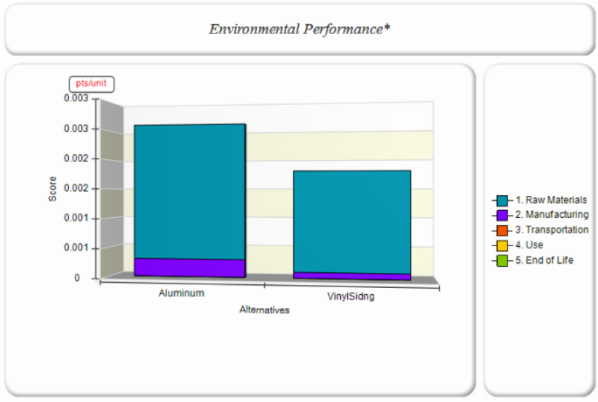
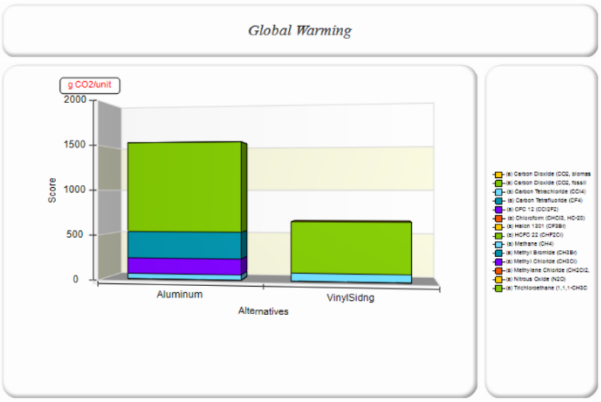
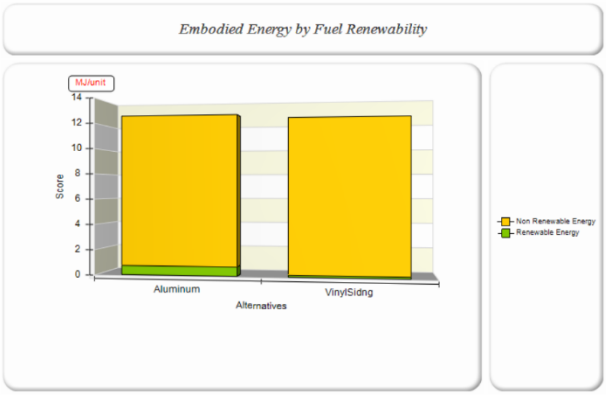
AATOF Engineering
Life Cycle Analysis for Shipping Box Cladding



GRAPH 1: Environmental Performance



GRAPH 2: Global Warming



GRAPH 3: Embodied Energy by Fuel Renewability

GRAPH 4: Economic Performance

Interpretation of results:

As can be seen in the above charts, the vinyl siding presents a much lower environmental impact than does the aluminum, excepting the "Embodied Energy" category, where the two are roughly identical. It is important to recall that in the Building for Environmentally and Economical Sustainability software, the Environmental Performance graph (Graph 1) should be viewed as a penalty score, implying that a lower score, which the vinyl siding has, is better. It can be observed from the results presented in the graph titled Global Warming (Graph 2) Neither option enables much use of renewable energy (Graph 3) and both are raw material intensive products to produce, although the high energy savings obtained from the use of recycled aluminum may serve to provide a different dynamic for this calculation, were this to be taken under consideration. The vinyl is also a cheaper material than the aluminum siding is, so the economic incentive to use the less environmentally impactful material is present as well according to the analysis performed via the BEES software.

While vinyl siding presents a lower total environmental impact than does aluminum siding in the entirety of the BEES assessment provided above, in some areas the differences are more pronounced. Vinyl siding presents a much lower impact on global warming by substantially

reducing the CO2 emissions for comparable quantities of siding material as compared to what is required by aluminum siding. Given that the embedded energy of the two materials is approximately the same, this indicates that the embedded energy of the vinyl siding is due to the polymer makeup of the siding, being derived from oil. Thus, while aluminum siding takes substantially more energy to manufacture than does the vinyl siding, the vinyl siding has a much higher energy content in the material itself. The vast majority of the environmental impact for both materials is due to the raw materials, with the next largest component being from manufacturing. This is due to the extractive nature of producing both the bauxite ore to process into aluminum, and the need for drilling in order to obtain the petroleum to process into vinyl. The future economic costs for both materials are roughly the same; it is in the initial purchase costs where the vinyl siding presents substantial savings when compared to the aluminum siding, which presents substantial benefits to the firm when constructing the shipping container, as the immediate costs are of primary concern in determining affordability.

The steel frame is providing the structure and rigidity of the container, the siding material's ability to resist deformation is of minimal importance. The increased flexibility of the vinyl may contribute to such a package, being of suitable size, performing better in regards to potential puncture or tear resistance. Such a consideration would be of utmost importance were the robots to be shipped via a waterway, especially over the ocean as the effect of seawater on metallic and electronic components would be deleterious. According to the stipulations provided in the assignment document, both materials are suitable, but since vinyl has a smaller environmental impact than does aluminum, in addition to being the cheaper of the two options, AATOF will select vinyl to cover the steel frame used to construct the packing box for the robots, as this is both environmentally and economically more sound than is the aluminum siding.