


Jun 2, 2017, 06:00am EDT

# How To Build An Energy-Efficient Home

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**Real Estate**  
*The new way to design your home.*

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*Jen Dalley, [Houzz](#)*

The last time you decided to plant something in your garden, where did you begin? Maybe you looked at the particular plant and analyzed its characteristics and what it needed to thrive. How much sun did it require? Was it hardy enough to survive in your growing zone? Once you gathered the facts, you determined the location in your yard where the plant would flourish.

It's a similar situation when you're choosing a site for an off-grid home. Do you want the sun to illuminate the kitchen in the morning? Will the western sun be too harsh or cause too much glare in the dining room in the late afternoon? Establishing your goals early on will allow the architect to fit these pieces together with the overall site constraints, ensuring a high-performance, energy-efficient home.



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Since a true off-grid house is able to operate completely independent of all public utilities, you will want to minimize the amount of work your systems will have to do from the start by using what the environment has already given you.

Architect Lisa Moffitt's Ontario client wasn't sure if she wanted to build off-grid. "She wanted the house to sit lightly on the land and to minimize consumption of resources as much as possible. However, we were also working to a tight budget, so most decisions were made based on a range

of variables, including aesthetics, environmental concerns and costs,” says Moffitt.

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To get the most out of the renewable energy systems, Moffitt went back to the basics.



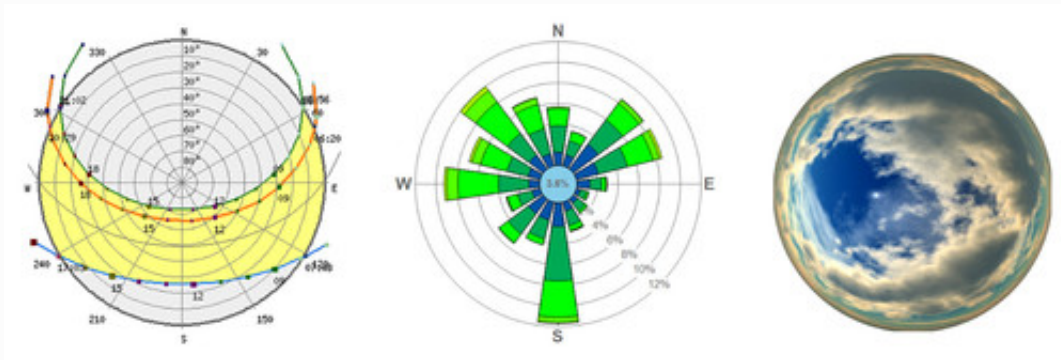
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“In terms of going off-grid, the importance of reducing electrical demand can’t be overstated,” Moffitt says. “Photovoltaics and other microrenewables generate fairly small amounts of electricity, so it is essential that consumption is minimized first.”

This is achieved through home orientation and window placement, the use of energy-efficient appliances and keeping the home’s footprint small.

“Once these measures have been considered, going off-grid is fairly

straightforward,” Moffitt says. “The technologies are reliable, and there is something very satisfying about knowing that your home is running in a way that is attuned to larger natural cycles.”



By Jen Dalley ||| ||| ||| ||| ||| ||| ||| ||| ||| Salt Lake City - See more Home Design Photos

## Consider the Known Conditions: Sun, Wind and Light

A few tools can help you make a smart decision about the orientation of your home.

Obtain a **sun path diagram** for your site’s location. This will help you determine the orientation of your home by giving a visual of where the sun travels in the sky throughout the day. Make note also of any obstructions surrounding the site (buildings, trees, telephone poles etc.) and potential obstructions (for instance, a vacant lot that could be developed) that might block potential passive solar gain.

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A **wind rose** notes the direction and frequency of prevailing winds. The United States Department of Commerce has wind data collected from many airport locations, so you may be able to find one close to your site. This is key in determining the effectiveness of a windmill to help produce electricity.

It's also important to be aware of your **predominant sky conditions** throughout the year: overcast, clear or partly cloudy. This will become useful knowledge when you're determining how to light the home's interior. By taking advantage of natural light, you can reduce your electrical load and your dependency on artificial illumination.

Did you know that an overcast sky is three times brighter at the zenith (the highest point in the sky dome) than at the horizon? If you live in a predominantly overcast area like the Pacific Northwest, this is the perfect environment to let in that bright light from above and maximize free illumination. In an area with predominantly clear skies, be aware of the placement of windows, so as not to have unwanted glare from direct sun.



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## **Building Orientation**

Based on the information you've collected about the site's sun, wind and

light, you can now make a meaningful decision regarding where the home will be located.

Both the shape and the construction of your home will greatly influence the heating and cooling requirements. For example, a building in a hot, arid climate experiences a large load from the sun in the summer. If the building is shaped in a way that reduces exposure to the sun — the glass is shaded by a large overhang and the walls are well insulated — the solar gain can be minimized and cooling requirements can be decreased, saving energy.



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The best tip for minimizing energy consumption is to orient the home facing south (in the Northern Hemisphere) to capture solar gain in the winter and block solar gain in the summer, as shown in this plan for an



## off-grid home in Nova Scotia by Solterre Design.



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### **Building Envelope**

Remember the last time you were wrapped up in a wool blanket? It was just a simple layer between you and the ambient temperature of the room,

but it worked to keep you warm. The building envelope acts in much the same way a blanket does. Depending on the insulation and system used, the building envelope helps to keep the interior temperature at the level you desire. And it works whether you want the house to be warm on a cold winter night or cool on hot summer day. If there are holes in your wool blanket, the outside air will easily travel in. The larger the blanket, the more work it has to do maintaining the temperature differentials. Keep this in mind when you want to conserve energy.

According to Stephanie Horowitz, architect and managing director at ZeroEnergy Design, “every square foot you don’t build is energy saved. Scrutinizing the program and being creative with space is key. Regardless of size, we make it a goal to design all homes to perform at least 50 percent better than code.”

Although the ZeroEnergy-designed house shown here is not off-grid, it illustrates some of the basic, low-tech solutions that form the foundation of off-grid design.





Photo by ZeroEnergy Design - More modern living room photos

These walls conceal a big reason for this home’s energy efficiency: a combination of spray-foam and rigid-foam insulation; the two work in tandem to eliminate thermal bridging.

“Low-tech solutions such as continuous insulation and air sealing have a big impact on the energy efficiency of a home — especially in cold climates,” says Horowitz. “These systems don’t break. There is no maintenance. And they have been around for a really long time.”

A blower door test during construction can identify potential air leaks and remedy them before construction concludes.



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Earlier we stressed the importance of minimizing west-facing glass to reduce cooling loads. Yet the majority of the time, no site is perfect. What happens if the site has a spectacular west-facing view? It may even be the very reason you wanted to live there in the first place.

Though not off the grid, the home shown here still manages to be energy efficient while framing westerly views with walls of glass; the rest of the building envelope was constructed with a double stud frame and a continuous layer of foam insulation. This, together with a geothermal system and radiant heating, allows the overall home to be extremely energy efficient without sacrificing views.



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Increasing the amount of insulation will lower the loads on your heating and cooling system. For this Colorado home, which is not off the grid but was designed using Passive House methods, the insulation package consists of R-100 for the roof, R-55 for the walls and R-50 for the floor. Thanks to that, the primary spaces can be heated using only a small gas fireplace.



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Home insulation isn't limited to the rigid-foam, batt and spray-foam products found at your local hardware store. Here, straw bales provide the home's insulation. Straw bale R-values have been widely debated; different tests have found that they can range from R-20 to R-50. However, low costs and low environmental impact make it an intriguing option.





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When will you know you have a superefficient building envelope? When the weather outside is beautiful to look at, but you're glad you're inside.

This off-grid Vermont cabin uses a hybrid insulation system to achieve energy efficiency. It has both a closed-cell spray-foam insulation and batt insulation. The home stays airtight and warm in the cold winters with help from a radiant floor heat system.





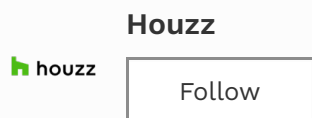
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## Remember the Basics

When beginning a project with the goal of off-grid or energy-efficient living in mind, always rely on building orientation and [passive solar design](#) to do the heavy lifting before leaning on mechanical and electrical systems. Understanding and responding to your site's natural context will greatly influence how much energy your home uses.

Now that you've conquered the basics of siting a building, you're prepared to choose the renewable energy sources that will power your off-grid home.

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