

The Twelve Essential Steps to Net Zero Energy

with Ted Clifton (Pacific Northwest)

1. **Building Orientation.** Ridge-line needs to be east-west oriented, with lots of clear, south-facing area at an appropriate roof angle for the latitude.
2. **Simple Design.** Surface area is your enemy, both in terms of cost, and in terms of conductive heat loss. The closer you can keep your design to a cube, the less surface area you will have. "Dress" the house up with covered porches, and other useful outside living areas that will also provide shade when you need shade, and protection from the rain & wind, without needing to be mechanically heated and cooled.
3. **Window Orientation.** Window sizes and locations much match the needs of the climate zone. Shading of the windows, with overhangs and covered porches, should match the requirements of the climate zone.
4. **Thermal Mass.** There needs to be sufficient thermal mass to absorb and hold excess daytime energy to be released at night, eliminating day-night temperature swings of more than one or two degrees inside the dwelling. Thermal mass should have direct sunlight exposure where possible in heating climates. Thermal mass needs to be entirely within the building envelope!
5. **Tight Envelope.** The building envelope needs to be tight. Ventilation should be by plan, not by accident. Wall cavities must not be allowed to act as filters for pollutants.
6. **Balanced Insulation.** It is not cost-effective to super-insulate one part of a house while ignoring other parts. Windows and doors are typically the weakest link, so it is usually more cost-effective to specify and use the most energy efficient windows and doors available. Match the insulation level for walls, floors, and ceilings to the climate zone. The vapor profile of the various components of the building envelope needs to be consistent with the requirements of the climate zone.
7. **Balanced Ventilation.** Whether fully balanced, or partially balanced, the ventilation system should be designed to use the least amount of energy to operate, with a heat-recovery factor that is appropriate for the climate zone. HRVs do not always pay off.
8. **Heat Pump.** Where not prohibited by climate zone issues, a heat pump should be used as the primary heating system. Other sources, such as natural gas, should only be used as back-up systems, for the most extreme weather. Ground source heat pumps, in-floor radiant systems, and ductless heat pumps are preferred. Heat with heat, cool with air.
9. **Solar Hot Water, or Heat Pump Water Heater.** Where appropriate by climate zone, solar hot water heating, and heat pump water heating should be used. Water storage tanks should be inside the building envelope, unless the home is in a hot climate. Heat pump water heaters are preferred inside the envelope in hot climates.
10. **Efficient Appliances.** Appliances should each be the lowest energy-use of any in their respective categories.
11. **Efficient Lighting.** Most residential lighting should use standard type "A" sockets. CFLs can be used for most applications, high-use locations should use LEDs. Lighting should be focused on surfaces. Excessive use of redundant lighting systems should be avoided.
12. **Alternative Energy.** The last consideration! PV system size should match intended annual loads. Local climate conditions and shading will be a primary determinate. Powering your electric car

https://www.youtube.com/watch?v=SE0_CJKADPk

with your house is feasible in most climate zones, and should be considered for the greatest long-term financial benefit.