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# Essential Elements For Battery Storage Contracts

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Gregg D. Ottinger

Jon R. Stickman

202-289-8400

[gdo@duncanallen.com](mailto:gdo@duncanallen.com)

[jrs@duncanallen.com](mailto:jrs@duncanallen.com)

Duncan & Allen  
COUNSELLORS AT LAW

# Topics To Be Discussed

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- Growth of Renewable Resources, VERS and Energy Storage
- Examples of Types of Storage
- Applicable Laws and Regulations
- Municipal Contracts for Storage
- Municipal Case Study – Behind The Meter Storage

# Renewable and Variable Energy Resources: Growing Use

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- Demand for VERs (especially wind and solar generation) is increasing
  - Increase in State-adopted Renewable Resource Portfolio Standards\*
  - Prices for VERs generation falling – On Dec. 15, 2017, SPP set record for peak wind generation of 15,690 MW; SPP has more than 19 GW of wind generation and 215 MW of solar generation installed
  - Prices for coal and nuclear generation increasing – About 600 MW of coal resources retired in 2018 alone
- Obama Administration Climate Action Plan
  - Cut 6 billion tons of carbon pollution through 2030
  - Equivalent of removing all U.S. cars from the road for 4 years

\* See

[http://www.nrel.gov/tech\\_deployment/state\\_local\\_governments/basics\\_portfolio\\_standards.html](http://www.nrel.gov/tech_deployment/state_local_governments/basics_portfolio_standards.html) for National Renewable Energy Laboratory report on state Renewable Portfolio Standards.

A Renewable Portfolio Standard (“RPS”) is a legislative mandate that requires jurisdictional utilities to provide a specified percentage of their electricity from renewable resources. RPS policies have been responsible for 44% of all U.S. RE capacity additions in 2016. In the West, Mid-Atlantic and Northeast, however, RPS policies were responsible for 70-90% of 2016 Renewable Energy capacity additions.

*2017 Annual Status Report, Galen Barbose, Lawrence Berkeley National Laboratory, July 2017.*

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About half the growth in U.S. renewable energy generation since 2000 can be attributed to state renewable energy requirements.

Twenty-nine states, Washington, D.C., and three territories have adopted an RPS, while eight states and one territory have set renewable energy goals. These are listed, state-by-state, with citations, in the Appendix to this presentation.

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Iowa was the first state to establish an RPS (in 1983) and Hawaii is the first to require 100% renewable (by 2045).

Many states include municipalities and electric cooperatives in their RPS requirement. States whose RPS policies apply to municipal electric systems include California, Colorado, Indiana, Michigan, Minnesota, New York, North Carolina, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Vermont, Washington and Wisconsin.

# RE Becoming Cost Competitive

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- According to a November 2017 report by Lazard, the cost of renewable energy is becoming competitive with conventional generation. Conventional gas combined cycle generation has a levelized cost of \$42-\$78/MW, while wind generation is available at \$30-\$60/MW. At the higher-cost end of the spectrum, Community Photo Voltaic Solar generation is available at a cost of \$76-\$150/MW, which compares favorably with the cost of generation from diesel reciprocating engines, at \$197-\$281.

# Renewables Are Everywhere

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Backpacks with solar powered phone rechargers are becoming common. This BirkSun bag has a built-in lithium battery that outputs power at 2.4amps (same as the wall).

This interior battery can be recharged by placing the backpack in direct sunlight or by plugging into any wall outlet.





## Sandpoint, Idaho

- First municipality to use roads that feature solar panels and LED lights
- Eliminates the need to paint traffic lines and caution messages
- Surface is strong enough to support semi-tractor trailers

# Historic Route 66 Welcome Center

Conway, Missouri

- Use of solar panels in the sidewalks
- Missouri Dept. of Transportation partnered with Solar Roadways of Sandpoint, Idaho
- Potential precursor to paving roads and sidewalks with solar panels



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“We’ve got a little over 28,000 square miles of paved surfaces in the lower 48 states. If we covered all those surfaces we’d produce three times more energy than we use”

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-SCOTT BRUSAW, inventor of Solar Roadways

# Energy Storage Options

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- Mechanical Storage
  - Hydroelectricity
  - Pumped-Storage
  - Compressed Air
  - Flywheel Energy Storage
  - Gravitational Potential Storage with Solid Masses
- Thermal Storage
  - Latent Heat Thermal Energy Storage (LHTES)

# Energy Storage Options (continued)

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- Electrochemical
  - Rechargeable Battery
  - Flow Battery\*
  - Supercapacitor
  - Ultrabattery\*
- Electrical Methods
  - Capacitor
  - Superconducting Magnetics\*
- Other Chemical

# Applicable Laws and Regulations

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- Commission Orders
  - Order No. 755 (RM11-7, AD10-11)
  - Order No. 764 (RM10-11)
  - Order No. 784 (RM11-24, AD10-13)
  - Order No. 841 (RM16-23)
- Credits
  - Renewable Energy Credits or Certificates
  - Renewable Portfolio Standards
  - Internal Revenue Code Investment Tax Credits
  - Production Tax Credits
- Notice of Inquiry on Primary Frequency Response

# Order No. 755

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*Frequency Regulation Compensation in the Organized Wholesale Markets*, FERC Docket Nos. RM11-7-000, AD10-11-000, 137 FERC ¶ 61,064 (2011), *order denying reh'g*, Order No. 755-A, 138 FERC ¶ 61,123 (2012)

- Increased payment for faster ramping responding services like batteries or flywheels that are bidding into frequency regulation service markets

# Order No. 764

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*Integration of Variable Energy Resources*, FERC Docket No. RM10-11-000 (2012), *order on reh'g and clarification*, Order No. 764-A, 141 FERC ¶ 61,232 (2012), *order on clarification and reh'g*, Order No. 764-B, 144 FERC ¶ 61,222 (2013)

- Orders reforms to remove barriers to the integration of VERS
- Requires each Public Utility Transmission Provider to:
  1. Offer intra-hourly transmission scheduling at 15-minute intervals;
  2. Incorporate provisions in the pro forma Large Generator Interconnection Agreement requiring interconnection customers whose generating facilities are VERS to provide meteorological and forced outage data to the Public Utility Transmission Provider

# Order No. 784

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*Third-Party Provision of Ancillary Services; Accounting and Financial Reporting for New Electric Storage Technologies*, FERC Docket Nos. RM11-24-000, AD10-13-000, 144 FERC ¶ 61,056 (2013); Order No. 784-A, order granting clarification in part and denying clarification in part, 146 FERC ¶ 61,114 (2014)

- Expands Order No. 755 pay-for-performance requirements to ensure speed and accuracy
- Modifies Ancillary Service Schedule 3 (Regulation and Frequency Response) to include a statement that:

“will take into account the speed and accuracy of regulation response in its determination or reserve requirements for Regulation and Frequency Response service . . .”

# Order No. 784 (cont.)

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- Revised accounting and reporting requirements under the FERC's Uniform System of Accounts\* to:
  - Better account for and report transactions associated with the use of energy storage devices
  - Revision included in:
    - FERC Form No. 1
    - FERC Form No. 1-F
    - FERC Form No. 3-Q

Order No. 841,  
162 FERC ¶ 61,127 (2/15/18)

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*Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*

FERC amended its regulations to remove barriers to the participation of electric storage resources in the capacity, energy, and ancillary service markets operated by RTO and ISO markets. It required each RTO and ISO to revise its tariff to establish a participation model consisting of market rules that, recognizing the physical and operational characteristics of electric storage resources, facilitates their participation in the RTO/ISO markets.

## Order No. 841 (cont.)

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The participation model must:

- (1) ensure that a resource using the participation model is eligible to provide all capacity, energy, and ancillary services that the resource is technically capable of providing in the RTO/ISO markets;
- (2) ensure that a resource using the participation model can be dispatched and can set the wholesale market clearing price as both a wholesale seller and wholesale buyer consistent with existing market rules that govern when a resource can set the wholesale price;
- (3) account for the physical and operational characteristics of electric storage resources through bidding parameters or other means; and (4) establish a minimum size requirement for participation in the RTO/ISO markets that does not exceed 100 kW.

# Applicable Credits or Certificates

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- Renewable Energy Credits or Certificates\*
- Renewable Portfolio Standards
- Internal Revenue Code Investment Tax Credits\*\*
  - Internal Revenue Code § 48
- Production Tax Credits\*\*\*
  - Internal Revenue Code § 45

\* See <http://markets.flettexchange.com/ohio-srec/> for reporting of prices for solar Renewable Energy Credits (sRECs) in Ohio and other states.

\*\* See <http://www.seia.org/policy/finance-tax/solar-investment-tax-credit> for information on the solar Investment Tax Credit.

\*\*\* See <https://energy.gov/savings/renewable-electricity-production-tax-credit-ptc> for Department of Energy for a summary of the Production Tax Credit.

# Frequency Response Capability Required

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Order No. 842, FERC Docket No. RM16-6, 162 FERC ¶ 61,128 (Feb. 15, 2018), modified the pro forma Large and Small Generation Interconnection Agreements to require all new generation resources to include frequency response capability as a precondition to interconnection.

The Order applies to storage resources, but requires specific accommodations for electric storage resources and places limitations on when electric storage resources will be required to provide primary frequency response.

# CAISO Invites Behind-The-Meter Storage

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In early September of 2018 the California Independent System Operator (“CAISO”) approved measures to assist behind-the-meter resources to participate in wholesale markets. One of these was to allow behind-the-meter energy storage systems to be paid for charging during times of oversupply of electricity and negative pricing on the wholesale market. Battery systems on the utility side of the meter already had the ability to be paid to recharge during times of negative pricing, but extending this benefit to customer-sited batteries is expected to increase solar generation significantly.

The new changes are driven by “the increasing incidence of negative pricing, and the desire of the CAISO’s board not to have to curtail clean solar energy,” according to Scott Murtishaw, a consultant with the California Solar and Storage Association. “This decision is a big step in unlocking a huge opportunity for storage to be more precise and accurate.”

On October 1, 2018, the CAISO issued a Market Notice announcing a public stakeholder meeting on October 23 to discuss a second revised straw proposal for its Storage as a Transmission Asset initiative.

On October 2, the New York Power Authority announced plans to establish a new 20 MW battery project to demonstrate the operation of a large-scale energy storage system.

# Municipal Contracts with Storage Developers

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May require 3 contracts for Solar Project (if owned by Developer):

1. Site Lease
2. Interconnection and Operating Agreement
3. Power Purchase Agreement

# Terms of Site Lease

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- Definitions (consistent for all agreements)
- Purpose: Generation; Energy Storage
  - Construction, Installation, Maintenance, Removal, Clean Up
  - Solar Easement: For Direct Sunlight; No Lessor Improvements such as trees or buildings
  - Delivery of Energy and Recharging
- Term; Renewal Term; Termination; Purchase by Host?
- Payments and Taxes
  - Annual Rent During Term; Initial Term and Renewal Term; Removal Period
  - Taxes, Assessments and Utilities
- Lessee's Covenants
  - Mechanic's Liens
  - Permits and Laws
  - Lessee's Improvements
  - Insurance
  - Hold Harmless
  - Hazardous Materials
  - Letter of Credit or Fund for Removal and Restoration
- Lessor's Covenants
  - Title and Authority
  - Cooperation To Eliminate Lien Interference
  - Quiet Enjoyment
  - Exclusivity
  - Operation of the Facility (acknowledge that it may cause/emit electromagnetic and frequency interference)
  - Maintenance of the Premises
  - Hazardous Materials

# Site Lease Terms – Sample Language Premises

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Lessor leases to Lessee, and Lessee leases from Lessor, the Premises, as legally described on Exhibit A, and as further identified on the site plan attached hereto as Exhibit A-1 (the “**Site Plan**”), for the purpose of development and use of a generating facility (hereinafter, the “**Generating Facility**”) that will be comprised of a solar power facility (the “**Solar Array**”) and a battery energy storage system (the “**ESS**”), including but not limited to: monitoring, testing and evaluating the Premises for solar energy generation; activities related to the production of solar energy including constructing, installing, using, maintaining, operating, replacing, relocating and removing solar panels, overhead and underground electrical transmission and communications lines, electric transformers, energy storage facilities and systems, telecommunications equipment, power generation facilities to be operated in conjunction with solar panel installations, including roads, and energy measurement equipment, fencing, and related facilities and equipment. The Generating Facility shall be installed in compliance with the provisions of the PPA, the Interconnection Agreement, and this Lease. Such activities may be conducted by Lessee, its employees, agents, licensees or permittees.

# Site Lease Terms – Sample Language Solar Easement

**Solar Easement.** Lessor hereby grants and conveys to Lessee an exclusive easement on, over and across the Premises for direct sunlight to any solar panels on the Premises and an exclusive easement prohibiting any obstruction of direct sunlight (collectively, the “**Solar Easement**”) throughout the entire Premises to and for the benefit of the area existing horizontally three hundred and sixty degrees (360°) from any point where any solar panel is or may be located at any time from time to time (each such point referred to as a “**Site**”) and for a distance from each Site to the boundaries of the Premises, together vertically through all space located above the surface of the Premises, that is, one hundred eighty degrees (180°) or such greater number or numbers of degrees as may be necessary to extend from each point on and along a line drawn along the surface from each point along the exterior boundary of the Premises through each Site to each point and on and along such line to the opposite exterior boundary of the Premises.

**Lessor Improvements.** Lessor may not place or plant any trees, buildings, and other improvements (an “**Improvement**”) on the Premises after the date of this Lease which may, in Lessee’s reasonable judgment, impede or interfere with direct sunlight to any portion of the Generating Facility, unless Lessor has received written approval from Lessee for any such trees, structure or improvement. If at any time during the duration of this Lease, Lessor would like a variance of the preceding requirements, Lessor may submit a letter of request to Lessee for approval, and approval or denial of such request shall be in Lessee’s reasonable discretion.

# Site Lease Terms – Sample Language

## End of Lease – Removal Period

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- If Host purchases the Facility, there will be no Removal Period.
- During the Removal Period, Provider will discontinue the operation of the Facility and dismantle, demolish, and remove from the Host Property the Provider's facilities and equipment, including but not limited to any foundation, sub-surface structure, or other support structure on which any part of the Facility was mounted.
- Before the end of the Removal Period, Provider will vacate the Host Property in a clean and orderly condition and will repair to its pre-existing condition any damage to improvements on the Host Property caused by Provider's removal activities.

# Terms of Power Purchase Agreement

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- Definitions
- System Installation
  - Installation
  - Conditions Precedent
  - Permits
  - Delivery of Energy
- Technical
  - O&M and Technical Assistance
  - Malfunctions
  - Title
  - IRC § 7701(e)(3), (4)
  - Safe-Harbor Test for alternative energy facilities
  - Outages
  - Hazardous Materials
  - Metering
  - Compliance with Utility Specifications
- PPA Services
- Purchase of Energy
  - Purchase Requirement
  - RECs
  - Price and Payment and Taxes
  - Billing
- General Covenants of Provider and Customer
- Insurance
- Force Majeure
- Term
  - Indemnity
  - Customer Options at Expiration of Term
- Defaults and Remedies
- Governing Law
- Notice
- Representations and Warranties
- Assignments
- Amendments
- Waivers
- Partial Invalidity
- Execution in Counterparts
- Cooperation
- Right to Off-Set
- Confidentiality (subject to Open Records laws)

# Terms of Interconnection and Operating Agreement

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- Purpose
- Definition
- Intent
- Facility Specifications
- Maintenance and Repair
- Effective Date and Term
- Operations, Services and Compensation
- Provision of Interconnection Service
- Facilities Design
- Construction and Cost Responsibility
- Interconnection Specifications
- Metering
- Equipment Testing and Inspection
- Temporary Disconnection
- Assignment
- Modifications After Commercial Operation
- Indemnity

# ESS System and Services Description

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<u>Requirement</u>	<u>Notes</u>
Peak Power	+/- 7.5 MW
Energy Storage	7.5 MWhr
Battery Type	Li-ion
Max Charge / Discharge rate	1C
Reactive Power Capability	4.0 MVAR (Can function simultaneous with FR)

# ESS System and Services Description

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<u>Requirement</u>	<u>Notes</u>
Peak Power	+/- 7.5 MW
Energy Storage	7.5 MWhr
Battery Type	Li-ion
Max Charge / Discharge rate	1C
Reactive Power Capability	4.0 MVAR (Can function simultaneous with FR)

# ESS Services Description

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The ESS system shall be capable of providing the following services:

**Frequency Regulation (FR):** The ESS shall be capable of responding to a power command from PJM to deliver or receive power from the utility (up to +/-7.5MW capability) for the purpose of supporting grid frequency.

**Power Factor Correction (PFC):** The ESS shall be capable of providing up to 4MVAR of reactive power for the purpose of correcting or improving the Power Factor of the Utility. The reactive power can be provided simultaneous with FR function. The reactive power output (1) may be fixed or (2) may be variable in response to an external signal in order to maintain a certain power factor or voltage for the Utility.

**Emergency Back-up Power:** The ESS shall be capable of providing emergency back-up to the Utility at a level of power and energy to be mutually agreed upon. The Utility shall provide (1) a signal to the ESS indicating an emergency back-up event and (2) external grid disconnection means required for island-mode operation.

# Peak Shaving and Other Benefits from Energy Storage System - Intent

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**Intent.** The purpose of the interconnection of the Generating Facility to the Utility's Electric System is to provide benefits to Interconnection Customer and Utility as contemplated in this Agreement. The Parties are entering this Agreement with the understanding that Utility will not incur any additional costs (including, but not limited to, costs associated with establishing a new transmission peak demand) as a result of Interconnection Customer's operation (charging or discharging) of the ESS, except as expressly set forth in this Agreement. Utility retains the burden of establishing through reasonable measurement and verification procedures deemed satisfactory to Interconnection Customer that such costs are solely attributable to operation of the ESS. Interconnection Customer reserves the right to independently access, review, and analyze all data or other information used by Utility to calculate costs alleged to be solely attributable to operation of the ESS. Utility and not Interconnection Customer shall be solely responsible for all ongoing data analysis or accounting of its costs at all times during the term of this Agreement. Absent an express provision in this Agreement establishing an obligation or liability of Utility, all provisions of this Agreement will be interpreted so as to avoid the imposition of any such additional costs on Utility or, if such additional costs are imposed on Utility as a result of the operation of the ESS (and are not expressly required to be paid by Utility), Interconnection Customer agrees to reimburse such costs and keep Utility whole within 30 days of receipt of written notice from Utility specifying or explaining the additional costs that have or will be incurred by Utility as a result of operation of the ESS.

# Peak Shaving and Other Benefits from Energy Storage System – Payments for Services

**Section X.1.** Interconnection Customer shall pay Utility, at Utility's applicable tariff, for all station power delivered through a separately metered electric service and at Utility's actual cost for all net energy delivered through the Point of Delivery. Any energy charges incurred by Interconnection Customer due to Interconnection Customer providing reactive power compensation as provided in Section X.4(a) shall be the responsibility of the Utility, unless otherwise agreed to in writing. If Transmission Operator or other entity charges Utility for providing power factor correction, Interconnection Customer shall have the option to charge for providing reactive power compensation as provided in Section X.4(a), and to the extent Interconnection Customer's provision of reactive power compensation has the effect of reducing Utility's costs for reactive power, then Utility shall share all such savings with Interconnection Customer, with Utility retaining fifty percent (50%) of such savings and paying Interconnection Customer fifty percent (50%) of such savings for as long as such savings continue to be accrued;

# Peak Shaving and Other Benefits from Energy Storage System - Charging

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**Section X.2** If Interconnection Customer recharges the ESS and such charging or recharging (whether during On-Peak or Off-Peak hours) causes Utility to establish a greater Peak Load Contribution, for Transmission Operator's transmission service billing purposes, than Utility otherwise would have established, then Interconnection Customer shall reimburse the Utility for all such increased charges associated with the increase in Utility's Peak Load Contribution, following receipt of appropriate documentation from Utility.

# Peak Shaving and Other Benefits from Energy Storage System – Peak Shaving Savings

**Section X.3** Utility shall have the right to request Interconnection Customer to operate the ESS and the Solar Array to provide power and energy to Utility's Electric System to reduce Utility's peak load and capacity requirements during Peak Alert Periods issued by Utility or its designated representative, and Interconnection Customer agrees to use its best commercial efforts to provide load reduction for Utility during any Peak Alert Period. Interconnection Customer, in its sole discretion, shall determine whether to utilize the ESS to provide such load reduction for Utility or to provide Regulation Service to Transmission Operator. If such operation of the ESS has the effect of reducing Utility's peak and lowering (or preventing an increase in) Utility's costs, then Utility shall share all such savings with Interconnection Customer (as calculated in accordance with Annex I of this Agreement), with Utility retaining fifty percent (50%) of such savings (or avoided cost increases) and paying Interconnection Customer fifty percent (50%) of such savings for the first five years, thereafter the split shall be  $YYY$  percent ( $YYY\%$ ) to the Utility and  $(100-YYY)$  percent ( $100-YYY\%$ ) to the Interconnection Customer (or avoided cost increases), for as long as such savings (or avoided cost increases) continue to be accrued. To facilitate analysis of any savings, Utility agrees to promptly provide to Interconnection Customer Utility's electricity charges detail for the immediately preceding calendar year, and thereafter, within a reasonable period following the completion of each calendar year, to provide to Interconnection Customer the electricity charges detail for such year, it being understood that all such information provided to Interconnection Customer is confidential information of Utility and must be kept confidential by Interconnection Customer. The Parties agree to consider, in good faith, a transition to a fixed monthly capacity payment from the Utility to the Customer in exchange for the Utility retaining all of the ESS-based reduction in peak costs after the first year of operation, to be separately negotiated as an amendment to this Agreement.

# Peak Shaving and Other Benefits from Energy Storage System – Power Quality

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**Section X.4** The Parties agree that:

- (i) Interconnection Customer's primary purpose for entering into this Agreement is to enable Interconnection Customer to obtain rights to interconnect the Generating Facility to the Electric System to enable the sale of Energy Output as contemplated under the PPA, and of operating the ESS is to provide Regulation Service to Transmission Operator, and
- (ii) Interconnection Customer has no obligation to provide the reactive power or voltage support to the Utility as provided in this Section X.4 at any time Interconnection Customer is providing Regulation Service to Transmission Operator.

During any period in which Interconnection Customer is not providing Regulation Service to Transmission Operator Utility may request and upon such request Interconnection Customer shall use commercially reasonable efforts to provide to Utility, the following services to Utility (as such services are further described in Annex \_\_):

# Peak Shaving and Other Benefits from Energy Storage System - Services

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**Section X.4(a)** A potential for reactive power compensation, provided that the Utility agrees to equitably compensate the Interconnection Customer, as provided in Section X.1, for all of the losses due to providing reactive power, up to 4 MVA of reactive power during the first three years of operation, which will be managed remotely or via program control; provided, however, that this service will be extended for the remainder of the Term of this Agreement if, prior to the end of the initial three-year period, Interconnection Customer has determined that its inverters have experienced greater than 98% up-time;

(b) voltage support, also managed remotely; and

(c) Interconnection Customer will consider, in good faith, requests from Utility to provide back-up power to certain Utility customers and other potential benefits from the ESS at a rate to be negotiated.

Interconnection Customer and Utility agree that solar power from the Solar Array may be used to charge the ESS, and that power may be shifted to provide power for delivery to Utility immediately or during evening peak hours.

# Peak Shaving and Other Benefits from Energy Storage System – Wheeling Service

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**Section X.5** The Parties acknowledge that Utility will be providing Wheeling Service to Interconnection Customer, at no cost to Interconnection Customer, when Interconnection Customer is providing Regulation Service to Transmission Operator, but Utility agrees to provide such Wheeling Service to Interconnection Customer for such purpose (and only for such purpose) in exchange for Interconnection Customer providing Utility the services listed in Section X.4 of this Agreement.

# Calculating Savings for Peak Load Shaving

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The savings for peak load shaving shall be calculated as follows:

The savings are composed of the both the (1) savings from PJM RPM Capacity Charge and the (2) savings from the DP&L Transmission Demand Charge.

(1) For the PJM component, the savings per month  $\$SavingsPJM_{ave}$  shall be determined from averaging the power  $P_{ave}$  delivered **from the ESS** during the PJM 5 coincident peak hours for the previous planning year (the particular hours are identified by PJM), multiplied by the PJM RPM Capacity Charge per month  $\$PJM RPM Cap_{mo}$

$$P_{ave} = (P_{hr1} + P_{hr2} + P_{hr3} + P_{hr4} + P_{hr5})/5$$

$$\$SavingsPJM_{mo} = P_{ave} * \$PJM RPM Cap_{mo}$$

# Calculating savings for peak load shaving (cont.)

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(2) For the DP&L Transmission component, the savings per month  $\$SavingsDP\&L_{mo}$  shall be determined by multiplying the power  $P_{peak}$  delivered **from the ESS** during the peak hour on the DP&L Transmission System for the previous calendar year (as determined by DP&L) by the DP&L Transmission Demand Charge per month  $\$DP\&LTransDmd_{mo}$ .

$$\$SavingsDP\&L_{mo} = P_{peak} * \$DP\&LTransDmd_{mo}$$

The total savings per month is:

$$\$SavingsTotal_{mo} = \$SavingsPJM_{mo} + \$SavingsDP\&L_{mo}$$

# Questions?

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Gregg D. Ottinger  
Jon R. Stickman  
Duncan & Allen  
(202) 289-8400  
[gdo@duncanallen.com](mailto:gdo@duncanallen.com)  
[jrs@duncanallen.com](mailto:jrs@duncanallen.com)



# Appendix:

## State RPS Requirements

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Source: <http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx>

Table: Renewable Portfolio Standards or Voluntary Targets

Note: States and territories listed in italics have voluntary renewable energy goals.

### Alaska

**Enabling Statute, Code or Order:** *In the 2009-2010 legislative session, the Alaska legislature enacted [House Bill 306](#) with the goal that “the state receive 50 percent of its electrical generation from renewable energy sources by 2025.” This language does not appear in codified statutes.*

### Arizona

**Title:** Renewable Energy Standard.

**Established:** 2006.

**Requirement:** 15 percent by 2025.

**Applicable Sectors:** Investor-owned utility, retail supplier.

**Cost Cap:** None.

**Details:** Distributed Generation: 30 percent of annual requirement in 2012 and thereafter. The state has several credit multipliers for different technologies.

**Enabling Statute, Code or Order:** [Ariz. Admin. Code §14-2-1801 et seq.](#)

## California

- **Title:** Renewables Portfolio Standard.
- **Established:** 2002.
- **Requirement:** 33 percent by 2020; 40 percent by 2024; 45 percent by 2027; 50 percent by 2030.
- **Applicable Sectors:** Investor-owned utility, municipal utilities.
- **Cost Cap:** Determined by the California Public Utilities Commission.
- **Details:** A 2013 amendment allows the California Public Utilities Commission to adopt additional requirements.
- **Enabling Statute, Code or Order:** [Cal. Public Utilities Code §399.11 et seq.](#); [Cal. Public Resources Code §25740 et seq.](#); [CA A 327](#) (2013); [CA S 350](#) (2015).

## Colorado

- **Title:** Renewable Energy Standard.
- **Established:** 2004.
- **Requirement:** 30 percent by 2020 (IOUs); 10 percent or 20 percent for municipalities and electric cooperatives depending on size.
- **Applicable Sectors:** Investor owned utility, municipal utilities, cooperative utilities.
- **Cost Cap:** 2.0 percent.
- **Details:** Distributed Generation: 3 percent of IOU retail sales by 2020, 1 percent of cooperative retail sales by 2020 (for those providing service to 10,000 or more meters) or 0.75 percent of cooperative retail sales by 2020 (for those providing service to less than 10,000 meters). The state has several credit multipliers for different technologies.
- **Enabling Statute, Code or Order:** [Colo. Rev. Stat. §40-2-124](#); [CO S 252](#) (2013).

## Connecticut

**Title:** Renewables Portfolio Standard.

**Established:** 1998.

**Requirement:** 28 percent by 2020.

**Applicable Sectors:** Investor-owned utility, local government, retail supplier.

**Cost Cap:** 5.8 percent.

**Details:** Class I renewable energy sources (including distributed generation): 20 percent by 2020. Class I or II (biomass, waste-to-energy and certain hydropower projects): 3 percent by 2010. Class III (combined heat and power, waste heat recovery and conservation): 4 percent by 2010.

**Enabling Statute, Code or Order:** [Conn. Gen. Stat. §16-245a et seq.](#); [Conn. Gen. Stat. §16-1](#).

## Delaware

- **Title:** Renewables Energy Portfolio Standard.
  - **Established:** 2005.
  - **Requirement:** 25 percent by 2025-2026.
  - **Applicable Sectors:** Investor-owned utility, local government, retail supplier.
  - **Cost Cap:** 3 percent; 1 percent (PV).
  - **Details:** Photovoltaics: 3.5 percent requirement by 2025-2026. The state has multiple credit multipliers that apply to different technologies.
  - **Enabling Statute, Code or Order:** [Del. Code Ann. 26 §351 et seq.](#)
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## Hawaii

- **Title:** Renewable Portfolio Standard.
- **Established:** 2001.
- **Requirement:** 30 percent by 2020; 40 percent by 2030; 70 percent by 2040; 100 percent by 2045.
- **Applicable Sectors:** Investor-owned utility.
- **Cost Cap:** None.
- **Enabling Statute, Code or Order:** [Hawaii Rev. Stat. §269-91 et seq.](#); [House Bill 623](#) (2015).

## Illinois

- **Title:** Renewable Portfolio Standard.
- **Established:** 2001 (voluntary target); 2007 (standard).
- **Requirement:** 25 percent by 2025-2026.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** 1.3 percent.
- **Details:** Distributed Generation: 1 percent of annual requirement beginning in 2015 for IOUs. Wind: 75 percent of annual requirement for IOUs, 60 percent of annual requirement for alternative retail electric suppliers. Photovoltaics: 6 percent of annual requirement beginning in 2015-2016.
- **Enabling Statute, Code or Order:** [Ill. Rev. Stat. ch. 20 §688](#) (2001); [Ill. Rev. Stat. ch. 20 §3855/1-75](#) (2007); [Senate Bill 2814](#) (2016).

## Indiana

- **Title:** Clean Energy Portfolio Goal.
- **Established:** 2011.
- **Requirement:** 10 percent by 2025.
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities, retail supplier.
- **Cost Cap:** None.
- **Details:** 30 percent of the goal may be met with clean coal technology, nuclear energy, combined heat and power systems, natural gas that displaces electricity from coal and other alternative fuels.
- **Enabling Statute, Code or Order:** [Ind. Code §8-1-37](#).

## Iowa

- **Title:** Alternative Energy Law.
- **Established:** 1983.
- **Requirement:** 105 MW of generating capacity for IOUs.
- **Applicable Sectors:** Investor-owned utility.
- **Cost Cap:** None.
- **Enabling Statute, Code or Order:** [Iowa Code §476.41 et seq.](#)

## Kansas

- **Title:** *Renewable Energy Goal.*
- **Established:** *2009 (standard); 2015 (goal).*
- **Requirement:** *15 percent by 2015-2019; 20 percent by 2020.*
- **Applicable Sectors:** *Investor-owned utility.*
- **Cost Cap:** *Caps gross RPS procurement costs.*
- **Details:** *20 percent requirement for peak demand capacity.*
- **Enabling Statute, Code or Order:** [Kan Stat. Ann. §66-1256 et seq.](#); [Goal: Senate Bill 91](#).

## Maine

- **Title:** Renewables Portfolio Standard.
- **Established:** 1999.
- **Requirement:** 40 percent by 2017.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** 5.4 percent.
- **Details:** Includes a 10 percent requirement by 2017 for Class I (new) sources. The state also has separate goals for wind energy: 2,000 MW of installed capacity by 2015; 3,000 MW of installed capacity by 2020, including offshore and coastal; and 8,000 MW of installed capacity by 2030, including 5,000 MW from offshore and coastal. The state has a credit multiplier for community-based renewable energy.
- **Enabling Statute, Code or Order:** [Me. Rev. Stat. Ann. 35-A §3210 et seq.](#); [Me. Rev. Stat. Ann. 35-A §3401 et seq.](#) (wind energy).

## Maryland

- **Title:** Renewable Energy Portfolio Standard.
- **Established:** 2004.
- **Requirement:** 25 percent by 2020.
- **Applicable Sectors:** Investor-owned utility, local government, retail supplier.
- **Cost Cap:** 7.6 percent.
- **Details:** Solar: 2.5 percent by 2020. Offshore wind: 2.5 percent maximum by 2017.
- **Enabling Statute, Code or Order:** [Md. Public Utilities Code Ann. §7-701 et seq.](#); [Senate Bill 921](#); [House Bill 1106](#) (2016 enrolled, 2017 veto override).

## Massachusetts

- **Title:** Renewable Portfolio Standard.
- **Established:** 1997.
- **Requirement:** Class I: 15 percent by 2020 and an additional 1 percent each year after. Class II: 6.19 percent by 2019.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** 19.2 percent.
- **Details:** Photovoltaic: 1,600 MW required by 2020. Class I resources are new sources. Class II (resources in operation by 1997) requirement includes 2.69 percent renewable energy and 3.5 percent waste-to-energy.

**Enabling Statute, Code or Order:** [Mass. Gen. Laws Ann. ch. 25A §11F.](#)

## Michigan

- **Title:** Renewable Energy Standard.
- **Established:** 2008; 2016.
- **Requirement:** 15 percent by 2021 (standard), 35 percent by 2025 (goal, including energy efficiency and demand reduction).
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities, retail supplier.
- **Cost Cap:** 2.5 percent.
- **Details:** The state has several credit multipliers for different technologies.
- **Enabling Statute, Code or Order:** [Mich. Comp. Laws §460.1001 et seq.](#); [Senate Bill 438](#) (2016).

## Minnesota

- **Title:** Renewables Energy Standard.
- **Established:** 2007.
- **Requirement:** 26.5 percent by 2025 (IOUs), 25 percent by 2025 (other utilities).
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities.
- **Cost Cap:** None.
- **Details:** Xcel Energy has a separate requirement of 31.5 percent by 2020; 25 percent must be from wind or solar. Solar: 1.5 percent by 2020 (other IOUs); Statewide goal of 10 percent by 2030.
- **Enabling Statute, Code or Order:** [Minn. Stat. §216B.1691](#).

## Missouri

- **Title:** Renewable Electricity Standard.
- **Established:** 2007.
- **Requirement:** 15 percent by 2021 (IOUs).
- **Applicable Sectors:** Investor-owned utility.
- **Cost Cap:** 1 percent.
- **Details:** Solar-Electric: 2 percent carve-out.
- **Enabling Statute, Code or Order:** [Mo. Rev. Stat. §393.1020 et seq.](#)

## Montana

- **Title:** Renewable Resource Standard.
  - **Established:** 2005.
  - **Requirement:** 15 percent by 2015.
  - **Applicable Sectors:** Investor-owned utility, retail supplier.
  - **Cost Cap:** 0.1 percent.
  - **Enabling Statute, Code or Order:** [Mont. Code Ann. §69-3-2001 et seq.](#)
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## Nevada

- **Title:** Energy Portfolio Standard.
- **Established:** 1997.
- **Requirement:** 25 percent by 2025.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** None.
- **Details:** Solar: 6 percent for 2016-2025 (1.5 percent of total sales in 2025). The state has a credit multiplier for photovoltaics and on peak energy savings.
- **Enabling Statute, Code or Order:** [Nev. Rev. Stat. §704.7801 et seq.](#)

## New Hampshire

- **Title:** Electric Renewable Portfolio Standard.
- **Established:** 2007.
- **Requirement:** 25.2 percent by 2025.
- **Applicable Sectors:** Investor-owned utility, cooperative utilities, retail supplier.
- **Cost Cap:** 6.6 percent.
- **Details:** Solar: 0.7 percent new solar in 2020 and after. Requires at least 15 percent of requirement to be met with new renewables.
- **Enabling Statute, Code or Order:** [N.H. Rev. Stat. Ann. §362-F.](#)

### New Jersey

- **Title:** Renewables Portfolio Standard.
- **Established:** 1991.
- **Requirement:** 50 percent by 2030.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** 9.9 percent.
- **Details:** 50 percent Class I renewables by 2030. 2.5 percent Class II renewables each year. 5.1 percent solar-electric by 2021, then gradually reduced to 1.1 percent by 2031. Offshore wind: 3,500 MW.
- **Enabling Statute, Code or Order:** [N.J. Rev. Stat. §48:3-49 et seq.](#)

### New Mexico

- **Title:** Renewables Portfolio Standard.
- **Established:** 2002.
- **Requirement:** 20 percent by 2020 (IOUs); 10 percent by 2020 (co-ops).
- **Applicable Sectors:** Investor-owned utility, cooperative utilities.
- **Cost Cap:** 3.5 percent.
- **Details:** Solar: 20 percent by 2020 (IOUs). Wind: 30 percent by 2020 (IOUs). Other renewables including geothermal, biomass and certain hydro facilities: 5 percent by 2020 (IOUs). Distributed Generation: 3 percent by 2020 (IOUs). The state has a credit multiplier for solar energy that was operational before 2012.
- **Enabling Statute, Code or Order:** [N.M. Stat. Ann. §62-15](#); [N.M. Stat. Ann. §62-16](#).

### New York

- **Title:** Renewable Portfolio Standard; Reforming the Energy Vision (REV).
- **Established:** 2004.
- **Requirement:** 50 percent by 2030.
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities, retail supplier.
- **Cost Cap:** None.
- **Details:** Offshore wind: goal of 2,400 MW by 2030.
- **Enabling Statute, Code or Order:** [NY PSC Order Case 03-E-0188](#); [2015 New York State Energy Plan](#).

### North Carolina

- **Title:** Renewable Energy and Energy Efficiency Portfolio Standard.
- **Established:** 2007.
- **Requirement:** 12.5 percent by 2021 (IOUs); 10 percent by 2018 (munis and coops).
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities.
- **Cost Cap:** 1.3 percent.
- **Details:** Solar: 0.2 percent by 2018. Swine Waste: 0.2 percent by 2018. Poultry Waste: 900,000 MWh by 2015. The state offers credit multipliers for biomass facilities located in cleanfields renewable energy demonstration parks.
- **Enabling Statute, Code or Order:** [N.C. Gen. Stat. §62-133.8](#).

### North Dakota

- **Title:** *Renewable and Recycled Energy Objective.*
- **Established:** 2007.
- **Requirement:** 10 percent by 2015.
- **Applicable Sectors:** *Investor-owned utility, municipal utilities, cooperative utilities.*
- **Enabling Statute, Code or Order:** [N.D. Cent. Code §49-02-24 et seq.](#)

### Ohio

- **Title:** Alternative Energy Resource Standard.
- **Established:** 2008.
- **Requirement:** 12.5 percent by 2026. [Senate Bill 310](#) (2014) created a two-year freeze on the state's standard while a panel studied the costs and benefits of the requirement. The freeze was not extended in 2016.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** 1.8 percent.
- **Details:** Solar: 0.5 percent.
- **Enabling Statute, Code or Order:** [Ohio Rev. Code Ann. §4928.64 et seq.](#)

### Oklahoma

- **Title:** Renewable Energy Goal.
  - **Established:** 2010.
  - **Requirement:** 15 percent by 2015.
  - **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities.
  - **Enabling Statute, Code or Order:** [Okla. Stat. tit. 17 §801.1 et seq.](#)
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### Oregon

- **Title:** Renewable Portfolio Standard.
- **Established:** 2007.
- **Requirement:** 25 percent by 2025 (utilities with 3 percent or more of the state's load); 50 percent by 2040 (utilities with 3 percent or more of the state's load); 10 percent by 2025 (utilities with 1.5–3 percent of the state's load); 5 percent by 2025 (utilities with less than 1.5 percent of the state's load).
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities, retail supplier.
- **Cost Cap:** 4 percent.
- **Details:** Photovoltaics: 20 MW by 2020 (IOUs). The state has a credit multiplier for photovoltaics installed before 2016. The state's two investor-owned utilities must phase out coal generation by 2035. By 2025 at least 8 percent of aggregate electrical capacity must come from small-scale community renewable energy projects with a capacity of 20 megawatts (MW) or less.
- **Enabling Statute, Code or Order:** [Or. Rev. Stat. §469a](#); [Senate Bill 1547 \(2016\)](#).

### Pennsylvania

- **Title:** Alternative Energy Portfolio Standard.
- **Established:** 2004.
- **Requirement:** 18 percent by 2020-2021.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** None.
- **Details:** Tier I: 8 percent by 2020-2021 (includes photovoltaic). Tier II (includes waste coal, distributed generation, large-scale hydropower and municipal solid waste, among other technologies): 10 percent by 2020-2021. Photovoltaic: 0.5 percent by 2020-2021.
- **Enabling Statute, Code or Order:** [Pa. Cons. Stat. tit. 66 §2814](#).

### Rhode Island

- **Title:** Renewable Energy Standard.
- **Established:** 2004.
- **Requirement:** 14.5 percent by 2019, with increases of 1.5 percent each year until 38.5 percent by 2035.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** 12 percent.
- **Details:** The state has a separate long-term contracting standard for renewable energy, which requires electric distribution companies to establish long-term contracts with new renewable energy facilities.
- **Enabling Statute, Code or Order:** [R.I. Gen. Laws §39-26-1 et seq.](#); [R.I. Gen. Laws §39-26.1 et seq.](#) (contracting standard); [House Bill 7413a](#) (2016).

### South Carolina

- **Title:** Renewables Portfolio Standard.
- **Established:** 2014.
- **Requirement:** 2 percent by 2021.
- **Applicable Sectors:** Investor-owned utility.
- **Cost Cap:** None.
- **Details:** Systems less than 1 MW: 1 percent of aggregate generation capacity, including at least 0.25 percent of total generation from systems less than 20kW. 1 – 10 MW facilities: 1 percent of aggregate generation capacity.
- **Enabling Statute, Code or Order:** [House Bill 1189](#).

### South Dakota

- **Title:** *Renewable, Recycled and Conserved Energy Objective.*
- **Established:** 2008.
- **Requirement:** 10 percent by 2015.
- **Applicable Sectors:** *Investor-owned utility, municipal utilities, cooperative utilities.*
- **Enabling Statute, Code or Order:** [S.D. Codified Laws Ann. §49-34A-94](#); [S.D. Codified Laws Ann. §49-34A-101 et seq.](#)

## Texas

- **Title:** Renewable Generation Requirement.
- **Established:** 1999.
- **Requirement:** 5,880 MW by 2015. 10,000 MW by 2025 (goal; achieved).
- **Applicable Sectors:** Investor-owned utility, retail supplier.

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- **Cost Cap:** 3.1 percent.
- **Details:** Non-wind: 500 MW (goal).
- **Enabling Statute, Code or Order:** [Tex. Utilities Code Ann. §39.904.](#)

## Utah

- **Title:** *Renewables Portfolio Goal.*
- **Established:** 2008.
- **Requirement:** 20 percent by 2025.
- **Applicable Sectors:** *Investor-owned utility, municipal utilities, cooperative utilities.*
- **Enabling Statute, Code or Order:** [Utah Code Ann. §54-17-101 et seq.](#); [Utah Code Ann. §10-19-101 et seq.](#)

## Vermont

- **Title:** Renewable Energy Standard.
- **Established:** 2005 (voluntary garget); 2015 (standard).
- **Requirement:** 55 percent by 2017; 75 percent by 2032.
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities, retail supplier.
- **Cost Cap:** None.
- **Details:** Distributed Generation: 10 percent by 2032. Energy Transformation: 12 percent by 2032 (includes weatherization, thermal energy efficiency and heat pumps).
- **Enabling Statute, Code or Order:** [Vt. Stat. Ann. tit. 30 §8001 et seq.](#); [Standard: House Bill 40.](#)

### Virginia

- **Title:** Voluntary Renewable Energy Portfolio Goal.
  - **Established:** 2007.
  - **Requirement:** 15 percent by 2025.
  - **Applicable Sectors:** Investor-owned utility.
  - **Details:** The state has several credit multipliers for different technologies.
  - **Enabling Statute, Code or Order:** [Va. Code §56-585.2](#).
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### Washington

- **Title:** Renewable Energy Standard.
- **Established:** 2006.
- **Requirement:** 15 percent by 2020.
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities.
- **Cost Cap:** 4 percent.
- **Details:** Standard is applicable to all utilities that serve more than 25,000 customers. Requirement also includes all cost-effective conservation. The state has a credit multiplier for distributed generation.
- **Enabling Statute, Code or Order:** [Wash. Rev. Code §19.285](#); [Wash. Admin. Code §480-109](#); [Wash Admin. Code §194-37](#).

### West Virginia

- **Title:** Alternative and Renewable Energy Portfolio Standard- **REPEALED**.
- **Established:** 2009; **Repealed 2015**.
- **Requirement:** 10 percent from 2015-2019, 15 percent from 2020-2024, 25 percent by 2025.
- **Details:** Goal is applicable to IOUs that serve more than 30,000 residential customers. Goal includes alternative energy sources, including coal technology, coal bed methane, natural gas, combined cycle technologies, waste coal and pumped storage hydroelectric projects.
- **Enabling Statute, Code or Order:** [W. Va. Code §24-2F](#); [Repeal: H.B. 2001](#).

### Wisconsin

- **Title:** Renewable Portfolio Standard.
- **Established:** 1998.
- **Requirement:** 10 percent by 2015.
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities.
- **Cost Cap:** None.
- **Details:** Standard varies by utility. 2011-2014: utilities may not decrease its renewable energy percentage below 2010 percentages. 2015: utilities must increase renewable energy percentages by at least 6 percent above their 2001-2003 average. Utilities may not decrease their renewable energy percentage after 2015.
- **Enabling Statute, Code or Order:** [Wisc. Stat. §196.378](#).

### Washington, D.C.

- **Title:** Renewable Portfolio Standard.
- **Established:** 2005.
- **Requirement:** 20 percent by 2020, 50 percent by 2032.
- **Applicable Sectors:** Investor-owned utility, retail supplier.
- **Cost Cap:** 18.9 percent.
- **Details:** Solar: 2.5 percent by 2023; 5 percent by 2032.
- **Enabling Statute, Code or Order:** [D.C. Code §34-1431 et seq.](#), [Bill 650 \(2016\)](#).

### Guam

- **Title:** *Renewable Energy Portfolio Goal.*
- **Established:** 2008.
- **Requirement:** 25 percent by 2035.
- **Applicable Sectors:** *Investor-owned utility, municipal utilities, cooperative utilities.*
- **Details:** *Goal applies to net electricity sales.*
- **Enabling Statute, Code or Order:** [Guam Public Law §29-62](#).

### Northern Mariana Islands

- **Title:** Renewables Portfolio Standard.
- **Established:** 2007; goal reduced in 2014.
- **Requirement:** 20 percent by 2016.
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities.
- **Cost Cap:** Data unavailable.
- **Details:** Requirement applies to net electricity sales. Requirement allows for non-compliance if it is not cost-effective.
- **Enabling Statute, Code or Order:** [N. M. I. Public Law §15-23](#); [House Bill 165](#) (2014).

### Puerto Rico

- **Title:** Renewable Energy Portfolio Standard.
- **Established:** 2010.
- **Requirement:** 20 percent by 2035.
- **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities.
- **Cost Cap:** Data unavailable.
- **Details:** Requirement does not take effect until 2015.
- **Enabling Statute, Code or Order:** [PR S 1519](#) (2010); [PR H 2610](#) (2010).

### U.S. Virgin Islands

- **Title:** Renewables Portfolio Targets.
  - **Established:** 2009.
  - **Requirement:** 20 percent by 2015; 25 percent by 2020; 30 percent by 2025; up to 51 percent after 2025.
  - **Applicable Sectors:** Investor-owned utility, municipal utilities, cooperative utilities.
  - **Cost Cap:** Data unavailable.
  - **Details:** Standard applies to peak demand generating capacity. Standard will increase until a majority of capacity is from renewable or alternative energy.
- Enabling Statute, Code or Order:** [VI B 9](#) (2009).