Demand Forecast Advisory Committee Meeting 3 in Preparation for the Seventh Power Plan

November 7th , 2014

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Charlie Grist
Steve Simmons

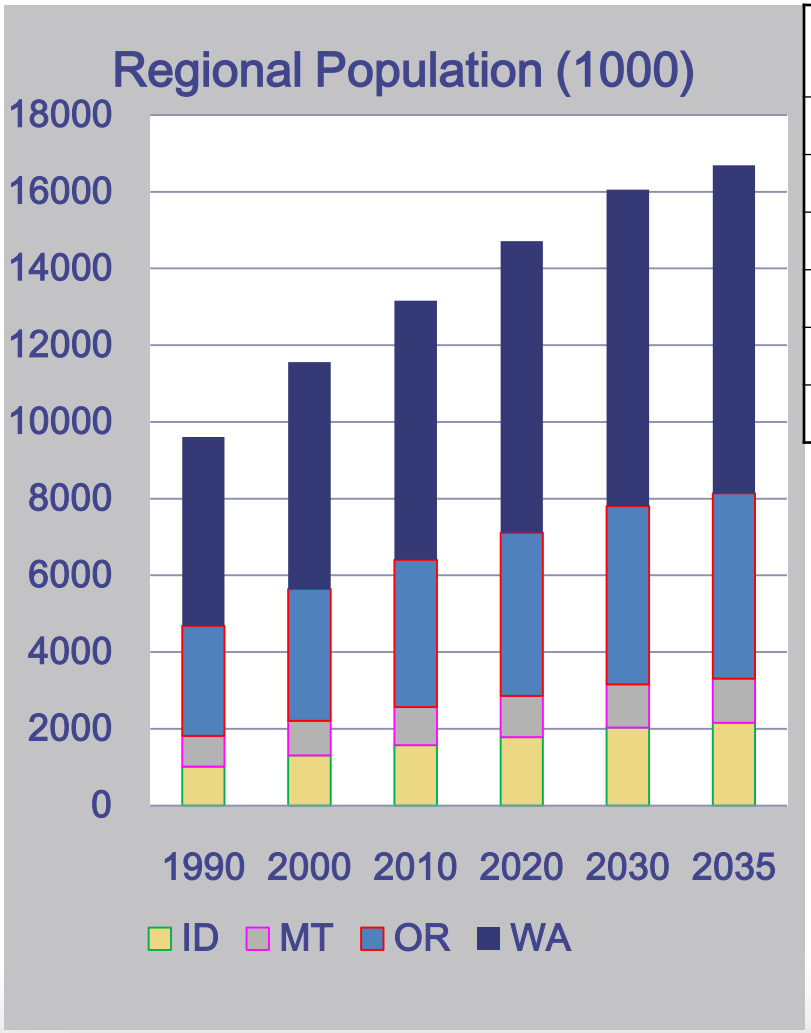
Draft Agenda

- Welcome and introductions
- Review of Agenda — 9:00 to 9:05
- Review of components of preliminary load forecast — 9:05 to 10:20
  - Review of Economic Drivers- July 2013
  - Review of Federal Standards- June 2014 – Charlie Grist
  - Miscellaneous end-uses
  - Rooftop Solar – Charlie Grist
  - Electric Vehicles
  - In-door Ag – Washington I502/Oregon
  - Data Centers
- Break — 10:20-10:30
- Discussion on preliminary load forecast — 10:30-11:55
  - To Freeze or not to Freeze or when to Freeze- Charlie Grist
  - Draft Sector level forecasts
  - Forecast Range
- Next steps/ Next meeting — 11:55 to 12:00

Key Demographic and Economic Drivers

- Population growth
- Business drivers
  - New homes
  - Commercial floor space
  - Industrial output
- Natural Gas Prices

Regional Population



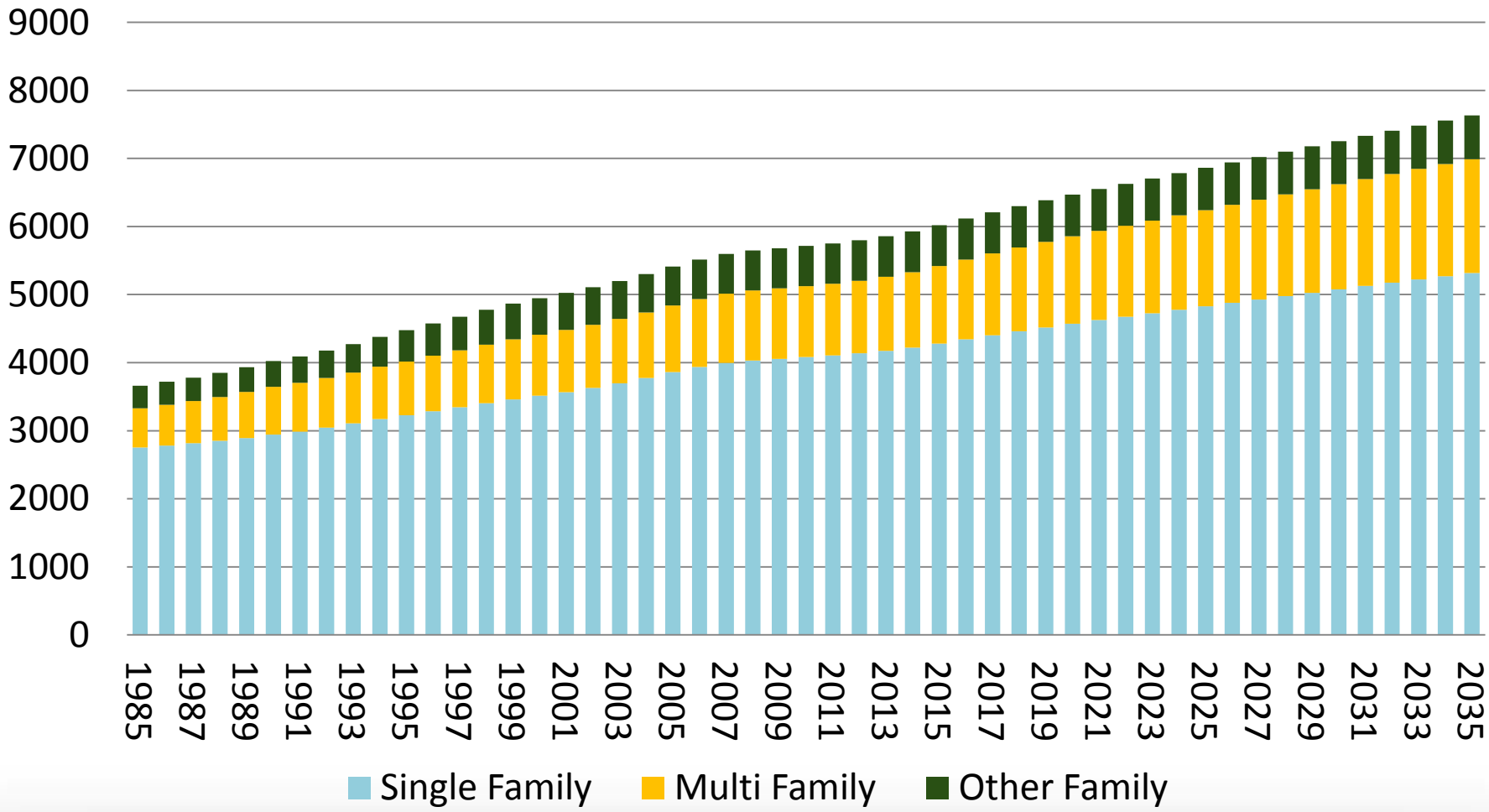
	1985-2014	2015-2035
ID	1.73%	1.30%
MT	0.77%	0.50%
WA	1.64%	0.90%
OR	1.37%	0.80%
4 States	1.50%	0.90%
USA	1.03%	0.90%

Average Annual Addition to Population (1000)	1985-2015	2015-2035
ID	21	24
MT	7	6
WA	90	66
OR	43	34
4 States	162	130

Overall regional population growth projected to slow down.

Northwest population remains about 4% of national population.

Historic and forecasted Number of New Homes (1000)



•**Source: HIS_GI August 2014 state level forecast.**

Market share and annual Growth Rate for residential units

AAGR	2015-2020	2021-2035
Single Family	1.34%	1.00%
Multi Family	2.42%	1.75%
Other Family	0.35%	0.34%

Market share	1985	2015	2035
Single Family	**75%**	**71%**	**70%**
Multi Family	**16%**	**19%**	**22%**
Other Family	**9%**	**10%**	**8%**

Estimated Current Stock of Commercial Building *

	Estimated 2013 Commercial SQF (millions)				
Building type	Idaho	Montana	Oregon	Washington	Region
office	78	54	213	402	747
Retail	69	46	170	295	581
hospital	15	12	30	54	111
Elder care	24	18	69	106	217
Hotel	15	20	38	54	127
Restaurant	21	17	60	95	193
Grocery	17	14	43	51	147
K-12	34	24	66	146	268
University	34	27	93	167	321
Warehouse	38	23	91	137	290
Assembly	31	27	104	134	295
Other	7	3	25	19	55
Grand Total	383	286	1,003	1,681	3,352

Subject to change as CBSA data becomes available

Commercial Sector*

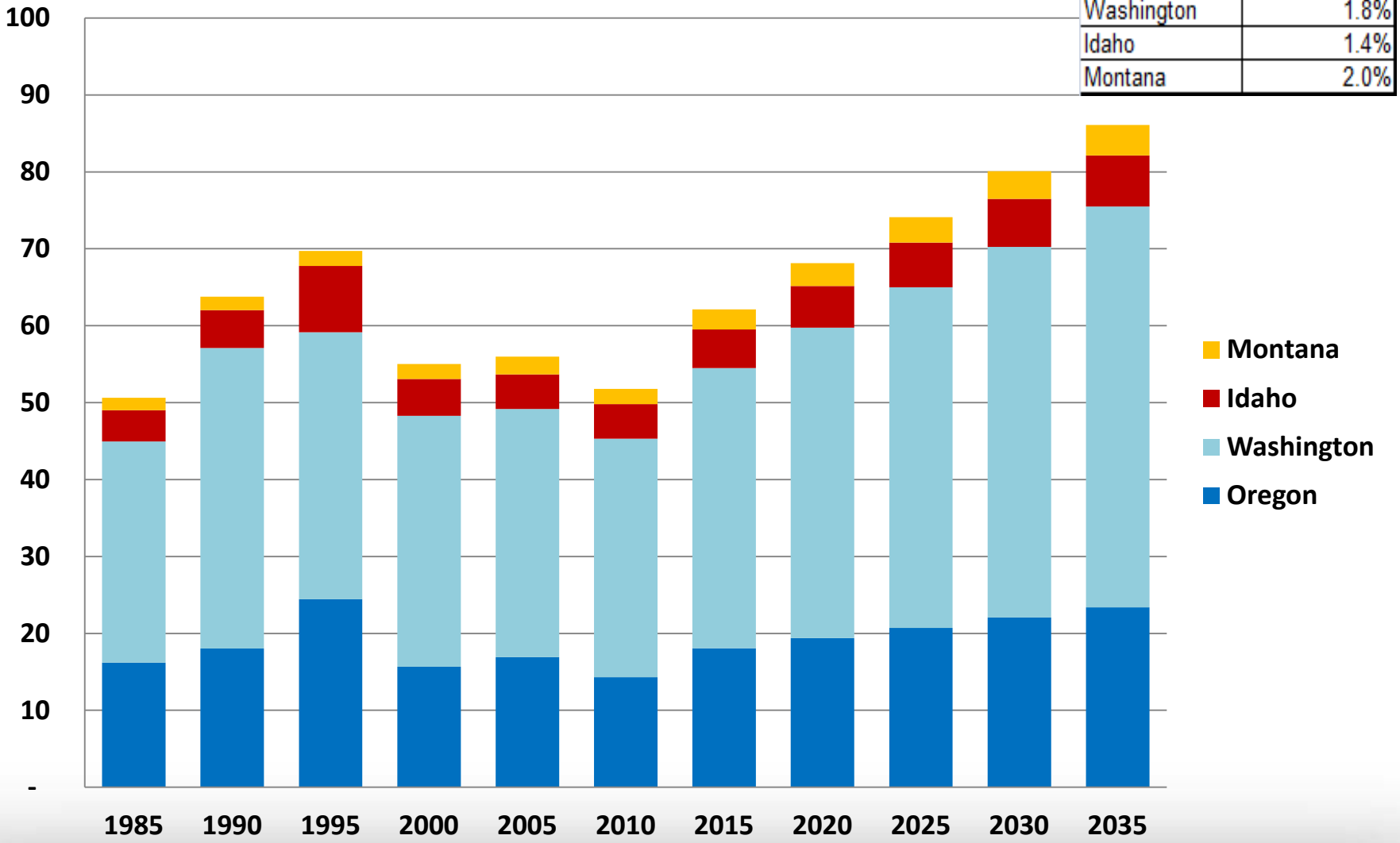
	Annual Growth Rate		
	2005-2011	2011-2020	2020-2035
Employment	0.8%	1.4%	0.6%
Floor space Stock Req.	0.4%	1.0%	0.5%

Millions of square Feet	Cumulative	Annual Average
1985-2011 Addition	1,406	52
2015-2035 Requirement	951	40

* Subject to change as Commercial Building Stock Assessment becomes available

Industrial Output (billions of 2012 dollars)

	2015-2035
Oregon	1.3%
Washington	1.8%
Idaho	1.4%
Montana	2.0%



•Source: GI March 2014 state level forecast, modified by state economists inputs and smoothed..

•Subject to change from finding from Industrial Facilities Site Assessment (IFSA)

Assumed aggregated Average Annual Growth Rate Across Scenarios

	Low	Med	High
Residential	**0.7%**	**1.1%**	**1.6%**
Commercial	**1.0%**	**1.2%**	**1.4%**
Industrial	**1.5%**	**1.6%**	**1.7%**
Agriculture	**0.5%**	**0.9%**	**1.3%**

Natural Gas Prices 2012$ and Nominal $

Proposed Henry Hub Price Forecasts as of July 2014			$2012/MMBTU
	Council L	Council M	Council H
2013	3.7	3.7	3.7
2014	3.9	4.7	4.9
2015	4.0	4.6	5.1
2020	3.9	5.0	6.0
2025	3.8	5.7	7.3
2030	3.5	6.6	8.9
2035	3.2	7.4	10.8
Average 2015-2035	3.8	5.8	7.5

Proposed Henry Hub Price Forecasts as of July 2014			Nominal Dollars
	Council L	Council M	Council H
2014	4.0	4.9	5.1
2015	4.2	4.8	5.3
2020	4.4	5.7	6.8
2025	4.7	7.1	9.1
2030	4.7	8.9	12.0
2035	4.7	11.0	16.0
Average 2015-2035	5.7	8.7	11.4

Feedback

- Do the current key drivers seem reasonable?
- Are we missing an important driver?
- Are we missing economic trends?

Federal Standards

Federal Standards

- In our June 2014 meeting we discussed the many federal standards that have been activated and are going to be active during the forecast horizon.
- Currently there are minimum energy efficiency standards for more than 50 categories of appliances and equipment.
- Products covered by standards represent about 90% of home energy use, 60% of commercial building use, and 29% of industrial energy use.
- DOE must now review each product standard every six years to determine whether it should be revised

Implication for the Seventh Plan

- Compared to the Sixth Plan:
  - Load forecast is lower, particularly over the long term
  - Remaining conservation potential will be lower
    - But not as much lower as the load forecast, since standard impact all units, but conservation assessment assumes less than 100% program success
  - Conservation programs will need adjust their focus to measures less impacted by federal standards

Impact Analysis Focuses Analysis on These Standards

Residential

- Residential Dishwashers
- Residential Clothes Washers
- External Power Supply
- Residential Refrigerators and Freezers
- Residential Water Heater
- Residential Heat Pumps
- Torchieres
- Ceiling Fan Lighting Kits

Commercial/Industrial

- Walk-in Coolers and Freezers
- Commercial Refrigeration Products
- Commercial Clothes Washers
- Pre-rinse Spray Valve
- Commercial CAC and Heat Pumps
- Packaged Terminal AC and HP
- Illuminated Exit Signs
- Electric Motors
- Distribution Transformers

Lighting

- Metal Halide Lamp Fixtures
- Mercury Vapor Lamp Ballasts
- Fluorescent Lamp Ballasts
- General Service Fluorescent Lamps
- General Service Incandescent Lamps
- Incandescent Reflector Lamps
- Candelabra& Intermediate Base Incandescent Lamps
- Medium Base Compact Fluorescent Lamps
- High Intensity Discharge Lamps

Major Product Categories Covered by Federal Efficiency Standards

- Battery Chargers and External Power Supplies
- Ceiling Fan Light Kits
- Residential & Commercial Clothes Washers
- Commercial Ice Makers
- Commercial Packaged Air Conditioners and Heat Pumps
- Commercial Packaged Heating and Cooling Equipment
- Residential & Commercial Refrigerators & Freezers
- Commercial Warm Air Furnaces
- Residential & Commercial Water Heaters and Unfired Water Heater Tanks
- Compact Fluorescent Lamps
- Dehumidifiers
- Direct heating equipment
- Electric Motors
- Exit Signs
- General Service Fluorescent Lamps and Ballasts
- General Service Incandescent Lamps
- Incandescent Reflector Lamps
- Low & Medium Voltage Transformers
- Metal Halide Lamps Fixtures
- Pool heaters
- Refrigerated Beverage Vending Machines
- Residential Central Air Conditioners and Heat Pumps
- Residential Clothes Dryers
- Residential Dishwashers
- Residential Furnaces & Boilers
- Residential Ranges and Ovens
- Room Air Conditioners
- Single Packaged Vertical Air Conditioners and Heat Pumps
- Torchiers
- Traffic and Pedestrian Signal
- Walk-in Coolers and Walk-In Freezers

Estimated reduction from Loads due to standards*

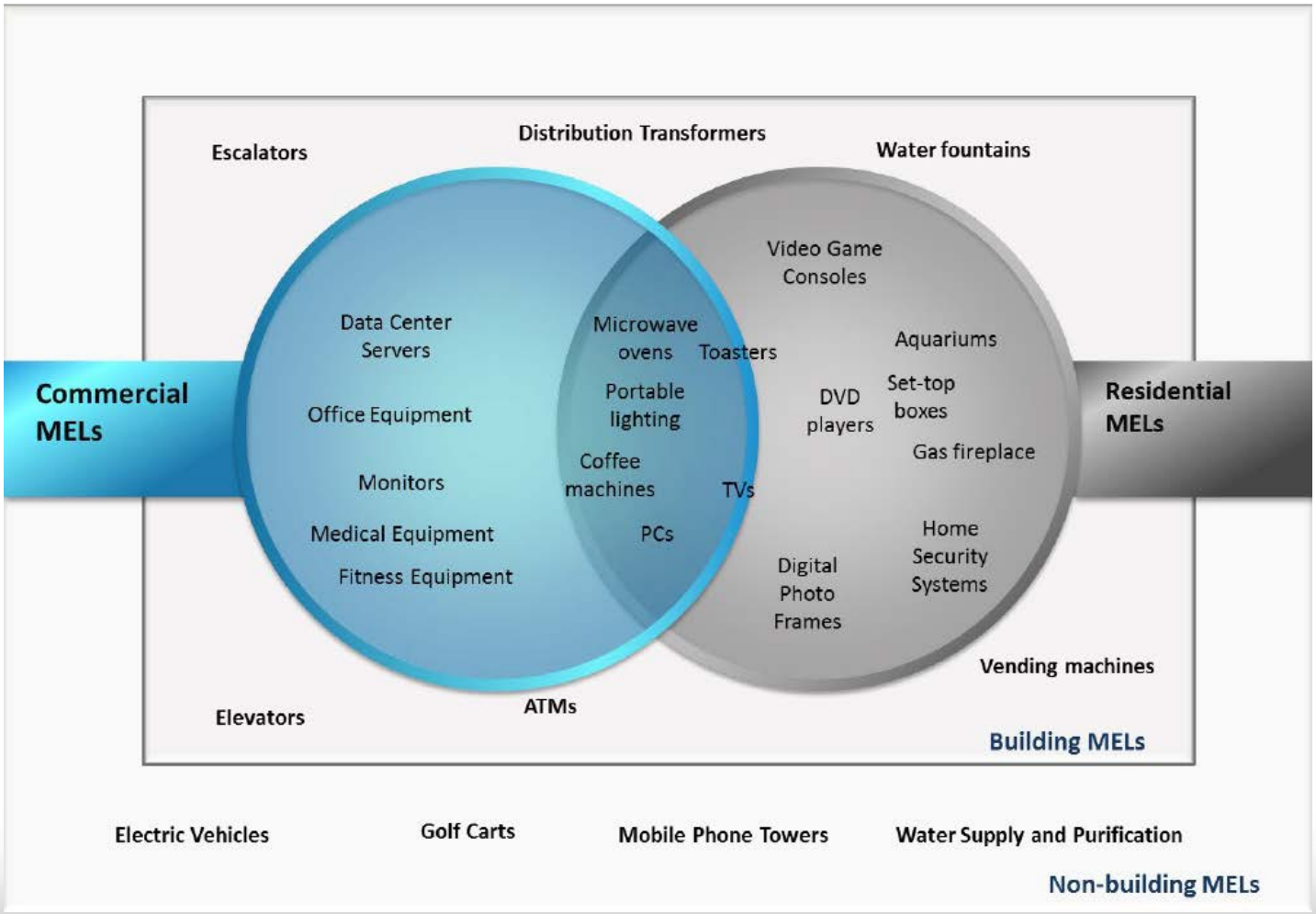
	2015	2020	2025	2030	2035
Peak MW	80	317	420	508	558
Average MW	66	245	327	396	433
Low load hours MW	28	121	164	202	224

*Excludes improvements in low and medium size transformer efficiencies ` ~200 MWa. Also excludes savings from Misc. appliances not modeled explicitly but were modeled in the MELS section. Savings starts in 2013. Impact of standards prior to 2013 not included.

Feedback

- How are you incorporating federal standards in your load forecast?

What Are MELs (Plug loads)?



Methodology for estimating Load for MELS

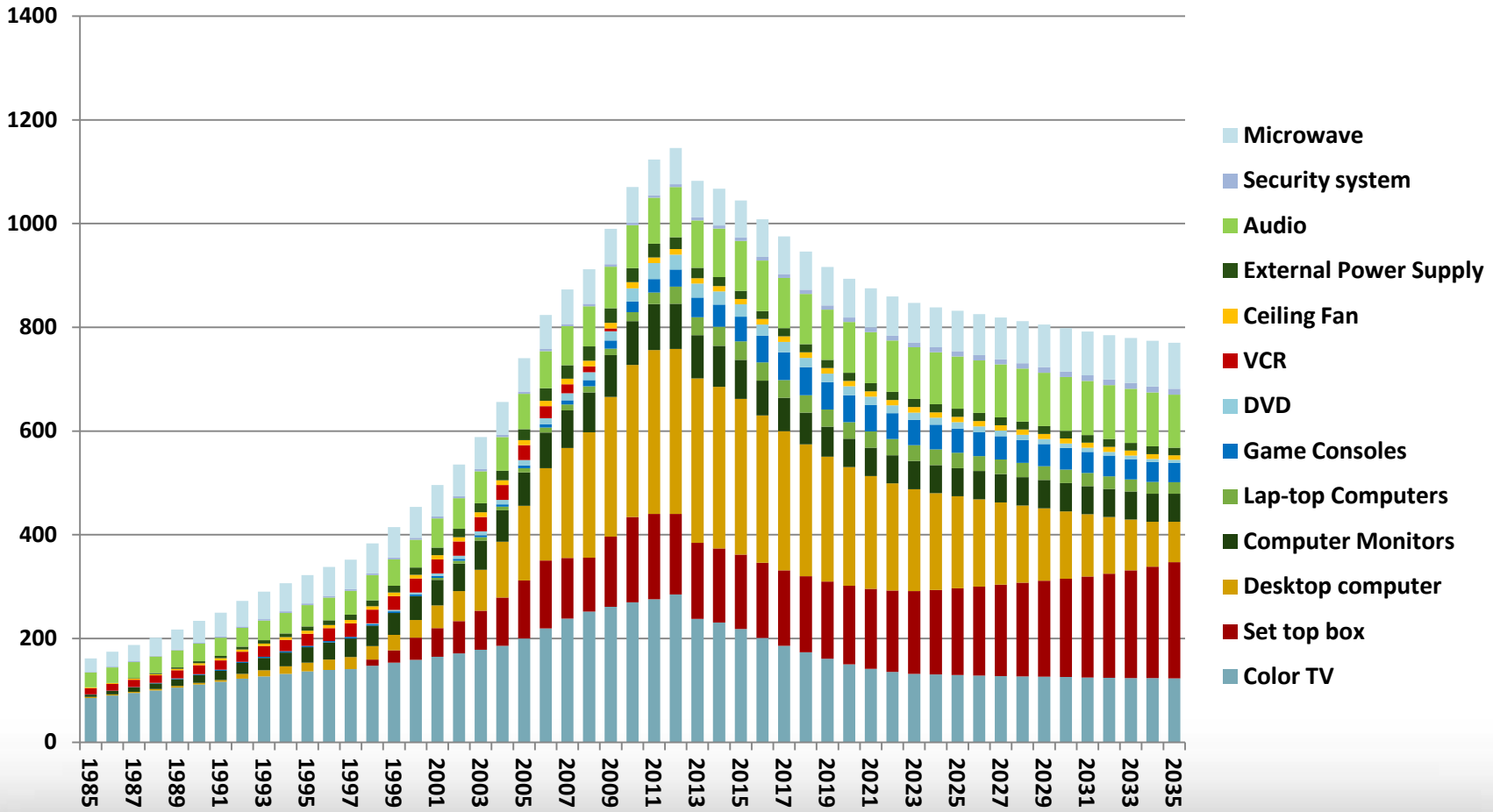
- We used the DOE report- “Analysis and representation of Miscellaneous Electric Loads in NEMS”- DEC 2013
- The national unit counts were scaled to the region.
- Marginal EUI and equipment lives were used to develop stock consumption levels.
- We estimated 1985-2035 loads for each enduse. The results is shown in the next slide.

Stock EUI *

National Average Stock EUI	1985	2000	2015	2030	2035
Color TV	141	141	162	75	69
Set-top box		111	119	80	77
Desktop Computers	49	51	195	82	49
Computer Monitor	97	97	80	57	57
Laptop computers	-	-	53	20	14
Game Consoles	24	17	98	45	33
DVD	-	19	23	15	12
VCR	58	58			
AUDIO	69	77	88	82	78
Ceiling fan	81	81	71	55	50
Security System	43	43	44	44	44
External Power Supplies	19	19	6	4	3
Microwave	131	124	117	110	110

EUIs modified by residence type (single, multi, other)

Estimated Past and Future Load from Residential MELS (MWA)



http://www.eia.gov/analysis/studies/demand/miscelectric/

Feedback

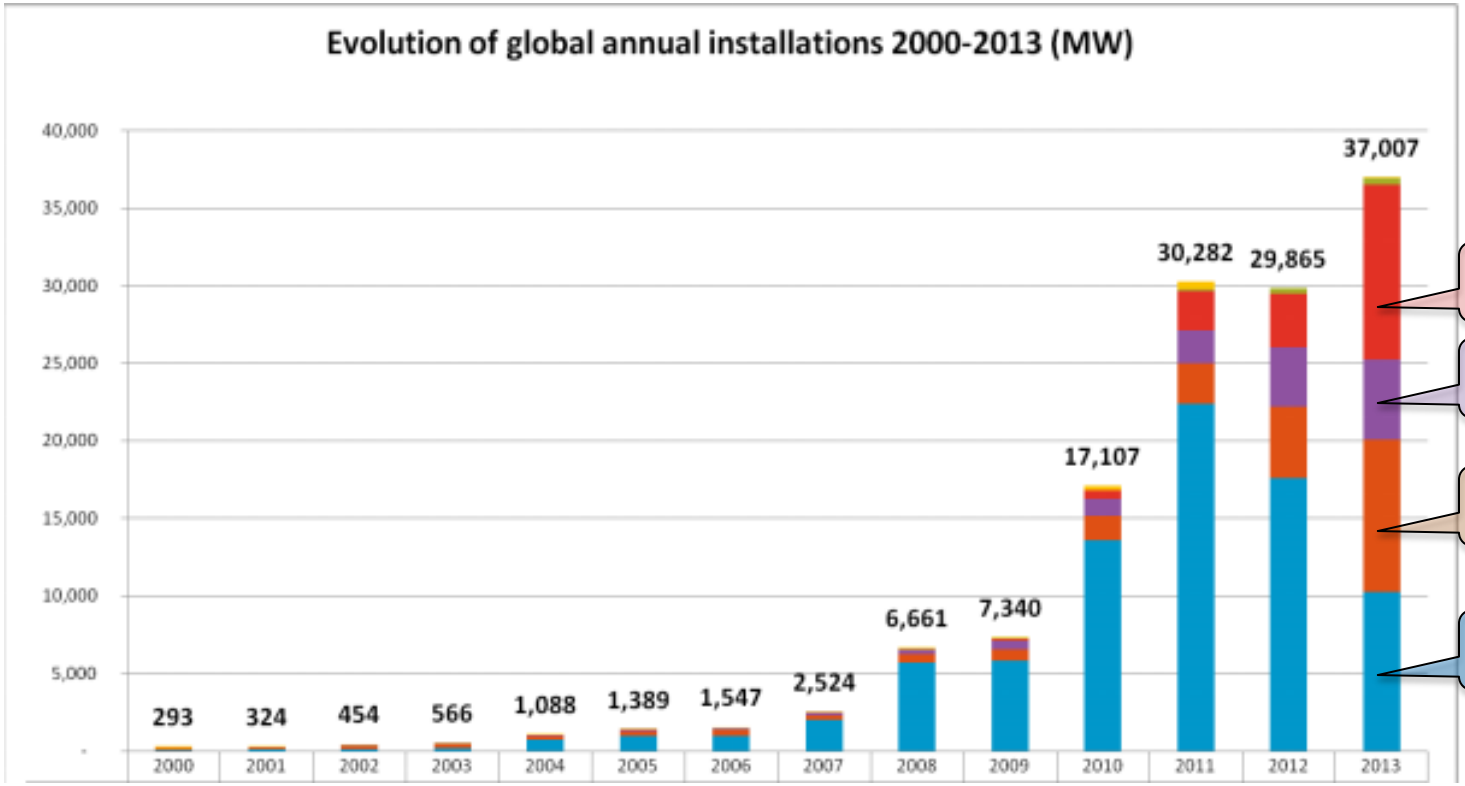
- How do you see the growth in plug-loads in your service area?
- Have you incorporated Ultra-HD in your forecast?

Roof-top Solar

Rooftop Solar Photovoltaic
Seventh Plan Approach to Analysis

November 7, 2014

A World Market

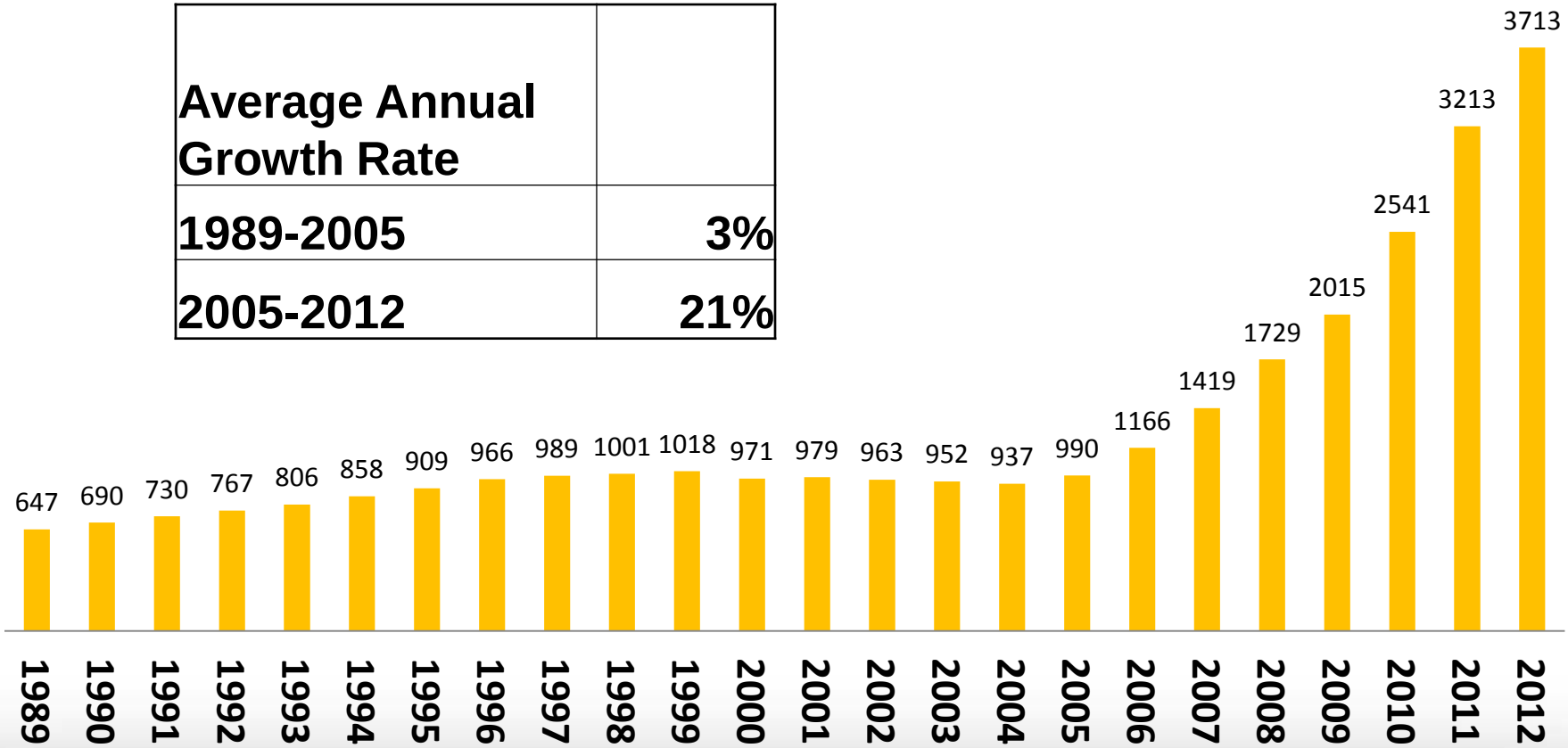


Source: European Photovoltaic Industry Association, Global Market Outlook 2014-2018

PNW Regional Energy Production by Rooftop Solar (Trillion Btu)

Source EIA : State Energy Data System

Average Annual Growth Rate	
1989-2005	3%
2005-2012	21%



By 2012 over 10,000 Utility Customers Installed 66 MW of PV Capacity (MW) Selling back about 1 MWa of Power

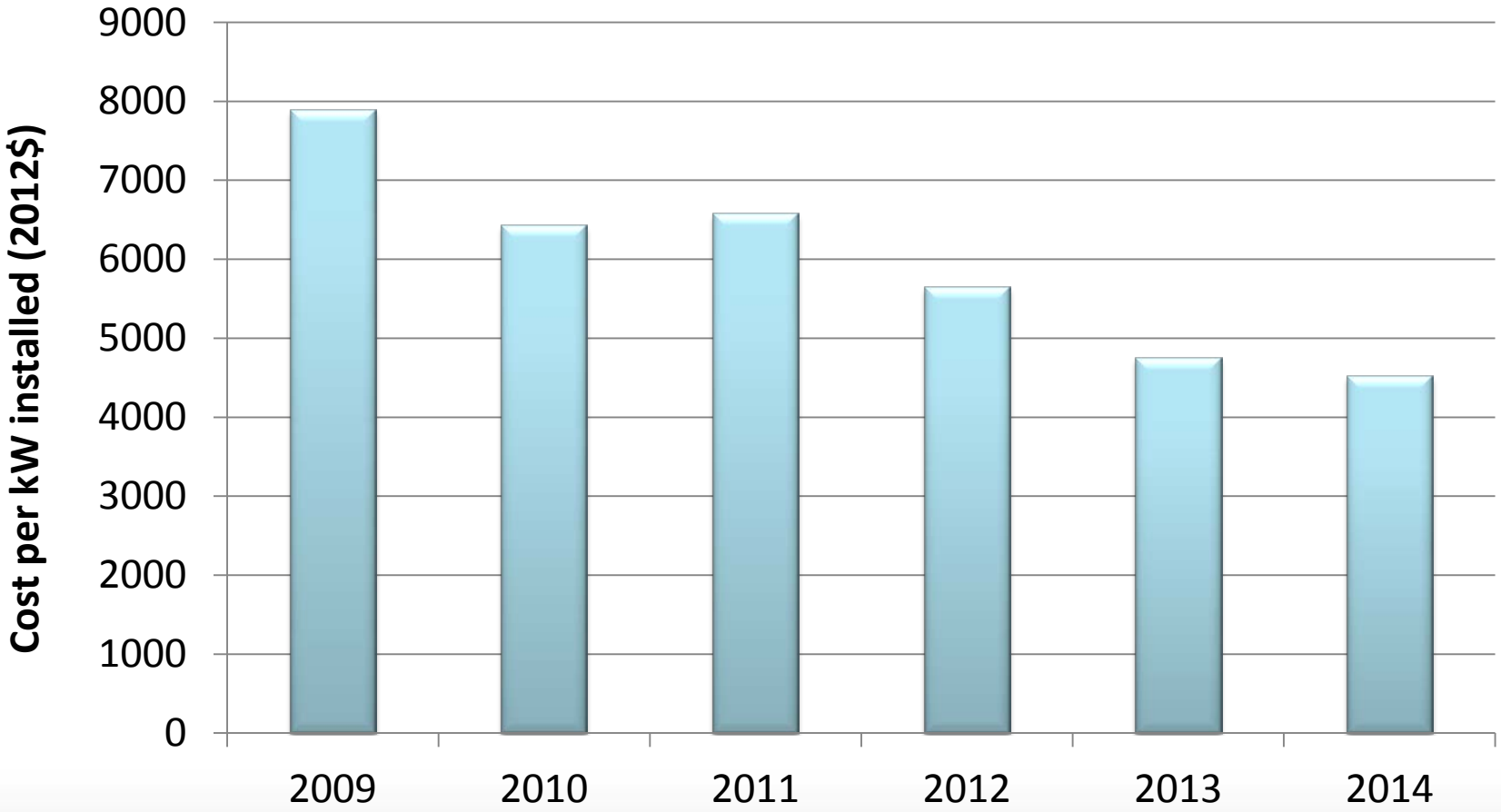
	Net Metering Customer Count	Capacity Installed (MW)	MWh of Power Sold back to utility
Idaho	349	2	2
Montana	1,010	4	122
Oregon*	6,269	43	8,687
Washington	3,222	17	932
Region	10,850	66	9,742

Source: EIA 861 annual Utility Net metering data

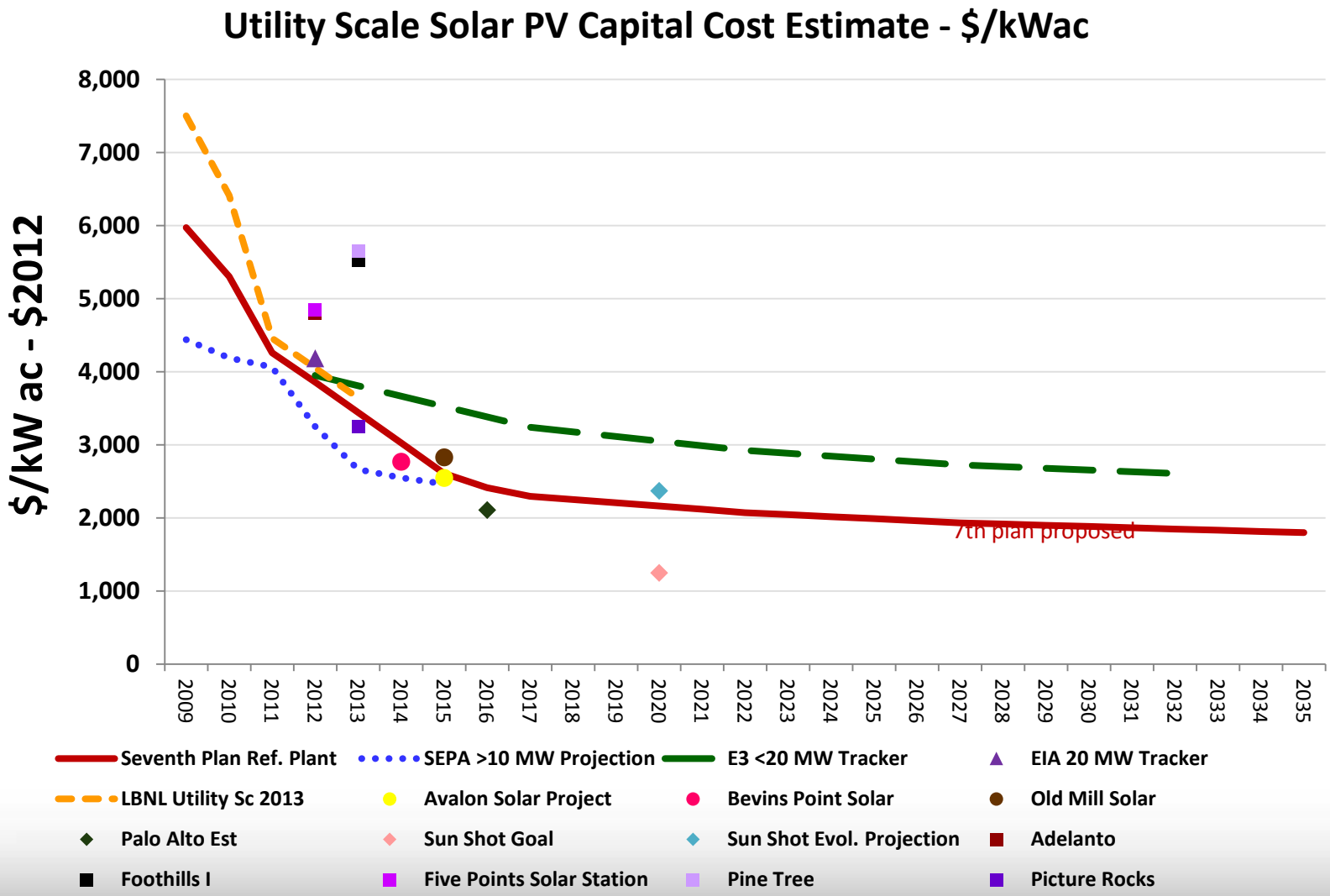
*OPUC's reports that by 2013 about 8000 customers in Oregon are on net-metering.

Installed Cost Falling

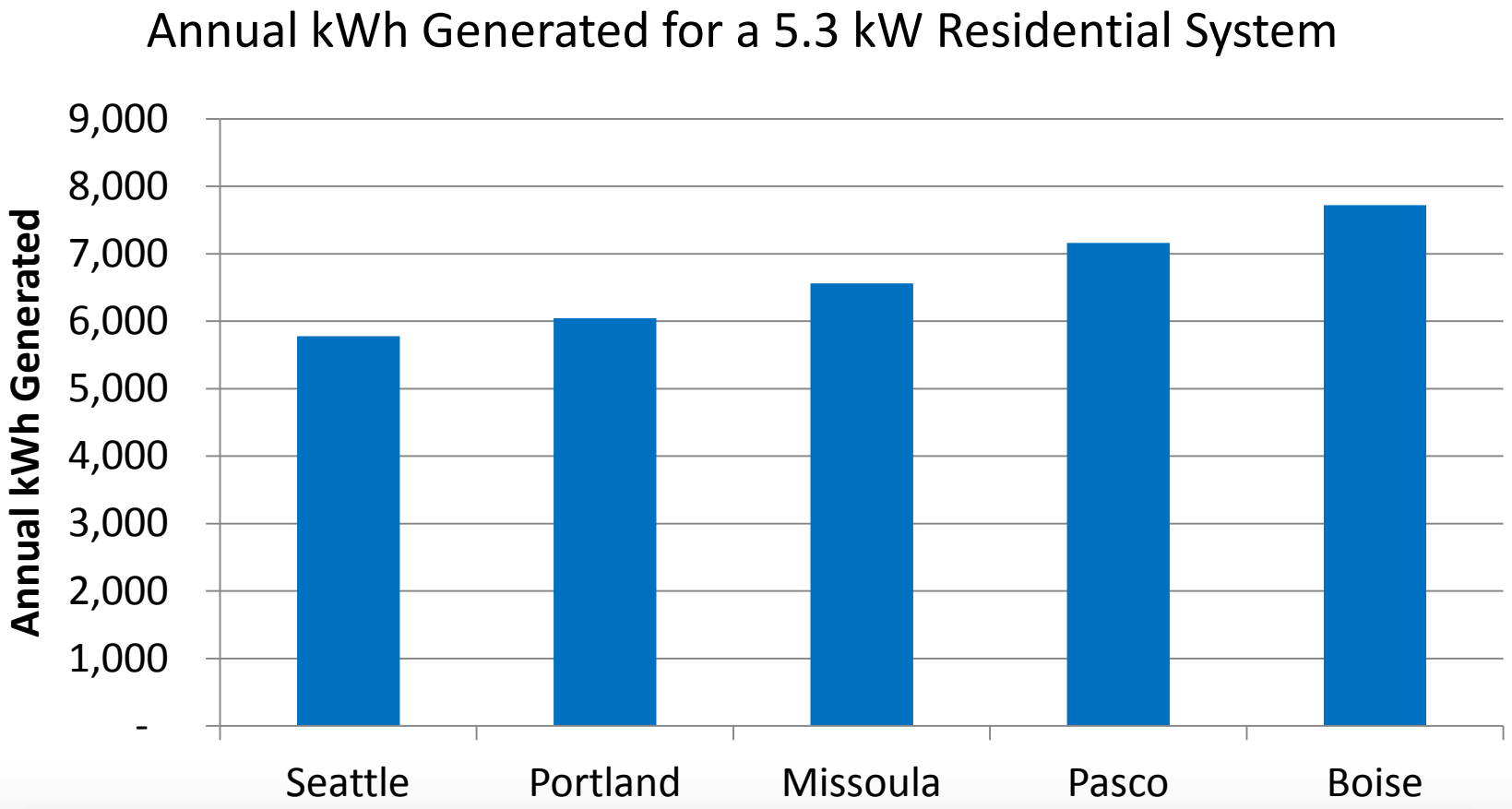
Energy Trust of Oregon Program Data



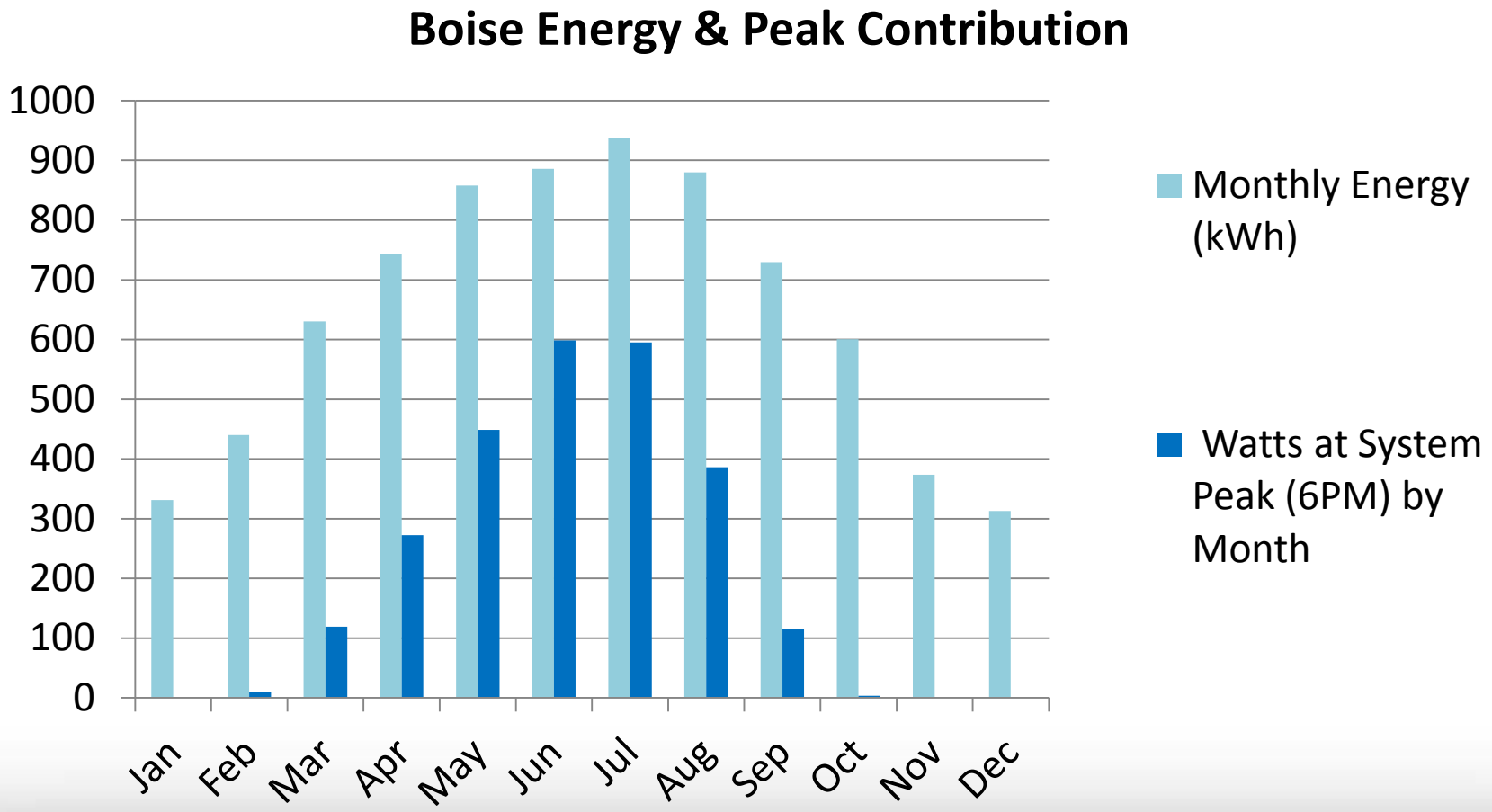
Many Forecasts Indicate Cost Declines



Location Matters:
More Sun Means More Energy Produced



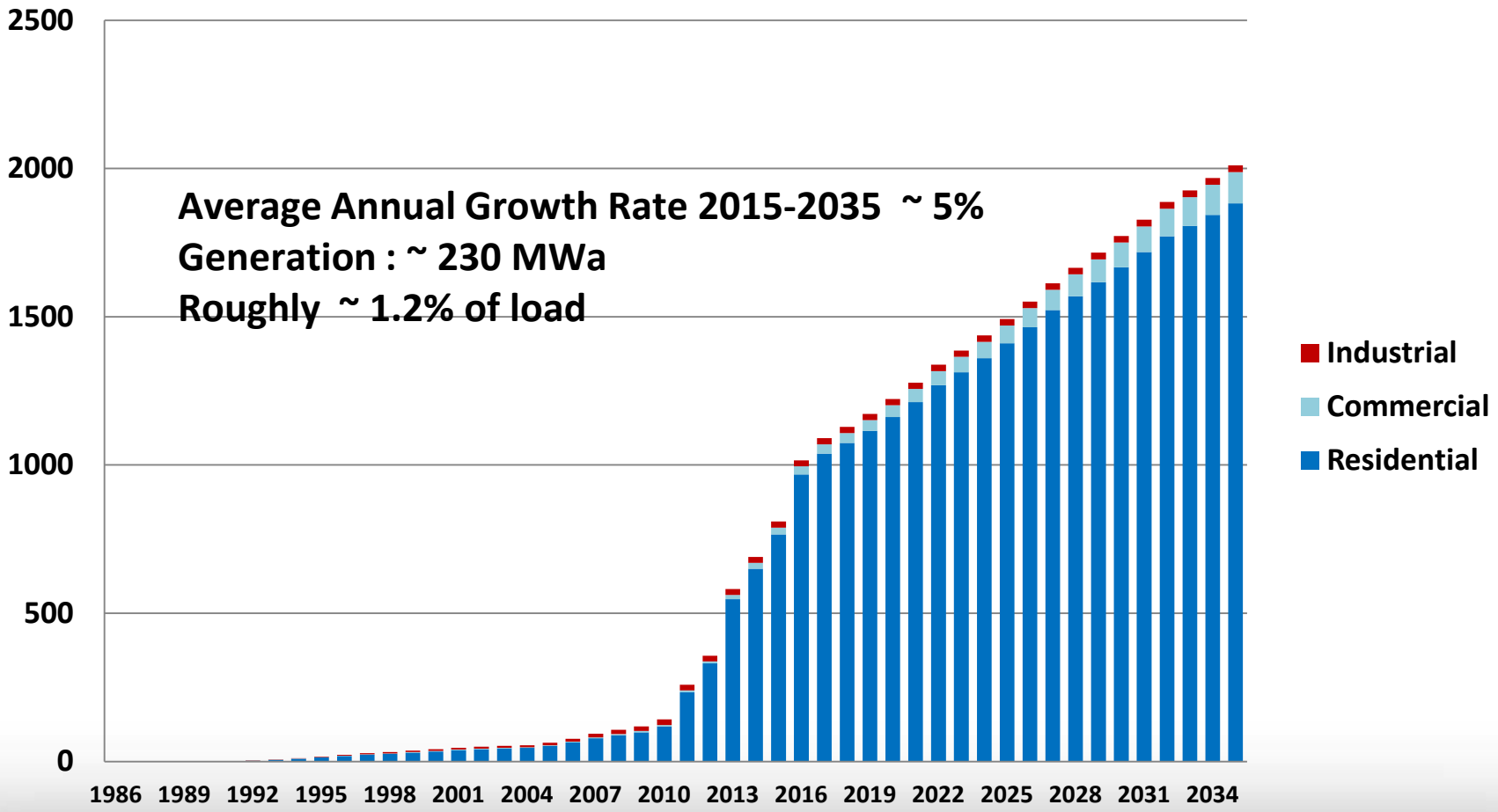
NREL Solar Calculator Used to Shape Energy & Peak Impacts



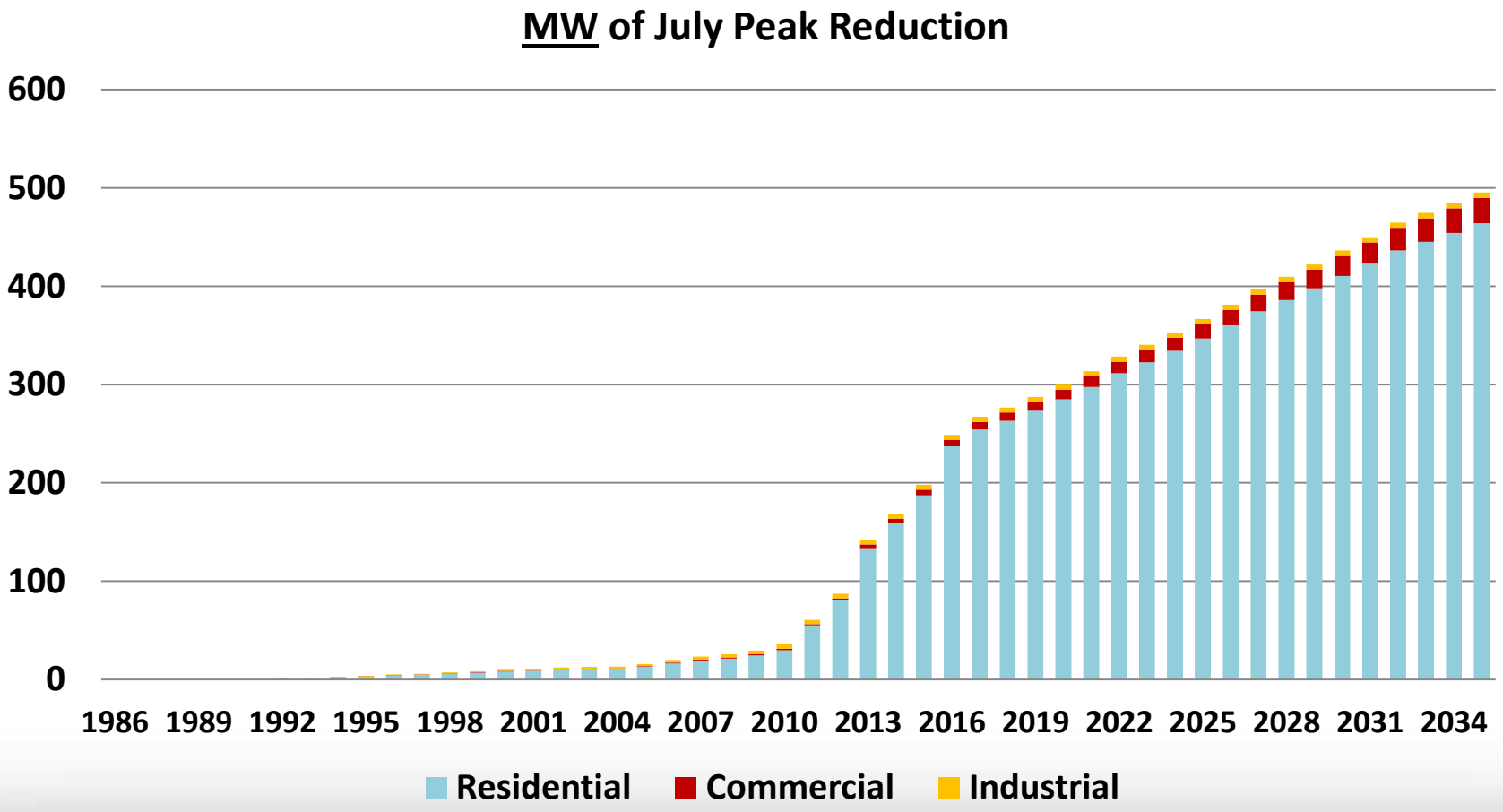
Forecast Long-Term Adoption (Business as Usual Case)

- Council's long-term load forecast model estimates consumer PV adoption rates
- Estimated for all sectors
  - Historical PV adoption trends (1985-2012)
  - Forecast retail power rates
  - Solar PV costs & performance
  - Both energy and peak impacts
- Forecast load reduced by forecast adoption of PV
  - Initial estimates: Consumer side-PV generation supplies 0.5-2.0% of regional electric load by 2035

Preliminary -Projection of Roof-top Solar PV Generation (GWH)



Preliminary- Roof-top Solar PV Generation Coincident with July System Peak



Solar PV Not Adopted in Forecast Model Remains As Resource Option

- Estimate Remaining Resource Potential
  - Number of homes & businesses
  - Average capacity per home or business
  - Adjust for orientation & shading
  - Minus forecast adoption in load forecast
- Cost per MWh Based on Forecast Cost
- Add to Supply Curves of Resource Potential

Summary: Approach for Seventh Plan

1) Estimate Roof top Solar PV System Cost
   - Use recent cost data from Energy Trust of Oregon
   - By solar zone, residential & commercial applications
2) Forecast Changes in Cost & Performance
   - Use same cost curve decline as utility scale
   - Apply to rooftop prices
3) Forecast Long-term Adoption Rate of Rooftop Solar
   - Long-term forecast model based on historical adoption
   - Business as usual case
4) Estimate Remaining Resource Potential
   - Number of homes & businesses
   - Fraction applicable (adjust for orientation & shading)
   - Minus forecast market uptake
5) Add to supply curves by year for RPM

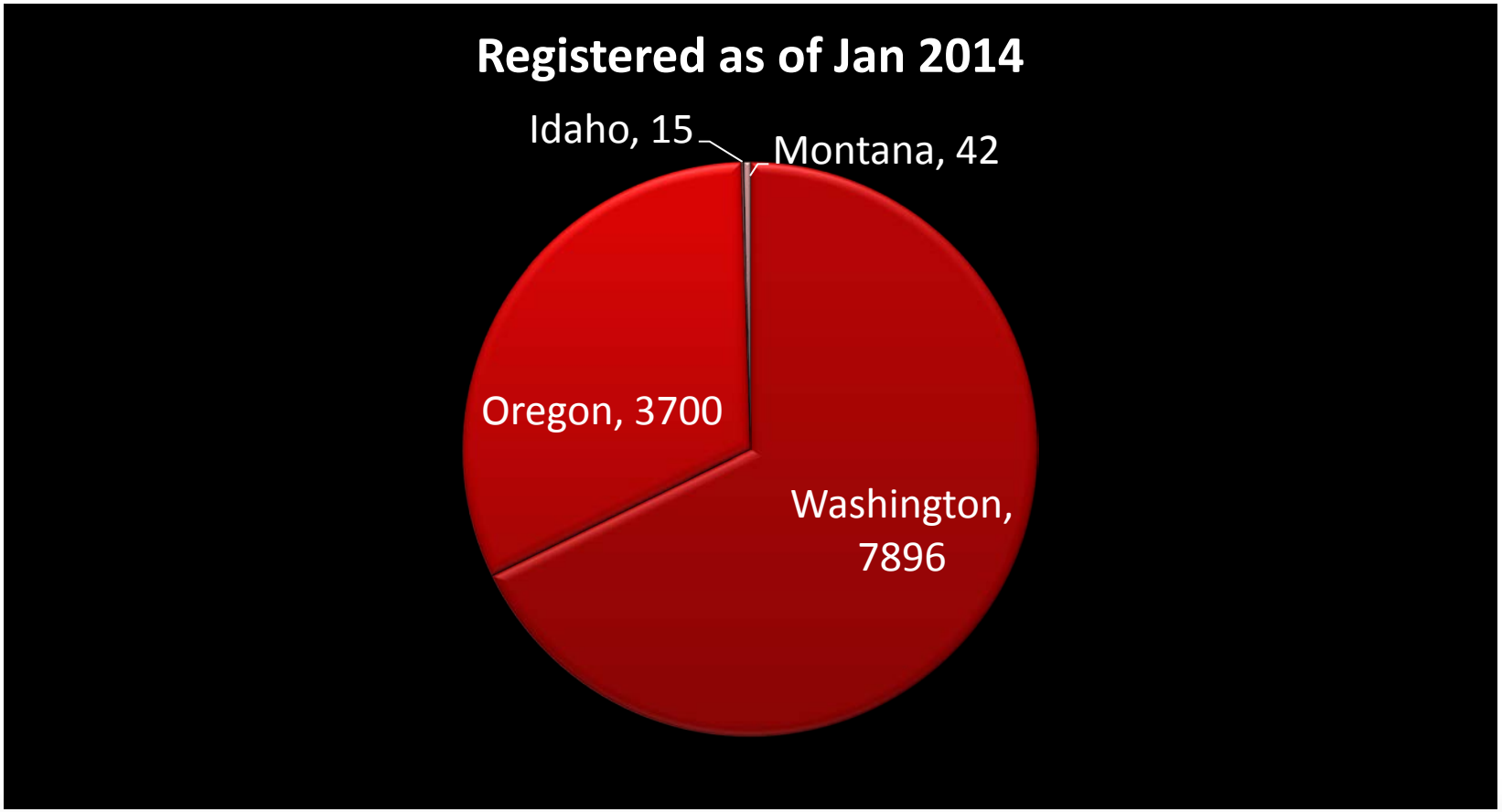
Feedback

- How do you see growth in Solar PV in your service area?
- Is there an integration cost in your utility for roof-top solar installations? How much is it? $/mwh ?

Plug-in Vehicles

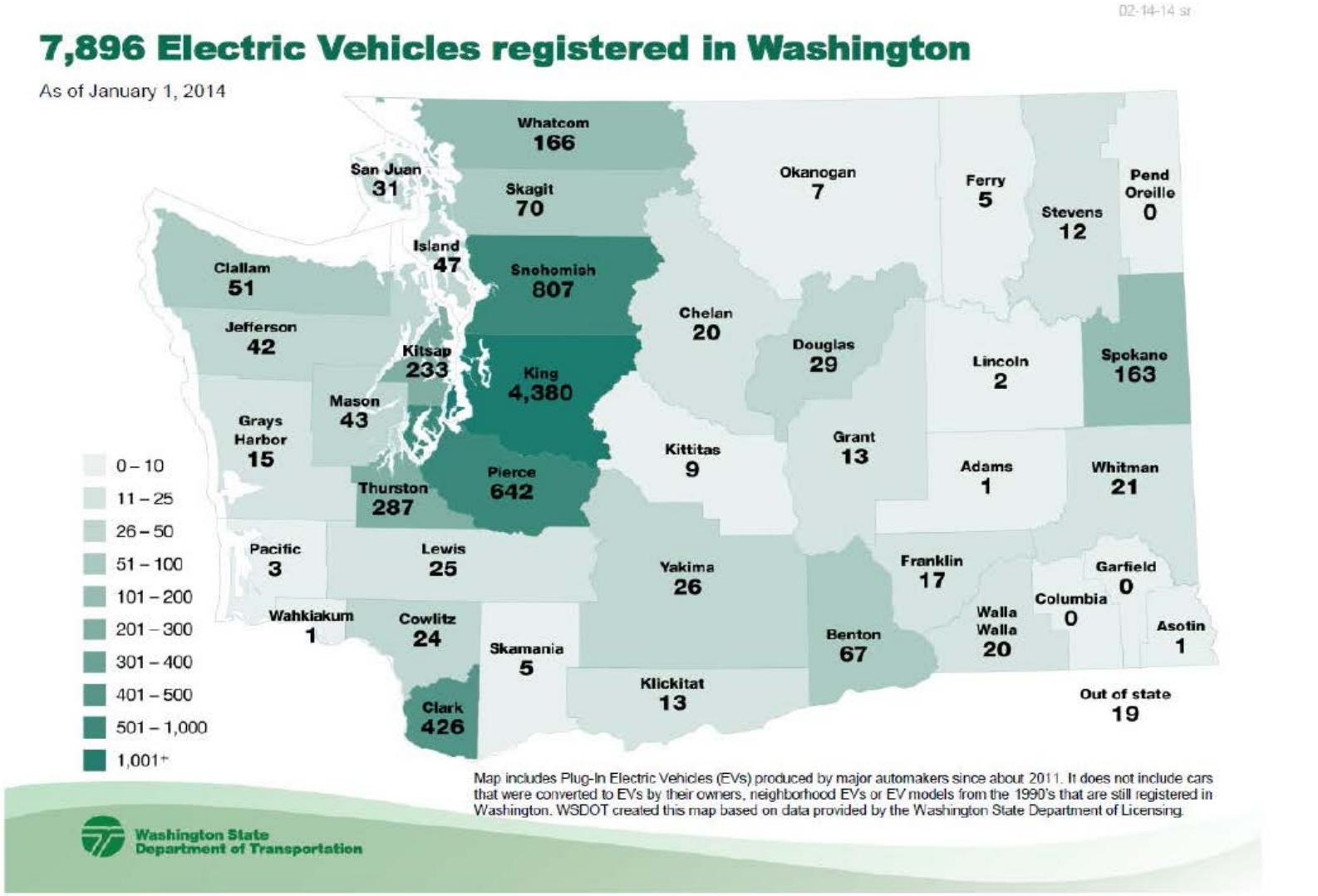
- In the 6th Power Plan, Plug-in electric vehicles were treated as a sensitivity.
- Loads were not included in the resource selection analysis.

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



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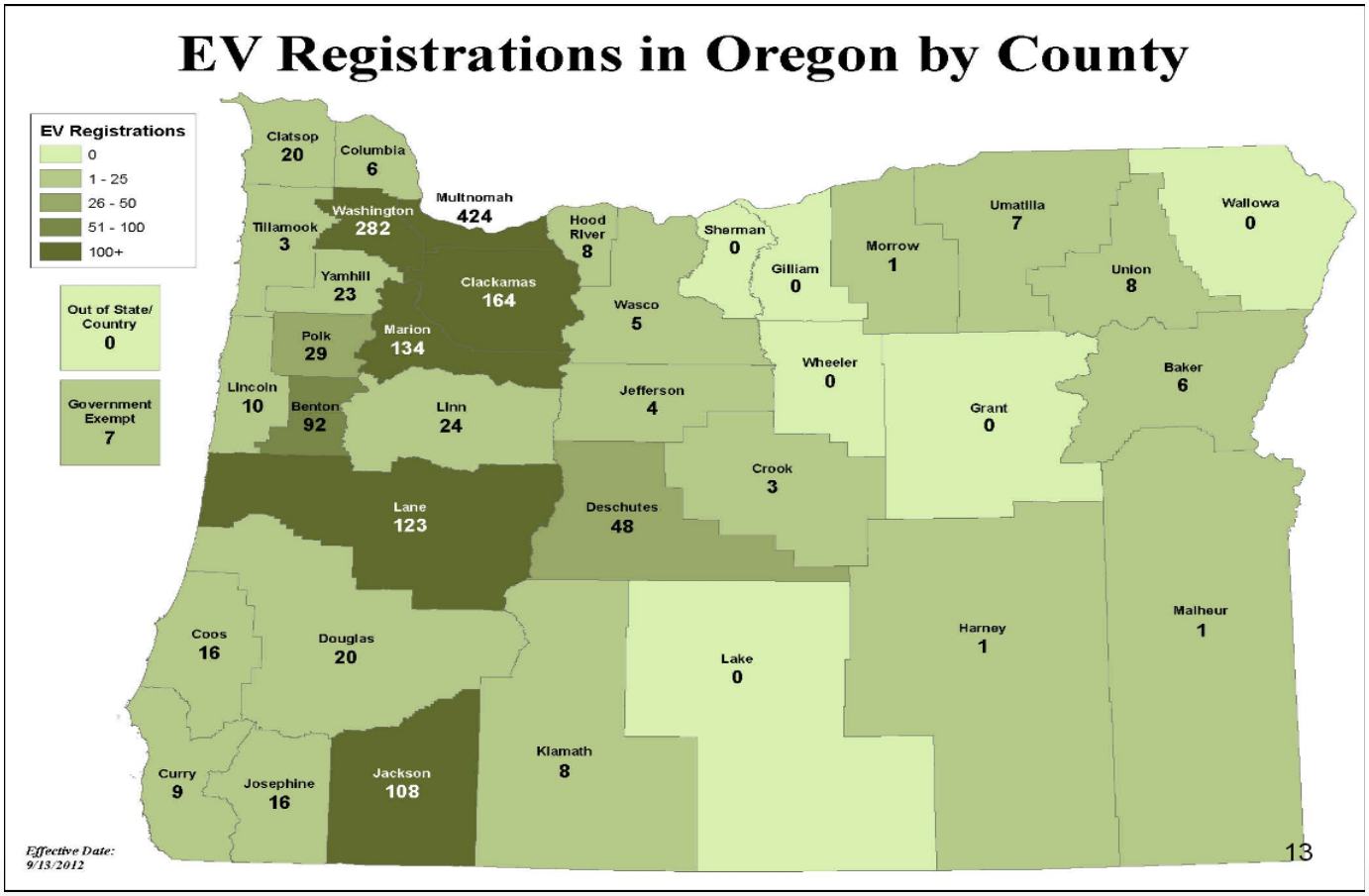
By the end of 2013 there were about 3700 EV registered in Oregon



EV project Results Nationwide

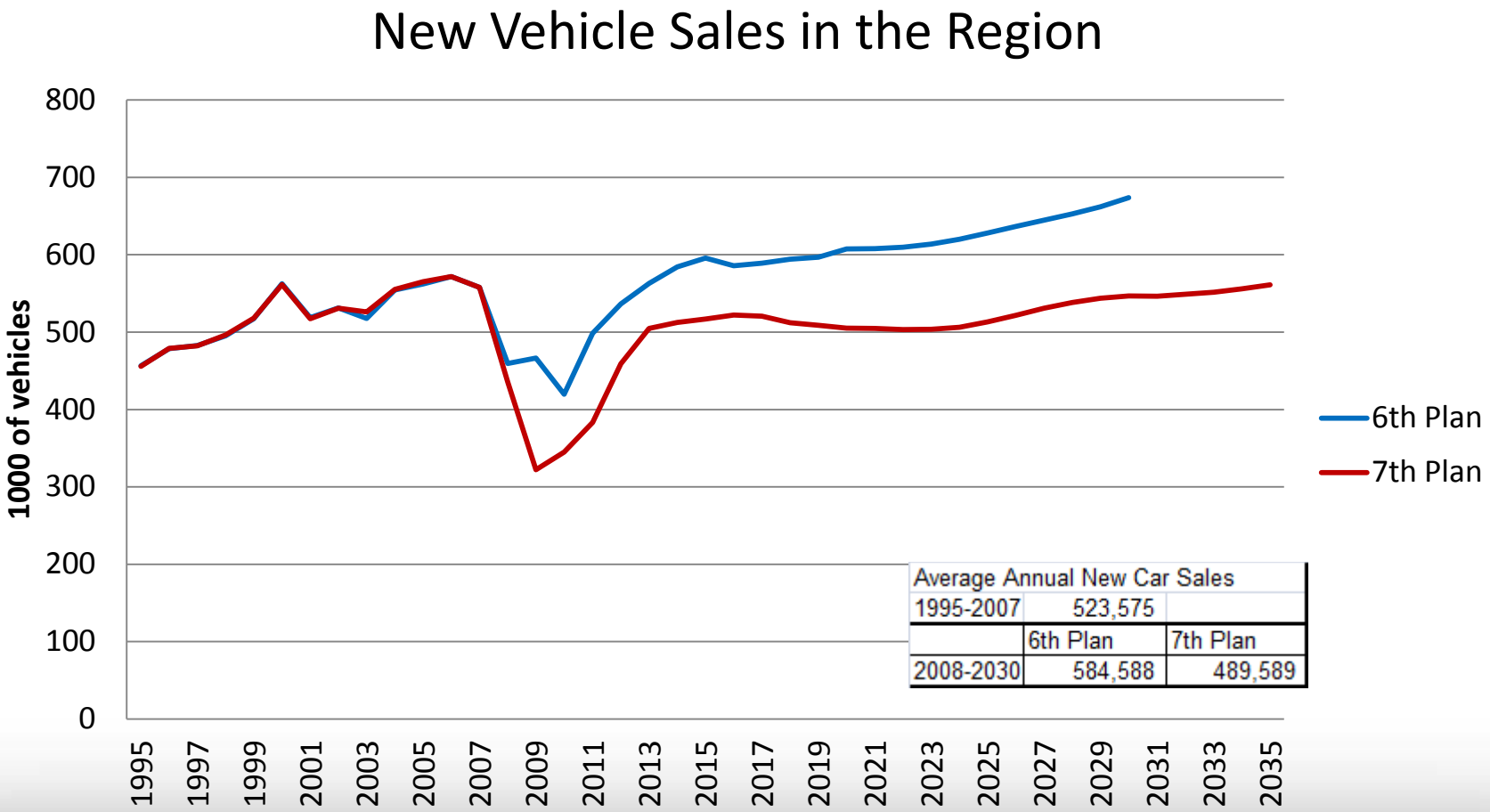
As of Q2 2013

- 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.

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.

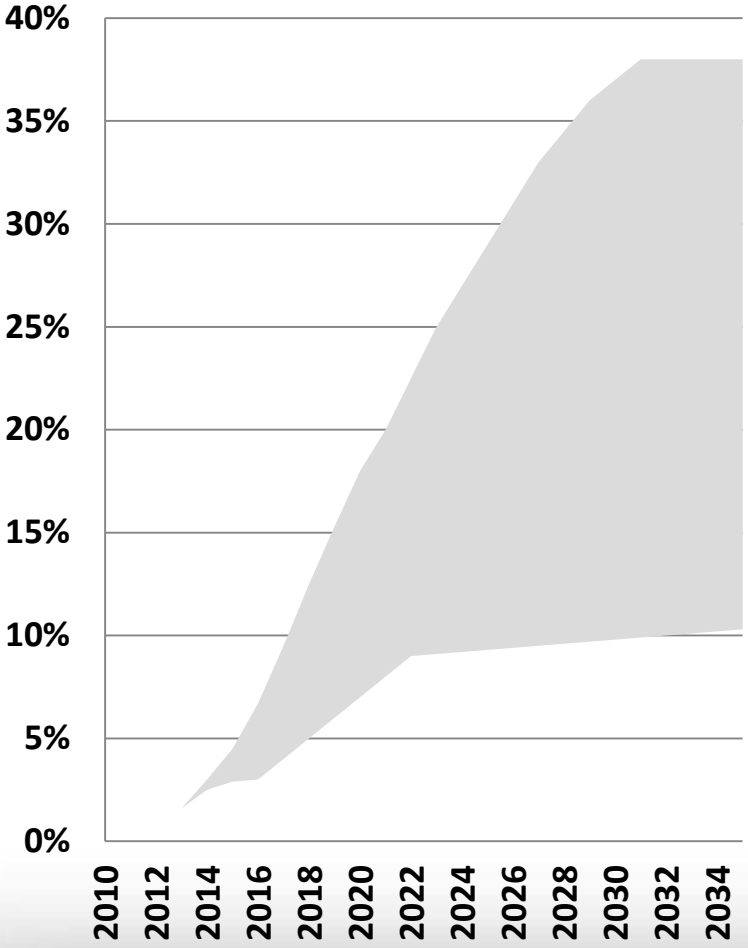
Forecast of new vehicles sales has gone down significantly



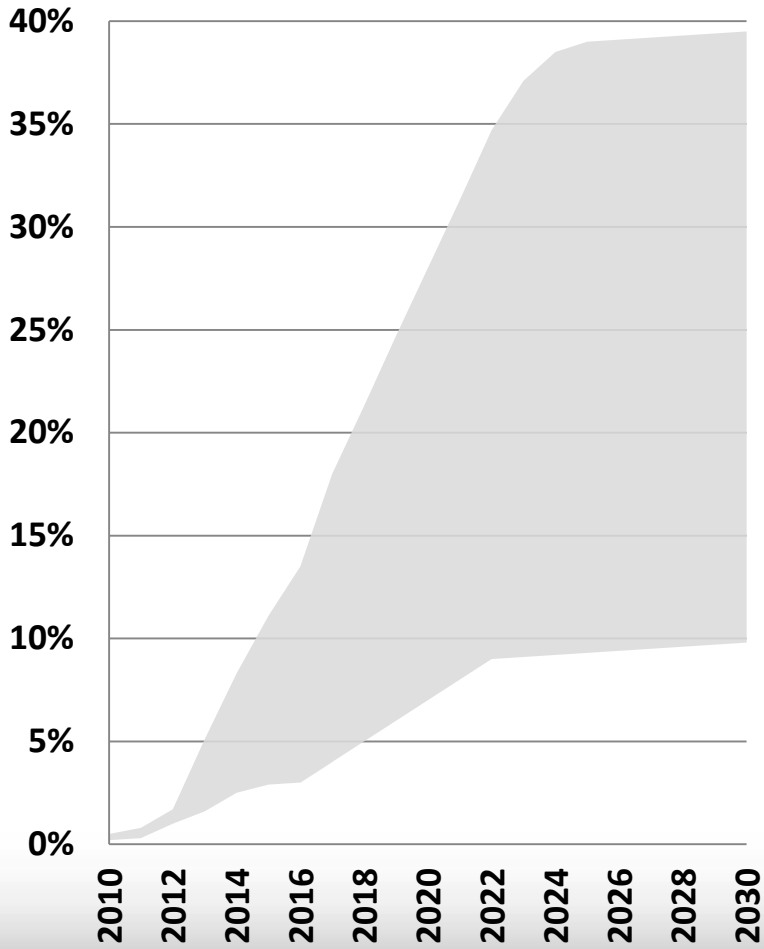
Source :IHS-Global Insight

Projected Market Share of PHEVs (Oregon and Washington)*

7th Plan (2035)



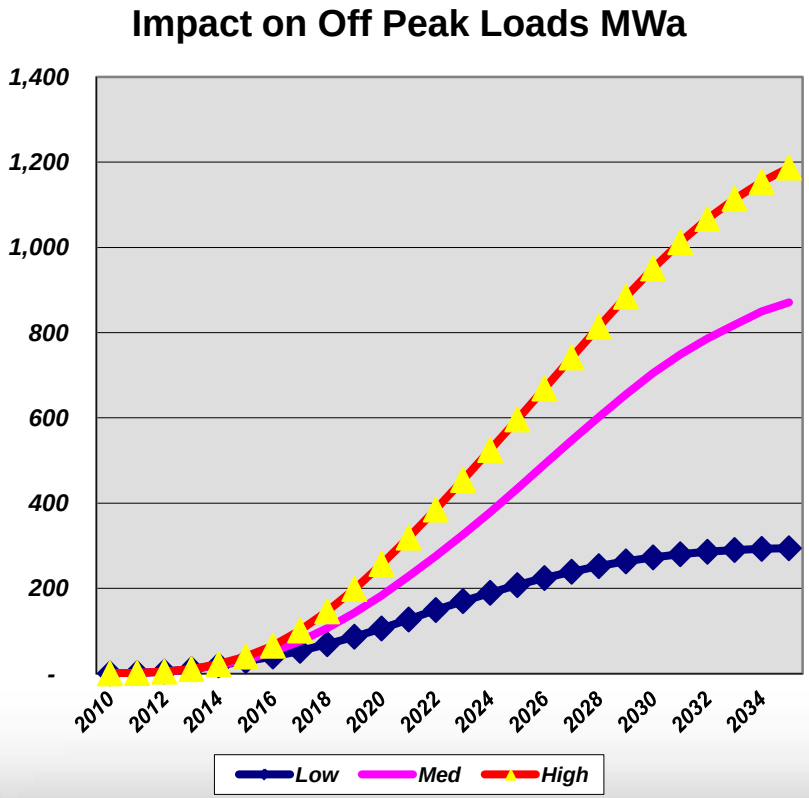
6th Plan (2030)



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

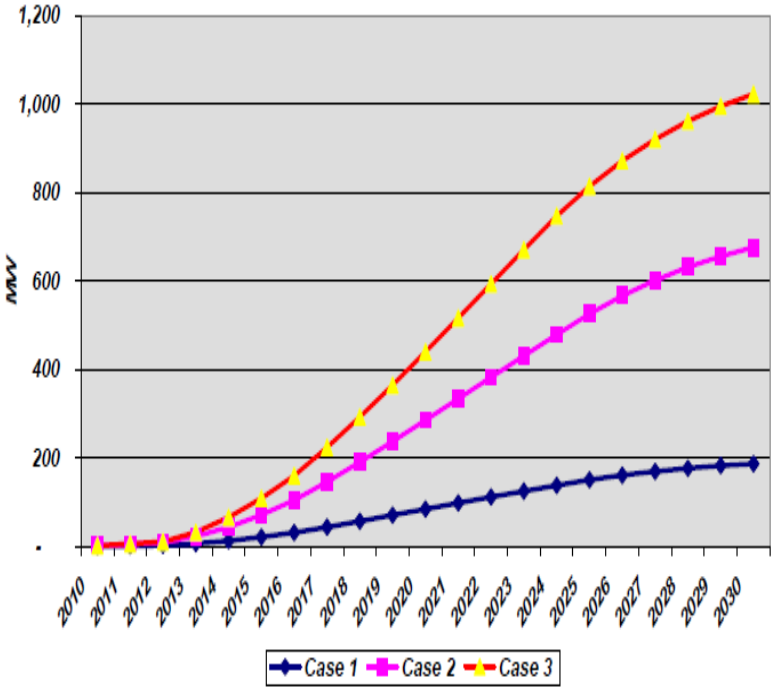
Off peak impact

7th Plan (2035)



6th Plan (2030)

Figure C-25: Project Off-peak Load from Plug-in Hybrid Vehicles



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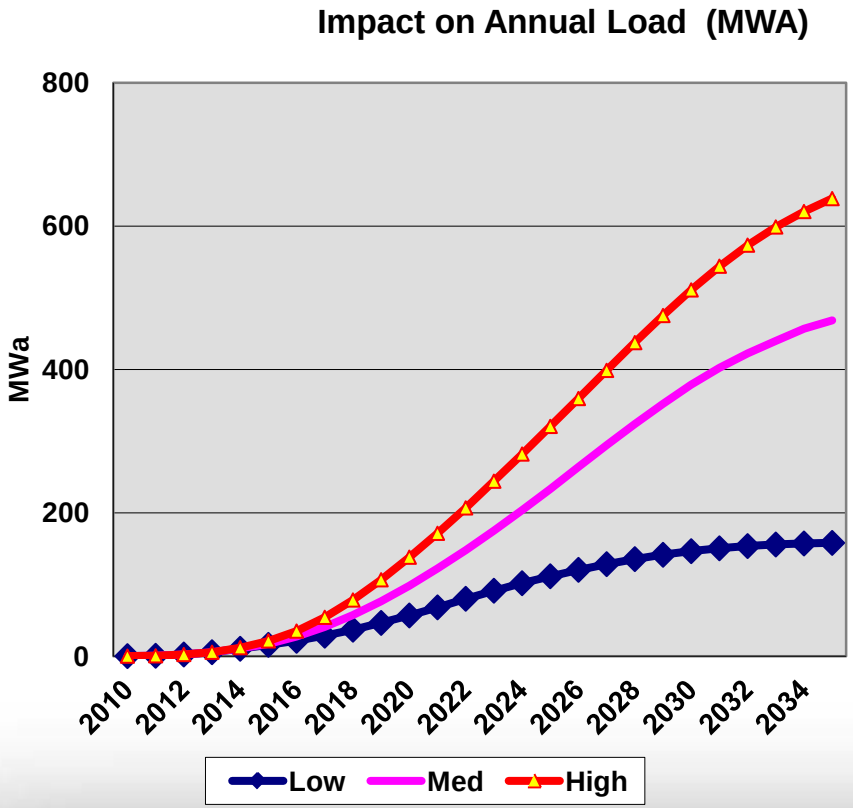
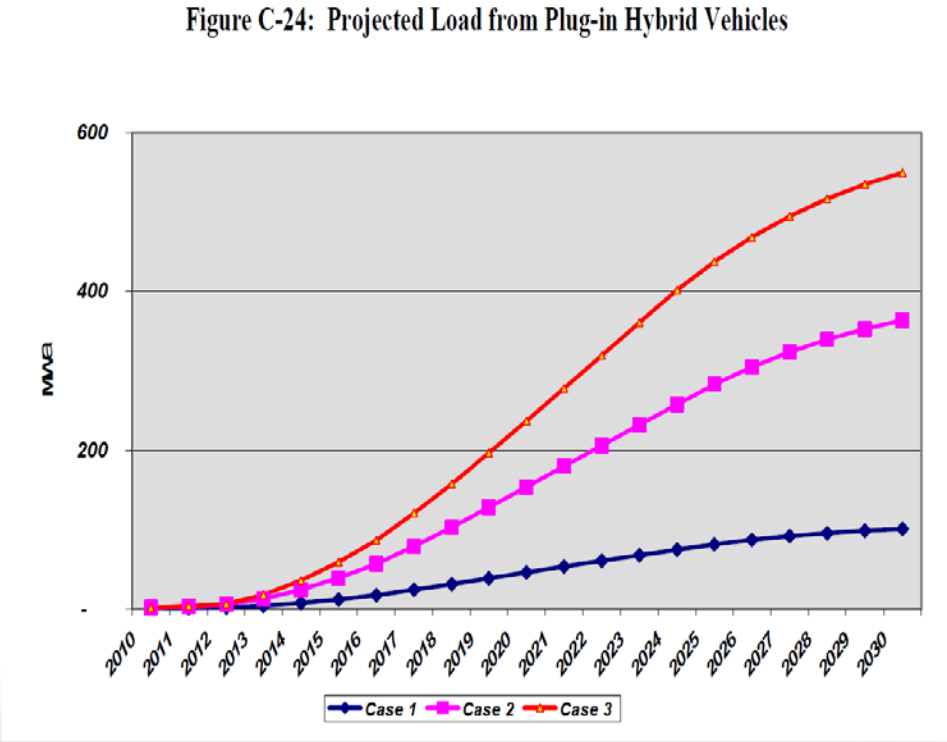
Average load

7th Plan (2035)



6th Plan (2030)



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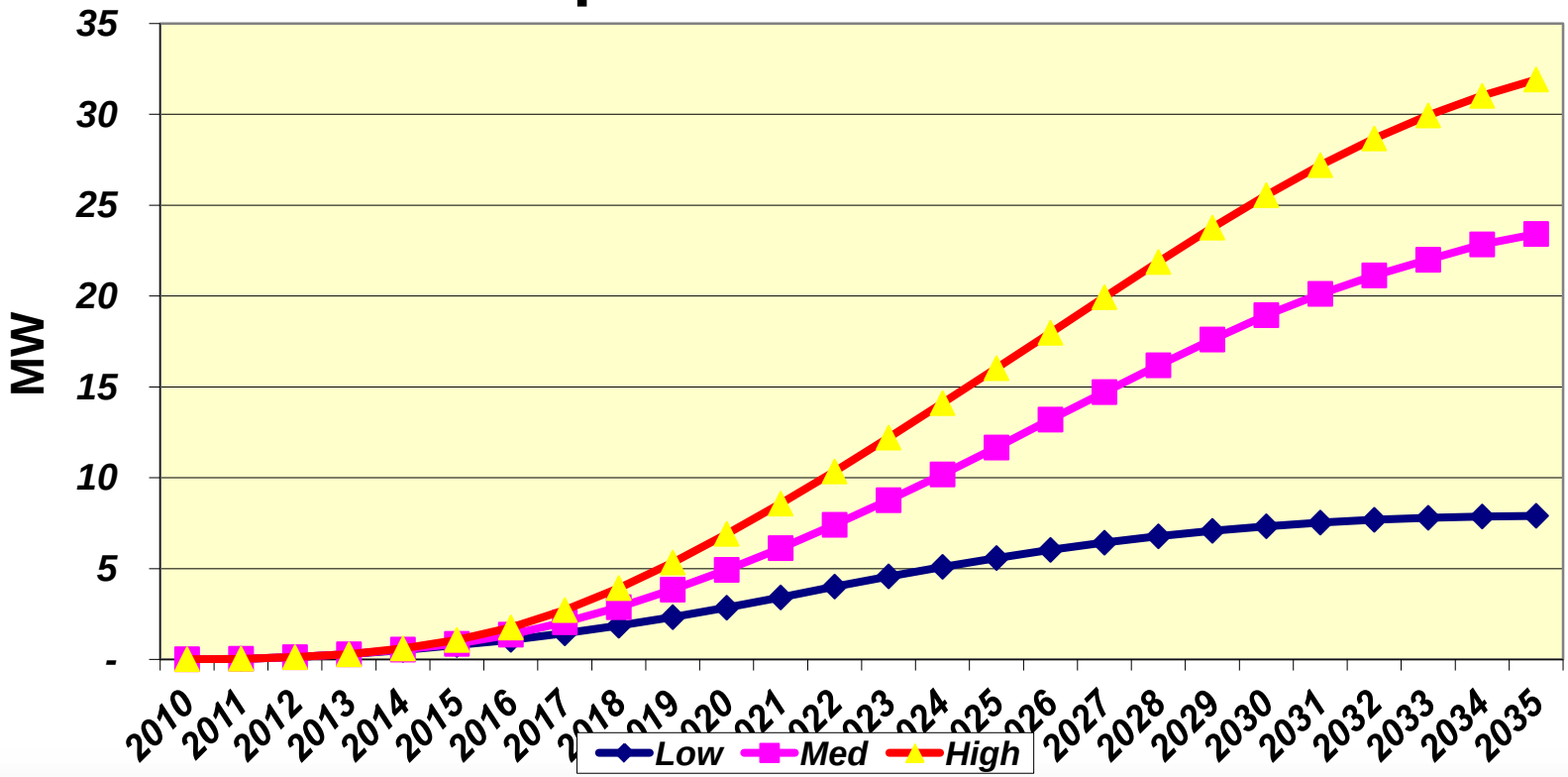
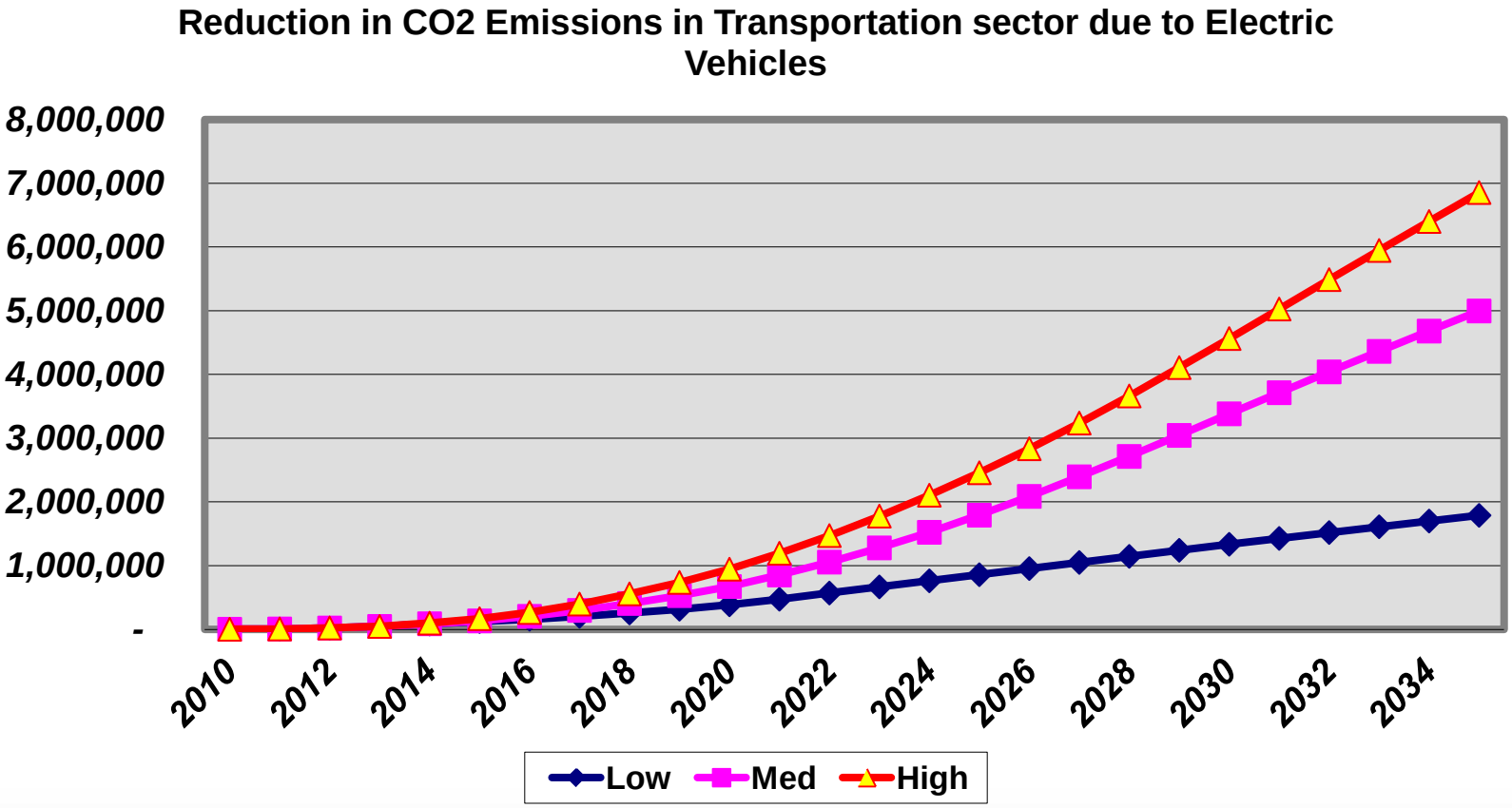
Impact on Peak Load



By 2035 PHEVs can reduce regional 2012 tailpipe emissions by about 2%-8% (depending on scenario)



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.

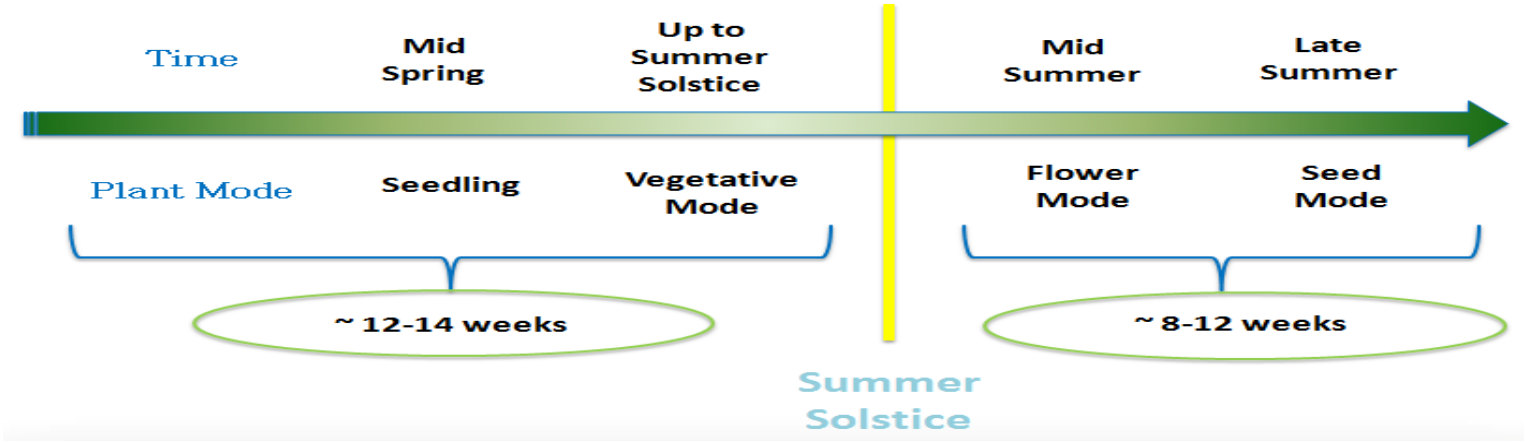
By 2030	6th Plan	7th Plan
Cumulative Number of PHEV (1000)	633 - 3400	416-1500
Average Load MWA	150-600	150-511

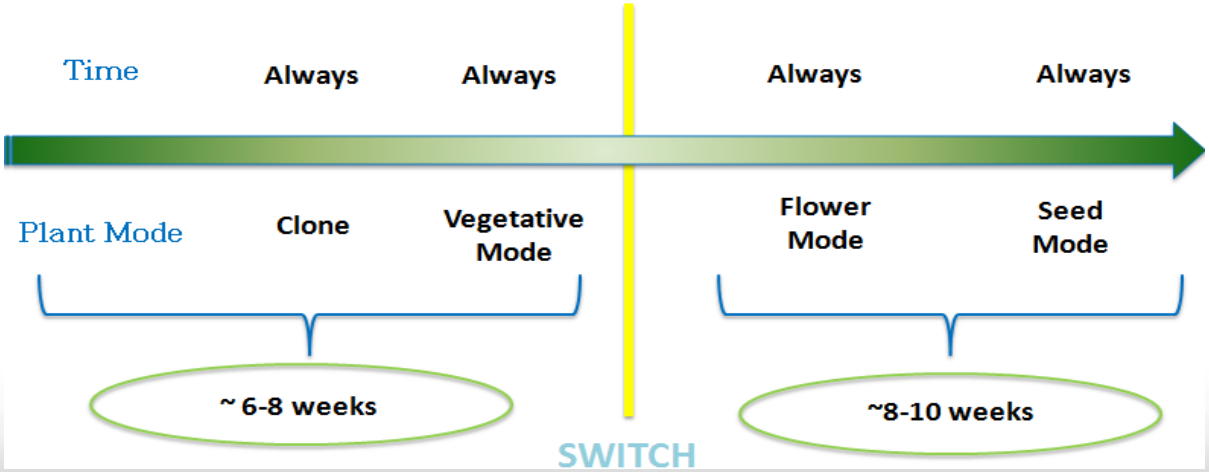
Feedback

- What do you think of future growth in PHEVs?
- Are our market penetration assumptions reasonable, conservative, aggressive?

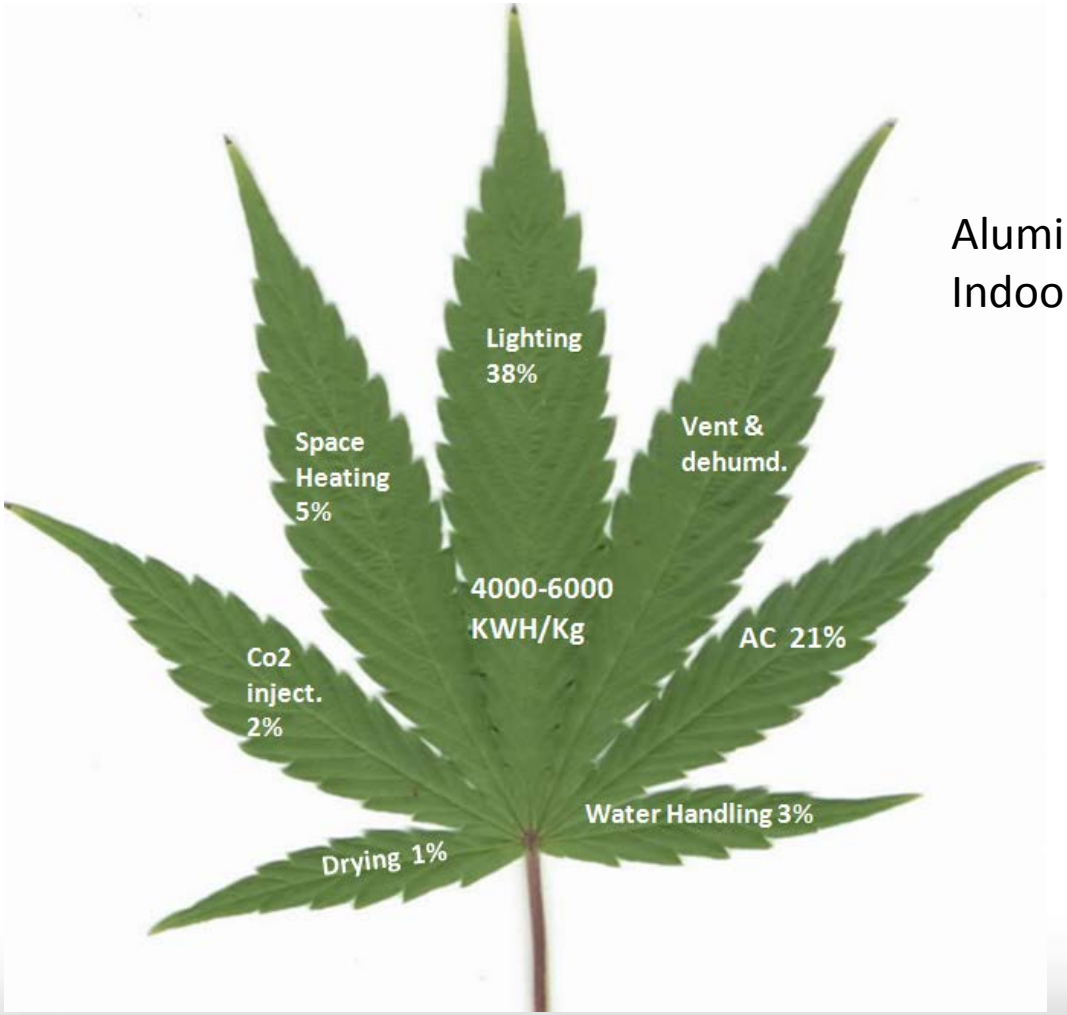
IMPACT OF CANNABIS PRODUCTION IN THE PACIFIC NORTHWEST ON REGIONAL ELECTRICITY LOADS

Outdoor -Natural growth cycle
Indoor - Manufacturing cycle



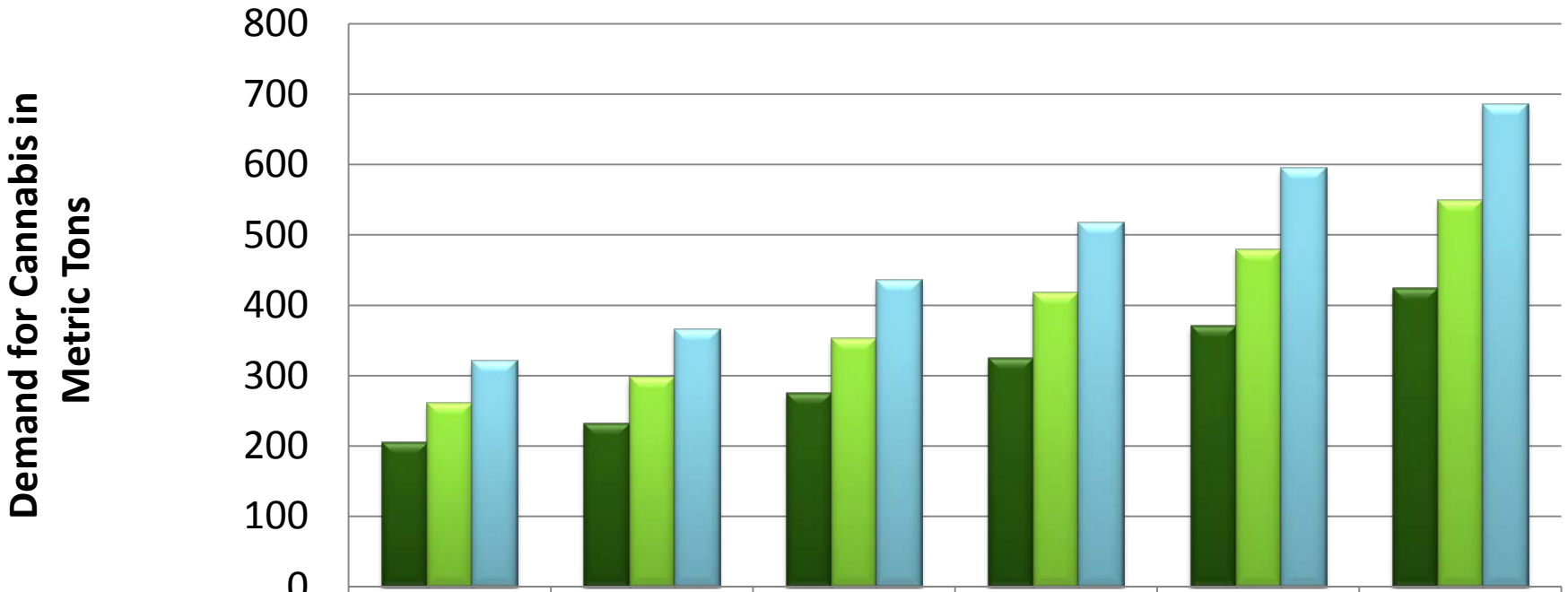


Electricity Use in Indoor Production



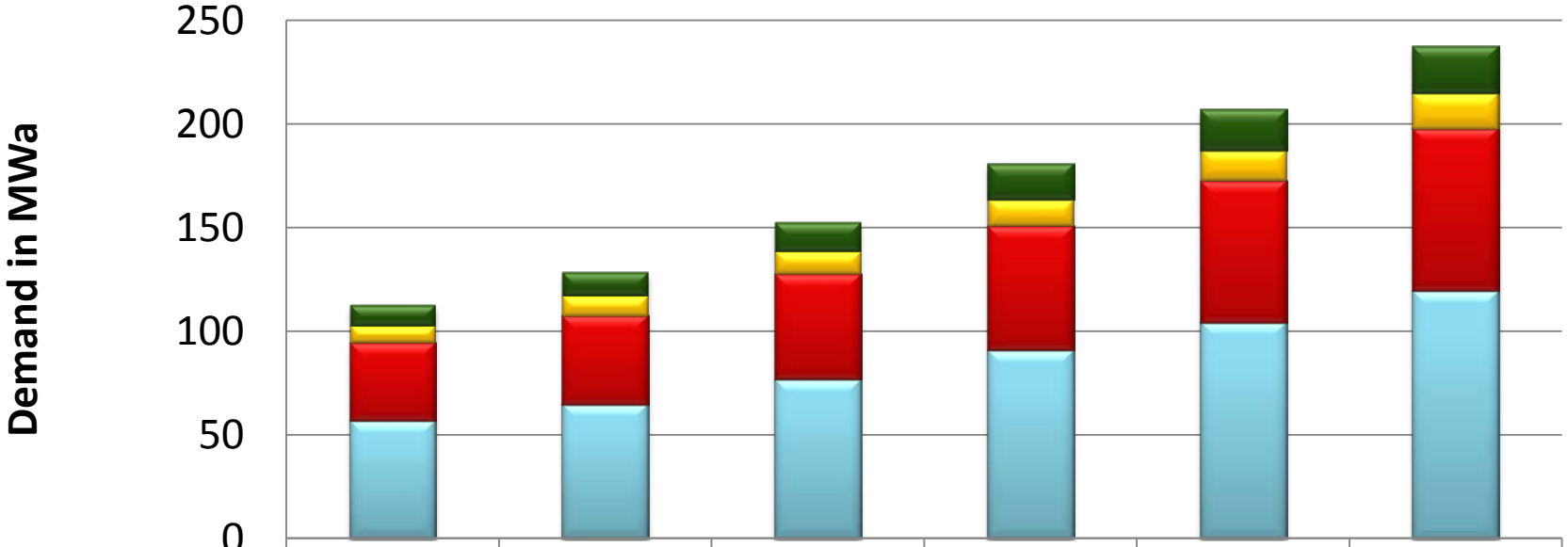
Aluminum Production ~ 16 KWH/kg
Indoor Cannabis production ~ 5000 KWH/kg

Preliminary Estimate of Demand for Cannabis 2014-2035



	2014	2015	2020	2025	2030	2035
Regional Low	205	233	276	325	371	424
Regional central	261	297	353	418	479	549
Regional high	320	366	437	518	595	685

Forecast of Demand from Producers* 2014-2035 (preliminary)



	2014	2015	2020	2025	2030	2035
Idaho	10	12	14	17	20	22
Montana	8	10	11	13	15	17
Oregon	37	43	51	60	68	78
Washington	57	65	77	91	104	120

* Does not include processors and retailers

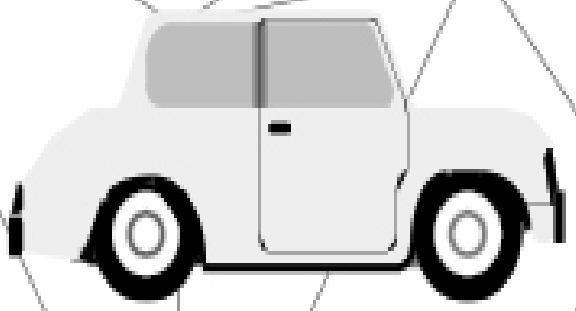
Feedback

- Should we include projected loads from indoor cannabis production in the load forecast?
  - For Washington and Oregon
- Do you have a projection of load from indoor cannabis production in your area?
- How do you deal with funding energy efficiency for indoor cannabis production?

Data Centers

HAPPY BIRTHDAY, WORLD WIDE WEB!!

YOU'RE OLD ENOUGH TO RENT A CAR!



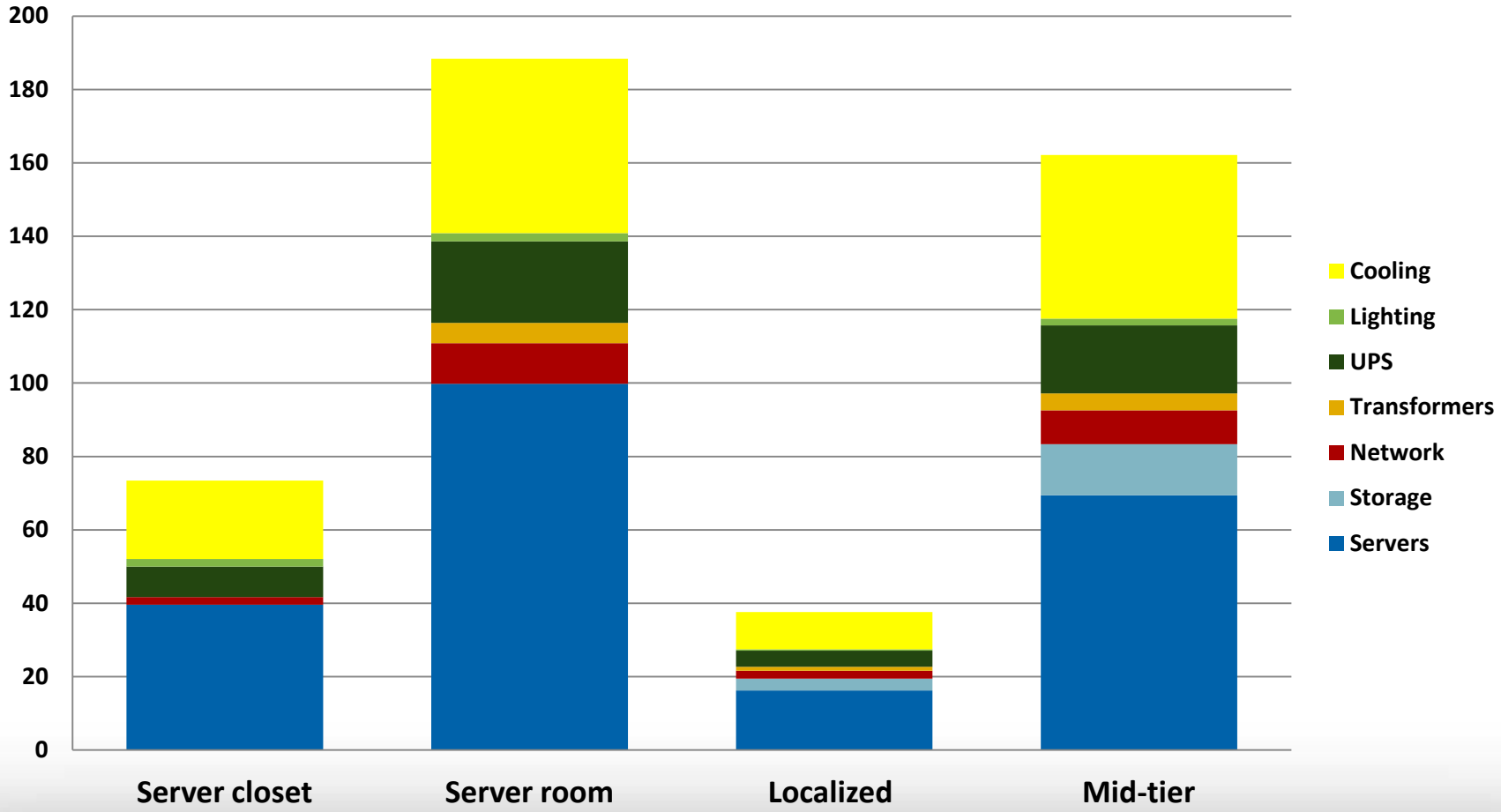
25TH ANNIVERSARY

Different Types of Data Centers

- Roughly 70 identifiable colocation data centers in the region
  - 40,000 embedded and 15 enterprise data centers

Type of Data Center	Example	Approximate Energy Consumption in load	Approximate Square Footage	% of Data Centers in the United States	% of Housed Servers in the United	Typical Location
private localized	Embedded, small-mid sized company	10-500 kW of load	<1,000 square feet	0.30%	28%	Business dependent
private mid-tier	Hospitals, financial institutions, etc.	.5-10 MW of load	<5,000 square feet	0.40%	15%	Metro-area
colocation	EasyStreet, Digital Fortress	Mid-tier: .5-10 MW	Mid-tier: <5,000 sq.ft. Large: 5,000+ sq.ft.	2.50%	16%	Metro-area or rural
private, enterprise	Apple, Google, Facebook	10+MW of load	5,000+ sq.ft.	96%	~40%	Non-metro/rural

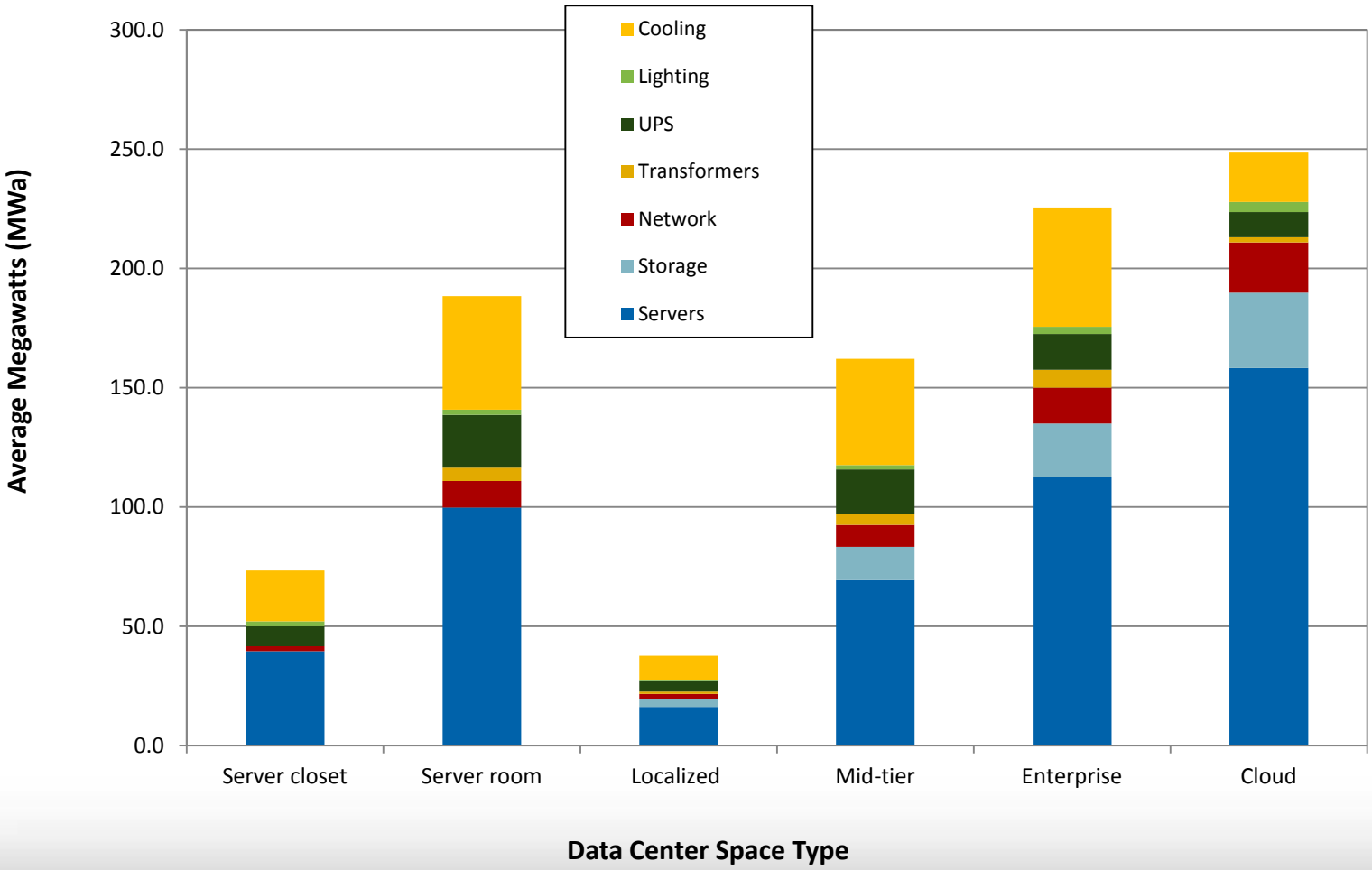
Estimated Demand From Embedded Data Centers in the NW ~460 MWa Total *



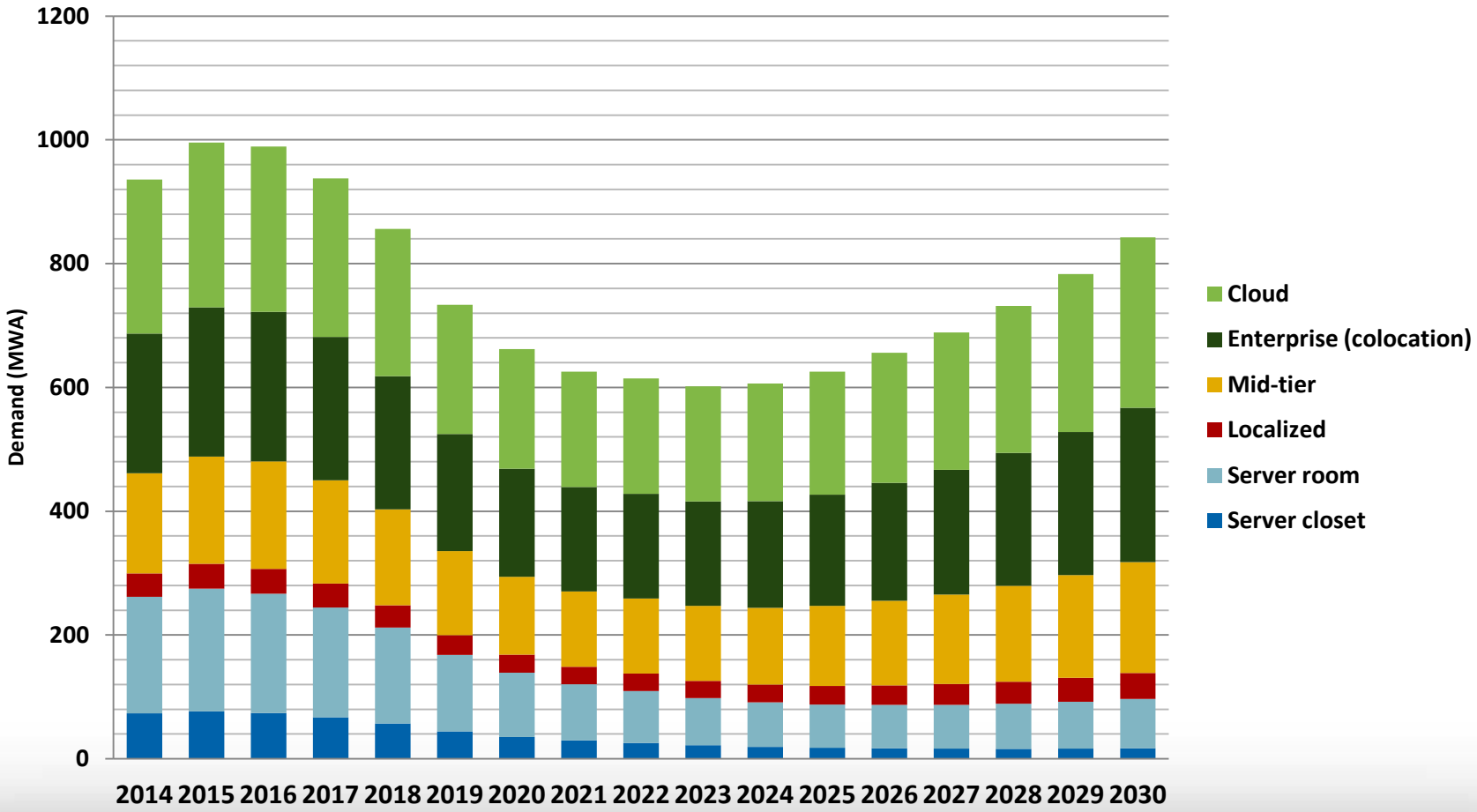
Subject to change, as improved CBSA data comes in.

NWPCC All Data Center Energy Use

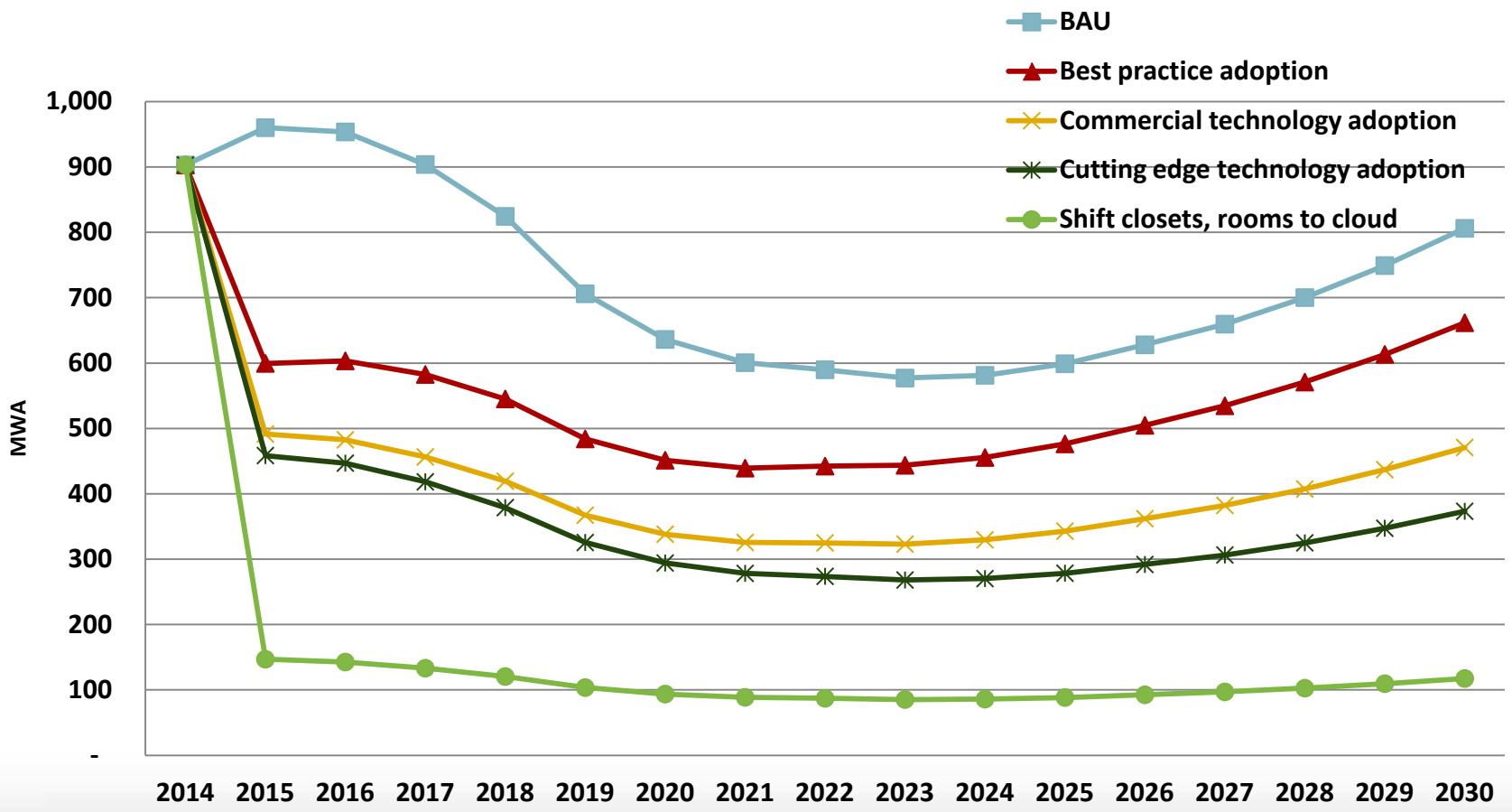
(total for all space types = 930 MWa)



Projected Growth in Data Center Loads Business-as-Usual



What If we could shift technology - overnight



Feedback

- Does the long-term forecast is reasonable.
- Do market driven efficiencies need to be supplemented by the utility programs?
  - For IT?
  - For non-IT ?

To Freeze or not to Freeze or when to Freeze

- Frozen Efficiency
  - What is it?
  - Why we have used this concept in the past in estimating conservation potential.
- New fast moving technologies and costs
  - Solid state lighting
  - Rooftop solar
- Would we be overstating conservation potential?

Potential Impact of Solid State lighting…

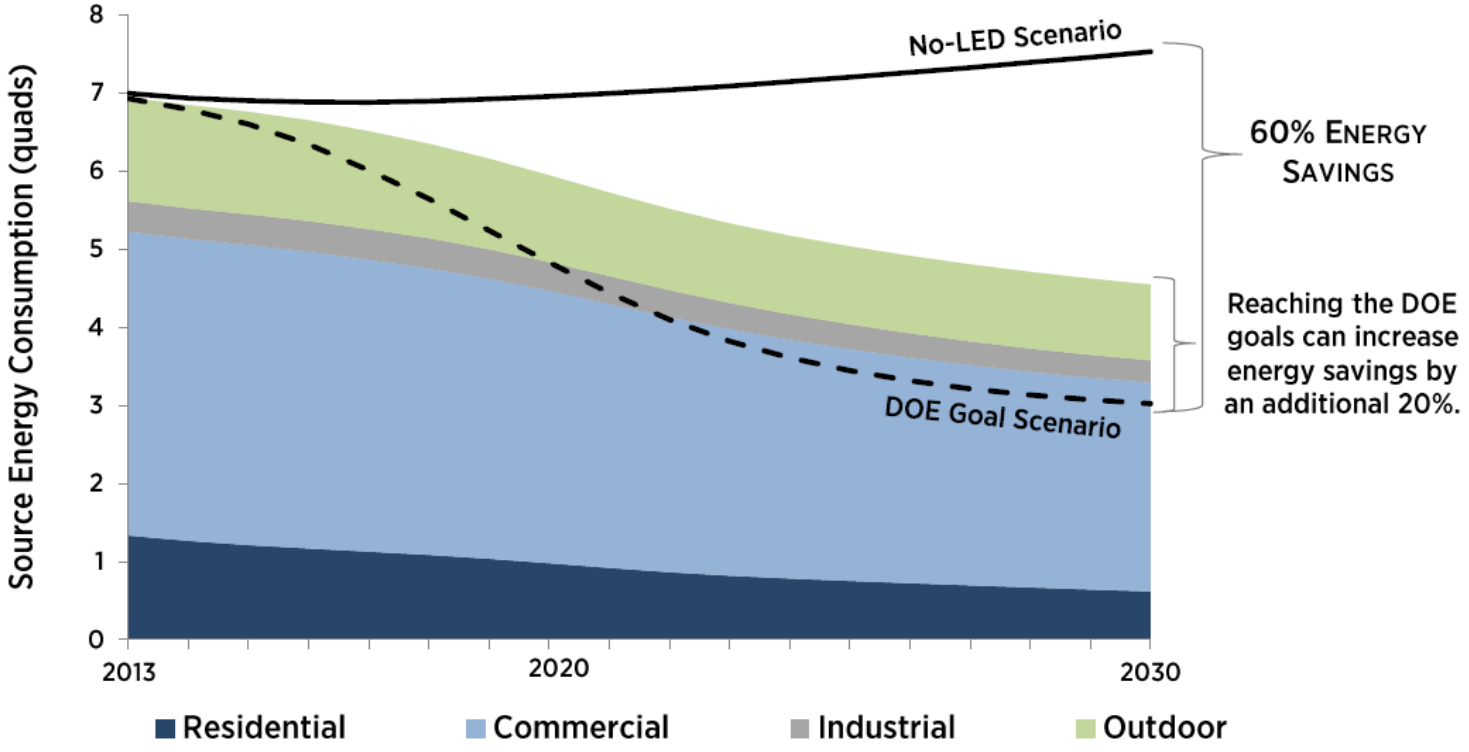
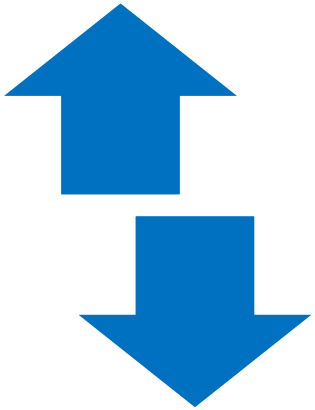


Figure 4.1 Forecasted LED Energy Savings if DOE SSL Program Goals are Realized

Solid-State Lighting



Efficacy

Cost

- Council generally assumes frozen efficiency
- But, LEDs have been changing rapidly
- Freezing at current cost & efficacy will overstate cost & understate savings potential – even in the near term
- Freezing penetration at current levels increases potential savings

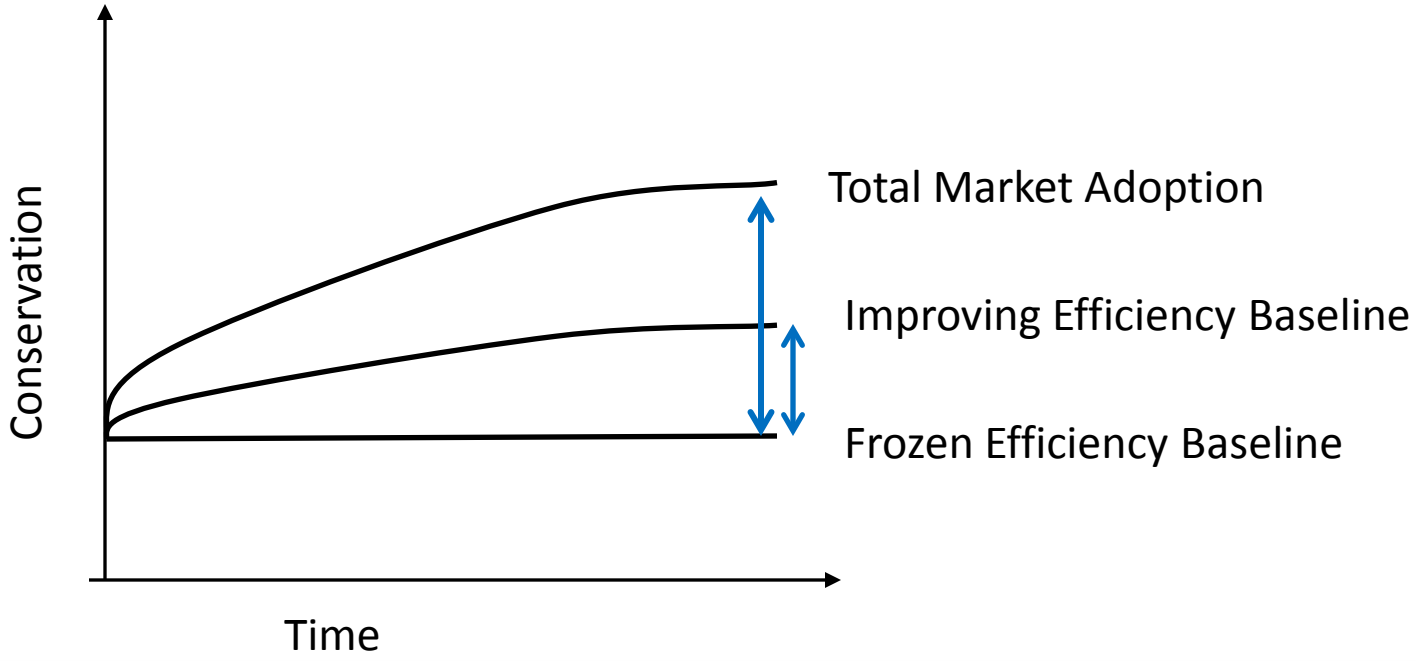
SSL: Proposal

- Cost & Efficacy
  - Forecast cost & efficacy changes to 2017 then freeze
  - Based on PNL analysis (reviewed November CRAC)
  - Use today's costs then use PNL trend forecast
  - By product class and application
- Market Penetration of SSL (options)
  - Freeze at known penetration
    - (CBSA ~2013, RBSA ~2011, DOE ~2013)
  - Freeze at forecast 2015 estimated penetration, or
  - Forecast economic uptake (moving baseline)

Discussion & Issues

- All baseline penetration assumptions are forecasts, whether frozen or changing
- Need to use same baseline penetration forecast in conservation as for forecast load
- Freezing penetration at start of forecast means larger EE potential
- High market uptake outside of programs counts towards EE targets
  - But requires tracking through market research
- Have to measure market uptake either way

Savings Potential & Baseline



Impact of Freezing loads

- If efficiency is frozen in 2015, then loads by 2035 increase by about 334 MWa.
- If efficiency is frozen in 2020, then loads by 2035 increase by about 180 MWa.

	Increase in load	Annual load increase
Base Case	3,582	179
Freeze base 2015	3,916	196
Freeze base 2020	3,762	188

Preliminary Load Forecast

- The load forecast presented below is subject to change.

Some of the Factors impacting loads by 2035(besides economic drivers)

Factors lowering loads

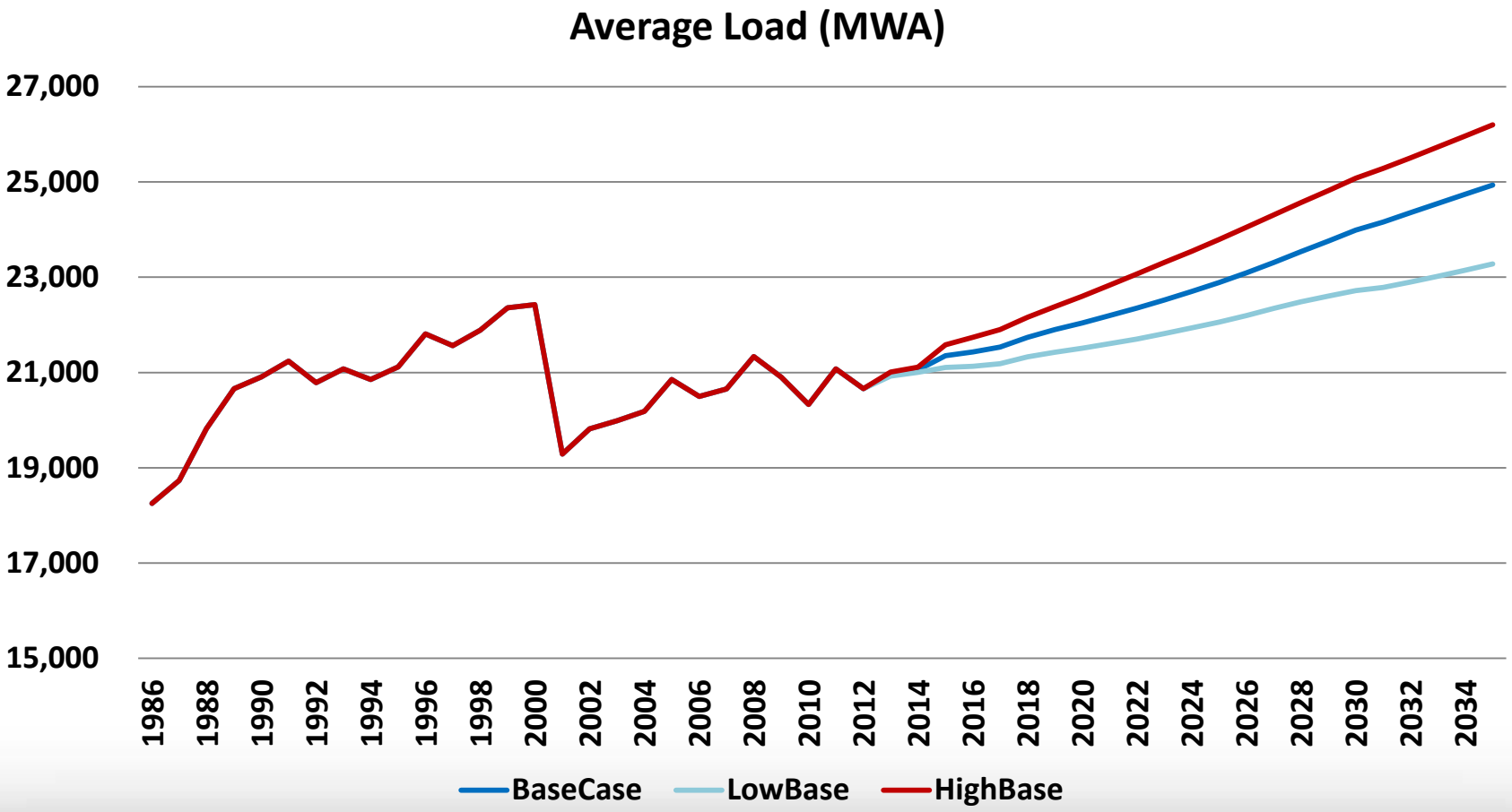
- Appliance and transformer standards ~700 MWA
- Improvement in efficiencies Misc. End-uses ~ 200 MWa
- Roof-top solar ~250 MWa
- More efficient data ~150 MWa centers
- Total ~1325 MWa

Factors increasing loads

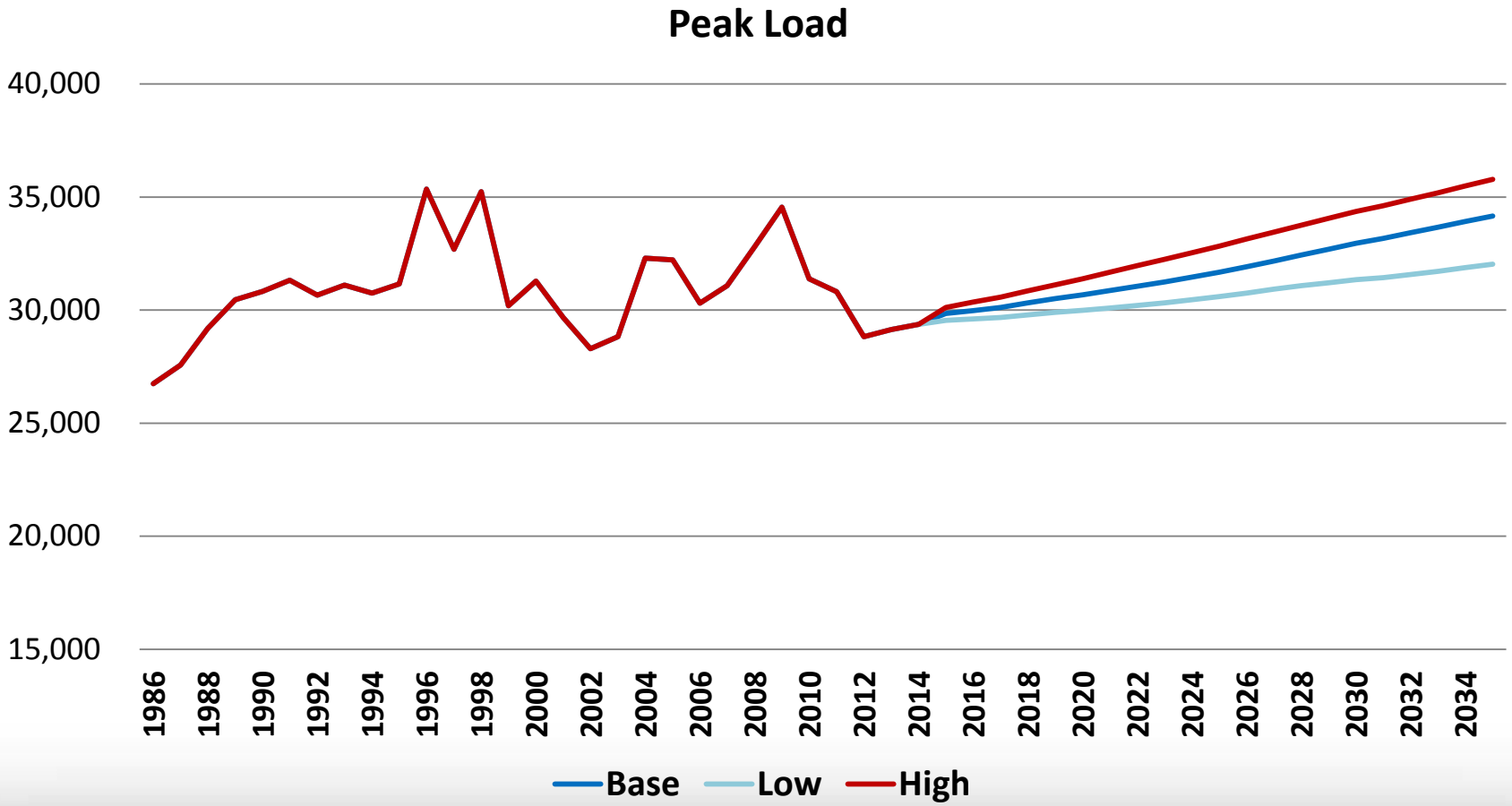
- Washington & Oregon cannabis production ~200 MWa
- Addition of Loads from PHEVs ~600 MWa

- Overall ~800 MWa

Draft Load Forecast 2015-2035



Draft Peak Load Forecast 2015-2035



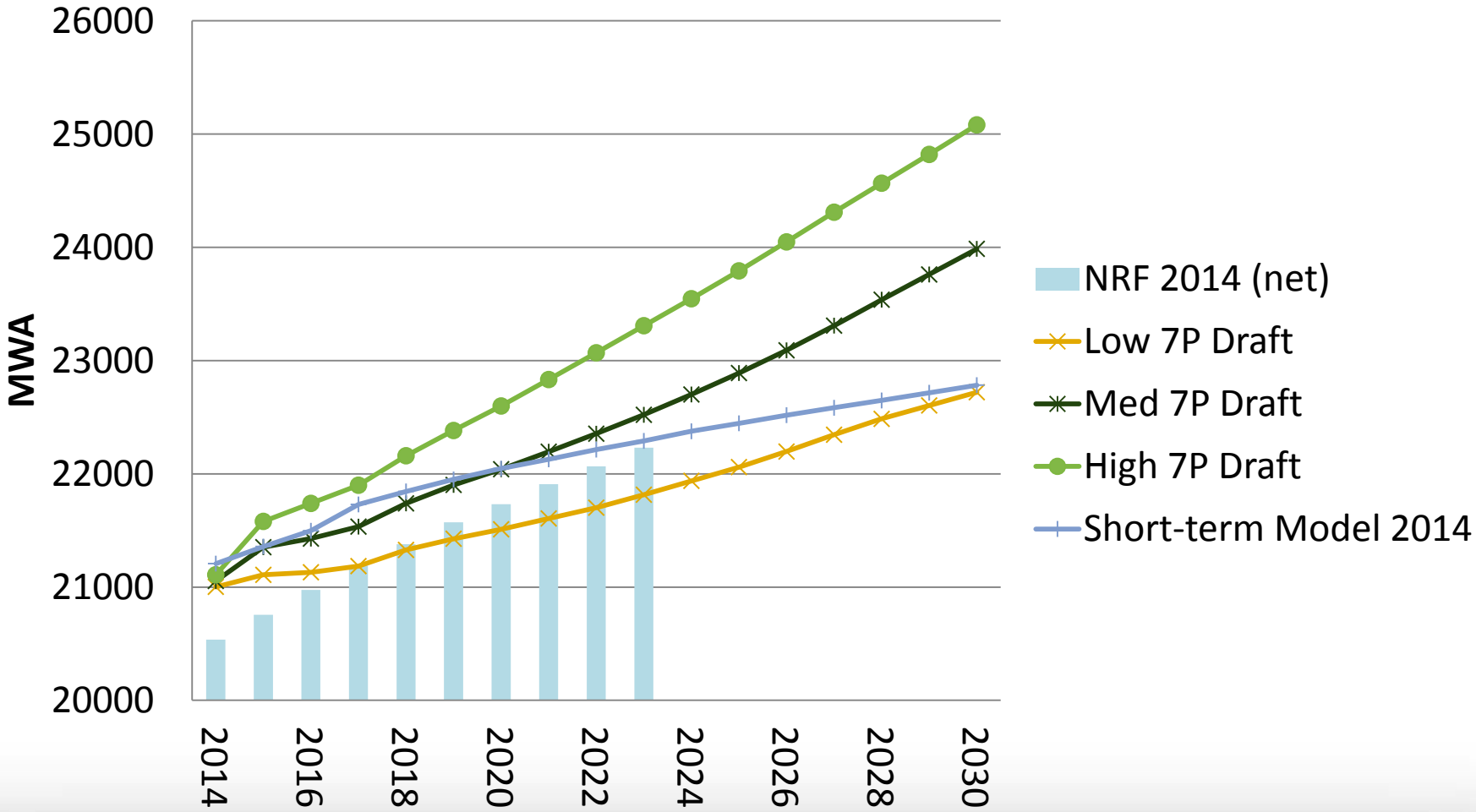
Projected Average Annual Growth Rates

2015-2035	Average	Peak Load	Low Load Hours
Base	0.8%	0.7%	0.9%
Low	0.5%	0.4%	0.6%
High	1.0%	0.9%	1.2%

Historic and Forecast of sector level Loads (base case)

Sector Level Loads* (MWA)	1986	2010	2015	2035	2015-2035
Residential	6,431	8,118	8,280	8,944	0.4%
Commercial	4,493	6,155	7,237	8,393	0.7%
Industrial	7,006	5,729	5,561	7,029	1.2%
Transportation	3	8	26	459	15.3%
Public service (stl,water)	322	342	350	360	0.1%
Total	18,256	20,352	21,454	25,185	0.8%
*- prior to rooftop solar					

Comparison of 7th Plan Load forecast with Other forecasts

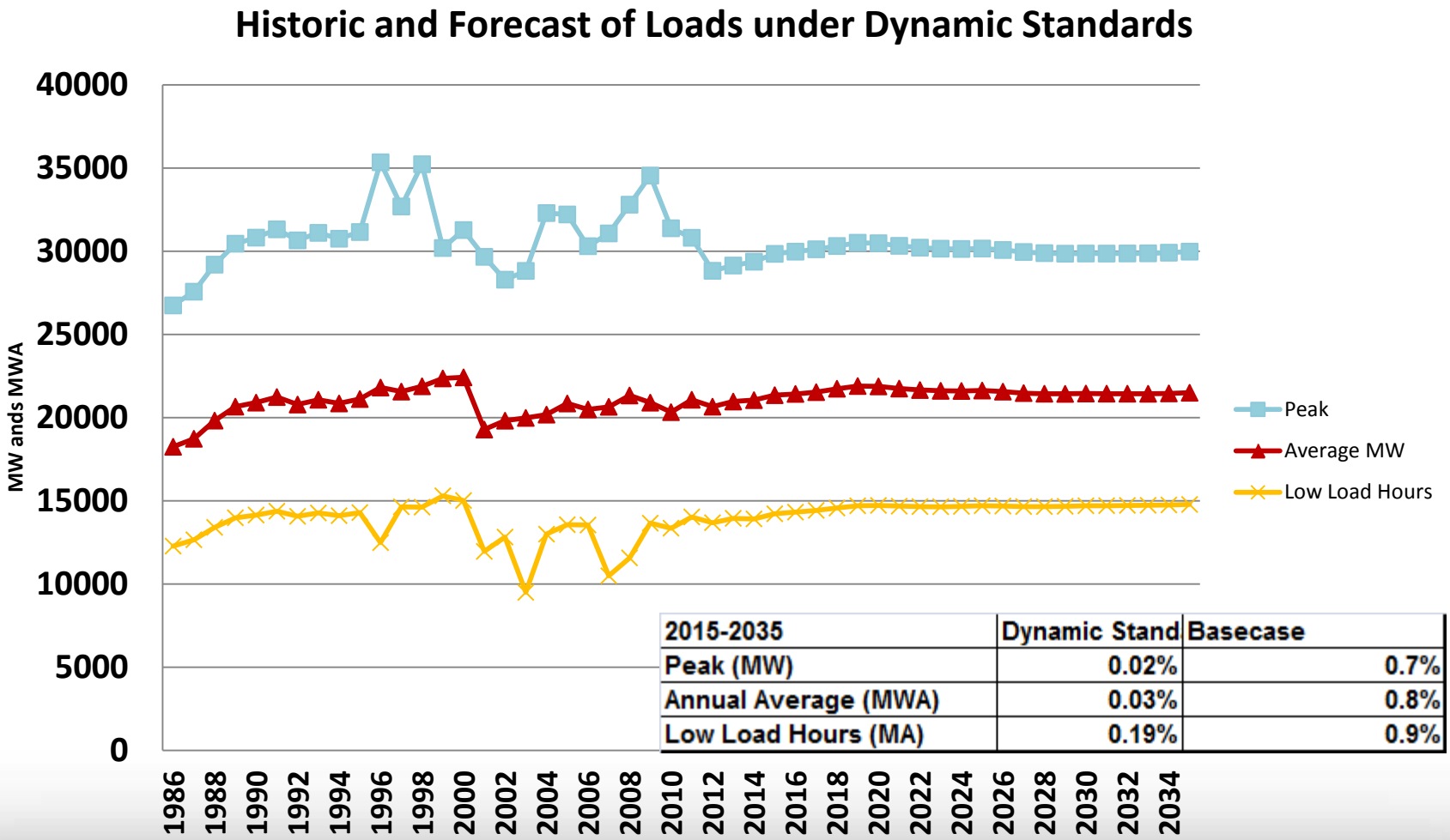


Source: 2013 G.R.A.C.

Dynamic Standards

- We have developed a “What If “analysis, assuming the standards that were passed since the 6th Plan would be updated in 6 year cycle.
- Do you think this is reasonable?
- Should we include the dynamic standards in our demand forecast range?

Under Dynamic Standards load growth is flat



2015-2035	Dynamic Stand	Basecase
Peak (MW)	0.02%	0.7%
Annual Average (MWA)	0.03%	0.8%
Low Load Hours (MA)	0.19%	0.9%

Summary/Feedback

- Does the overall load growth seem reasonable?
- How does it compare to your forecast?
- How likely is the Dynamic Standards

2015-2035	Total increase in load (MWa)	Annual load increase (MWa)
Base Case	**3,582**	**179**
Low Case	**2,172**	**109**
High Case	**4,617**	**231**

Next steps

- Revised forecasts based on feedback from this meeting.
- Include Cannabis load in Oregon
- Presentation to the Council in December
- Produce load forecast for Draft plan by Jan.
- Between draft and final, update on:
  - Commercial Building Stock Assessment
  - Industrial Facilities Assessment
  - 2013 data on sales

Thank You.