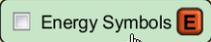
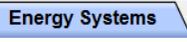
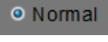


Quick Tips:

- This sim allows students to easily explore macroscopic systems with virtual tools. They can also turn on  to see a representation of energy that allows them to observe the flow and conversion of energy as well as to easily distinguish different types of energy.
- The sim has 2 tabs   to help teachers align activities with many different learning goals. The **Intro** tab has fewer tools and features, and is thus useful for basic concept building.
- The speed of the sim can be varied to help during lab or class discussion. The tools are at the bottom.   .  **Pause** and use  **Step** to see small changes.
- The thermometers can be grabbed and the arrow placed on objects, then the two will stick together. This helps to watch temperature changes.
- On the **Energy Systems** tab, after students design a system, they will sometimes need to do something to start the production of energy, such as turning on the flow of water or heating up the teapot.

**Important modeling notes / simplifications:**

- The goals are to help students develop qualitative “energy stories” with generalized vocabulary. The sim is *not* designed to be used as a comprehensive tool for learning about all forms of energy.
- Energy is represented in discrete amounts and the number of chunks is proportional to amount of energy. The chunks are large enough to provide concept building, but represent a wide range, so quantitative analysis is not appropriate.
- The air energy is not shown because the chunks represent too large of a value to be realistic, however, when it makes sense for energy to go into or out of the air, chunks are shown.



- The tool  will add or remove thermal energy. However, constraints were designed based on student interviews
 - Showing water freezing is too complex for this sim, so energy flowing into the tool stops near the freezing point of water. This can be explained to students by saying that the cooling mechanism is ice, so it can't cool things past the freezing point of water.
 - When the water is at boiling temperature, you can still add thermal energy and steam is shown. The energy going into the water is not enough to significantly change the volume of the water. In other words, the water will never ‘boil off’.
- Energy conversion efficiency is NOT modeled.

Insights into student use / thinking:

- Interviews have shown that students generally explore lots of features and do not need guidance on how to use the sim. Challenging open questions work very well for student engagement with this sim. For example, On the **Energy Systems** tab, a good challenge question might be: “Why don't all combinations light a bulb or heat water?”

Suggestions for sim use:

- For tips on using PhET sims with your students see: [Guidelines for Inquiry Contributions](#) and [Using PhET Sims](#)
- The simulations have been used successfully with homework, lectures, in-class activities, or lab activities. Use them for introduction to concepts, learning new concepts, reinforcement of concepts, as visual aids for interactive demonstrations, or with in-class clicker questions. To read more, see [Teaching Physics using PhET Simulations](#)
- For activities and lesson plans written by the PhET team and other teachers, see: [Teacher Ideas & Activities](#)
- Related sims: [Energy Skate Park: Basics](#), [Generator](#), [States of Matter](#), [Greenhouse Effect](#)