,355
Industrial output	117	119	121	123	125	127	146	161
Agricultural output	17	18	18	19	19	19	20	21
Reference Case	2017	2021	2022	2023	2024	2025	2040	2050
Residential Units	6,157	6,501	6,586	6,669	6,751	6,833	7,968	8,689
Commercial Floor space	3,548	3,710	3,744	3,783	3,818	3,854	4,589	5,120
Industrial output	117	122	123	125	126	127	141	150
Agricultural output	18	19	20	20	21	21	25	29

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Average Annual Growth Rates	1985-2017	2021-2025 Action Plan period	2021-2040
Idaho Population	1.73%	1.16%	1.06%
Montana Population	0.78%	0.53%	0.32%
Oregon Population	1.38%	0.83%	0.66%
Washington Population	1.64%	0.91%	0.75%
4 states Population	1.50%	0.89%	0.73%
USA population	0.98%	0.75%	0.64%
Idaho Employment	2.39%	0.87%	0.89%
Montana Employment	1.66%	0.13%	0.46%
Oregon Employment	1.89%	0.56%	0.69%
Washington Employment	2.10%	0.46%	0.67%
Regional Employment	2.03%	0.51%	0.69%
USA Employment	1.28%	0.39%	0.52%
Idaho output (nominal dollars)	5.51%	4.46%	4.38%
Montana output (nominal dollars)	4.64%	3.61%	3.83%
Oregon output (nominal dollars)	5.68%	4.25%	4.28%
Washington output (nominal dollars)	5.74%	4.07%	4.20%
Region output	5.63%	4.13%	4.22%
USA output	4.78%	4.36%	4.16%

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In summary

- **Population, employment and output are all forecast to increase more slowly than during the historical period shown.**
- **Regional growth drivers decrease substantially more than the national but remain slightly higher than the nation. This implies that the region's growth advantage will decrease substantially from the historic period.**
- **The action plan period appears to be a time of relatively slow growth for employment, though not for population or output.**

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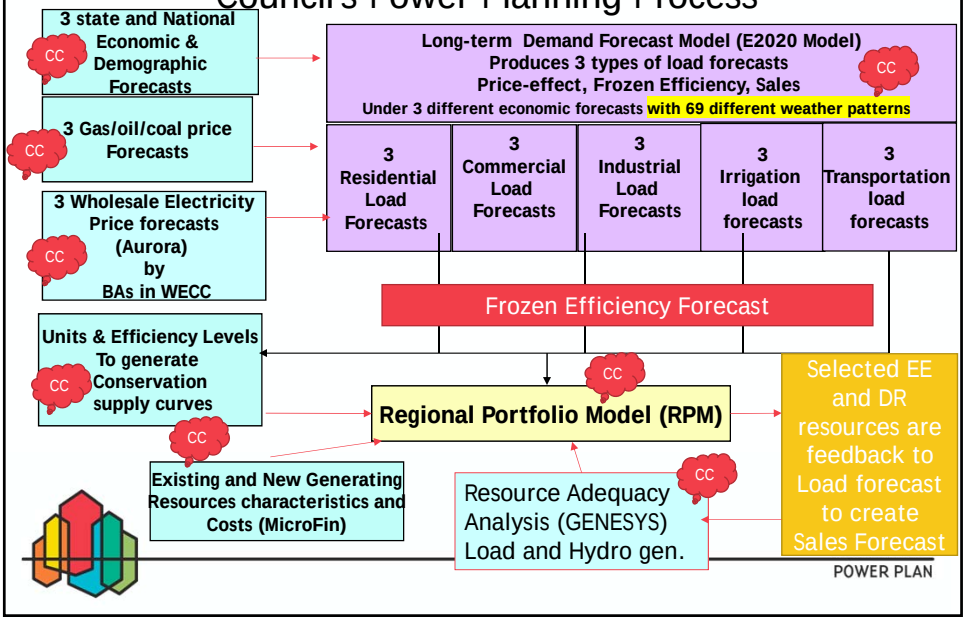
Incorporating Impact of Climate Change

- As stated earlier, for load forecasting we had applied "Normal" or Average historic temperatures to the load forecast for the future.
- Starting with the 2021 Plan, Council analytics is considering a departure from "Normal" temperatures and is introducing a range of uncertainty in future temperatures in load forecast.
- Climate Change will not only impact future temperature profiles, but also impact demographic, economic, social and power system in the Northwest.

Where impact of climate change is incorporated in Council's Power Planning Process



Next steps

- Staff is working on development of proposed methodologies for incorporation of direct and indirect impacts of climate change.
- BPA, Seattle City Light, climate change subject matter experts and members of advisory committees are invited to join in a Climate Change workshop, set for May 1st 2019.
- Feedback from the workshop will be reviewed and incorporated into the proposed methods and brought to the Power Committee for review.