Mechanical Projects:

General project description:

**Solar:** We are developing a model to show the potential output for photovoltaic solar panels as well as solar thermal panels. Hawaii offers an excellent opportunity to harness the sun's powerful rays and every possible place to put panels is being looked into. Utilizing the sun is vital to reducing the amount of energy the development draws from the grid.

**Deep Source Cooling:** We are also developing a system to utilize cold water from deep below the ocean's surface. Cold water would then be used to supplement air conditioning. This system is currently in use at a few locations, Cornell being one of them.

**Waste Gasification:** Could use municipal waste, trash or other solid wastes to produce energy for the development.

Transportation: Study Hawaii's transportation system and design an applicable fleet vehicle system

Goals:

- **Solar:** Show that solar power can potentially offset all of Palamanui's electrical needs and allow the site to be free of the grid.
- **Deep Source Cooling:** Show that a deep source cooling is realistic for the development and could also be used as a revenue stream for the development.

**Strategy:** Trying to optimize all systems to provide an applicable design at minimum cost.

Solar:

**Photovoltaic Solar:** Using PV panels, the development could potentially produce all the electricity needed in the development. Systems comprise of an array of several photovoltaic panels that feed power through a set of charge controllers and inverters that stabilize the electrical output before it is fed into the homes. Many systems allow for the meters to actually run backwards. If no battery banks are used, the system must be connected to the grid to provide uninterrupted power as ample roof space allows for a large net collector area.

- To take fullest advantage of this area, the roofs should be oriented facing south. This is most easily accomplished in the residential areas where the homes are still being designed. Parts of the hotel's roof can be used for collection as well, but will not be as efficient due to the roof lines. Large flat surfaces such as those found on the roofs of the business park offer a chance to produce air conditioning accounts for a majority of the power consumption. To reduce this load, intelligent residential home construction that relies on natural ventilation as opposed to air conditioning could drop the overall load by nearly half.
- Drawbacks are high cost for current panels so government subsidies are helpful for installations. Large orders such as would be found with Palamanui should reduce this cost. Backup systems also add to system cost if the development is to remove itself from the grid.

Solar Thermal:

**Thermal fluid is moved through a solar collector surface that converts the solar heat into useful thermal heat.**

- Heat is generally used for heating needs but also can be used for heating showers, pools, and even hot water for dishwashers and washing machines.
- Supplements energy needed to heat water that would be traditionally found with propane, oil or electric boilers. These fuels are very expensive on the island and an infrastructure would be needed to provide these fuels on a consistent basis. Electric boilers are inefficient compared to these other sources. In addition, because potentially all of the electricity will be derived from the sun, it is inefficient and unnecessary to convert the sun's thermal energy into electricity just to turn it back into thermal energy. Many solar thermal collectors can reach efficiencies of 79%.

Types of systems:

- **Flat Plate** thermal fluid is heated while moving behind solar collector
- **Evacuated Tubes** solar energy is concentrated on tubes within evacuated glass tubes. These are more efficient but more expensive.

**Strategies:** Both photovoltaic as well as solar thermal systems should be seamlessly combined into the design. The systems should be optimized to provide the most useful energy at a minimum cost.

Deep Source Cooling:

**Concept:** Deep source cooling uses a district cooling concept but augments conventional chillers with cold water found at ocean depths. Pipes are run down to depths of over 2000 ft where the water temperature reaches a steady 40°F.

**Benefits:**

- Reduced electricity usage within development
- Possible source of revenue by selling excess cooling to surrounding developments and air port expansion
- Potential to entirely offset half of electrical need=
- **Drawbacks**
- Possible environmental risks associated with discharged water
- **Future Work**
- Determine economics of DSC system

Deep Source Cooling Examples:

- **Cornell**
- **Toronto**

Other Mechanical Projects:

**Waste Gasification:**

- Produces electricity from fuels such as municipal waste, trash, and lawn waste
- Could potentially be a revenue source if the system is used to supplement Hawaii's already overloaded land fills
- Research on waste streams, current systems, and system economics will be included

Transportation:

- A detailed study of transportation in Hawaii will be covered. This includes travel trends and what kind of fleet transportation system could be set up for the development. Alternative means of transportation will also be looked into to see if they are feasible.