



# Behind-the-Meter Solar+Storage Permitting and Interconnection Guide for Boulder, Colorado



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<sup>1</sup> [http://solarmarketpathways.org/wp-content/uploads/2017/09/CUNYDecDGHub\\_EnergyStorageSystemsPermittingandInterconnectionGuide.pdf](http://solarmarketpathways.org/wp-content/uploads/2017/09/CUNYDecDGHub_EnergyStorageSystemsPermittingandInterconnectionGuide.pdf)

# Introduction

This guide reviews permitting and interconnection requirements and processes for the development of residential and commercial-scale solar photovoltaic (PV) systems paired with energy storage technologies (solar+storage) in Boulder, Colorado. The guide is only applicable to behind-the-meter solar+storage systems, those sited on the customer side of the utility meter, which is the most common configuration for residential and commercial installations.

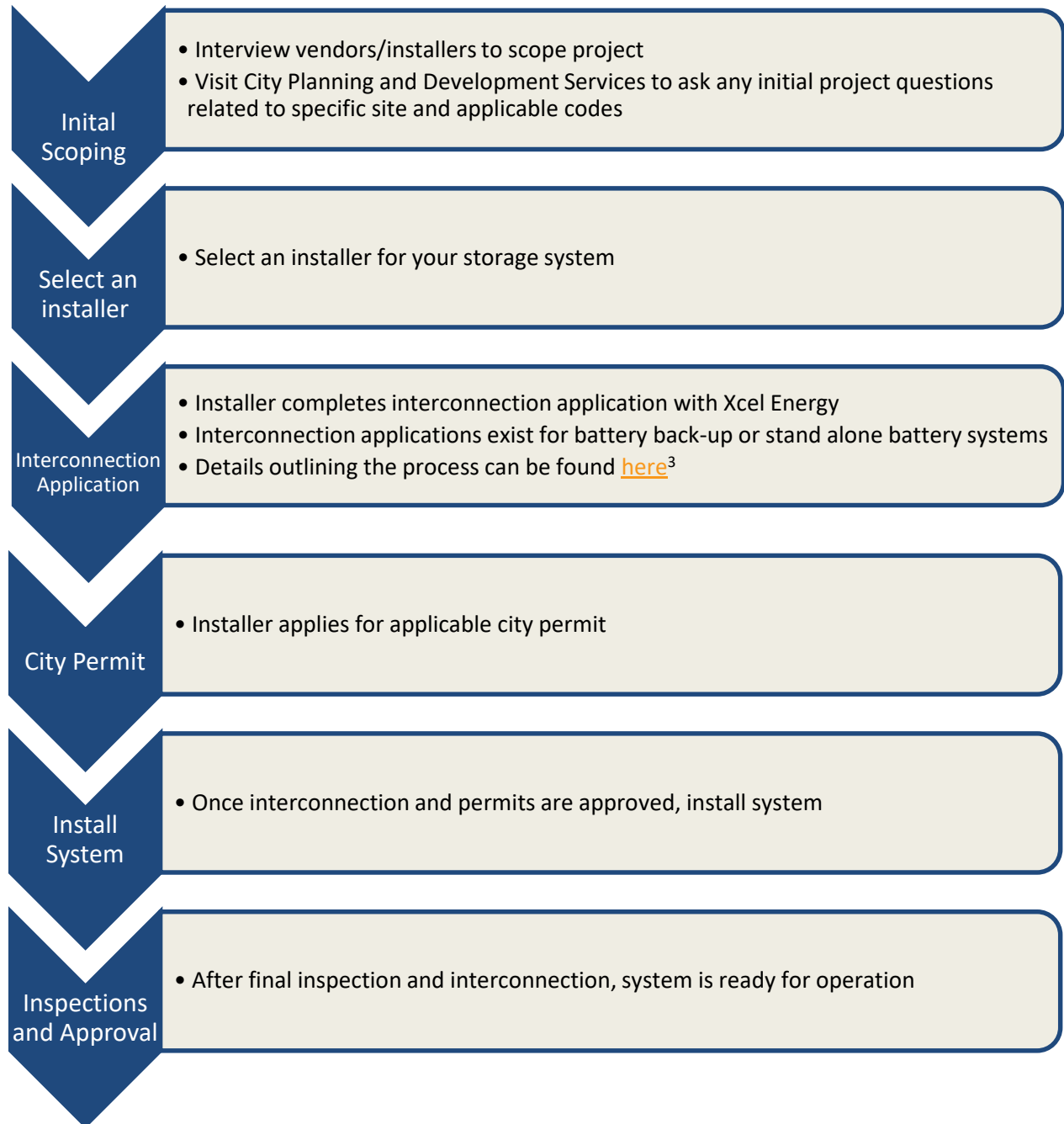
This guide was developed in support of Boulder’s Climate Commitment to “rapidly transition to a clean energy economy and lifestyle through innovative strategies, products, and services that dramatically reduce greenhouse gas emissions, enhance our community’s resilience, and support a vital and equitable economy.” As part of this commitment, the City of Boulder has established a goal of powering the city with 100% renewable electricity by 2030, with targets of 50 megawatts of locally produced renewable electricity by 2020, 100 megawatts by 2030, and 175 megawatts by 2050, most of which will likely be supplied by solar. Read more about Boulder’s Climate Commitment [here](#).<sup>2</sup>

By pairing solar with energy storage technologies, the city can advance both its renewables and resilience goals, while deploying flexible resources that can help ease the transition to a cleaner electric system. This guide is intended to advance the installation of solar+storage systems by laying out a clear process for businesses, residents, and developers to understand the process of getting a system approved for installation and interconnected to the electric grid.

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<sup>2</sup> <https://bouldercolorado.gov/climate>

## Timeline/Flow of Events



<sup>3</sup> <https://www.xcelenergy.com/staticfiles/xcel-responsive/Energy%20Solutions/Residential%20Solutions/Renewable%20Energy%20Solutions/CO-Res-Solar-Rewards-Installer-Training.pdf>

# General System Design Considerations

When planning a new solar+storage installation, or the incorporation of energy storage into an existing solar system, the following high-level design elements should be considered:

- System design must adhere to all applicable safety and electrical codes, such as the incorporation of exterior disconnect switches so that the system can be quickly and easily de-energized in case of an emergency, such as a fire.
- To ensure that emergency response teams are aware of the presence of advanced energy systems at a property, an outside electrical meter must be labeled with information about the presence of any on-site solar and energy storage systems and related disconnect switches.
- System design must adhere to all applicable building codes, such as siting energy storage technologies above the flood plain, whether located indoors or outside.
- Certain commercial critical building loads, such as emergency egress elevators and emergency lighting, must meet specified minimum performance specifications. Any standby energy system designed to support these types of loads must ensure the components are able to meet any required performance standards.

For a full list of applicable building codes and regulations, see the [City of Boulder Planning and Development Services webpage](#).<sup>4</sup>

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<sup>4</sup> <https://bouldercolorado.gov/plan-develop/codes-and-regulations>

# Building Permits

Depending on the type of property and complexity of the solar+storage installation, three types of building permits may be required: **electrical**, **building**, and **mechanical**.

Residential solar+storage projects often only require an electrical permit; however, certain project complexities or building alterations may trigger the need for building and mechanical permits as well. Due to the added complexities of many commercial projects, commercial solar+storage installations are more likely to require building and mechanical permits along with electrical permitting before proceeding.

### ***Obtaining a permit application:***

Permit applications are available at the Planning and Development Services Center on the third floor of the Park Central Building at 1739 Broadway or on the [building permits webpage](#).<sup>5</sup>

### ***Submitting a permit application:***

In general, permit applications must be submitted at the Planning and Development Services Center on the third floor of the Park Central Building at 1739 Broadway by the applicant or applicant's representative and discussed with a project specialist. Some permit applications, such as residential electrical permits, may be faxed to the office using a faxable Skip-A-Trip form. Some project permits may require additional documentation along with the submission.

### ***Permitting cost:***

The cost of each permit is dependent on the type of permit, scope of work, and many other variables. Contact the Planning and Development Services department for assessment of fees applicable to a proposed project, or visit the Planning and Development Services website for access to the most recent [schedule of fees document](#).<sup>6</sup>

### ***Permitting timeline:***

After submitting a completed application, a project specialist will indicate an approximate date when applicants can expect to hear from the city. The actual time it takes to receive approval is determined by the clarity and completeness of application materials, as well as the number of other applications awaiting review. Submitting documents that are complete, accurate, and meet all the code requirements should accelerate the approval process.

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<sup>5</sup> <https://bouldercolorado.gov/plan-develop/building-permits>

<sup>6</sup> <https://bouldercolorado.gov/plan-develop>

The following are typical approval timelines:

- Residential alterations and additions: Up to 20 business days
- Commercial alterations and additions: Up to 25 business days
- New single-family dwellings: Up to 40 business days
- New multifamily dwellings: Up to 60 business days
- New commercial buildings: Up to 60 business days

If for any reason a permit is not issued within 180 calendar days from the day of initial payment, the permit application will expire. Applicants may apply for an extension to the 180-day limit by contacting the chief building official at 303-441-1880 or [plandevlop@bouldercolorado.gov](mailto:plandevlop@bouldercolorado.gov).

***Permitting status:***

The status of a submitted permit application can be checked online by entering the application case number [on the permit status report webpage](#).<sup>7</sup>

***Scheduling an inspection:***

Depending on the type and complexity of the project, an inspection may be required. For details on how to schedule an inspection, see the [building inspections webpage](#).<sup>8</sup>

***Contact information:***

City of Boulder Planning and Development Services

Office hours: 8:00 am-4:00 pm on Mondays, Wednesdays, Thursdays, and Fridays; and 10:00 am-4:00 pm on Tuesdays

Email: [plandevlop@bouldercolorado.gov](mailto:plandevlop@bouldercolorado.gov)

Phone: 303-441-1880

## ELECTRICAL PERMIT

An electrical permit is required for any electrical work at a property. All new solar+storage systems, or the incorporation of storage into an existing solar system, must obtain an electrical permit from the City of Boulder.

A new solar+storage installation may require two separate electrical permits, one for the solar system and a separate permit for the storage system. This is in part due to an established flat-rate permitting fee for solar installations, which does not currently include review of energy storage components. The addition of energy storage to an existing solar system should only require a single electrical permit.

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<sup>7</sup> <https://bouldercolorado.gov/plan-develop/permit-status-report>

<sup>8</sup> <https://bouldercolorado.gov/plan-develop/building-inspections>

The electrical permitting process may include an inspection by the Boulder Department of Planning and Development Services. System designs with a high degree of complexity could potentially require third-party inspection and review, or assurances from the design engineer that the system was properly installed and inspected according to design specifications.

***Obtaining an electrical permit application:***

[Electrical permit applications](#)<sup>9</sup> are available at the Planning and Development Services Center or on the [building permits webpage](#).<sup>10</sup>

***Submitting an electrical permit application:***

Completed residential project applications can be submitted via fax to 303-441-4241, or delivered in person at the Planning and Development Services Center. All commercial project applications must be submitted in person. One-line diagrams and load calculations must be submitted along with the permit application for properties with an electrical service size of 400 amps or more.

***Electrical permit cost:***

Electrical permit fees can be found in the complete [schedule of fees document](#).<sup>11</sup>

## BUILDING PERMIT

A building permit may be required for solar+storage installations at commercial developments, including new buildings and additions or remodels of existing space. Building permits are not typically required for solar+storage installations at existing residential properties, unless the installation involves significant structural or land-use changes to the property.

The building permitting process may include an inspection by the Boulder Department of Planning and Development Services.

***Obtaining a building permit application:***

Building permit applications are available at the Planning and Development Services Center. Commercial projects should obtain a Multi-Family and Non-Residential Building Permit Application and a Multi-Family and Non-Residential Building Permit Checklist. Residential properties requiring a building permit should obtain a Residential Building Permit Application with Checklist.

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<sup>9</sup> [https://www-static.bouldercolorado.gov/docs/PDS/forms/1200\\_electrical.pdf?\\_ga=2.107762242.1112518963.1509111447-1188258390.1509111447](https://www-static.bouldercolorado.gov/docs/PDS/forms/1200_electrical.pdf?_ga=2.107762242.1112518963.1509111447-1188258390.1509111447)

<sup>10</sup> <https://bouldercolorado.gov/plan-develop/building-permits>

<sup>11</sup> [https://www-static.bouldercolorado.gov/docs/2018\\_Schedule\\_of\\_Fees-1-201801290853.pdf](https://www-static.bouldercolorado.gov/docs/2018_Schedule_of_Fees-1-201801290853.pdf)



**Submitting a building permit application:**

All building permit applications must be submitted in person at the Planning and Development Services Center.

Depending on the project, applications may also need to include the following:

- Solar analysis
- [Energy Code compliance](#)<sup>12</sup>
- Site plan
- Floor plans
- Elevations
- Structural drawings
- Foundation plans
- Sections
- Plumbing fixture count form
- Allocations for commercial, new residential, or demolition/rebuild of residential properties
- Storm Water and Flood Management Fee and Plant Investment Fee (PIF) [calculation form](#)<sup>13</sup>
- Commercial and Multi-Family or Residential Building Permit Checklist

Commercial projects may also need:

- Industrial/commercial environmental information
- [Housing and Development Excise Tax form](#)<sup>14</sup>
- Copies of rated assemblies
- Copies of any approved Tec Doc drawings (grading and drainage plans, easement dedications, etc.)

Residential projects might also need a Floor Area Ratio (FAR) calculation.

**Building permit cost:**

Building permit fees can be found in the complete [schedule of fees document](#).<sup>15</sup>

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<sup>12</sup> <https://bouldercolorado.gov/plan-develop/energy-conservation-codes>

<sup>13</sup> <https://www-static.bouldercolorado.gov/docs/stormwater-flood-management-fee-plant-investment-fee-calculation-worksheet-1-201307160929.pdf>

<sup>14</sup> [https://www-static.bouldercolorado.gov/docs/PDS/forms/1604\\_Impact\\_Fee\\_Worksheet\\_Non\\_Res.pdf](https://www-static.bouldercolorado.gov/docs/PDS/forms/1604_Impact_Fee_Worksheet_Non_Res.pdf)

<sup>15</sup> [https://www-static.bouldercolorado.gov/docs/2018\\_Schedule\\_of\\_Fees-1-201801290853.pdf](https://www-static.bouldercolorado.gov/docs/2018_Schedule_of_Fees-1-201801290853.pdf)

## MECHANICAL PERMIT

A mechanical permit may be required for solar+storage installations that involve the construction, addition, replacement, alteration, or repair of heating, ventilation, refrigeration, comfort cooling systems, and other miscellaneous heat-producing appliances in new and existing buildings.

The mechanical permitting process may include an inspection by the Boulder Department of Planning and Development Services

### ***Obtaining a mechanical permit application:***

Mechanical permit applications for commercial projects are available at the Planning and Development Services Center. [Skip-A-Trip mechanical permit applications](#)<sup>16</sup> for residential projects are also available on the [building permits webpage](#).<sup>17</sup>

Residential properties of two units or less may also apply online for stand-alone mechanical permits. See the [Boulder e-permits webpage](#)<sup>18</sup> for more information about the online process.

### ***Submitting a mechanical permit application:***

Completed commercial and residential mechanical applications can be submitted in person at the Planning and Development Services Center. Skip-A-Trip residential mechanical permit applications may be submitted via fax to 303-441-4241. E-permit applicants will submit and pay for their mechanical permit through the online process.

Commercial applications may also be required to include two sets of mechanical design drawings.

### ***Mechanical permit cost:***

Mechanical permit fees can be found in the complete [schedule of fees document](#).<sup>19</sup>

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<sup>16</sup> [https://www-static.bouldercolorado.gov/docs/PDS/forms/1202\\_skip\\_mech.pdf?\\_ga=2.210171349.1112518963.1509111447-1188258390.1509111447](https://www-static.bouldercolorado.gov/docs/PDS/forms/1202_skip_mech.pdf?_ga=2.210171349.1112518963.1509111447-1188258390.1509111447)

<sup>17</sup> <https://bouldercolorado.gov/plan-develop/building-permits>

<sup>18</sup> <https://bouldercolorado.gov/plan-develop/boulder-e-permits>

<sup>19</sup> [https://www-static.bouldercolorado.gov/docs/2018\\_Schedule\\_of\\_Fees-1-201801290853.pdf](https://www-static.bouldercolorado.gov/docs/2018_Schedule_of_Fees-1-201801290853.pdf)

# Utility Interconnection

All electrical sources that operate in parallel with Xcel Energy and are configured to serve a customer's main electrical panel are required to have an interconnection review and interconnection agreement to ensure safety, system reliability, and operational compatibility. Energy storage details can be submitted as part of the same Xcel application process as for a solar system.

## INTERCONNECTION APPLICATION PROCESS

Xcel's online interconnection application process is composed of several steps:

- *Basic project details*  
Includes information about the applicant, site location, type of installation, and type of program, such as net energy metering.
- *Solar system details*  
Detailed information about new and existing solar installations and inverters.
- *Battery system details*  
In addition to detailed information about the energy storage system, applications with storage must submit a completed attestation. Sample attestation documents are available on Xcel's [Solar\\*Rewards Developer Resources webpage](#).<sup>20</sup>
- *Supporting documents*  
Electrical line diagram (including storage system design configuration) and site plan. All systems 10 kilowatts or greater also require a Small Generation Interconnection Agreement Form (SGIA).
- *Application deposit payment*  
Payment can be done either online or through the mail. All systems 10 kilowatts or greater also require a \$1,000 study fee.
- *Engineering review*  
Xcel engineers have up to 10 business days to review applications once submitted. If the project is approved by engineering, the application will move on to final information documentation. If a project is rejected for any reason, the applicant will receive an email with further instructions.
- *Final information documentation*  
Includes documentation of proof of insurance, final electric inspection, and North American Board of Certified Energy Practitioners (NABCEP) certification.

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<sup>20</sup> [https://www.xcelenergy.com/working\\_with\\_us/renewable\\_developer\\_resource\\_center/solar\\_rewards\\_developer\\_resources](https://www.xcelenergy.com/working_with_us/renewable_developer_resource_center/solar_rewards_developer_resources)

- *Meter installation*

PV production and net meters will be installed approximately 15 business days from the meter order date established after confirmation of final information documentation.

For more detailed information about the application process, see [Xcel's 2018 Installer Training presentation](#).<sup>21</sup>

## ENERGY STORAGE CONFIGURATION GUIDANCE

Xcel has established a set of guidance documents for the incorporation of energy storage behind a customer's utility meter. These guidelines are designed to ensure that customers under net metering agreements are not compensated for stored energy exported to the grid that was not produced by a qualified source of renewable generation, such as solar and wind.

Integrated solar and storage system configurations allowed by Xcel must meet one of the following general conditions:

- The energy storage system is used for standby purposes only (does not serve the main electrical panel).
- The energy storage system is exclusively charged by solar.
- The energy storage system is not able to export to the grid, aside from brief inadvertent exports.

Allowable configurations satisfying these conditions are defined in three Xcel guidance documents, which are described in more detail below. The guidance documents include conceptual one-line diagrams illustrating allowable system configurations. Variations on these configurations and alternative designs may also be considered acceptable.

How the energy storage system is configured to operate is considered part of Xcel's interconnection agreement. Any changes to operating modes, which may include any software or firmware system updates, could require another interconnection review. This may be an issue for some installers. In some cases, storage installers have met this requirement by making certain components of the inverter hardware inaccessible to customers. In other cases, where the inverter is an integral component of the storage system, this issue has temporarily put new storage system installations on hold until the issue has been resolved with Xcel. Xcel has stated that unauthorized changes to energy storage settings or operating modes could result in the loss of a system's net metering eligibility. Customers should discuss this issue with their installer before proceeding with a project.

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<sup>21</sup> <https://www.xcelenergy.com/staticfiles/xcel-responsive/Energy%20Solutions/Residential%20Solutions/Renewable%20Energy%20Solutions/CO-Res-Solar-Rewards-Installer-Training.pdf>

Examples of systems not allowed under the approved guidelines include configurations where the energy storage could be charged with electricity from the grid or from a diesel or gas generator and then discharged to the electric grid.

A line drawing or diagram of the proposed system must be submitted to Xcel at the time of initiating a new interconnection review process, along with a description of how the system will be programmed to operate.

There is no set timeline for the interconnection review process. Xcel typically responds with questions or issues flagged within two weeks. The process may take significantly longer if the system design does not conform to one of the allowable configurations detailed in Xcel's guidance documents. Based on feedback from local installers, most standard system designs should be able fall into one of the configurations detailed by Xcel.

Xcel's established allowable energy storage configuration guidance is as follows:

- **Guidance No. 1 for the Interconnection of Electric Storage as Stand-Alone Sources, Parallel Operation for Customers without Generation, and in Parallel with Self-Generation**

This [Guidance No. 1 document](#)<sup>22</sup> applies to energy storage that is not integrated with a renewable generation asset. It does not apply to solar+storage systems.

Customers with stand-alone energy storage systems are not required to have an interconnection agreement with Xcel as long as they are in compliance with electrical code NEC 702, have obtained an appropriate safety inspection, and can verify that the system does not serve their main electrical panel. These are typically systems designed to serve a critical load panel as a source of backup power.

If connecting non-renewable generation and storage at the same time, both systems may be reviewed together and included as part of the same interconnection review and interconnection agreement.

The document includes diagrams detailing three allowable system configurations:

1. Standby systems that supply power to facilities where life safety systems are not dependent on the performance of the system.
2. Energy storage systems operating in parallel with Xcel that do not export electricity.
3. Energy storage systems operating in parallel with Xcel that are paired with on-site non-renewable generation.

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<sup>22</sup> <https://www.xcelenergy.com/staticfiles/xe-responsive/Programs%20and%20Rebates/Residential/CO-solar-residence-Storage-Guidance-1.pdf>

- **Guidance No. 2 for Interconnection of Energy Storage Systems Operated in Front of a Production Meter and Paired with Onsite Renewable Generation Connected Under a Net Metering Tariff**

This [Guidance No. 2 document](#)<sup>23</sup> applies to energy storage paired with net metered renewable generation in an AC-coupled configuration, where the storage system is integrated on the utility side of the customer’s production meter.

This type of configuration requires an interconnection review and interconnection agreement. The storage system must be either charged exclusively by on-site renewable generation or configured so that it does not export to the grid.

If connecting renewable generation and storage at the same time, both systems may be reviewed together and included as part of the same interconnection review and interconnection agreement. Any changes in storage system operating modes may require another review of the facility.

These types of system configurations include a separate inverter for the renewable generation and the energy storage system. The inverter software programming controlling the storage operation is required to be inaccessible to the customer, either through locks or other physical security or restricted through password protection.

The document includes diagrams detailing three allowable system configurations:

1. Standby systems paired with on-site renewable generation, which cannot discharge to the customer’s main electrical panel. This configuration does not require any metering changes.
2. Energy storage systems operating in parallel with Xcel that are 100 percent charged with on-site renewable generation, with the storage connected on the utility side of the production meter.
3. Energy storage systems operating in parallel with Xcel that can be charged from on-site renewable generation, the grid, or a non-renewable generation but is not able to export to the grid, aside from minimal inadvertent exports. The storage must be connected on the utility side of the production meter. This configuration requires that the production meter reads values for the same intervals as the net meter.

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<sup>23</sup> <https://www.xcelenergy.com/staticfiles/xe-responsive/Programs%20and%20Rebates/Residential/CO-solar-residents-Storage-Guidance-2.pdf>

- **Guidance No. 3 for Interconnection of Energy Storage Systems Operated Behind a Production Meter and Paired with Onsite Renewable Generation Connected Under a Net Metering Tariff**

This [Guidance No. 3 document](#)<sup>24</sup> applies to energy storage paired with net metered renewable generation in a DC-coupled configuration, where the storage system is integrated on the customer side of the production meter.

This type of configuration requires an interconnection review and interconnection agreement. The storage system must be charged exclusively by on-site renewable generation. Because battery operation includes some amount of energy losses, these configurations will result in some loss of meter recorded renewable energy credits (RECs) and corresponding payments. Only generation recorded by the production meter will be eligible for REC incentives.

If connecting renewable generation and storage at the same time, both systems may be reviewed together and included as part of the same interconnection review and interconnection agreement. Any changes in storage system operating modes may require another review of the facility.

These types of system configurations are assumed to use a shared hybrid inverter for the renewable generation and energy storage system. The inverter software programming controlling the storage operation is required to be inaccessible to the customer, either through locks or other physical security or restricted through password protection.

The document includes diagrams detailing two allowable system configurations:

1. A hybrid inverter with a second load meter. When a protected load panel is installed with the hybrid inverter and supplied through that inverter, a second unidirectional load meter must be installed between the inverter and load panel. The main production meter is required to be a dual-register bidirectional meter.
2. A hybrid inverter with a transfer switch. When a transfer switch is used to supply the protected load panel under normal conditions, no power will flow in reverse through the production meter. This type of configuration eliminates the need for a second production meter.

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<sup>24</sup> <https://www.xcelenergy.com/staticfiles/xcel-responsive/Company/Rates%20&%20Regulations/CO-Stakeholders-Groups-Grid-Storage-Guidance-3.pdf>