The Environmental Benefits of Montana's RPS

MT Department of Environmental Quality
Renewable Energy Program
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Energy & Telecommunications Interim Committee
November 8, 2013

Agenda

- Overview of Montana Electricity Sector
- RPS Compliance
- Air Quality Benefits
  - Power plant emission rates
  - Potential avoided emissions
- Water Consumption Impacts
- Economic Impacts
- Conclusions

- Chief Takeaway: Montana is expanding its electricity generation without increased environmental degradation.

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Montana's RPS Developments

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How is MT's RPS being met?

Currently being used for compliance

- Wind (Judith Gap, Spion Kop, Diamond Willow, etc.)
- Small hydro (Lower S. Fork, Turnbull, Flint Creek)

Possible Future Fuels

- Biomass
- Biogas
- Solar
- Geothermal
- Hydro Capacity Expansions

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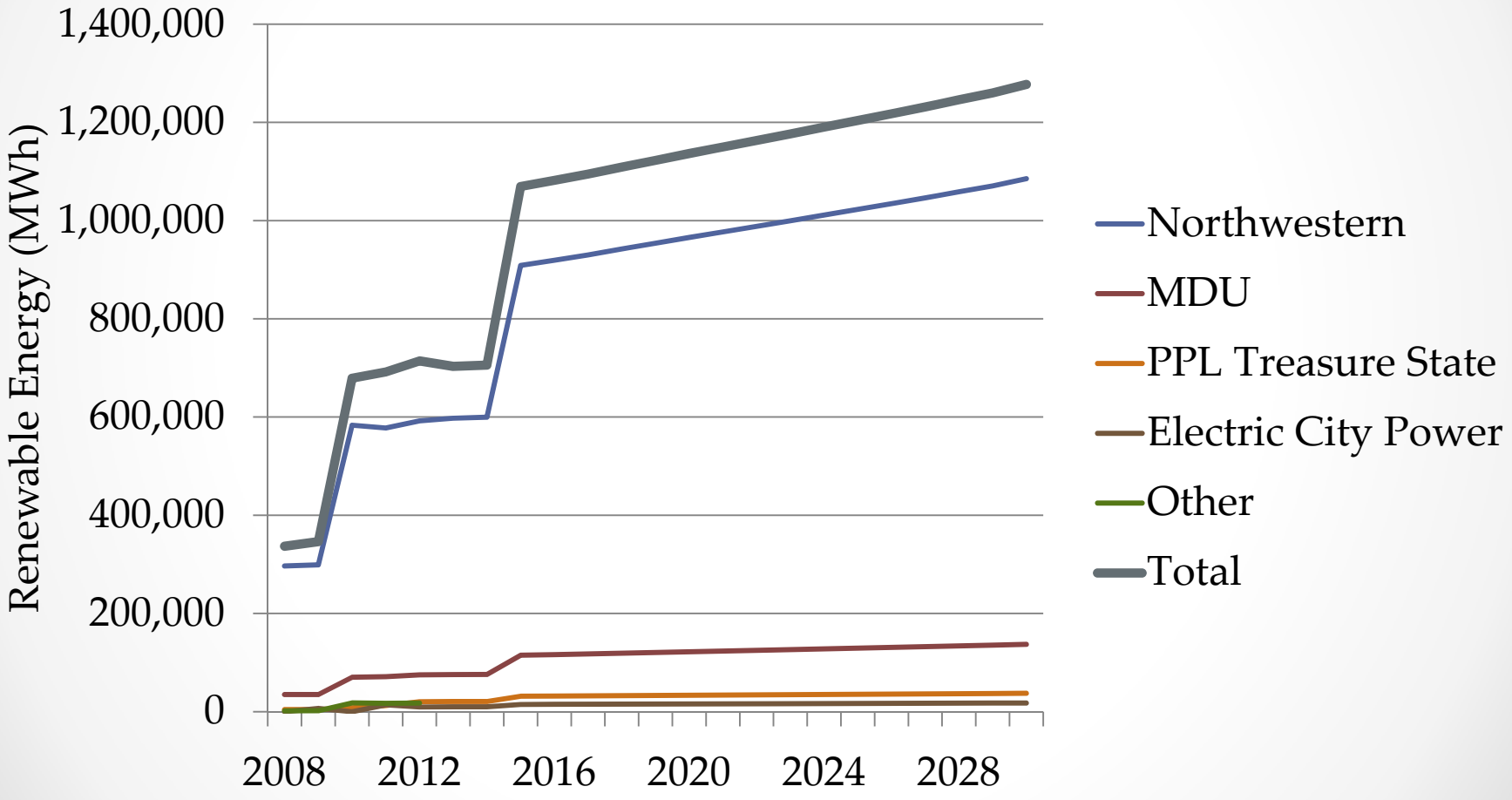
RPS Compliance



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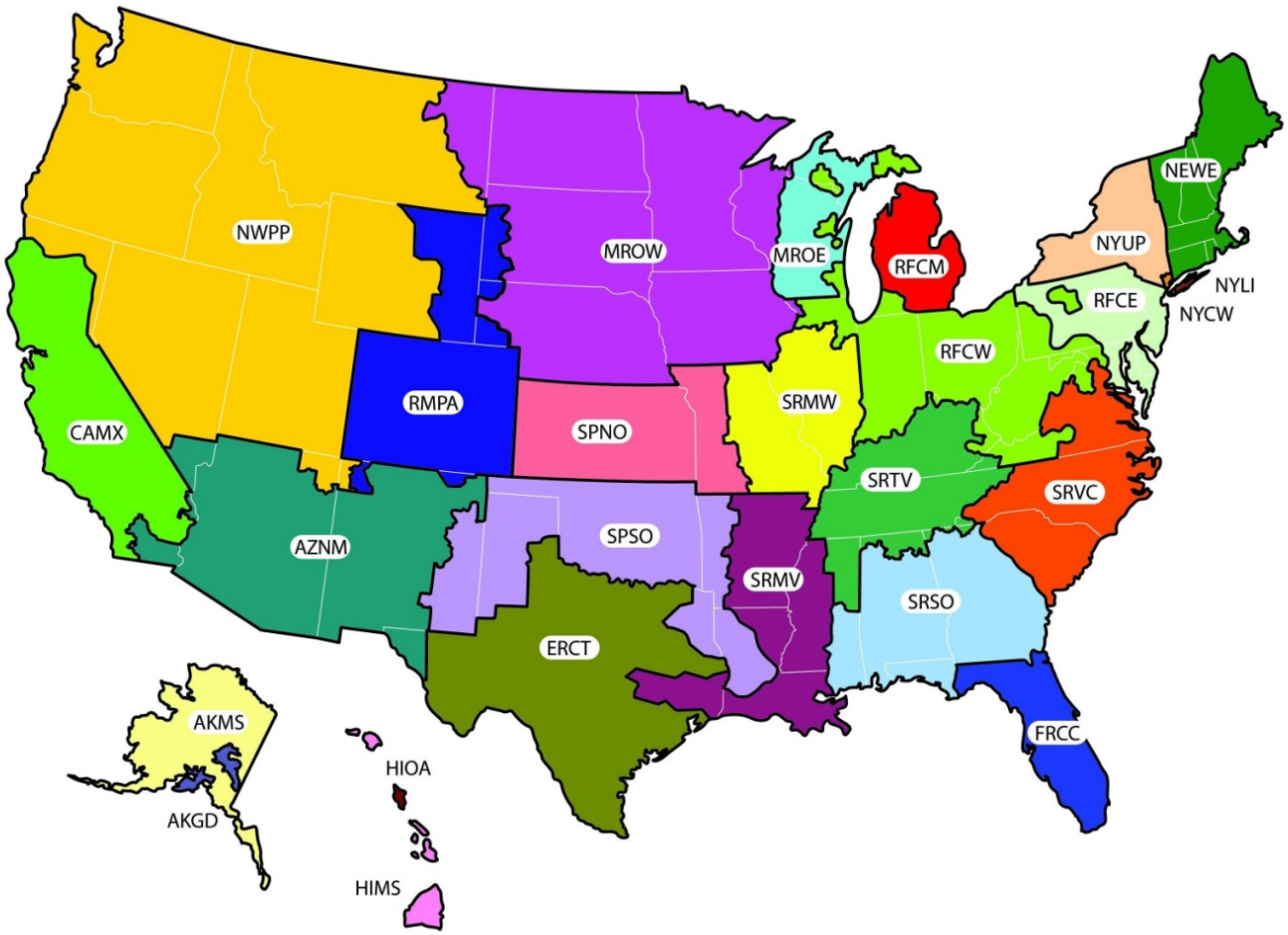
Air Quality Benefits

U.S. NERC Sub-regions



This Is a representational map; many of the boundaries shown on this map are approximate because they are based on companies, not on strictly geographical boundaries.
USEPA eGRID2010 Version 1.0 December 2010

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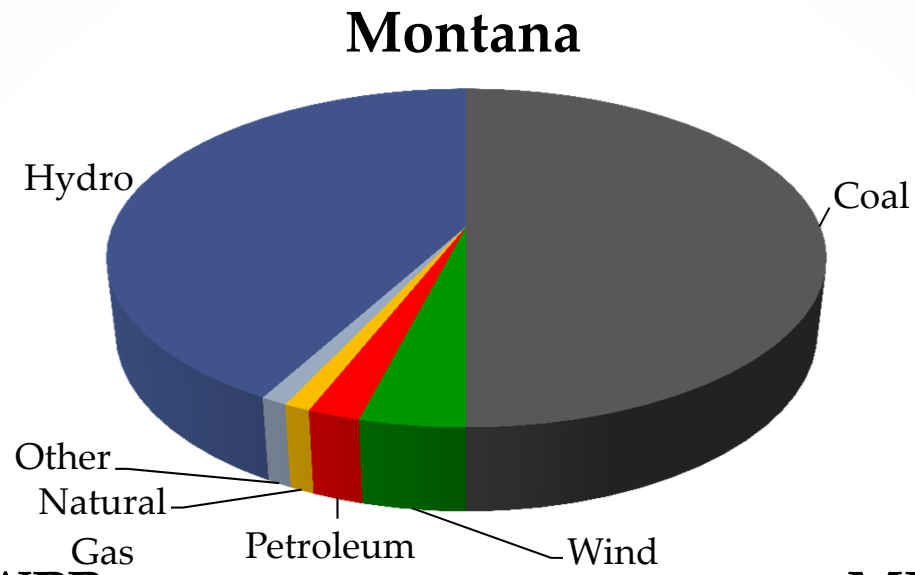
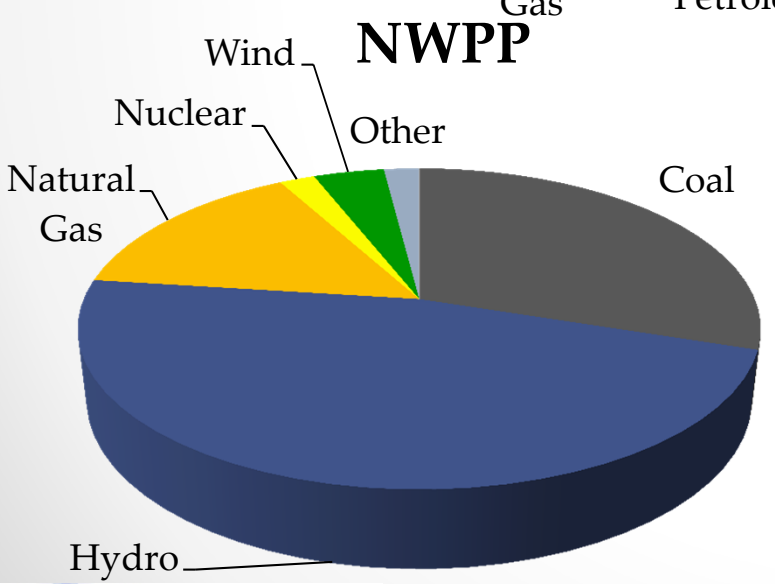
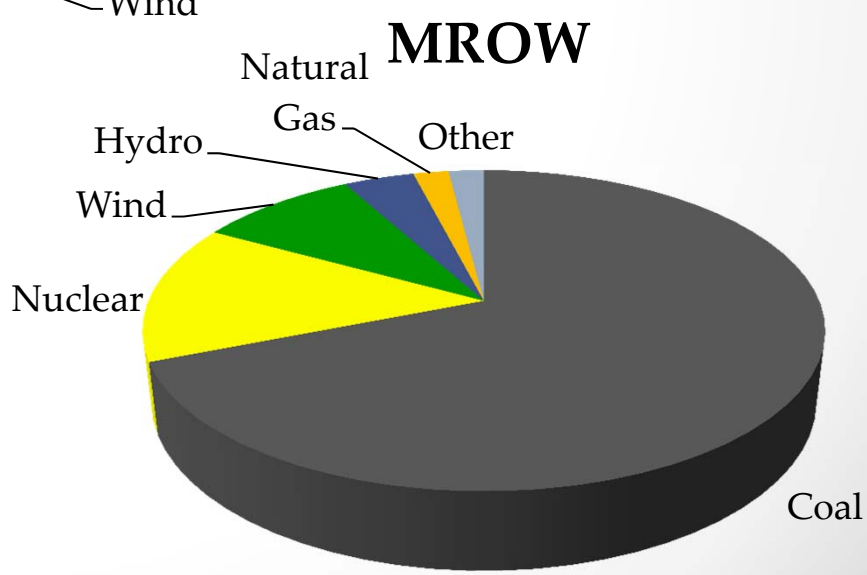
Generation Resource Mix







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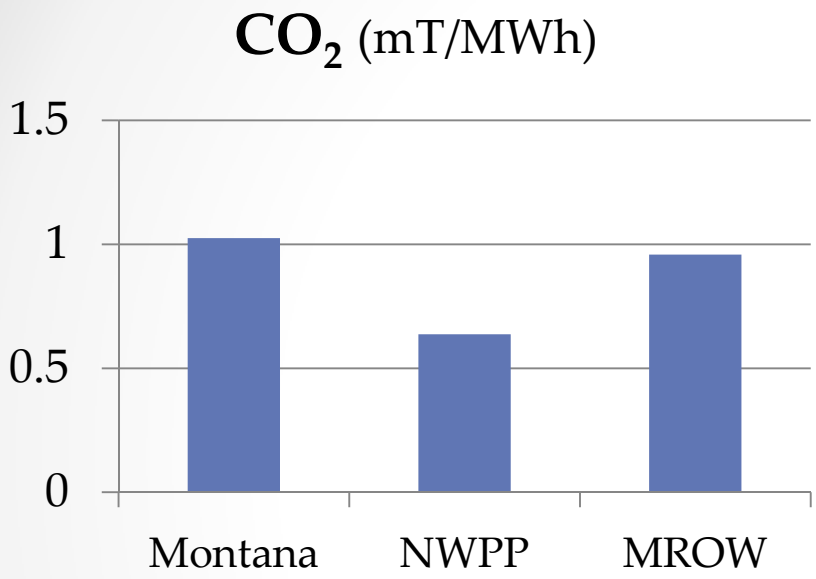
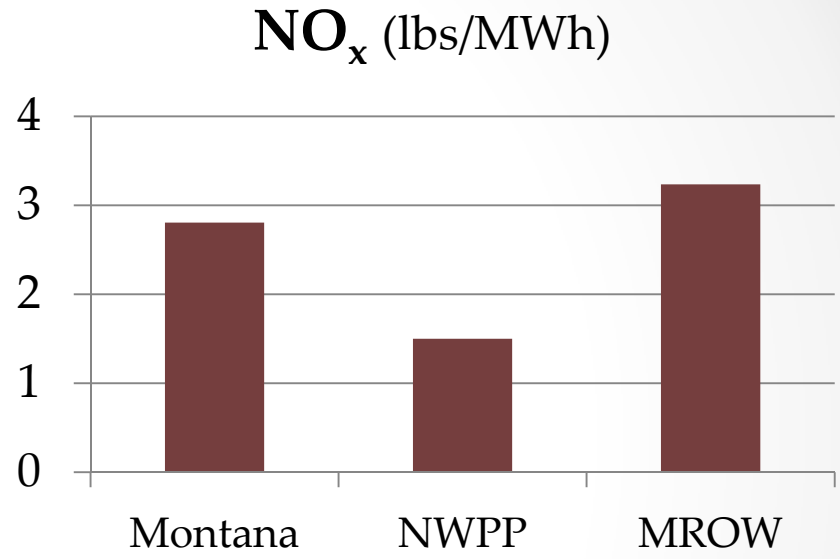
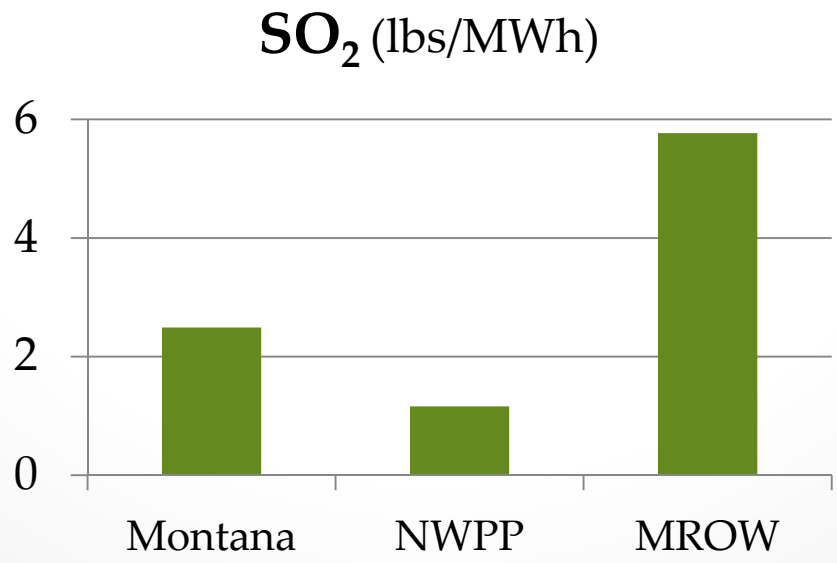
Non-baseload Avoided Emission Scenarios







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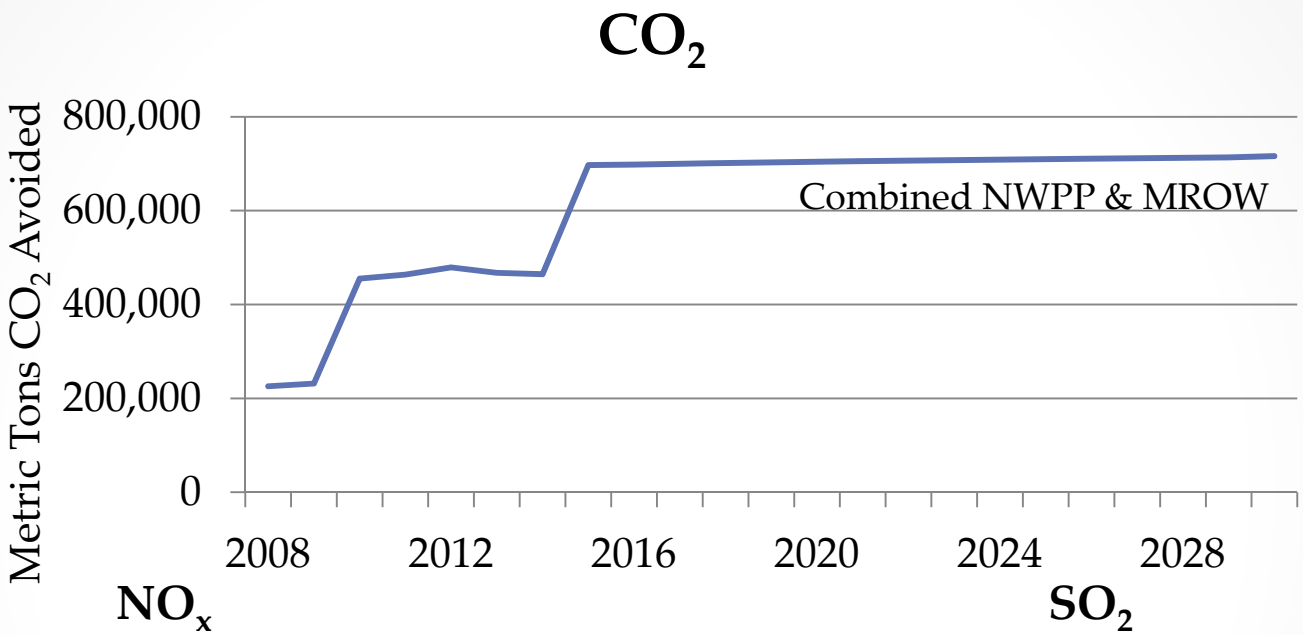
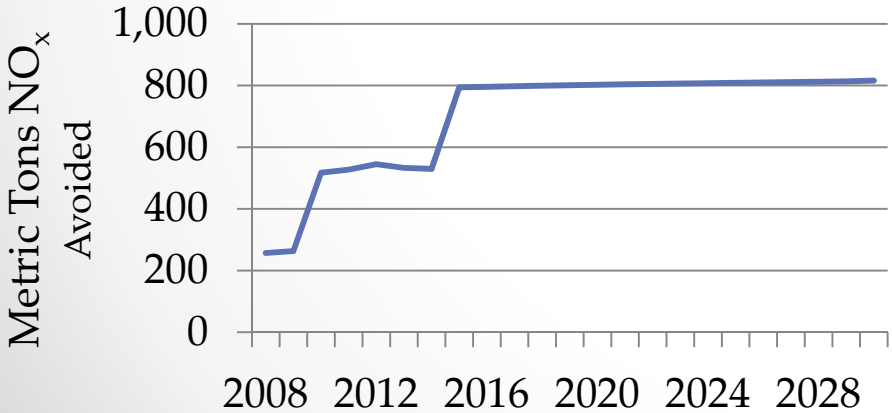
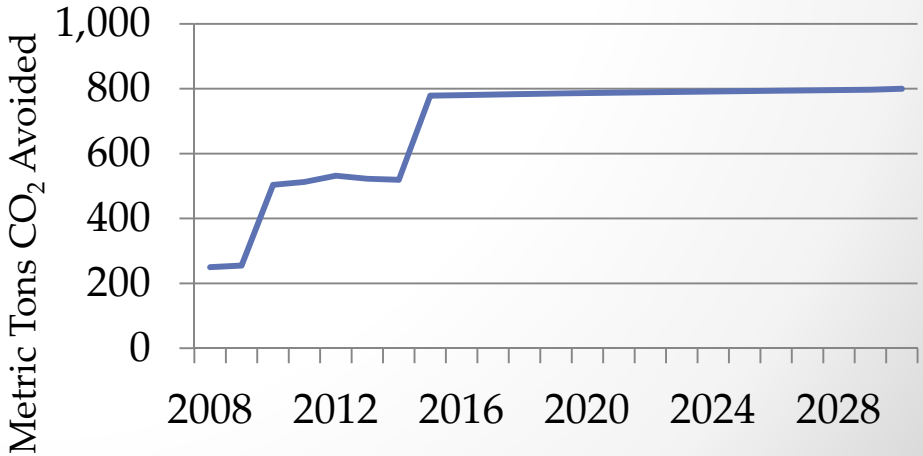
Potential Avoided Emissions







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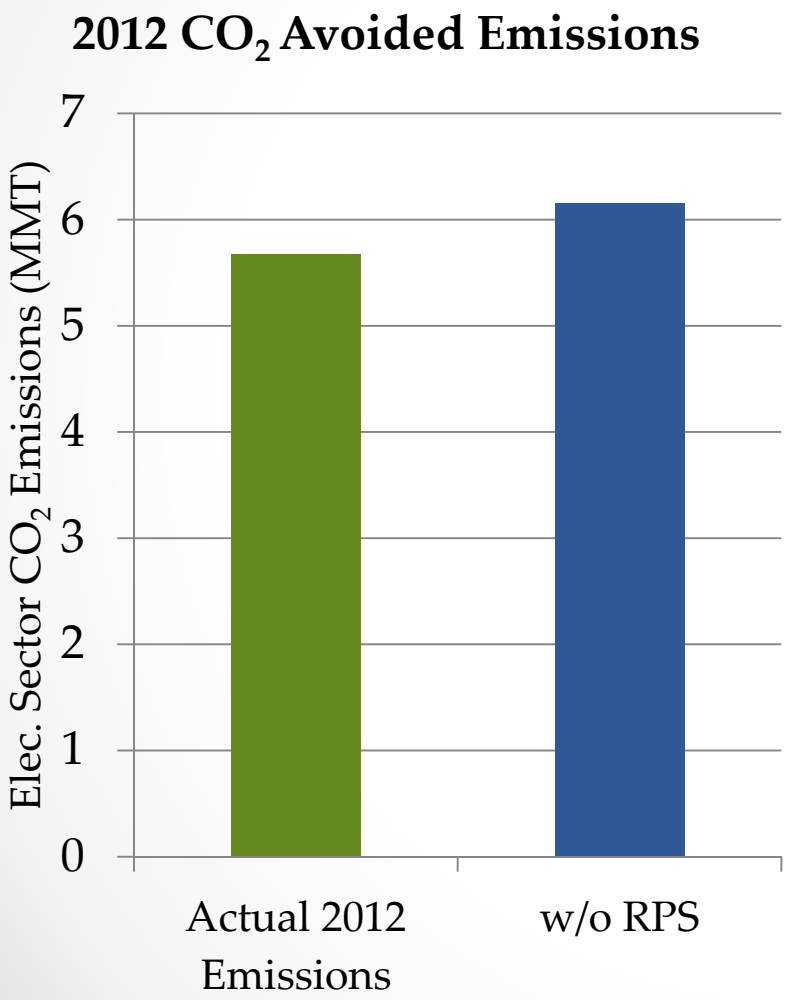
Potential Avoided CO_2



- CO_2 emissions from MT electricity would have been an estimated 8.4% higher in 2012 without the renewable energy consumption required by MT RPS.
- Equivalent to taking 100,000 cars off the road for the year

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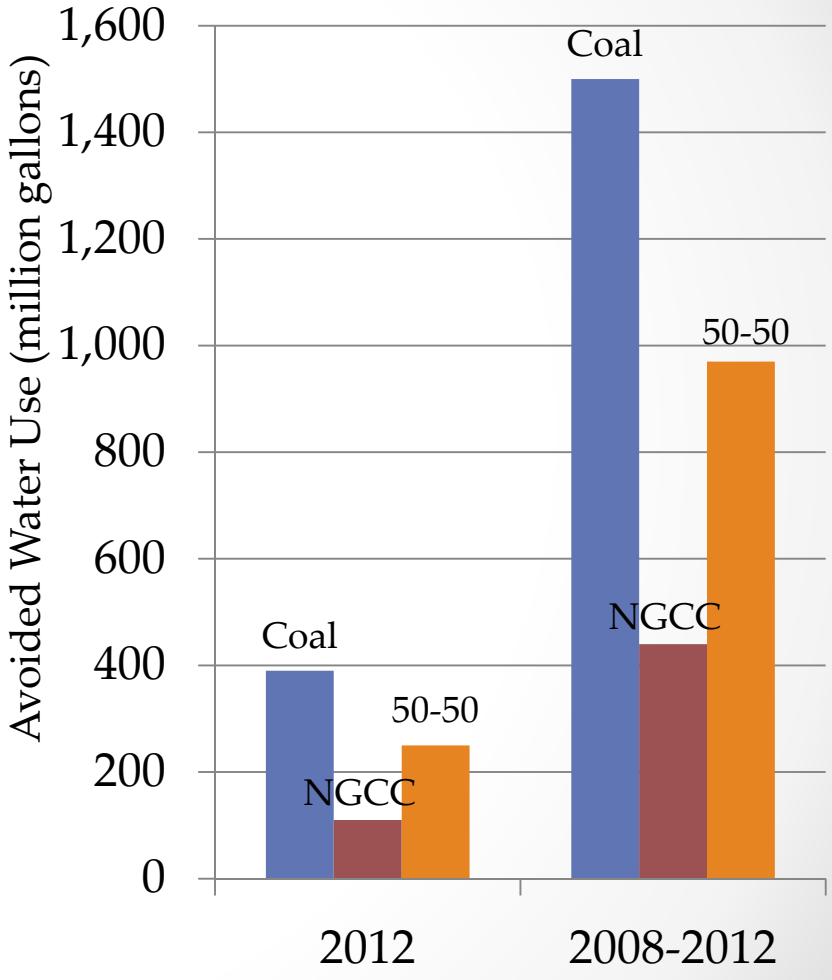
Water Consumption Benefits

Avoided Water Consumption

- Thermal power plants use water for steam generation, cooling, and pollution control and transport.
- A typical coal power plant consumes an average of 550 gallons of water per MWh of net generation.
- An NGCC power plant consumes an average of 160 gallons per MWh.



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Economic Impacts of RPS

- Since 2005, MT RPS has created:
  - 336 temporary construction jobs
  - 26 permanent jobs
- Resulted in $400 million in total capital investment in Montana.
- 250 MW of additional electricity generating capacity with no additional emissions or increased water consumption.

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Conclusions

- Montana is increasing electricity generation without increased environmental degradation.
- Increased Montana renewable energy consumption changes the overall mix of resources used to meet Montana electricity consumption.
- Increased reliance on renewable energy resources:
  - Reduces the greenhouse gas and criteria air emissions Montanans are responsible for through their electricity consumption.
  - Reduces the water consumed to meet Montana's electricity demand.

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… And Finally

- Many of the environmental benefits of the Montana RPS are being enjoyed by neighboring states.
- However, as an exporter of renewable electricity, many of the benefits of other state RPS programs are being enjoyed by Montana.
- "The region's commitment to renewable energy benefits Montana's environment, just as Montana's commitment to renewable energy benefit's the region's environment."

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The Environmental Impact of Montana's Renewable Portfolio Standard

Prepared by MT Dept. of Environmental Quality

Montana's renewable portfolio standard (RPS), enacted in April 2005 as part of the Montana Renewable Power Production and Rural Economic Development Act, requires public utilities and competitive electricity suppliers to obtain a percentage of their retail electricity sales from eligible renewable resources. Beginning in 2008, public utilities and competitive electricity suppliers were required to meet 5% of their total retail electricity sales with renewable electricity purchases. This renewable energy requirement was increased to 10% beginning in 2010 and will increase to 15% beginning in 2015. Because the RPS applies to only public utilities and competitive electricity suppliers, and because subsequent amendments to the RPS exempted small utilities and competitive electricity suppliers, the RPS will only apply to four companies in Montana in 2013. Combined, these four companies account for approximately half of the state's retail electricity sales.

As part of Senate Joint Resolution No. 6, the Montana Legislative Council assigned the Energy and Telecommunications Interim Committee (ETIC) to conduct a study of the impacts that the Montana RPS program has had on the state since its implementation. As part of this study, ETIC must review the environmental benefits of the RPS program.

Since the RPS program was enacted in 2005, Montana has seen more than 650 megawatts (MW) of renewable energy projects installed within the state. The vast majority of this renewable energy capacity has utilized wind energy technology to take advantage of the state's strong and consistent wind resources. The remaining renewable energy projects have consisted mostly of small hydroelectric projects. However, only 250 MW of the more than 650 MW of Montana renewable energy capacity have been used for compliance with the Montana RPS. The 189 MW Rim Rock and 210 MW Glacier wind farms are being used for compliance with the California RPS. Several electricity providers have utilized small amounts of renewable energy from neighboring states to meet their Montana RPS requirements. Table 1 below shows the number of megawatt-hours (MWh) of renewable energy each electricity provider has submitted to achieve RPS compliance through 2012 and estimates the acquisitions needed for future compliance.

Table 1 - Renewable Energy Required to Meet Montana RPS (MWh)[i]

	2008	2010	2012	2015	2020	2025	2030
Northwestern Energy	296,696	583,403	592,007	908,584	965,764	1,022,772	1,085,243
MDU	34,718	70,040	74,756	114,732	121,953	129,151	137,040
PPL Treasure State	4,058	7,712	20,406	31,318	33,289	35,254	37,407
Electric City Power	*	*	9,587	14,714	15,640	16,564	17,575
Other	1,490	17,771	17,429				
Total	336,962	678,926	714,186	1,069,349	1,136,645	1,203,741	1,277,265
Cumulative	336,962	1,362,127	2,768,137	5,246,420	10,791,229	16,674,357	22,906,403

* Paid fee instead of procuring renewable energy

Based on the market activities within the electricity sector since 2005, the Montana RPS is having an impact on the electricity sector. A wide range of environmental benefits can be ascribed to these activities depending upon the assumptions being made. The DEQ has identified two key areas where increased renewable energy use within Montana has resulted in environmental benefits: air quality and water consumption.

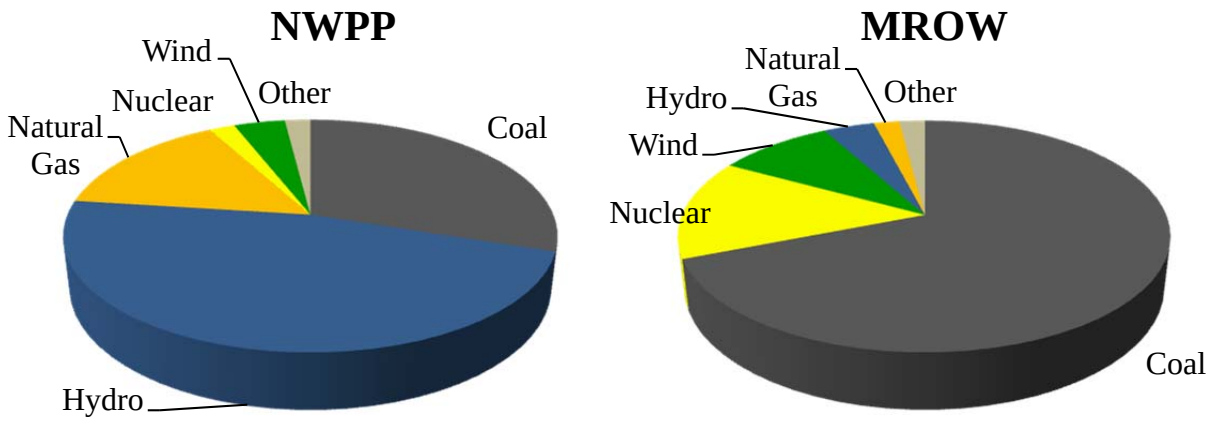
Air Quality

For this analysis, the DEQ will use the emissions accounting methods recommended by the U.S. Environmental Protection Agency's (EPA) Green Power Partnership that call for reporting air quality impacts based on the use and retirement of renewable energy credits (RECs), which denote 1 MWh of renewable electricity generation. The air quality impact of the Montana RPS can be best estimated by determining what types of energy generation Montana electricity providers are reducing their purchases of in response to increased renewable energy purchases. While more than 90% of the electricity generated in Montana currently comes from either coal-fired power plants or large hydroelectric dams, Montana's electricity consumption patterns are far more complicated. Much of the electricity generated in Montana is exported to other states while electricity generated in the broader region, including natural gas and nuclear power, is imported. As a result, the air quality emissions associated with Montana's electricity consumption are best estimated by using regional grid emission factors, not Montana specific numbers.

The EPA's 2012 Emissions and Generation Resource Integrated Database (eGRID) tracks emissions from the nation's power plants and aggregates these emissions to create state and regional grid averages, including average emission rates for all of a state or region's electricity generation and also for only the non-baseload generation. Non-baseload generation is the electricity generation used to meet fluctuations in electricity demand over the course of the day. It is the type of generation resource most likely to be replaced by renewable energy generation, especially when considering the high percentage of wind energy, whose output can vary throughout the day, being used to meet Montana's RPS.

The majority of Montana resides within the Northwest Power Pool (NWPP) sub-region of the western U.S. electricity grid. The NWPP has a diverse generation mix, generating 47% of its electricity in 2009 from hydroelectric dams, 30% from coal, and 15% from natural gas.[ii] However, the service territory of Montana-Dakota Utilities in eastern Montana resides within the eastern U.S. grid and is part of the Midwest Reliability Organization West (MROW) sub-region. Unlike the NWPP sub-region, MROW generated 69% of its electricity in 2009 from coal power plants, 14% from nuclear, 9% from wind. Natural gas accounted for only 2% of generation in the region.[iii]

Figure 1 - Generation Mix in NWPP and MROW Sub-regions



The DEQ estimates avoided air pollution emissions based on eGRID's regional, non-baseload average emission rates, because these figures represent the best available data for estimating how the regional electricity market adjusts to accommodate renewable energy generation and consumption. These figures are the industry standard for estimating the air quality impacts of renewable energy consumption and can be found in Table 2.[iv]

Table 2 - Electricity Emissions Rates for Select Resources[v]

	CO_2	NO_x	SO_2
	mT/MWh	lbs/MWh	lbs/MWh
eGRID State and Sub-regional, Non-Baseload Emission Rates			
Montana	1.025	2.806	2.492
NWPP	0.637	1.501	1.160
MROW	0.959	3.236	5.769

The NWPP sub-region's average, non-baseload emission rates reflect the diversity of energy resources used to meet non-baseload electricity demand within the sub-region, falling approximately in the middle between the typical emission factors associated with coal and natural gas power plants. In contrast, the average, non-baseload emission rates within the MROW sub-region are only slightly less than the emission rates associated with a typical coal power plant. This is because the MROW sub-region's non-baseload power is dominated by coal power plants.

Air Quality Summary

The air quality impact of the Montana RPS program, in terms of avoided air emissions, can be calculated by multiplying the average non-baseload emission rates for the two sub-regions by the number of RECs used by the electricity providers to achieve RPS compliance.

As shown in Table 3 below, for the calendar year 2012, electricity provider compliance with the Montana RPS is estimated to have avoided emitting 479,000 metric tons of carbon dioxide, 545

metric tons of nitrogen oxide, and 532 metric tons of sulfur dioxide.[vi] The avoided carbon dioxide emissions alone are equivalent to taking almost 100,000 cars off the road for a year. Had Montana not consumed this renewable energy, the CO_2 emissions associated with the state's retail electricity consumption in 2012 would have been an estimated 6.15 million metric tons instead of 5.67 million metric tons, an 8.4% increase in emissions.[vii]

In calendar year 2015, the first year of compliance at the RPS program's 15% renewable energy standard, the RPS program is equivalent to avoided air emissions of nearly 700,000 metric tons of carbon dioxide, equivalent to taking 150,000 cars off the road for a year, as well as almost 800 metric tons of nitrogen oxide and sulfur dioxide. Without this renewable energy consumption, the CO_2 emissions associated with Montana's retail electricity consumption can be expected to be at least 12.7% higher in 2015 than they will be if Montana's RPS achieves 100% compliance.[viii]

Table 3 - Estimated Annual Avoided Emissions from RPS Compliance[ix]

		2008	2010	2012	2015	2020	2025	2030
RECs Required (MWh)		336,962	678,926	714,186	1,069,349	1,136,645	1,203,741	1,277,265
CO_2	Metric Tons	225,863	455,108	479,092	696,912	704,446	709,486	715,925
NO_x	Metric Tons	257	517	545	794	803	809	816
SO_2	Metric Tons	250	504	532	778	787	793	800

Through 2012, the cumulative air quality impact from avoided power plant emissions in the region, shown in Table 4 below, is equal to more than 1.85 million metric tons of carbon dioxide and more than 2,000 metric tons of both nitrogen oxide and sulfur dioxide. Through 2030, the current RPS program could avoid as much as 14 million metric tons of carbon dioxide that would otherwise be associated with Montana's retail electricity consumption.

Table 4 - Estimated Cumulative Avoided Emissions from RPS Compliance[x]

		2008	2010	2012	2015	2020	2025	2030
RECs Required (MWh)		336,962	1,362,127	2,768,137	5,246,420	10,791,229	16,674,357	22,906,403
CO_2	Metric Tons	225,863	912,745	1,855,520	3,484,610	6,990,408	10,527,873	14,091,458
NO_x	Metric Tons	257	1,037	2,110	3,996	7,961	11,993	16,054
SO_2	Metric Tons	250	1,008	2,053	3,872	7,789	11,470	15,721

Water Consumption

Along with being a major emitter of carbon dioxide and other key air pollutants, the electricity industry is also one of the largest consumers of water in the country. The water is used to operate the steam generators that power most conventional, thermal power plants as well as to cool the resulting steam back to liquid water. Significant amounts of water are also used to control pollution emissions and, in the case of coal power plants, to transport coal ash into settling ponds. In contrast, Montana's existing renewable energy developments consume minimal amounts of water.

Using figures reported to the U.S. Energy Information Administration (EIA) in Form 923, a typical large coal power plant utilizing a recirculating cooling system will consume and evaporated an average of 550 gallons of water for every MWh of electricity generated by the power plant. Alternatively, newer NGCC power plants tend to consume less water than older coal power plants, but a typical NGCC power plant with a recirculating cooling system still consumes approximately 160 gallons of water per MWh of electricity generated. Assuming the avoided regional generation from increased renewable energy consumption is equally divided between coal and natural gas power plants, each MWh of renewable energy consumption avoids the consumption of an estimated 355 gallons of water. This translates into a quarter of a billion gallons of water saved in 2012 alone as a result of Montana's RPS and just under 1 billion gallons saved between 2008 and 2012, as is shown in Table 5.

Table 5 – Potential Avoided Water Consumption from Renewable Energy Generation[xi]

Type of Power Plant	Water Consumed (/MWh)	Potential 2012 Water Savings (gallons)*	Potential Cumulative Water Savings (gallons)**
Conventional Coal	550	390,000,000	1,500,000,000
NGCC	160	110,000,000	440,000,000
50-50 Split	355	250,000,000	970,000,000

* /MWh water consumption rate multiplied by 714,186 MWh, the total number of RECs used to meet Montana's 2012 RPS requirements.

**/MWh water consumption rate multiplied by 2,768,137 MWh, the cumulative number of RECs used to meet Montana's RPS through 2012.

Economic Impacts

In addition to the environmental impact of Montana's RPS, it's worth noting that the RPS has also had a significant economic impact within the state, particularly in more rural counties. Since 2005, renewable energy projects developed directly in response to Montana's RPS requirement have created approximately 335 temporary construction jobs and 26 permanent jobs. These projects have resulted in over $400 million in total capital investment in Montana. In addition, 250 megawatts of generation capacity have been built in Montana with no additional emissions and little water consumption. As we continue to review the impacts of the RPS with ETIC, DEQ's State Energy Office looks forward to providing further analysis regarding the economic impacts to local communities and the state from Montana's RPS program.

Conclusions

The environmental benefit of Montana's RPS can be quantified using reasonable assumptions about the impacts increased renewable energy generation in Montana are having on the rest of the electricity sector. Increased renewable energy generation and consumption in Montana have helped to decouple the connection between increased electricity consumption and increased environmental degradation. By generating increasing amounts of renewable energy locally, Montana is able to meet its increased electricity demand without increasing its greenhouse gas and criteria air pollution emissions and without increasing water consumption.

Because Montana is part of two larger electricity grids, the environmental benefits of the Montana RPS program are not limited to Montana and are being achieved throughout the region. However, it's also the case that at least some of the environmental benefits of other state RPS programs are being felt in Montana since the state is now a major exporter of renewable electricity, just as it is a major exporter of conventionally generated electricity. As a result, the region's commitment to renewable energy benefits Montana's environment, just as Montana's commitment to renewable energy benefits the region's environment.

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[i] RECs used for years 2008 through 2012 come from Public Service Commission Summary of Renewable Portfolio Standard Compliance documents. All REC requirements beyond 2012 were calculated by projecting retail sales growth using the U.S. Energy Information Administration's Mountain region retail sales growth estimates for 2013 through 2030.

[ii] Based on eGRID 2012 figures which utilize electricity generation figures from 2009.

[iii] Based on eGRID 2012 figures which utilize electricity generation figures from 2009.

[iv] While Montana electricity providers are meeting the current 10% renewable energy standard, they represent only half the retail sales within the state. In addition, retail sales are typically less than half the total electricity generation in Montana in a given year, with the net surplus electricity exported to other states.

[v] The emission rates for Table 2 are from eGRID 2012 which utilizes emission figures from 2009.

[vi] Calculated using EPA's Greenhouse Gas Equivalency Calculator. http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results.

[vii] The total CO_2 emissions figure for Montana's retail electricity consumption with RPS renewable energy consumption was calculated by multiplying the sub-regional average CO_2 emissions rates (subtracting renewable energy generation) for NWPP and MROW from eGRID 2012 by an assumed 13.3 million MWh of non-renewable retail electricity consumption in 2012 and assumed that NWPP represented 92% of the state's retail electricity sales while MROW accounted for 8%. The potential total CO_2 emissions without the consumption of renewable energy was calculated by adding the avoided CO_2 emissions calculated in Table 3 to the total CO_2 emissions figure that included the RPS renewable energy.

[viii] Calculated using the methodology used in endnote vii above but including the assumed electricity demand growth between 2012 and 2015 noted in endnote i as well as the slightly lower CO_2 emissions rate for the NWPP and MROW grids in 2015 as described in endnote ix below.

[ix] Calculated by multiplying each electricity provider's number of RECs needed for compliance by the appropriate regional avoided grid emissions rates. Beginning in 2013, the avoided emission rates are reduced by 1% annually to account for air quality benefits associated with business-as-usual technology improvements and to account for the ongoing trend towards using cleaner burning fuels for electricity generation.

[x] Calculated by multiplying each electricity provider's number of RECs needed for compliance by the appropriate regional avoided grid emissions rates. Beginning in 2013, the avoided emission rates are reduced by 1% annually to account for air quality benefits associated with business-as-usual technology improvements and to account for the ongoing trend towards using cleaner burning fuels for electricity generation.

[xi] Figures calculated using EIA Form 923 water consumption data from years 2009 through 2012 for the Colstrip and Port Westward power plants.