Northwest Power and Conservation Council

November 6, 2008

MEMORANDUM

TO: Power Committee

FROM: Tom Eckman

SUBJECT: Agriculture and Irrigated Agriculture Conservation Resource Potential and Cost

In the 5th Plan, staff identified approximately 100 average megawatts of conservation potential available in the region through improvements in the irrigation system hardware efficiency improvements. Since the 5th Plan, almost 685,000 acres have been added to the land irrigated by pressurized sprinkler systems. However, due to improvements in system efficiency, water management, and weather conditions, total estimated regional electricity use for irrigation decreased from 655 average megawatts to 645 average megawatts. After accounting for these changes, staff estimates that between 85 - 90 average megawatts of conservation potential remain available through improvements in pump efficiency, leak reduction, conversion to lower pressure applications, and better sprinkler/nozzle management practices.

In addition to improvements in irrigation system hardware, better water management practices could also reduce the energy consumed in irrigation. However, due to existing water laws, only a small portion of the region (the Columbia Basin Water Management Area in Washington) can assure that water savings on one farm are not eliminated by increased use on farms with junior water rights. Despite this limitation, just over 20 average megawatts of conservation potential are available in the region through scientific irrigation water scheduling.

Non-irrigation "on farm" electricity use in the remainder of the agriculture sector is dominated by dairy milk production. According to the Department of Agriculture, the region produced approximately 20 billion pounds of milk in 2007. Idaho and Washington rank among the top 10 states in milk production and Oregon ranks 18th. Staff estimates that 2007 electricity use for dairy milk production was approximately 55 average megawatts. Many of the dairies in the region, and particularly in Idaho, were established and/or enlarged within the last decade. Consequently, many already have installed energy efficient lighting, pumps, and milk cooling equipment. Nevertheless, staff estimates that approximately five average megawatts of conservation potential are available through improvements such as variable speed drives on milking machine vacuum pumps, the use of flat-plate heat exchangers for pre-cooling milk prior to refrigeration, and improved lighting.

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Agriculture Sector
Regional Conservation Potential

November 18, 2008

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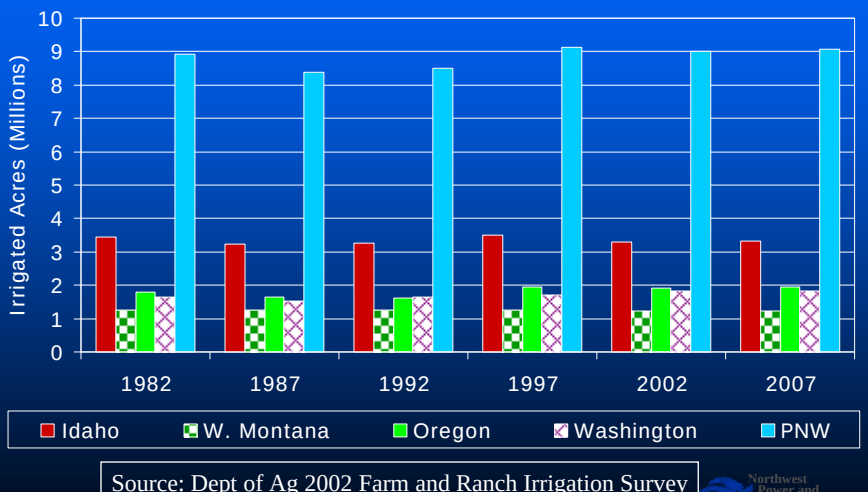
PNW Irrigated Acreage Has Been Stable



Source: Dept of Ag 2002 Farm and Ranch Irrigation Survey

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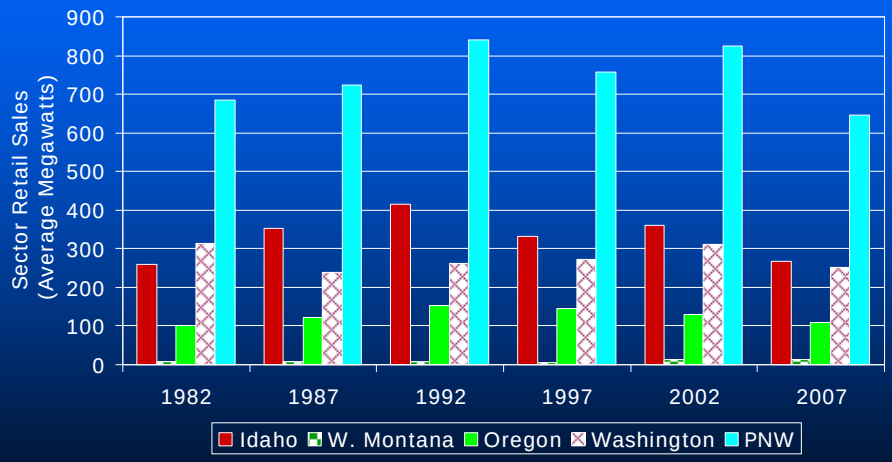
While Electricity Use for Irrigated Agriculture Has Fluctuated



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Sprinkler Systems Dominate Irrigated Acreage in PNW

State	Total Irrigated Acreage	Sprinkled Acreage		Gravity Acreage	
		Acres	%	Acres	%
Idaho	3,126,857	2,202,917	70%	929,177	30%
Montana	2,131,955	773,008	36%	1,361,731	64%
Oregon	1,731,660	1,048,211	61%	685,264	40%
Washington	1,806,782	1,450,274	80%	268,122	15%
PNW Total	8,797,254	5,474,410	62%	3,244,294	37%

Source: Dept of Ag 2002 Farm and Ranch Irrigation Survey

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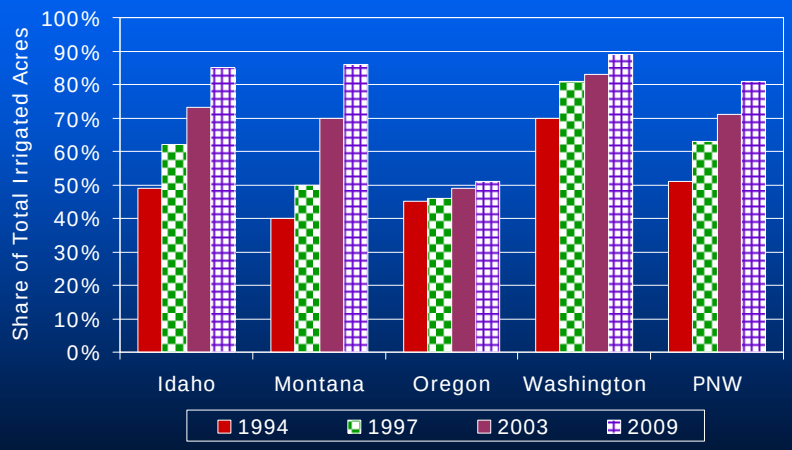
Center Pivot Sprinkler Acreage Has Also Been Increasing



Source: Dept of Ag 2002 Farm and Ranch Irrigation Survey

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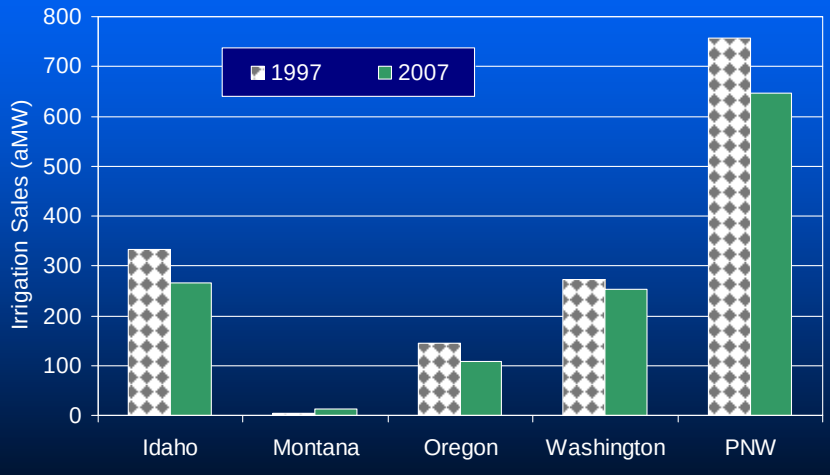
While Total Electricity Use for Irrigated Agriculture Has Been Decreasing



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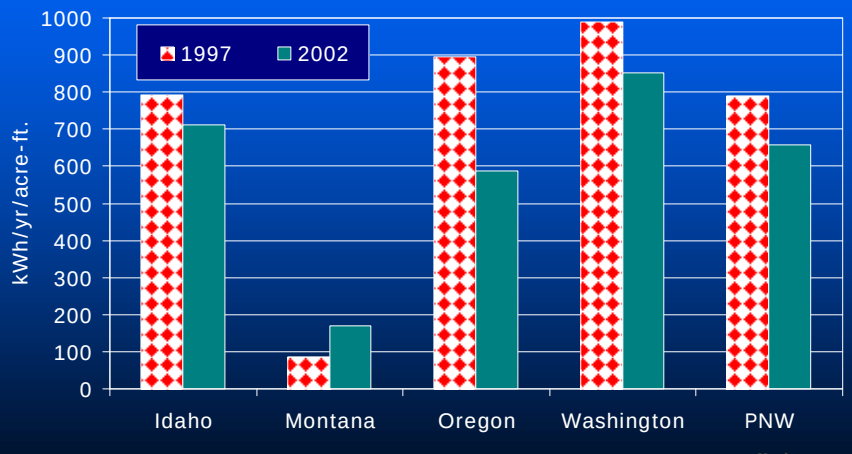
This Has Been Driven by Conversions to Lower Pressure Center Pivot Systems

Change in Acreage Irrigated by Center Pivot Systems at High, Medium and Low System Pressures 1994 to 2002			
State	Change in High Pressure (60 + PSI) Acres	Change in Medium Pressure (30 – 59 PSI) Acres	Change in Low Pressure (30 PSI & lower) Acres
Idaho	-11%	109%	84%
Montana	-68%	71%	242%
Oregon	-33%	9%	28%
Washington	-34%	89%	102%
PNW	-28%	81%	98%

Source: Dept of Ag 2002 Farm and Ranch Irrigation Survey

As A Result Average Electricity Use/Acre-Ft Has Been Declining (*Except in MT*)



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Resource Assessment Methodology - Overview

- Estimate "Base Case" System Efficiency by State and System Type for Sprinkler Systems:
  - Center Pivot
    - » High Pressure
    - » Medium Pressure
    - » Low Pressure
  - Wheel Line
  - Hand Line
- Estimate Cost of System Efficiency Improvements by System Type
- Estimate Savings from System Efficiency Improvements by State and System Type

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Results: Estimated Technical Potential by State

State	Technical Potential (aMW)	2007 Sales (aMW)	% of 2007 Sales
Idaho	48	266	18%
Montana	5	13	34%
Oregon	12	109	11%
Washington	25	252	10%
PNW Region	89	647	14%

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Results: Resource Potential by Measure

Measure	Resource Potential (aMW)	Levelized Cost (Cents/kWh)
Convert wheel line systems to low pressure systems on alfalfa acreage	3	9.6
Convert hand line systems to low pressure systems on alfalfa acreage	2	6.9
Convert Center Pivots from High to Low Pressure	5	1.8
Convert Center Pivots from Medium to Low Pressure	13	1.1
Replace Nozzles & Gaskets	33	7.4
Replace Pumps, Nozzles & Gaskets	32	2.7
Total	89	4.0

Irrigation Water Management Resource Potential

- Resource Definition
  - Scientific scheduling of irrigation water applications based on soil moisture measurement and plant moisture requirements
- New Measure in 6th Plan
  - Post 5th Plan's adoption, Bonneville funded research to estimate potential savings from improved water management
  - Research indicated that through "scientific irrigation scheduling" pumping energy use could be reduced by approximately 10%

Irrigation Water Management – Issues

- Applicability
  - Energy Savings from irrigation water management require that the unused water not be applied elsewhere in the system
  - Except for the Columbia Basin Project, Western water law does not prohibit the "use" of the saved water
  - This limits applicability of irrigation water management to just 16% of the region's irrigated acreage
- The large non-energy benefits from better irrigation water management are already increasing its adoption
  - Improved crop yields
  - Reduced erosion
  - Reduced ground water pollution
  - Reduced fertilizer use

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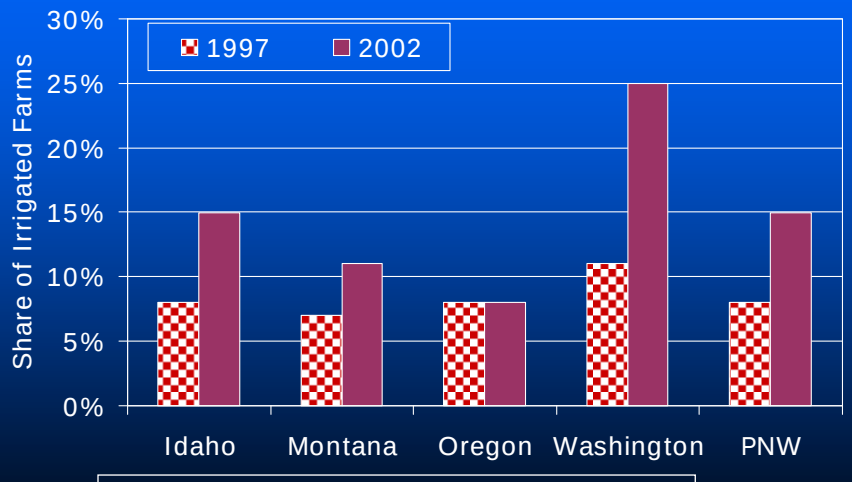
PNW Use of Scientific Irrigation Water Management Practices



Source: Dept of Ag 2002 Farm and Ranch Irrigation Survey

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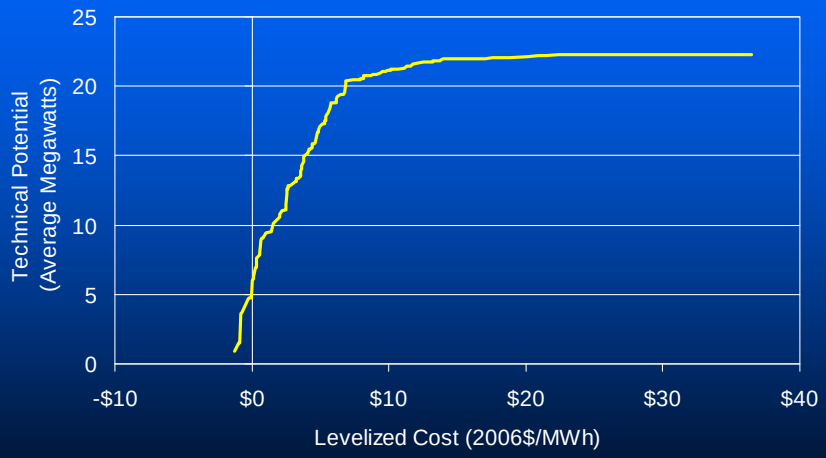
Irrigation Water Management Technical Potential*



*Includes Columbia Basin Project Area Only

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Dairy Milk Production Conservation Potential

- "On farm" dairy milk production is the largest single use of electricity in agriculture sector after irrigation
- New Measure for 6th Plan
  - Current conservation programs are targeting savings from dairies, but no regional estimate of savings potential

Average dairy uses 800 – 1200 kWh/cow-yr

There are approximately 885,000 milking cows in PNW

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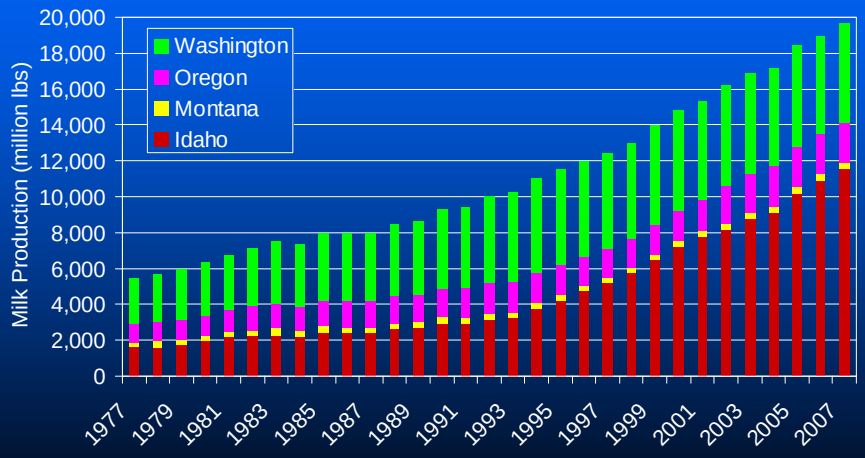
PNW Milk Production Has Double Since 1990
(Idaho Production is up 400%)



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Major Electricity Using Functions on a Dairy Farm

- Milk Harvest*
- Milk Cooling*
- Lighting*
- Air Circulation* and Ventilation
- Washing and Water Heating*
- Feed Handling
- Manure Handling
- Water Pumping
- Compressed Air

*Indicates uses where significant energy savings is possible

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Free Stall vs. Tie Stall Barn Have Different Energy Use

Tie Stall

Small Farms (<100 head)

Cows milked in barn

Use: 550 – 1600 kWh/cow-yr

Average Use: 870 kWh/cow-yr

Free Stall

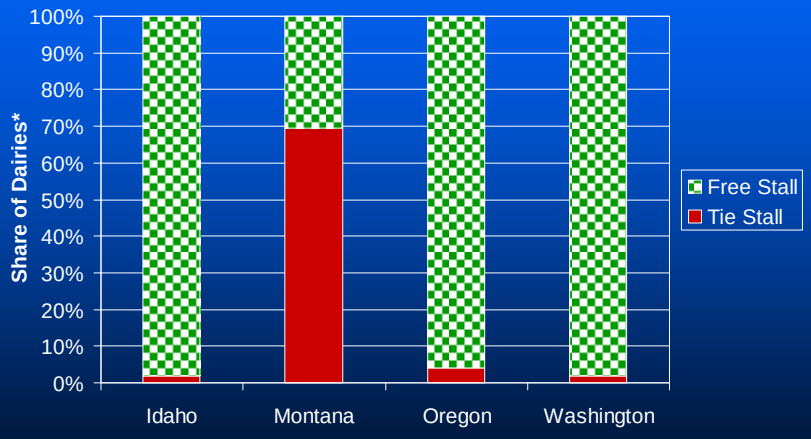
Large Farms (>100 head)

Cows milked in separate parlor

Use: 425 – 1800 kWh/cow-yr

Average Use: 785 kWh/cow-yr

Free Stall Barns Dominate New Dairy Production Facilities



*Estimated based on share of milk production by herd size

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Energy Efficiency Measures for Dairy Farms

- Variable speed drive on milking machine vacuum pump
- Flat Plate Heat Exchanger for milk pre-cooler
- Energy efficient lighting
- Refrigeration heat recovery

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Dairy Milk Production Conservation Technical Potential

State	Retrofit Potential (aMW)	Lost-Opportunity Potential (aMW)	Total Potential (aMW)
Idaho	2.6	0.4	3.1
Montana	0.3	0.0	0.3
Oregon	0.5	0.3	0.8
Washington	1.3	0.0	1.3
Total	4.7	0.8	5.5

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Total Agriculture Sector Conservation Technical Potential

State	Irrigation Hardware (aMW)	Irrigation Water Management (aMW)	Dairy (aMW)	Total (aMW)
Idaho	48	-	3	51
Montana	5	-	0	5
Oregon	12	-	1	12
Washington	25	22	1	49
PNW	89	22	5	117