STEP 4: ESS RESIDENTIAL CODE INSTALLATION REQUIREMENTS

1. The individual ESS units are no larger than 20 kWh. Units installed meet one of the size and location limitations shown in items (2) and (3) below.

This requirement limits the size of an individual ESS unit to 20 kWh. One reason for this basic limitation is to put an upper bound on the amount of energy that can be stored in one enclosure. Each enclosure must meet the separation requirements of items (2) and (3), but the individual enclosures are limited to 20 kWh which is consistent with the language of the 2021 IRC. No such limitation exists in the 2018 IRC. Although the 20 kWh storage unit limit is similar to the 20 kWh lithium-ion size when the IFC starts to be enforced for non-IRC buildings, this is simply a coincidence. ESSs of all sizes complying item (3) in or on one- and two-family dwellings are regulated by the IRC, not the IFC.

2. The individual ESS units are installed are separated by 36” or are installed in accordance with approved large-scale fire testing results (UL 9540a or equivalent approved tests).

The basic code requirement is for ESS units to be located 36” apart. For instance, two separate 20 kWh energy storage units could be installed on either side of an inverter that was processing the DC power from these storage units. If no additional large-scale fire testing is provided, these units could be installed as close to the inverter as permitted the inverter’s instructions and no closer than 36” apart from each other. A simple diagram below illustrates this concept.

However, if large-scale fire testing showed that the units could be safely installed 12” apart, it would be permissible to install both units next to one another on one side of the inverter. The diagram below illustrates this arrangement.

Figure 1 Two Storage Units Complying with 3’ Separation
While these two examples take up the same amount of wall area, one arrangement may be better than another depending on other factors such as electrical wiring. The 2021 IRC allows up to 80 kWh of energy storage in an attached garage. The 36” basic requirement may pose a significant spacing issue if large-scale fire testing does not allow for smaller separations. The diagrams below illustrate the difference between installations with the 36” spacing and those with a 12” spacing.
Every installation is different, but this example shows that the 36” spacing requirement can pose major siting issues for ESS components. Very few attached garages have over 18 feet of available wall space to install each unit 36” from one another. Products that are expecting to deploy multiple units at a residence will likely use the large-scale fire testing option to allow for closer spacing of their units.

3. Each ESS meet one of the size and location limitations shown below:

- a. 80 kWh in attached garages separated from the dwelling unit living space in accordance with Section R302.6.
   This limit is set for attached garages, one of the most common locations for an ESS. While setting the limit of an ESS in this space to 80 kWh, it also requires that the separation from the living space be done in accordance with section R302.6 of the IRC. This section of the IRC stipulates that the garage space be separate from the living space with certain types and thicknesses of gypsum board depending on whether the space is next to or above the garage. Many older homes do not have this separation, so sheetrock would need to be installed to meet this requirement of the 2021 IRC for spaces enclosing ESS.

- b. 80 kWh on exterior walls a minimum 3 feet (914 mm) from doors and windows directly entering the dwelling unit (garage doors and windows do not enter the dwelling unit).
   This option allows for ESS to be installed on exterior walls, but limits how close the ESS can be to doors or windows entering the dwelling unit. It is important to note that there is no restriction on how close an ESS unit can be to windows or doors entering a garage since the garage is not considered part of the dwelling unit. An attached garage is a space connected to a dwelling unit.

- c. 40 kWh within utility closets, basements, and storage or utility spaces with finished or noncombustible walls and ceilings. Walls and ceilings of unfinished wood-framed construction shall be provided with minimum 5/8 in. Type X gypsum.
   This option provides limitations on ESSs installed inside the dwelling unit. The maximum is the least of the five options and the protection requirements are the most stringent of all options. Inside a dwelling unit, an ESS must be in a utility closet, basement, or storage space with finished or noncombustible walls such as gypsum board walls or concrete block walls. If the space where the ESS is to be installed includes walls or ceilings with exposed unfinished wood-framing, it is required that the framing be covered with 5/8” Type X gypsum which has superior fire performance to standard gypsum board. Existing finished walls do not need any additional coverings.

- d. 80 kWh in detached garages and detached accessory structures.
   Detached garages and detached accessory structures are treated just like attached garages except they are not required to meet R302.6. The requirements of R302.6 state that even detached structures separated less than 3 feet from a dwelling unit needs to meet additional drywall separation requirements. If the installation is in an existing structure built prior to the requirements of R302.6, then no drywall is required to be added.
e. 80 kWh outdoors on the ground a minimum 3 feet (914 mm) from doors and windows directly entering the dwelling unit.

The last option for mounting an ESS in the 2021 IRC is that an ESS mounted outside of dwellings, and not on exterior walls or in detached structures, is also permitted to install 80 kWh of energy storage. There may be other issues in the code that may need to be observed such as setback requirements to neighboring properties, but this section only limits the distance from doors or windows directly entering the dwelling unit. This is identical to the requirement for exterior walls and should be applied in a similar manner. Distances to garage doors or windows are not required. However, there may be access requirements for a garage side door that may need to be observed as covered elsewhere in the IRC.

The following figure illustrates the effect that the location limitations have on an ESS on the outside wall of a residence or on this inside wall of an attached garage. The highlighted area depicts zones that meet the location limitations for outside walls in this guideline.
4. Where an ESS is installed in a garage, units are installed along side walls and units installed on end walls above 48” do not need vehicle protection. Where units are installed on end walls below 48”, approved vehicle protection is installed (e.g. parking curb, barrier, bollard).

The requirements in R328 of the IRC regarding vehicle protection are not specific. It simply states that equipment in a location subject to vehicle damage is required to have approved barriers. The lack of specific requirements makes this part of the IRC related to ESS particularly problematic. Since being “subject to vehicle damage” is not defined in the IRC, there can be considerable differences of opinion on this matter. Rather than
leave the issue uncertain, it is more helpful to simply focus on the one case where barriers might be necessary. The possibility of a homeowner entering their garage and not stopping in time to hit the back wall of the garage is real. However, if that equipment is elevated above 48”, very few vehicles will be capable to even reaching the equipment. A simple height of 48” on the end wall of a garage is chosen as a height above which equipment is unlikely to ever suffer vehicle damage. Equipment installed on the side walls of garages do not need impact protection, regardless of mounting height, as these locations are equally unlikely to experience vehicle damage.

![Figure 6 Mounting Detail for ESS on End Wall of Garage without Vehicle Protection](image)

These guidelines are not officially code language, but they are intended to help jurisdictions to address these issues. The following Figure 7 was developed to assist jurisdictions understand when protection from impact is necessary. While this diagram is not part of the IRC, it is provided to acknowledge the intent of the IRC. The portion of the garage wall that connects with the house in Figure 7 may require protection from impact. This is why it is colored differently from all the other highlighted areas.
5. Where required, smoke or heat alarms are installed.

The language of the 2021 IRC introduced a new fire detections requirement triggered by the installation of an ESS in R328.7. It is the recommendation of this guide not to follow this language precisely until the 2021 IRC is required by a jurisdiction. Once that occurs, the discussion below should be considered as each jurisdiction reviews the enforcement of this section.

**R328.7 Fire detection.**

*Rooms and areas within dwellings units, basements, and attached garages in which ESS are installed shall be protected by smoke alarms in accordance with Section R314. A heat detector listed and interconnected to the smoke alarms shall be installed in locations within dwelling units and attached garages where smoke alarms cannot be installed based on their listing.*

This new language has raised many questions that should be resolved for a jurisdiction to enforce the intent of this new section. This language went into effect in California in July 2021 with modifications, and in other
regions starting in January 2022. The first sentence is reasonably straightforward in that it reiterates the requirements of section R314 related to smoke alarms for one- and two-family dwellings. Many rules and exceptions are found in R314, particularly in the California Residential Code, and each jurisdiction may have their own policies on how section 314 is applied when any permits are pulled for work in and around a dwelling. Consistency in the enforcement of section 314 should be followed by each jurisdiction as it relates to ESSs.

The second sentence of section R328.7 is more problematic and may present new challenges for complying with this section. The requirement is that a heat detector be both listed and interconnected to the house smoke detectors (presumably those required in R314) where a smoke alarm cannot be installed. The fact that the requirement for interconnection of heat alarms was struck from the California Residential Code is an indicator of some of the problems with this sentence. Conditions where a smoke alarm may not be installed based on their listing would include areas that fall below 40°F or rise above 100°F ambient temperature. Other examples are areas of extreme humidity. Examples of locations where smoke alarms may not be allowed could include attached garages, some basements, and some attics.

Since attached garages and basements are the most common locations for ESS, this sentence of R328.7 is cause for concern. As of the publishing of this document, the author is unaware of a single product that meets this requirement. Several smoke alarm manufacturers are aware of the new requirement, but there is no guarantee that this requirement will generate enough sales to warrant the development of a new heat detector product. Of particular concern is the interconnection requirement to other smoke detectors. This requires that the heat detector be able to communicate with other smoke detectors, which will likely limit the options only to one or two manufacturers and product models.

A careful reading of R314 may provide some relief to this problem. Many older homes are not required to install smoke alarms as delineated in R314. For a home that did not require smoke alarms, there would be no smoke alarms with which to interconnect. In this case, the second sentence would simply require the installation of a heat detector that would presumably sound an alarm in the area of the ESS.

This section was placed in the code with the best of intentions for life safety, but if strictly enforced, it could have a negative impact on safety issues. In particular, if a jurisdiction were to insist on interconnected heat detectors, many installations would have prohibitive added costs for residential locations best suited for ESS—namely attached garages and basements. Installers would be encouraged to install ESS often in conditioned spaces which are arguably less suited for power equipment. Having an early warning alarm in areas containing ESS is a good idea. Creative methods for detection and alarm need to be explored for effective safety of these systems. For now, it is best to waive the heat alarm portion of the requirement until such time that listed products are available.