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THE ENERGY ANGLE ON THE WATER-ENERGY NEXUS FOR SYSTEM WATER LOSSES

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AIQUEOUS

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Water Planning, Policy, and Management

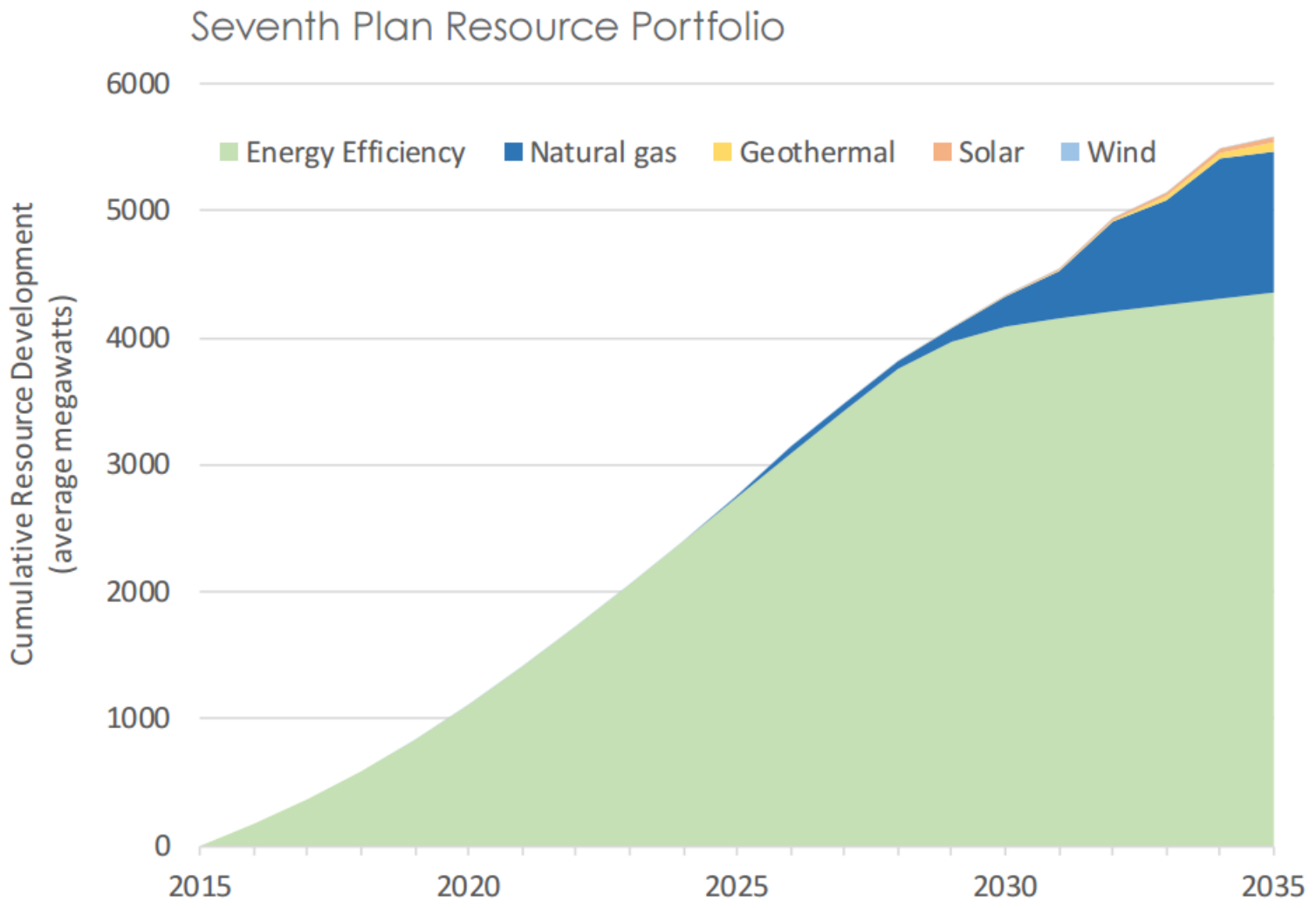
About the Northwest Energy Efficiency Alliance (NEEA)

- Founded in 1997
- Alliance of more than 140 Northwest utilities and energy efficiency organizations
- Represents more than 13 million consumers
- Dedicated to accelerating electric and gas energy efficiency through market transformation

Examples of product acceleration

- Heat pump water heaters
- ENERGY STAR® and Next Step Forward Homes
- 80 PLUS Computers
- 25 intensity Challenge
- Industrial Energy Efficiency Alliance

SEVENTH NORTHWEST CONSERVATION AND ELECTRIC POWER PLAN



Average resource development across all 800 futures tested in the Regional Portfolio Model. Actual development, particularly of non-energy efficiency resources, will depend on actual future conditions.

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Water efficiency in the 7th Power Plan

- **ANLYS-9: Conduct research to improve understanding of electric savings in water and wastewater facilities from reduction in water use.**
- Water conservation can save energy through reducing the embedded energy requirements for transporting and treating water as well as the non-energy benefit of using less water.
- Conduct research to better understand savings opportunities for water-processing industries (water supply and wastewater).

Project objectives

- Help NEEA better understand standard industry practice regarding real water loss.
- Characterize the water sector in terms of water production, use, and real water losses;
- Estimate a range of potential gallons of potable water that could be saved, and associated electric energy and demand savings;
- Identify potential policies that could generate long-term reductions in real water losses.

Project Approach

Water loss data sources

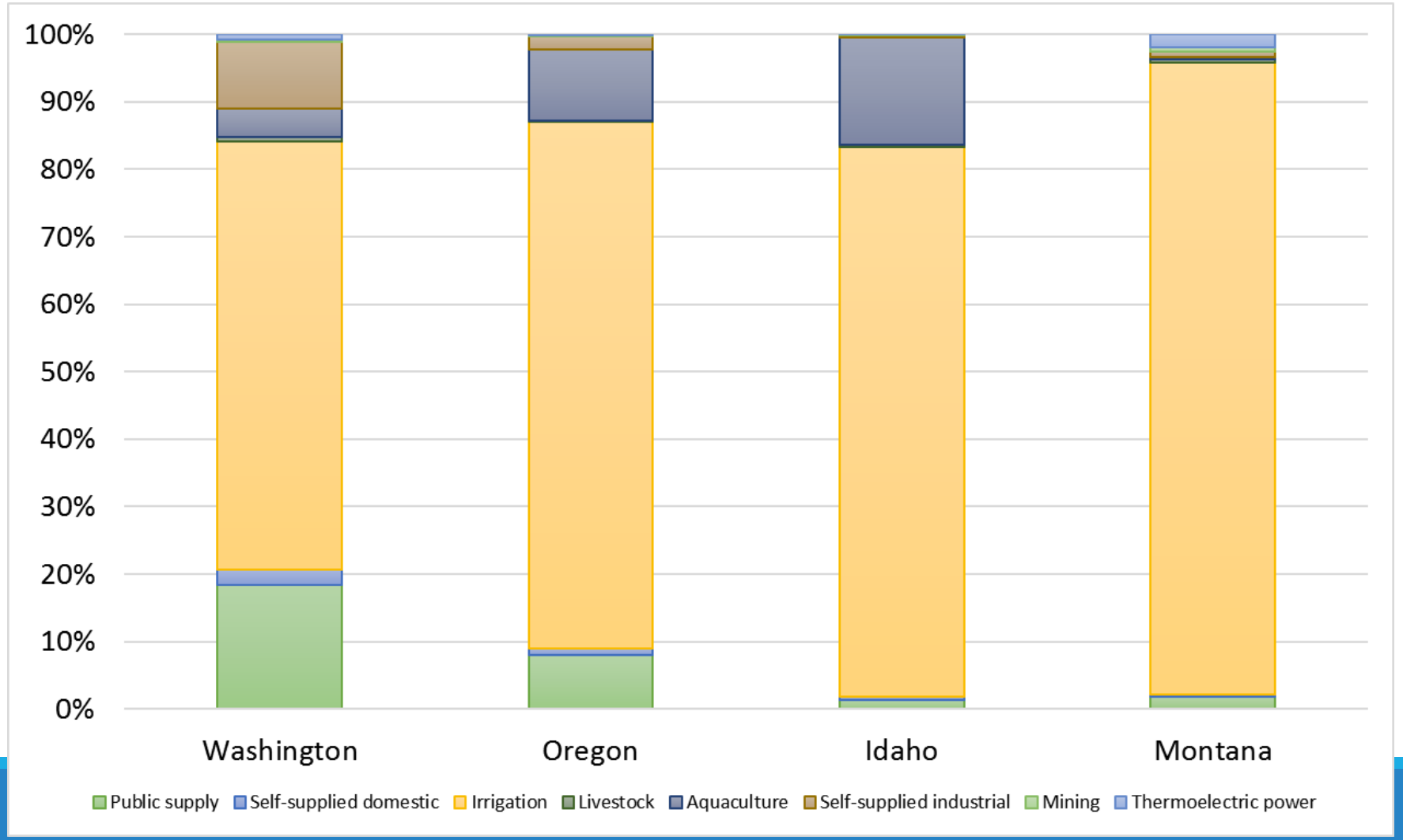
State	Agencies Contacted	Data Source(s)
Washington	Washington Dept. of Health, Office of Drinking Water	Water Use Efficiency Reporting (annual)
Oregon	Oregon Water Resources Department, Water Right Services Division	Select Municipal Water Management and Conservation Plans
Idaho	Idaho Department of Environmental Quality Idaho Rural Water Association Pacific Northwest Section AWWA	None
Montana	Montana Department of Environmental Quality Montana Rural Water Systems	None

Embedded energy data sources

Organization	Data Source (Date)	Embedded Energy Range
AWWA	Energy Index Development for Benchmarking Water and Wastewater Utilities (2007)	1,746 kWh/MG
University of Texas, Dept. of Mechanical Engineering	Evaluating the energy consumed for water use in the United States (2012)	1,510-1,900 kWh/MG
Regional Water Authority, Sacramento, California	Energy Intensity in the Sacramento Region (2015)	350 kWh/MG-2,400 kWh/MG
Pacific Gas & Electric	Water System Leak Identification and Control Field Evaluation (2015)	378-10,720 kWh/MG
California Public Utilities Commission	Water/Energy Nexus Program Study on Embedded Energy, Study 1 and Study 2 (2010)	1,189-3,786 kWh/MG

State of the Market

Freshwater Withdrawals in the Pacific Northwest (USGS)



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Public Supply Withdrawals, Surface and Ground Water, in the Pacific Northwest

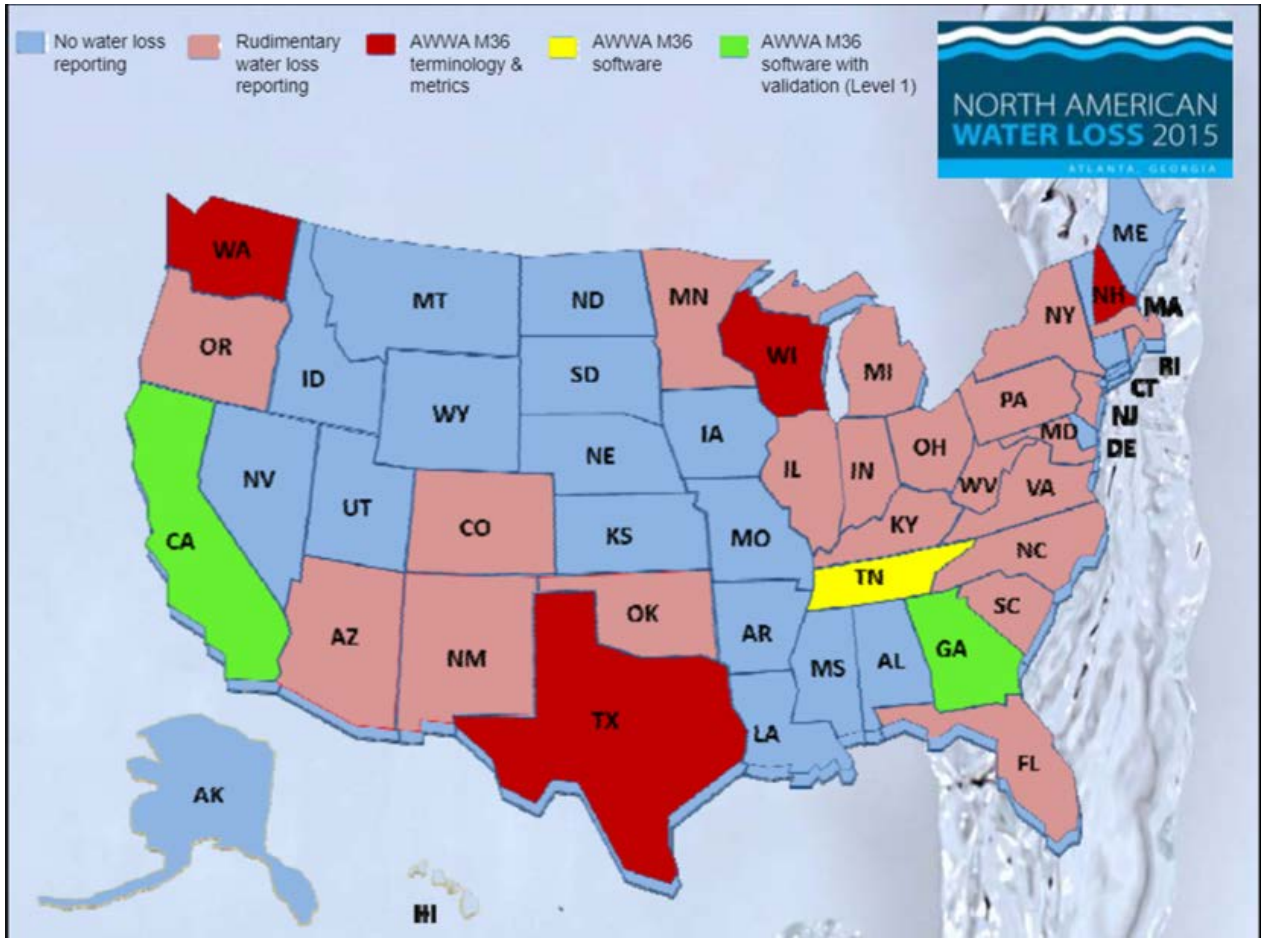
Table 4. Pacific Northwest public water supply withdrawals by surface and ground water, average million gallons per day (MGD), estimated 2015

State	Projected Public Supply Withdrawals – Million Gallons per Day (MGD)					
	Surface Water		Ground Water		Total	Avg. GPCD
Washington	468	48%	503	52%	971	159
Oregon	442	79%	120	21%	562	166
Idaho	29	11%	223	89%	252	210
Montana	76	52%	69	48%	144	196

Sources: USGS, 2014; U.S. Census, 2015.

Based on most recent USGS and US Census estimates

Current state of water loss policies and practices



Washington Department of Health Data

Table 5. Assessment of data validity from State of Washington Department of Health (WDOH) Water Use Efficiency (WUE) Worksheets, 2014 database

System Leakage Reporting: Washington State, 2014						
Reported Leakage (Real Losses), %	All WA Water Supply Systems		Total Produced, MG/Y	Authorized Consumption, MG/Y	System Leakage, MG/Y	Total Conn Count
≥0.1%	*number*	1,018	271,966	249,712	22,254	2,051,949
	percent	49.5%	79%	80%	86%	86%
≤0%	*number*	1,037	70,934	63,294	3,612	333,914
	percent	50.5%	20.7%	20.2%	14.0%	14.0%
	TOTAL ALL SYSTEMS	**2,055**	**342,900**	**313,006**	**25,866**	**2,385,863**

Source: WDOH, 2016.

Point of comparison: State of Texas

Statewide Totals 445 Audits Submitted	System Input Volume 894,229,837,180	Authorized Consumption 786,187,331,984 87.9%	Billed Consumption 739,319,009,398 82.7%	Billed Metered 737,001,477,726 82.4%	Revenue Water 739,319,009,398 82.7%
				Billed Unmetered 2,317,531,672 0.3%	
			Unbilled Consumption 46,868,322,586 5.2%	Unbilled Metered 20,388,773,256 2.3%	Non-revenue Water 154,969,778,459 17.3%
				Unbilled Unmetered 26,479,549,330 0.3%	
		Water Loss 108,110,833,152 12.1%	Apparent Loss 20,342,076,772 2.3%	Unauthorized Consumption 2,579,657,252 0.3%	
				Customer Meter Accuracy Loss 16,886,602,409 1.9%	
				Systematic Data Handling Discrepency 884,071,861 0.1%	
			Real Loss 87,795,656,568 9.8%	Reported Breaks and Leaks 10,284,868,244 1.2%	
				Unreported Loss 77,519,163,324 8.7%	

Quantitative Results

Estimated real water losses

Table 7. Real (Leakage) Water Losses in Public Water Supply Systems in Washington, Oregon, Idaho, and Montana, average million gallons per day (MGD), estimated 2015

State	Groundwater (MGD)		Total Surface & Ground Water Systems (MGD)		
	High (14.6%)	Average (9.8%)	Low (9.3%)	High (14.6%)	Average (9.8%)
Washington	73	49	90	142	95
Oregon	18	12	52	82	55
Idaho	33	22	23	37	25
Montana	10	7	13	21	14

Estimated recoverable losses

Table 10. Recoverable (Repairable) Real (Leakage) Water Losses in Public Water Supply Systems in Washington, Oregon, Idaho, and Montana, average million gallons per day (MGD, estimated 2015

State	Groundwater (MGD)		Total Surface & Ground Water Systems (MGD)		
	High (70%)	Average (53%)	Low (35%)	High (70%)	Average (53%)
Washington	51	26	32	99	50
Oregon	12	6	18	57	29
Idaho	23	12	8	26	13
Montana	7	4	5	15	7

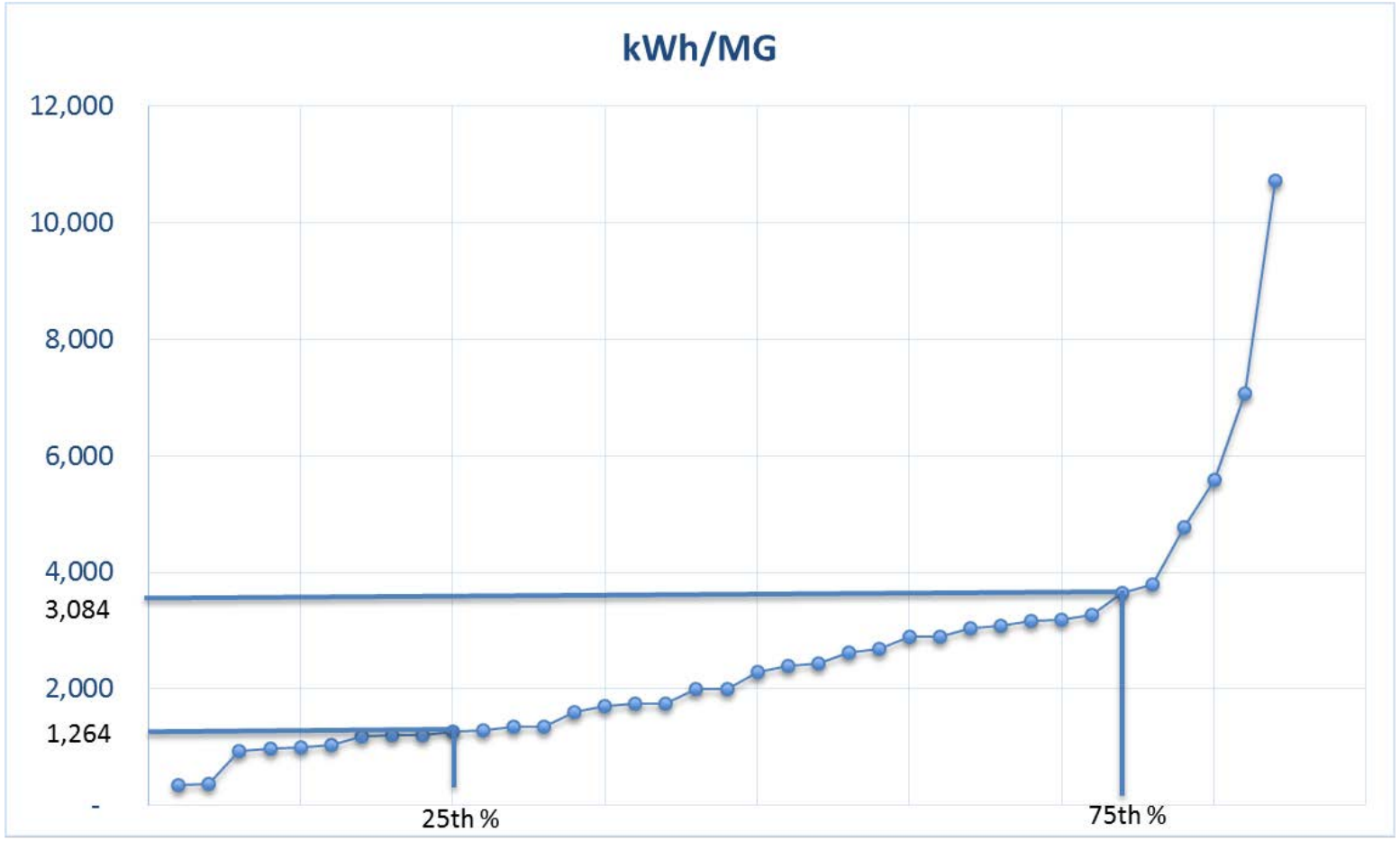
Embedded energy data

Table 8. Estimated Embedded Energy levels for California water utilities

Systems	kWh/MG					
	Average	Minimum	25th %	75th %	Maximum	Count
Groundwater	2,832	940	1,350	3,164	7,066	13
Surface Water	2,370	350	1,000	2,633	10,720	15
Surface Water (purchased)	1,833	1,200			2,300	3
Unknown	2,674	1,040			3,786	6
Grand Total	**2,538**	**350**	**1,200**	**3,164**	**10,720**	**37**

Sources: Talbot, 2015; PG&E, 2015; GEI/Navigant, 2010(a); GEI/Navigant, 2010(b).

Embedded energy - range



Estimated energy efficiency potential (aMW) - Technical

Table 9. Embedded Energy levels for real water loss estimates in Pacific Northwest (Technical Potential), annual Average Megawatts (aMW), estimated 2015

State	Groundwater (aMW)		Total Surface & Ground Water Systems (aMW)		
	High (75th)	Average	Low (25th)	High (75th)	Average
Washington	9.7	5.8	4.5	18.7	10.1
Oregon	2.3	1.4	2.6	10.8	5.8
Idaho	4.3	2.6	1.2	4.9	2.6
Montana	1.3	0.8	0.7	2.8	1.5
TOTAL	**17.6**	**10.6**	**9.0**	**37.1**	**20.0**

Remember: looking for more than 4,000 Average MW by 2035

Estimated energy efficiency potential (aMW) - Achievable

Table 11. Embedded Energy associated with recoverable losses (Achievable Potential), annual Average Megawatts (aMW), estimated 2015

State	Groundwater (aMW)		Total Surface & Ground Water Systems (aMW)		
	High (75th)	Average	Low (25th)	High (75th)	Average
Washington	6.8	3.1	1.6	13.1	5.3
Oregon	1.6	0.7	0.9	7.6	3.1
Idaho	3.0	1.4	0.4	3.4	1.4
Montana	0.9	0.4	0.2	1.9	0.8
TOTAL	**12.3**	**5.6**	**3.1**	**26.0**	**10.6**

Conclusions

Potential too low to merit further action

- Based upon available data, the achievable energy efficiency potential is 10.6 aMW.
- Data validity studies on water loss audits suggests that this is an underestimate of the achievable potential.
- Given the size of the energy efficiency potential, real water loss reduction in municipal / community water systems does not merit focus for NEEA at this time.
- There are also concerns about freeridership – will water systems reduce real water losses on their own, without energy efficiency program intervention?

Possible actions

- Publicize case studies across the region, and create a database of case studies on real water loss, recoverable water loss, and embedded energy values.
- Help the State of Washington communicate the costs and benefits of their data collection program to the water and energy utilities in the Pacific Northwest.
- NEEA could work with its member utilities to promote more tightly-coupled energy and water efficiency services across the Region.
  - While this could start with water loss reduction initiatives at water utilities specifically, it could also be expanded to include bundled energy and water projects.

Additional research opportunities

- Agriculture
  - Irrigation is the dominant water end use in all states, and energy requirements for its use and associated with losses are unknown
  - Energy efficiency potential associated with agriculture could be higher than for municipal
- Water and Energy Planning
  - Many of the alternative water supplies under consideration (e.g., reuse, desalination) are more energy-intensive than current supplies
  - What is the marginal energy and demand benefit to conservation over these supply alternatives?

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