Our project involves creating a scaled two-phase counter flow energy conversion system. The scaled model will use mathematical modeling to extrapolate efficiencies and results to a larger scale model. Having completed most of our math modeling and a bill of materials, we will begin building our scaled model next semester.

The energy conversion system consists of U-shaped piping with a reservoir at the top. Water flows from the reservoir to a Francis turbine at the bottom portion of the U, which powers a generator. After water passes through the turbine, air is injected into the system to create an air/water mixture. Because the mixture has a lower density than the water-filled portion of the pipe, the system is given an effective head, which drives the flow of the water through the turbine. The air/water mixture travels back up to the reservoir, creating a continuously flowing system. Our design is shown in figure 1.

**Application**

Hydroelectric dams use gravitational force via falling water to produce energy. Our project relates closely to the principles used in hydroelectric dams as they both rely on the potential head of water driving flow through a turbine to power a generator. The difference in the principles of our two-phase counter flow energy conversion system and a pumped storage hydroelectric dam is what happens after water flows through the turbine. During times of low energy demands, a pumped storage system uses excess electricity to pump water to a higher reservoir. During peak demands where more power is needed, the water flows from the high reservoir to a lower reservoir to produce additional power. Instead of water being pumped to a higher reservoir, our system would use excess energy to compress air for injection into the riser leg of our design.

**Turbine Description**

Our design utilizes a Francis turbine in conjunction with a power generator to produce energy. Water enters the turbine radially and exits axially. Our Francis turbine CAD model is shown in figure 2, and will be produced via a 3-D printer.

**Purpose**

Analyze the efficiency of a scaled two-phase counter flow energy conversion system with mathematical modeling in order to determine the viability of our system as a peak time shaver. If successful, our model could be used as an eco-friendly energy storage system in areas with limited water and land.