Update on Plug-in Electric Vehicles and Data Centers

November 18th webinar

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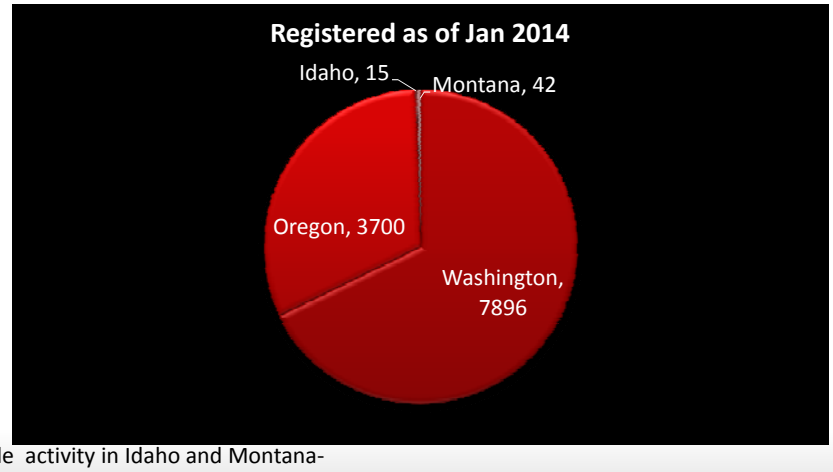
Plug-in Vehicles

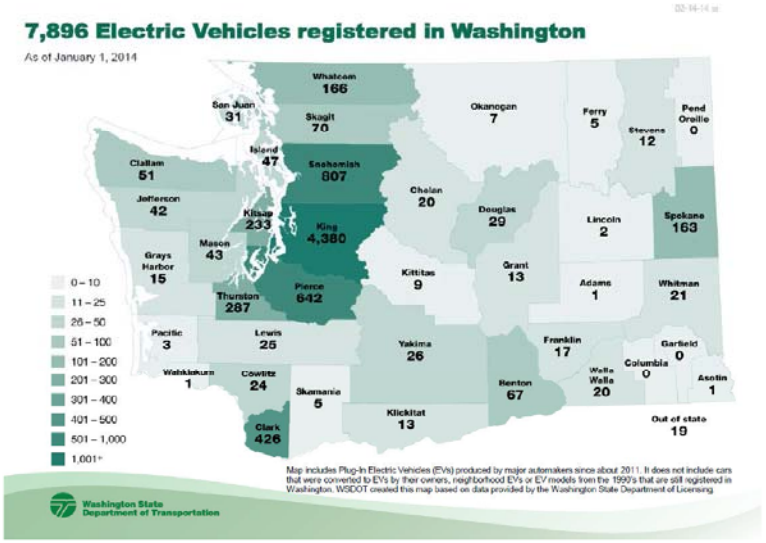
- In the 6th Power Plan, Plug-in electric vehicles were treated as a sensitivity.
- Loads were not included in the resource selection analysis.
- In the seventh Plan, PHEV loads will be included in the regional load forecast.

Number of Registered PHEVs are an small fraction of total new vehicles

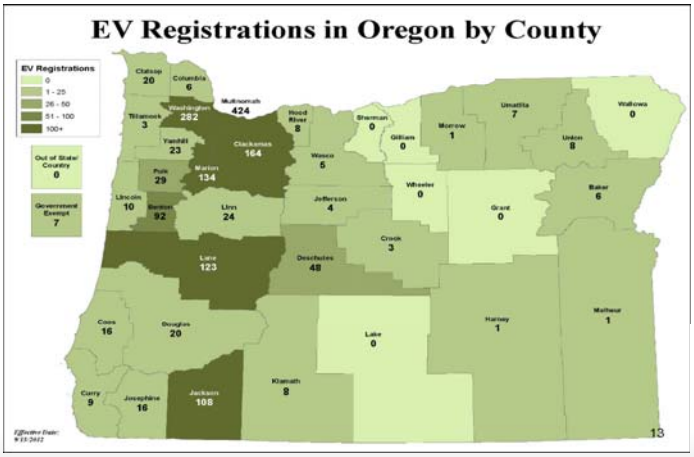


Little activity in Idaho and Montana-
we have lowered the forecast for PHEV in Idaho and Montana by 50%

Greater penetration in Urban markets



By the end of 2013 there were about 3700 EV registered in Oregon



Map as of 2012.

EV project Results Nationwide

As of Q2 2013

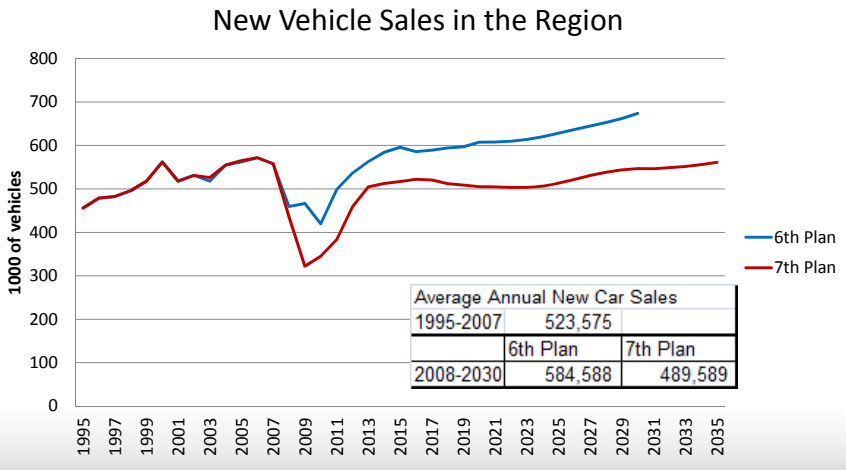
- 93 million miles since inception
- 24,000 MWH power consumption
- 0.26 KWH/mile or
- 3900 Miles per MWH
- Almost 3 million charging events
- Average Daily Distance Traveled
  - Washington.. Leaf 28 and Volt 38 miles
  - Oregon.... Leaf and volt about 24 miles
- EV projects showed that KWH/mile usage is less than was forecasted.

Draft - Subject to change

Methodology for Forecast of Load Impact from PHEVs

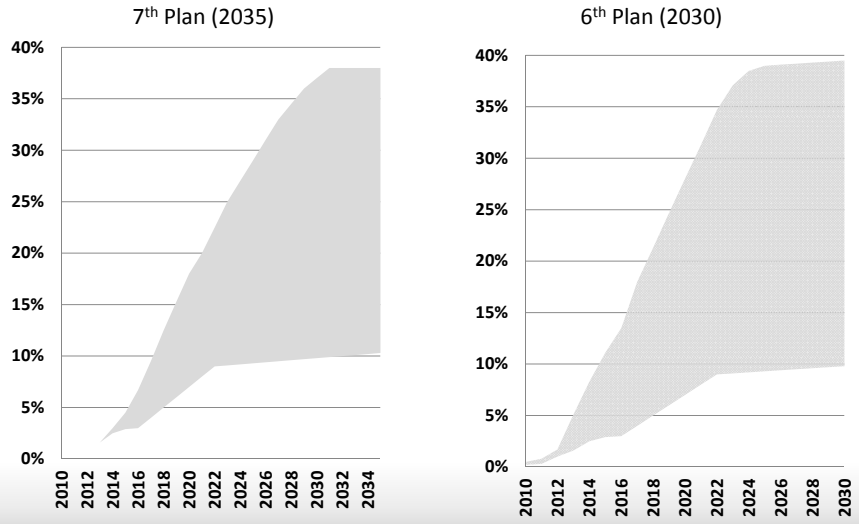
- Start with forecast of new vehicle purchases (IHS-Global Insight)~lower forecast than 6P
- Assumed penetration rates for PHEV
  - Idaho and Montana assumption set at ½ of Oregon and Washington (greater penetration in urban area)
- Used EV project results on KWH/mile and charging behavior. 0.26kwh/mile
- Incorporated efficiency gains assumed in the national models ~2% per year.

Forecast of new vehicles sales has gone down significantly



Source :IHS-Global Insight

Projected Market Share of PHEVs (Oregon and Washington)*



Northwest Power and Conservation Council

*Market shares in Idaho and Montana set to half the above .

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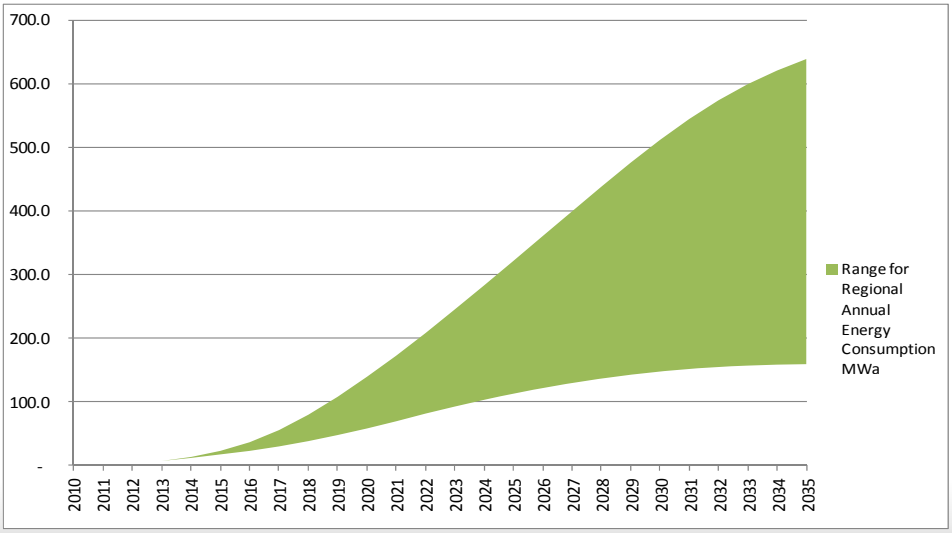
SEVENTH NORTHWEST POWER PLAN

Projected Impact on Annual Load (MWa)



Northwest Power and Conservation Council

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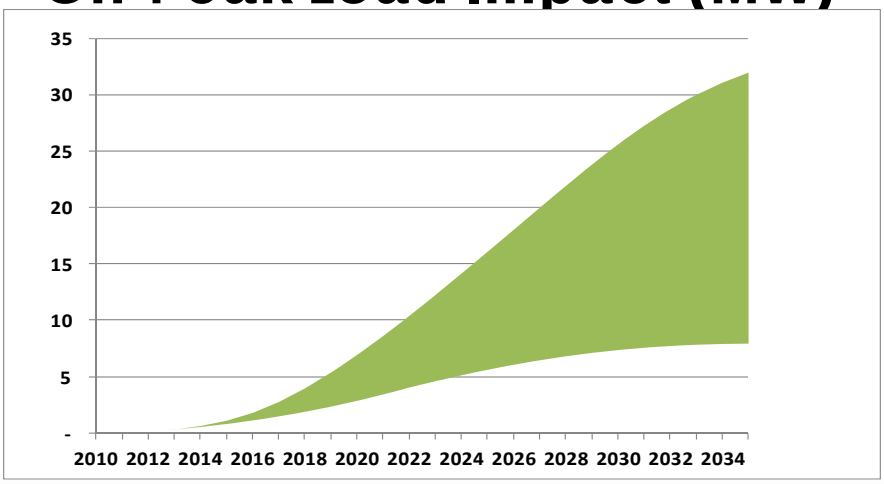
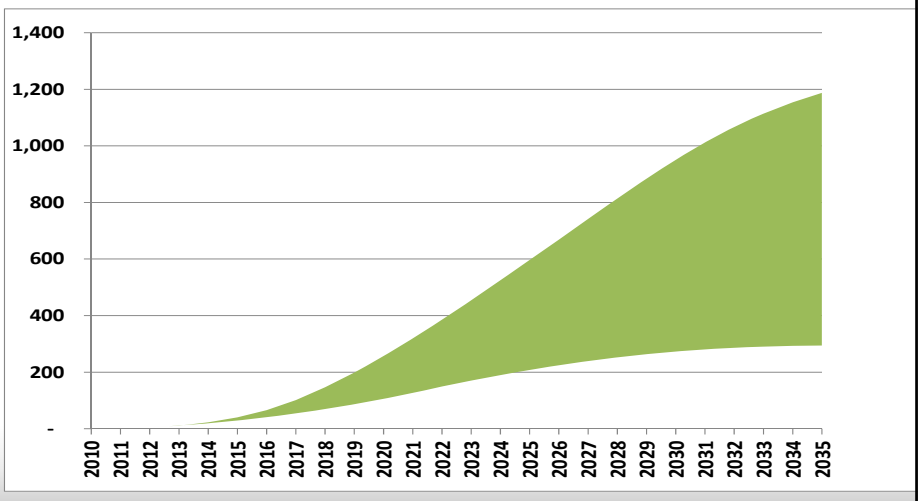
SEVENTH NORTHWEST POWER PLAN

On-Peak Load Impact (MW)



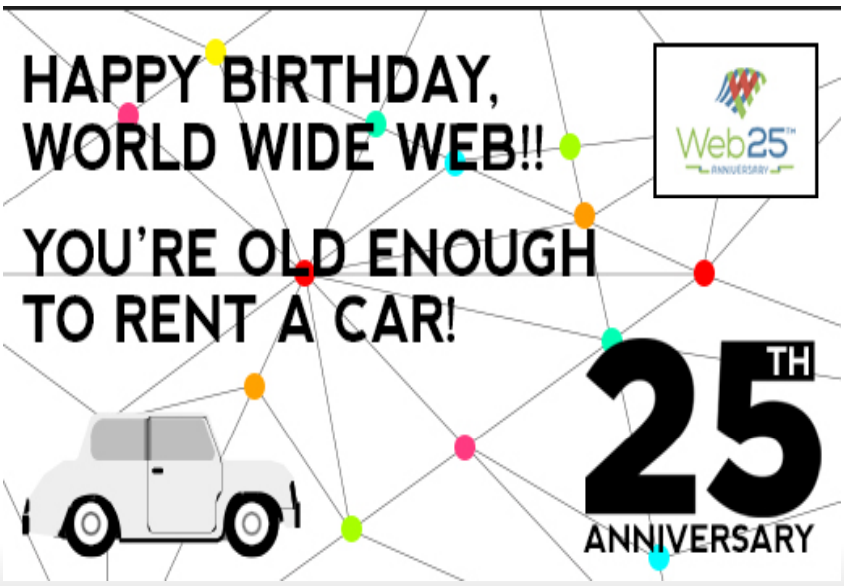
Off-peak Load Impact (MW)



In Summary

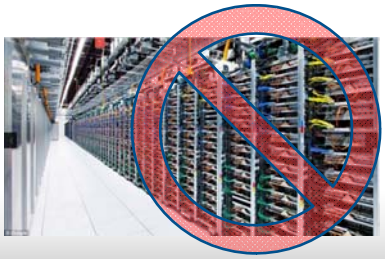
- EV project experience shows lower than expected KWH/Mile.
- Forecast of new vehicles sales and PHEV sales significantly lower than the 6th Plan.

Data Centers



- Embedded Data Centers
- Transition to Cloud
  - Internet of things
- Large cloud data centers

Data Centers within Commercial Buildings Exclude Dedicated DC Buildings



Embedded Data Center Project

- Contract to build model of Embedded DC
  - Load & Conservation Potential
  - Contractor: Cadmus & Eric Masanet
- Based on preliminary CBSA data 2013
  - Included key data on DC characteristics
- Functional model based on 2011 study
  - Masanet, E., Brown, R.E., Shehabi, A., Koomey, J.G., and B. Nordman (IEEE 2011)

CBSA Findings*

- One-third of buildings had Embedded Data Centers
  - 230 buildings with 260 EDC out of 750 sites sampled
- ENERGY STAR servers about 36%
- Virtualization
  - 35% of Embedded DC use some
  - 21% virtualized overall
- Cooling system type & capacity
  - About 50% EDC on dedicated cooling systems

* Preliminary: Based on preliminary CBSA data. Will update

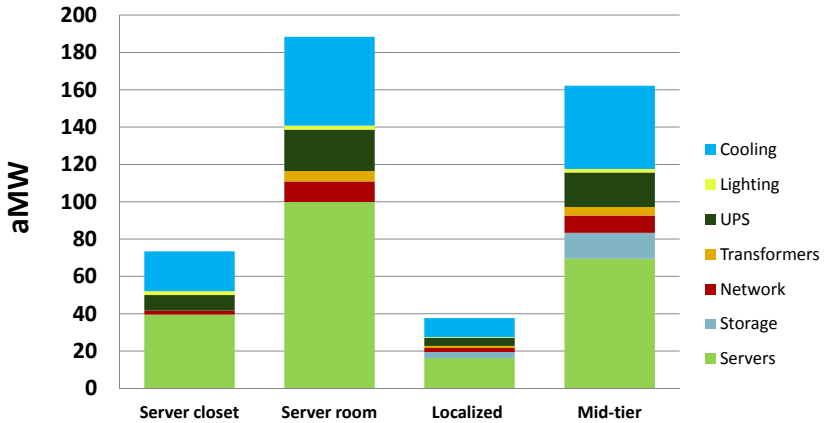
Preliminary Model Results

Estimated Count of Data Centers

Size Description	Minimum Size SF	Maximum Size SF	Number of Data Centers in PNW
Server closet	0	99	21,000*
Server room	100	749	22,000*
Localized data center	750	1,999	900*
Mid-tier data center	2,000	19,999	600*
Co-Location	2,000	19,999	70
Enterprise	20,000	Max	15

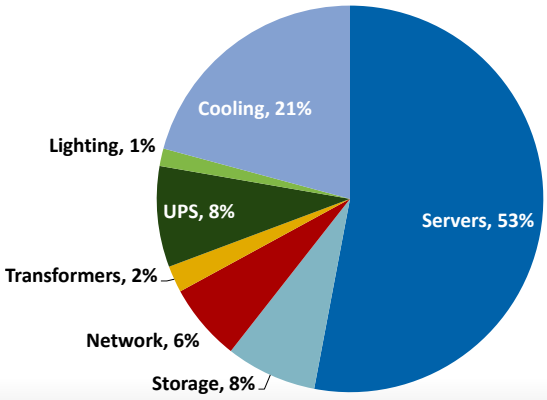
* Preliminary: Based on preliminary CBSA data. Will update

2014 Estimated Demand From Embedded Data Centers in the NW ~460 MWa Total *



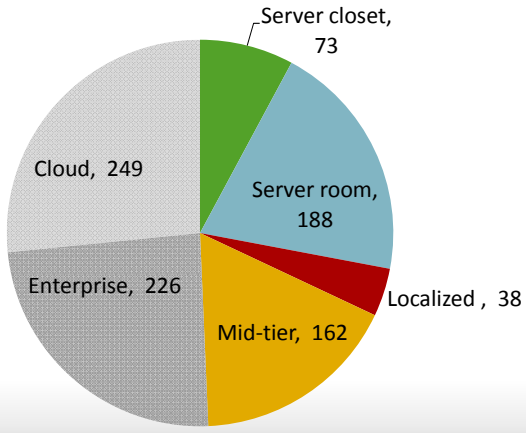
*Subject to change, as improved CBSA data comes in

Breakdown of Typical DC load



Embedded Data Centers Account for Half the Load

930 MWa Total 2014



Drivers of Embedded Data Center Energy Use

- Demand for IT service growing fast
- IT device efficiency growing faster

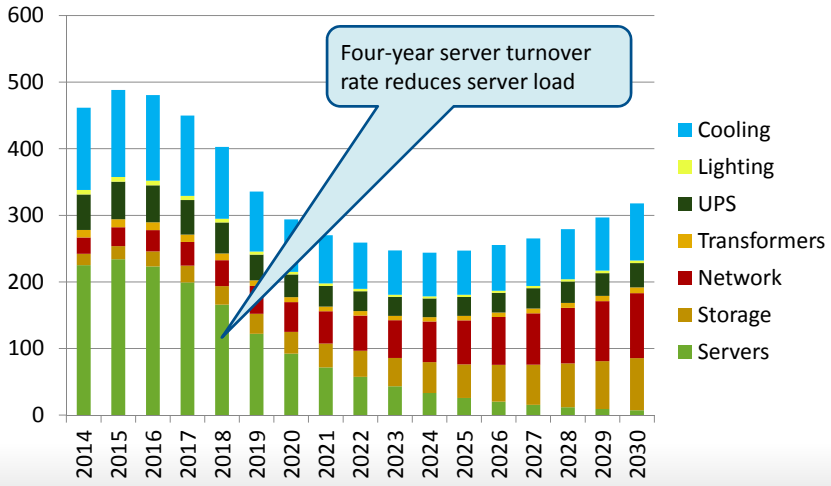
IT Traffic Drivers

Traffic type	Compound Annual Growth Rate (2013-2018)
All IP traffic	20%
Internet video traffic	27%
Web, email, and data traffic	16%
File sharing traffic	8%
Business IP traffic	20%

Cadmus Model Uses This

Source: Cisco 2014

Projected Growth in Embedded Data Center Loads
Business-as-Usual – Embedded Data Centers

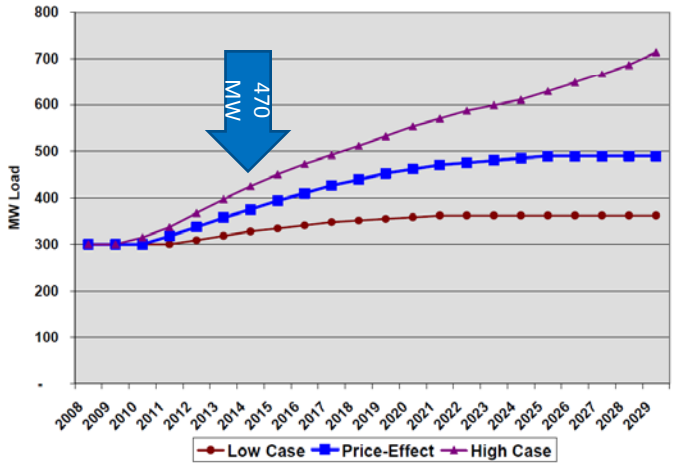


Large Data Center Updates

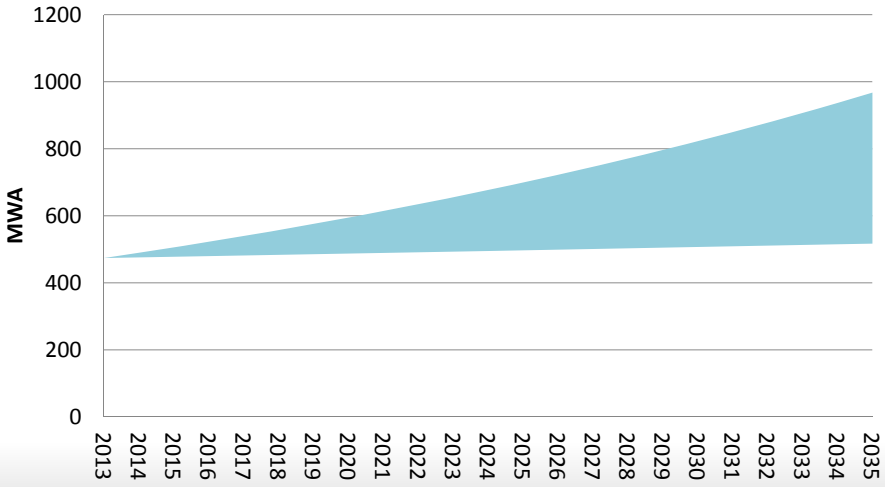
- Incorporated new load data from utilities
- Refined estimates of number, capacity and capacity utilization factors for co-locator data centers in state of Washington which has largest number of co-locators.

Comparison of 6th plan Forecast and Actual loads for Colocation and Enterprise DCs

Figure C-10: Projected Load (MW) from Custom Data Centers



Proposed Forecast of Loads for Large Data Centers



Summary

- PHEV can present a significant addition to regional off peak loads
- Although demand for data center services are increasing significantly, greater improvement in delivery of services can lead to reduction in current loads from embedded data centers.
- Load for large data centers are expected to increase.

Questions?