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February 4, 2014

### MEMORANDUM

**TO:** Power Committee

**FROM:** Gillian Charles and John Fazio

**SUBJECT:** Changes in existing and new generating resources since 1995

At the January Power Committee meeting, staff presented Committee Members with a review of how Pacific Northwest electricity peak and energy loads have changed since 1995. At the February Power Committee meeting, staff will present a review of how regional generating resource installed capacity and energy availability have changed over the same time period.

Since 1995, about 16,600 megawatts of new installed capacity has been added to the regional power supply. Of that amount, about 8,700 megawatts is from wind turbines and the rest is mostly from natural gas-fired generators. During the same period, about 870 megawatts of installed capacity has been retired.

In addition, the capability of the existing installed hydroelectric system to meet energy and peaking needs has been reduced. This reduced capability was primarily due to two main factors: 1) increases in fish and wildlife operating constraints; and 2) increases in reserve requirements to integrate variable generating resources (i.e., wind power). Since 1980, the hydroelectric system has lost over 5,000 megawatts of peaking capability and has lost about 1,200 average megawatts (or about 10%) of firm energy availability.

In sum, the overall change in regional peaking generating capability amounts to a net increase of about 2,000 megawatts. The overall regional change in energy availability amounts to a net increase of about 8,200 average megawatts.

# Changes in Existing and New Generating Resources: 1995 - 2013

**Power Committee, 2/11/14**

**Gillian Charles  
John Fazio**

Since 1995, the region has

- **Added ~ 16,600 megawatts installed capacity**
  - **Primarily wind and natural gas**
- **Retired ~850 megawatts installed capacity**
  - **Primarily petroleum and small natural gas plants**

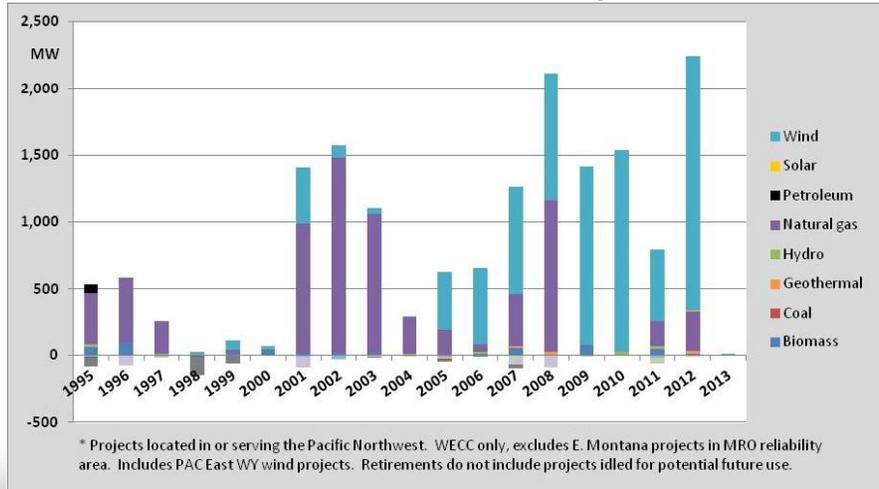
## Generating Resource Additions: 1995 - 2013

Resource	Capacity (MW)	Availability (MWa)
Wind	8,737	2,752
Natural Gas	7,183	5,888
Biomass	471	317
Hydro	111	84
Petroleum	68	51
Geothermal	50	44
Solar	13	6
Coal	-	-
<b>Total:</b>	<b>16,633</b>	<b>9,142</b>

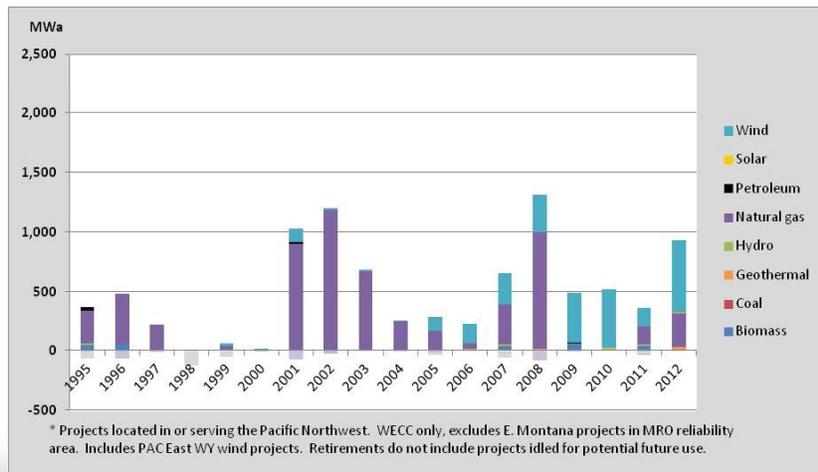
## Generating Resource Retirements: 1995 - 2013

Resource	Capacity (MW)	Availability (MWa)
Petroleum	340	310
Natural Gas	297	232
Biomass	110	74
Hydro	107	88
Coal	16	10
Geothermal	-	-
Solar	-	-
Wind	-	-
<b>Total:</b>	<b>870</b>	<b>714</b>

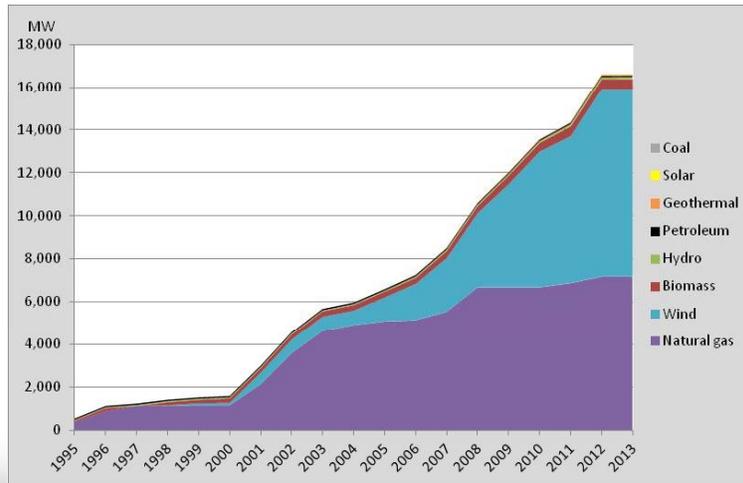
## Generation Additions and Retirements – Installed Capacity (MW)



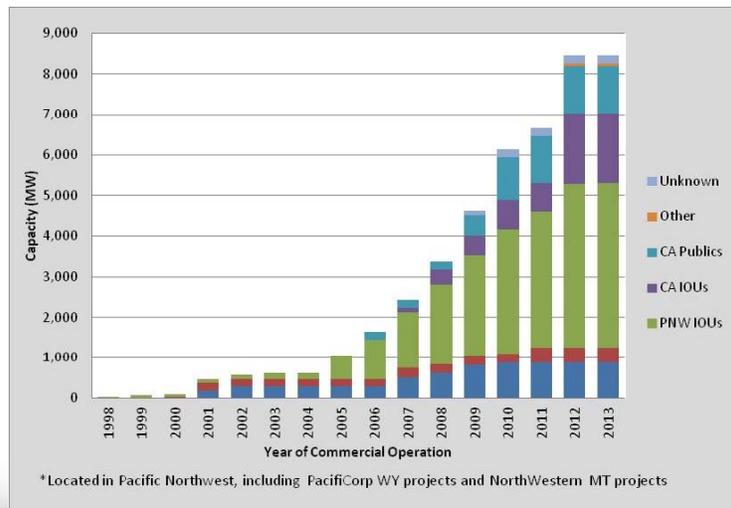
## Generation Additions and Retirements – Availability (MWa)



## Cumulative Generating Resource Additions (MW) Since 1995



## Breakdown of Wind Contracts



## Upcoming Generation Changes

- **Some new development through 2016 –**  
~1,000 MW planned\* or under construction
  - Natural gas, wind
- **Many utilities upgrading existing hydropower projects – additional capacity and improved efficiency**
- **Upcoming coal retirements**
  - 2020 – Centralia I (730 MW), Boardman (600MW)
  - 2025 – Centralia II (730 MW)

\* Planned – site certificate, utility ownership/power purchase agreement, announcement of construction schedule.

## Changes in Hydroelectric Power

- **Increases in capability due to**
  - New small hydro projects
  - Added capacity
  - Increased efficiency
- **Decreases in capability due to**
  - More restrictive operating constraints
  - Increasing reserve requirements

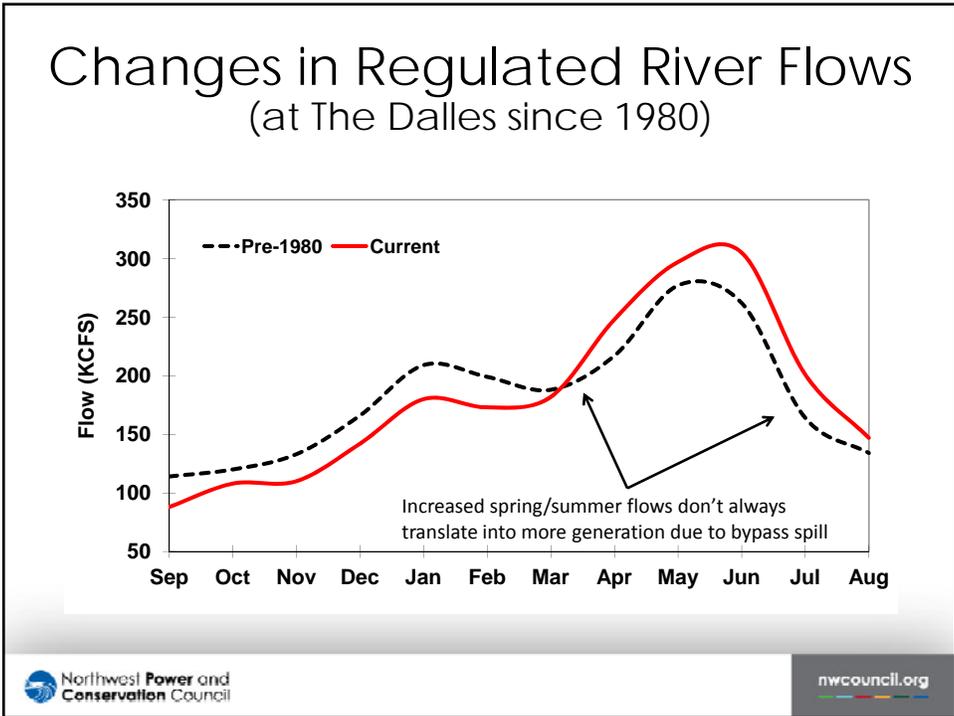
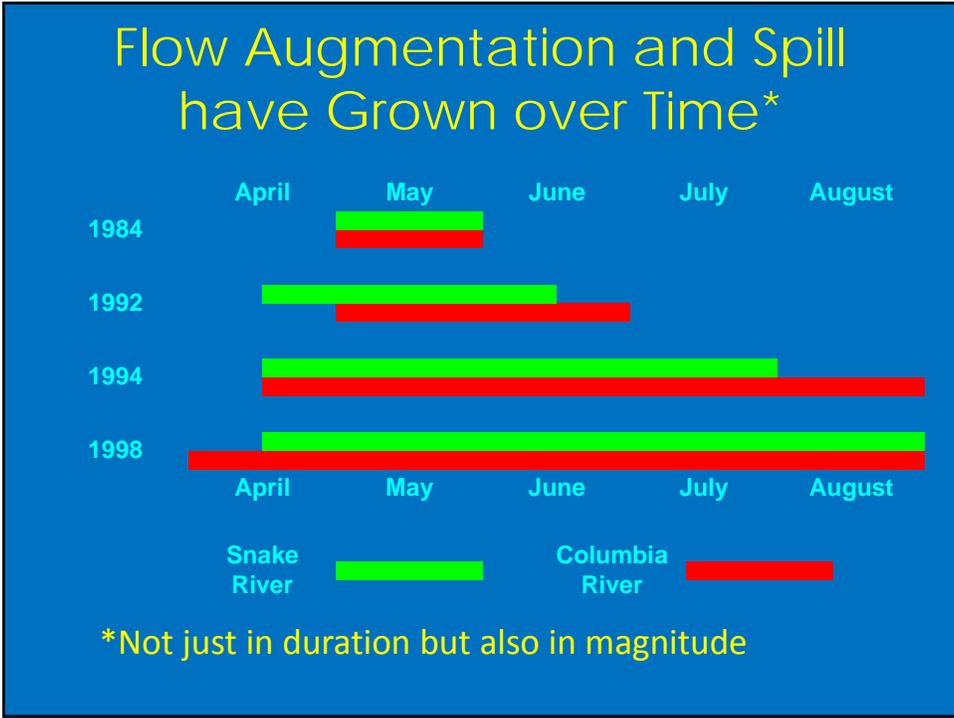
## Changes in Hydro Capability

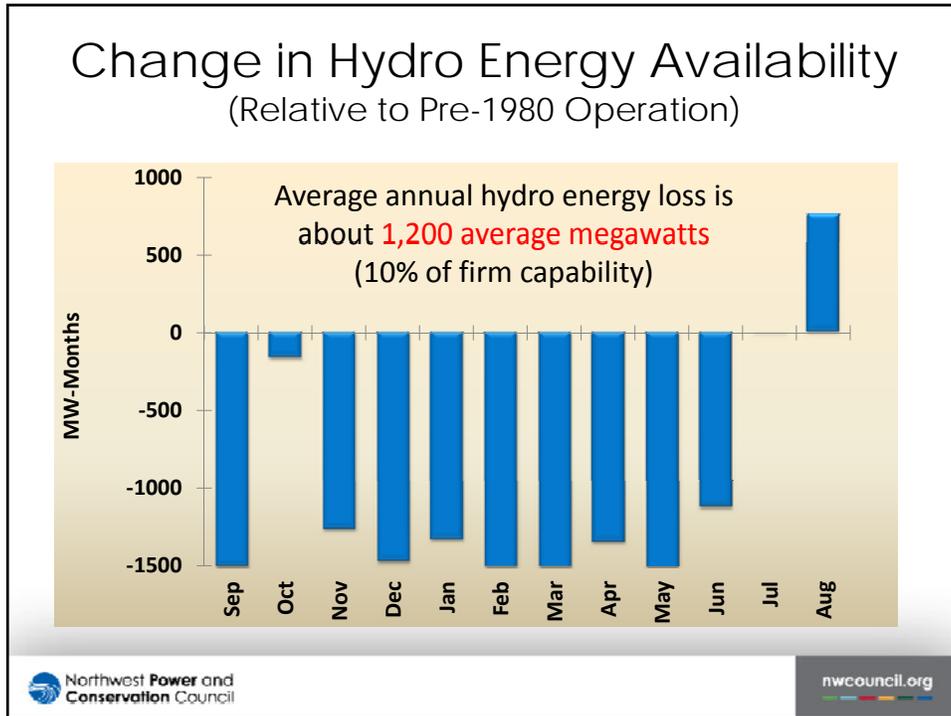
- New projects 111 MW
- Retired projects (107) MW
- Increased capacity ~100-300\* MW
- Efficiency improvements ~100-300\* MWa

\* Approximations based on information that we have today. Several utilities are in the process of upgrading their hydropower projects, which can result in increased capacity and improved efficiency.

## Decreased Hydro Capability Fish and Wildlife Operations

- Flow Augmentation – Decreases winter flows and increases spring and summer flows
- Bypass Spill – To improve passage survival, reroutes water around generating turbines in spring and summer



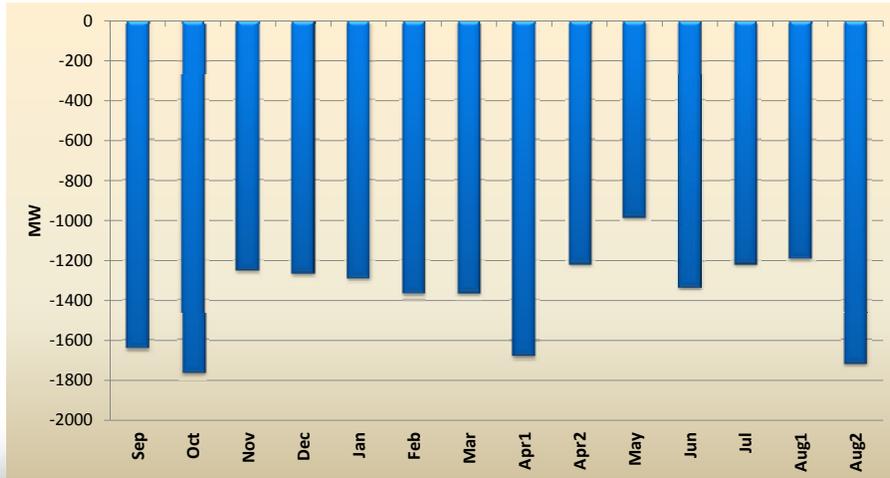


### Decreased Hydro Peaking Capability Reserves for Within-hour Balancing

- **INC Reserve** – Increases hydro generation during peak load hours when wind generation drops suddenly
- **DEC Reserve** – Backs off hydro generation during light load hours when wind generation increases suddenly

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### Effects of 900 MW INC and 1100 MW DEC (on 10-hour hydro sustained peaking)



### Total Change in Winter and Summer Hydro Peaking Capability\*

(MW)	1999	2014	Difference
Winter	26,000	20,600	5,400
Summer	28,300	23,200	5,100

\*Includes effects of INC and DEC  
Source: BPA White Books

## Summary of Resource Changes

Resource	Installed	Availability	Peak
Natural Gas	6,886 MW	6,656 MWa	6,886 MW
Wind	8,737 MW	2,752 MWa	437 MW
Other <sup>1</sup>	140 MW	20 MWa	140 MW
Hydro	(see Other)	- 1,200 MWa <sup>2</sup>	- 5,400 MW <sup>3</sup>
<b>Total Change</b>	<b>15,763 MW</b>	<b>8,228 MWa</b>	<b>2,063 MW</b>

<sup>1</sup> Includes biomass, coal, geothermal, hydro, petroleum, solar

<sup>2</sup> Since 1980

<sup>3</sup> Since 1999