Question of the Day

Each weekday, the HowStuffWorks Staff answers questions in the Question of the Day section of HowStuffWorks. The **Question Archive** lets you view hundreds of questions and answers. Click here to ask a question. Here is today's question!

Question

How much ice would I have to store up in the winter in order to air condition my house all summer?

Answer

This is a great question... there's a lot to love about free air conditioning!

It certainly would be an easy system to build. All you need is a big insulated container (probably in the form of a hole in the ground) with some coiled tubes at the bottom. You would run a chilled water circuit from the container to a radiator inside the air conditioner (see How Air Conditioners Work for details). You would need a small pump to pump the water in the chilled water loop, but that's it.

So let's make a couple of assumptions:

* Let's assume that your air conditioner runs for 12 hours a day for three months out of the year.
* Let's assume that your house has a 5-ton air conditioner (60,000 BTU -- British thermal units).
* Let's assume that we can store the snow and ice with 50 percent efficiency. That is, over the course of the summer we will lose half of it to melting, inefficiencies in our system, etc.

To cool the house, you therefore need:

60,000 BTU/hr * 12 hours/day * 90 days = 64,800,000 BTU

Multiplying by our 50 percent efficiency rating, let's call it 130 million BTU.

If you have a gram of ice at 32 degrees Fahrenheit (0 degrees Celsius), it will absorb 80 calories of energy converting from ice to liquid water. There are 252 calories in a BTU. So we need 3.15 grams of water to absorb 1 BTU of heat. The assumption here is that we are going to rely on the phase change from ice to water to power the air conditioner. Once all the ice melts, the water will warm up quickly.

So we need:

130,000,000 BTU * 3.15 grams/BTU = 409,500,000 grams of ice
That's about **410,000 liters of ice**, or 410,000 kilograms (902,000 pounds) of ice that you must store to cool your house all summer. That's a cube measuring 740 centimeters (24.26 feet) on a side. Very roughly speaking, you would have to dig a hole as big as your house and insulate it well, and then in the winter you would have to shovel it full of nearly a million pounds of ice. But if you do that, you can cool your house for free! (The value of the equivalent electricity to cool the house, at 7.5 cents per kilowatt-hour, would be about $1,500.)

(For E82) The given answer to this question is way on the high side. Assume that you maintain your house at 78°F and that the average outside temperature is 90°F. You have to extract 65 million BTU from your house and you'll need twice the ice calculated by the amount of heat rejected to the ice. What is the actual minimum?