



Permitting Solar Roofs

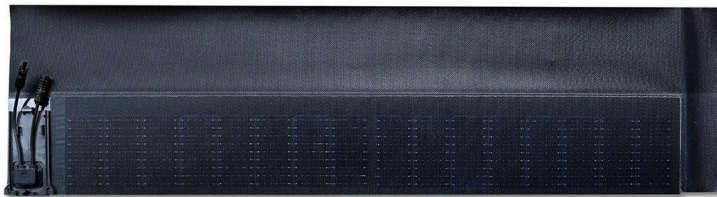
Energy Shingles: A Roof with Power Added

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Executive Summary

Timberline Solar™ from GAF Energy is a complete roofing system that combines energy shingles (referred to in building code as *photovoltaic shingles*) with asphalt shingles. The energy shingles are engineered to closely match the roofing characteristics of asphalt shingles. This includes their size, shape, thickness, weight, and safety certifications for wind and fire resistance. Like asphalt shingles, they are installed flush to the roof surface using roofing nails with no special racking required.



Timberline Solar™ Energy Shingle

What results is an innovative *building-integrated photovoltaic* (BIPV) roofing system that installs and performs like asphalt shingles using roofing tools, and is designed to leverage traditional roofing installation processes. Today's building codes and safety standards define and codify *photovoltaic shingles* as a *roof covering*.

As with any roofing system, the contractor must have the experience, knowledge, training, tools, and licenses to correctly install on and around the many features and obstructions of a roof. Roofing contractors represent the trade best qualified to install any roofing system including energy shingles, which will be a home's first defense against weather.

The growing scale of BIPV roofing products has implications beyond what a homeowner chooses to put on their roof. As BIPV continues to evolve and integrate into traditional roofing, it also means roofing contractors will play a central role in the installation of BIPV products.

In the brief history of residential solar, traditional rack-mounted systems have been installed by some combination of electricians, electrical contractors, or solar installers. BIPV roofing is a hybrid that will require the roofing and electrical trades in equal measure. As a consequence, regulatory authorities, contractor licensing boards, and local building departments will need to expand and evolve definitions and revise policies to enable the permitting and installation of BIPV by roofers, who are the most qualified trade to maintain the water shedding integrity of the roof and home.

New Technology Requires New Thinking

As with many construction projects, multiple trades are required to complete a job. While most stakeholders have grown accustomed to thinking “solar installations” are done by electricians, Timberline Solar combines roofing and electrical into a hybrid system while maintaining a defined separation of scope between each trade. This means the installation of the roof comes first, performed by the roofer, and the electrical connection to the home and the utility grid comes second, performed by the electrician.

Contractors from both disciplines must coordinate their work for a successful installation. As with any emerging construction technology, building departments may have to adjust their policies as to which trades have the appropriate training and licenses to apply for permits and perform code-compliant work. As energy shingles grow in the market, the role of roofers as BIPV installers will grow along with it.



Solar panels being installed

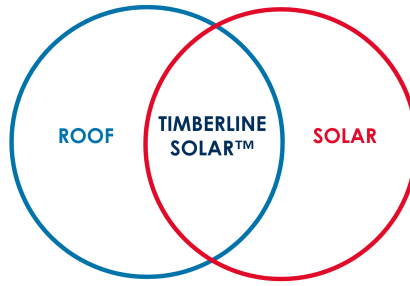


Energy shingles being installed

Different from Traditional Solar

In traditional solar, metal-framed panels are mounted onto racks and stand-offs above an existing roof. The roof and solar systems are installed separately by different contractors and function independently of each other. Because of its electrical and mechanical complexity, traditional solar is usually installed by electrical contractors.

By contrast, energy shingles perform both functions: roofing and solar energy generation. Timberline Solar is only installed as part of a new roof or replacement roof. It is never installed on top of an existing roof.

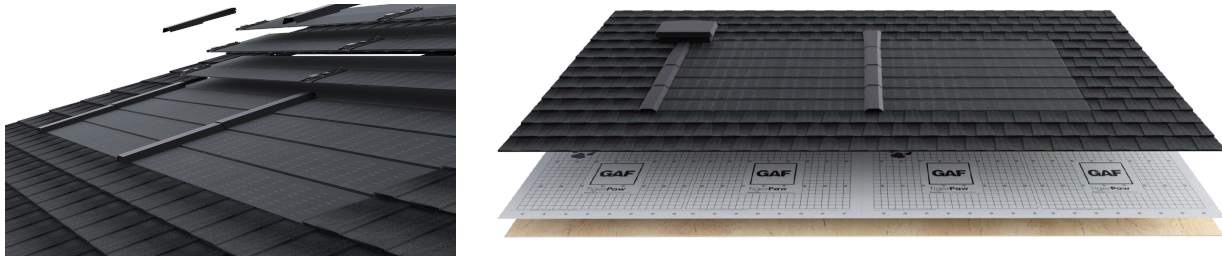


Timberline Solar™ Energy Shingles perform the functions of a roof and a solar product.

The installation combines both asphalt and energy shingles and requires the skills of an experienced roofing contractor to correctly integrate both roofing types. Just like asphalt shingles, Timberline Solar Energy Shingles are installed directly to the roof deck with roofing nails. As a replacement roof, energy shingles must be integrated with asphalt shingles, as well as all features of the roof, including valleys, ridges, hips, eaves, vents, dormers, etc. Each roof feature involves completing roofing tasks that are outside the scope of work performed by electricians and solar installers.

By matching the form, function, and installation method of asphalt shingles, Timberline Solar Energy Shingles eliminate both the electrical and mechanical complexity of traditional solar, and instead leverage the tools and practices of shingle roofing.

For example, Timberline Solar has no exposed metal common to retrofit solar installations (module frames, racking, stand-offs, etc.). By removing all exposed metal, Timberline Solar eliminates the grounding and bonding tasks normally performed by an electrician or solar installer.



The layers of Timberline Solar™. Both solar and roof are part of the same hardware system and installation processes.

However, Timberline Solar does not eliminate the need for an electrician. Instead, it shifts that role to the point when roofing is completed and system wiring goes from the roof to the ground. Likewise, an electrician will still perform all the normal tasks of connecting a home's solar installation to an inverter, the main service panel, and to the utility grid.

Energy Shingles in Building Code

In the U.S., the requirements to install roofing on one- and two-family dwellings are in the International Residential Code (IRC). Photovoltaic shingles have been in the IRC since 2012 and are defined as a *roof covering that resembles shingles and that incorporates photovoltaic modules.*

In the IRC, product safety standards for energy shingles address both the roofing and solar functions. Roofing standards for energy shingles closely match those for asphalt shingles and include wind resistance, fire classification, and underlayments. Solar standards cover the requirements for PV modules and building-integrated PV roofing, including solar (PV) shingles.

The IRC also establishes requirements for deck materials, slope, underlayment, ice barriers, and method of attachment. In all cases, the requirements for energy shingles closely match those for asphalt shingles.

When installed per the manufacturer's instructions, Timberline Solar is a certified, code compliant roof. Were none of the solar features enabled, Timberline Solar is still a roof with a 25-year warranty certified to the highest possible fire and wind ratings, capable of resisting sustained wind-driven rain, with a Florida Product Approval including High Velocity Hurricane Zones (HVHZ), and a Miami-Dade County Notice of Acceptance.

Photovoltaic Shingles in the Electrical Code

The other code that applies to any residential solar installation is the National Electrical Code (NEC/NFPA 70). The IRC requires PV systems be designed and installed in accordance with the NEC. Despite the difference in appearance between solar panels and energy shingles, their function is the same: converting sunlight into electricity. The electrical code requirements for both types of systems are identical.

Even the definition of *building-integrated photovoltaics* was removed from the NEC because no code articles referenced the term. As a result, the definition, safety standards, and installation requirements for residential installations of *photovoltaic shingles* are primarily dictated by the IRC.

While the electrical code requirements for both types of systems are the same, energy shingles are still simpler to install and therefore face fewer compliance requirements. They have no exposed metal to ground, like the frames of the solar panels or the racks they sit on. Nor do they use Module Level Power Electronics, like DC-to-DC converters or microinverters. This allows for clean separation between Step 1, the roofing installation by roofers, and Step 2, the electrical work by electricians.



While the electrical code requirements for both types of systems are the same, energy shingles are still simpler to install than solar panels and therefore face fewer compliance requirements.

Qualified Person

For all electrical installations governed by the NEC, there is a requirement that the work be performed by a “Qualified Person” defined as “one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.”

Energy shingles combine roofing and electrical equipment. Contractors selected by GAF Energy to install Timberline Solar receive real world training to ensure correct installation, and to *recognize and avoid the hazards involved*.

While Timberline Solar combines roofing and electrical functions, the scope of installation performed by roofing contractors still focuses on completing a roof. The role of the electrician has not been eliminated; it has been shifted to tasks that begin after the roof is installed.

Conclusion

As established by the requirements in the IRC, Timberline Solar is a certified, code compliant roofing system that combines energy and asphalt shingles. As a shingle roofing system, Timberline Solar has none of the electrical or mechanical complexity of traditional rack-mounted solar panels. Experienced roofing contractors are the trade with the knowledge, training, tools, and licenses to correctly complete Step 1: install energy and asphalt shingles on and around the many features of a roof.

Once the roofing features of Timberline Solar are complete, Step 2 is to interconnect solar to the home and to the electrical utility, tasks requiring the knowledge, training, tools, and licenses of an electrical contractor.

As solar roofing becomes more popular, roofing contractors will have a central role in its installation. Industry will need to work alongside regulatory authorities such as contractor licensing boards and local jurisdictions to ensure that trades with the appropriate training and credentials are allowed to permit and install these products.

Appendix

Photovoltaic Shingle Definition

“Photovoltaic shingles” are defined as “[a] roof covering that resembles shingles and that incorporates photovoltaic modules,” in both the International Residential Code (IRC) and International Building Code (IBC). The requirements specific to photovoltaic shingles are in R905.16 in the IRC and 1507.16 in the IBC.

Qualified Person Definition

Chapter 1 of the National Electrical Code defines a “Qualified Person” as “[o]ne who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.”

Florida Product Approval

Timberline Solar, Model TLS-1, has Florida Product Approval (FPA) #41599 and is approved for use in High Velocity Hurricane Zones. Testing required by the State includes demonstrated ability to withstand sustained wind driven rain.

Miami-Dade Notice of Acceptance

Timberline Solar, Model TLS-1 BIPV Shingle Roofing System and Accessories, has Miami-Dade Notice of Acceptance No. 23-1214.08 affirming compliance to the Florida Building Code including installation in code-defined High Velocity Hurricane Zones and has been certified to resist sustained wind-driven rain.

Residential Code Articles

See Table 1 (below) for key 2021 IRC code articles and standards that apply to photovoltaic systems generally and to PV shingles specifically:

PROPERTY	ARTICLE	STANDARDS & RELATED CODES
Definition	Ch. 2	NA
Photovoltaic systems	R324.3	NFPA 70 (NEC) UL 1703 UL 61730-1 UL 61730-2
Building-Integrated Photovoltaic Systems	R324.5	Various
Photovoltaic Shingles	R324.5.1	R905.16
Deck requirements	R905.16.1	Various
Deck slope	R905.16.2	2:12 or greater
Underlayment	R905.16.3	R905.1
Ice barriers	R905.16.3.1	R905.1.2
Material standards – Equipment listings	R905.16.4	UL 7103 UL 61730-1 UL 61730-2
Attachment	R905.16.5	Per Manufacturer
Wind resistance	R905.16.6	ASTM D3161 ¹ Per UL 7103
Fire classification	R902.3	UL 790/ASTM E108 ² Per UL 7103

Table 1 International Residential Code articles that apply to PV (solar) shingles.

¹ Timberline Solar has the highest possible wind resistance rating under ASTM D3161: Class F.

² Timberline Solar has the highest possible fire resistance rating under UL 790: Class A.