**Sustainability Project Fund Application**

**Applicant/Project Leader:** Andrew Shapiro

**Contact Information:**

Name: Andrew Shapiro

Email: andrew.shapiro2@mail.mcgill.ca

Daytime Phone: 514-705-3400

**Project Title:** Electric ATV Conversion

**Budget Requested:** $6000

**Project Group:**

Richard Shapiro – [richard.shapiro@mail.mcgill.ca](mailto:richard.shapiro@mail.mcgill.ca)

Carlo Spano – [carlo.spano@mail.mcgill.ca](mailto:carlo.spano@mail.mcgill.ca)

Peter D’Urso – [peter.durso@mail.mcgill.ca](mailto:peter.durso@mail.mcgill.ca)

Context

***The Gault Nature Reserve***

The Gault Nature Reserve in Mont-Saint-Hilaire of McGill University is a private conservation reserve that protects the primeval forests of the St. Lawrence Valley. Its multitude of walking trails throughout the reserve is a year-round tourist attraction, receiving up to a few thousand visitors on a given day. The reserve is divided into two sections: the preservation sector and the public sector. The preservation sector is strictly a refuge for flora and fauna, and is exposed to very little human interactions, while the public sector is where the hiking trails are located. Before the trail entrances is the service area where the various support facilities, such as various workshops, storage facilities and the chalet are found (Gault Nature Reserve). As with many large land attractions and natural reserves, constant maintenance is vital for keeping the grounds pristine. Due to its large size, the daily maintenance on the Gault Reserve is mostly done by ATV’s. These powerful 4-wheel vehicles are capable of transporting one or two passengers, as well as a trailer full of gear around the grounds, including up some of the hiking trails, to carry out the everyday upkeep.

Project Objective

This project is one that was chosen by our team for our final Mechanical Engineering Project; a year-long, 6-credit course that requires the design and build of a functional prototype. The goal of this project is to provide the Gault Nature Reserve with a functioning converted electric ATV that is capable of performing the daily maintenance tasks year round in an environmentally friendly fashion. These tasks entail, but are not limited to, hauling a lawnmower, collecting garbage and moving firewood to various locations on site. These are accomplished by means of trailers at the reserve and so our ATV will require the proper trailer connection. It is required that the ATV can haul at least 200 pounds of cargo in the trailer (excluding the trailer weight). Determination of the power requirements of the ATV will be done using topographical maps or with GIS technology to estimate average daily power consumption as well maximum potential power consumption in order to properly size the batteries and motors that will effectively be able to carry out the demands of the user. The ATV will be charged each night and thus the ultimate goal is for the ATV to be fully functional all day. The client has mentioned that for the ATV to be able to handle two passengers is ideal, but this may not be possible depending on the electrical system arrangement. It is important to note that our team will not in fact be provided with an ATV, but we will have to acquire one on our own. The goal is to select an ATV that will provide us with ample space for batteries and the various electrical components, but that is also not excessively heavy in order to reduce power losses.

Once the power requirements have been calculated, sufficient margin of error will be left, in the sense that we will overpower the vehicle to ensure that it can perform the required tasks. Thus, we guarantee that the user’s demands will be fulfilled. Similar vehicles already exist on the market that are capable of performing such tasks and thus with these comparison models, we are sure ours will perform as desired.

Project Eligibility

The purpose of the electric ATV is to enable the Gault Nature Reserve to perform their daily tasks while at the same time reducing their fossil fuel consumption. With the 200,000 plus visitors that the Gault Nature Reserve attracts annually, the exposure of the public to our eco-friendly ATV will be vast. As more and more people see that electric vehicles can perform just as well as gas-powered vehicles with no harmful emissions, it will motivate others to convert their vehicles as well. Additionally, the fact that this project was done by students will also encourage other students to engage in sustainability projects similar to this project that benefit the environment.

Proposed Milestones

The design process can be broken down into milestones that encompass the entire project from the design to the fabrication. Our project can be broken down into the following milestones:

**Problem Definition**

* Clarify design objectives with the client through face to face meetings and e-mail
* Establish requirements and functions of the vehicle
* Research similar projects and papers to obtain inspiration and ideas
* Create a detailed report in which the requirements and functions will be explicitly stated, and the design objectives will be set

**Concept Generation**

* Brainstorm and research all the key elements such batteries and electric motors, as well as potential options like regenerative braking
* Combine elements and concepts in a morphological chart to generate design alternatives

**Concept Evaluation**

* Analyze and evaluate conceptual designs through the use of a Pugh’s matrix and decision trees
* Select the most favorable design and make a final decision about what elements will be used

**Detailed Design**

* Determine the design layout and the configuration of the components of the selected concept through the use of CAD software and computer analysis
* Perform calculations in order to properly select materials and components
* Provide dimensions and tolerances through the use of detailed drawings

**Design Communication**

* Create a final report to document the complete design
* Include fabrication specifications, complete drawings and parts list
* Justify fabrication specifications and provide a cost analysis

Stakeholders

**Clients**

Martin Duval David Maneli, M.Sc.

Manager, Services & Security University Affairs Coordinator

Gault Natural Reserve of McGill Gault Natural Reserve of McGill

E-mail: martin.duval@mcgill.ca E-mail : david.manelli@mcgill.ca

Ph: 450-467-4010 ext. 236 Ph: 450-467-4010 ext. 229

Martin J. Lechowicz

Director, Gault Nature Reserve

Gault Natural Reserve of McGill

E-mail: martin.lechowicz@mcgill.ca

Ph : 514-398-6456

**Advisor**

Chris Prahacs

Engineer, Project Research Scientist – AQUA Project

McGill University

E-mail: cprahacs@cim.mcgill.ca

Ph: 514-398-8054

The Gault Nature Reserve clients have provided us with all of the necessary constraints and information we need to determine the power requirements and thus build the electric ATV. This includes the usage they require, topographical maps of the grounds and other relevant information. The GNR is willing to supply us with approximately a quarter of the necessary funds to complete this project. Our team will meet with Chris Prahacs on a weekly basis to provide him with updates, and for him to give us feedback and guidance throughout the design and build process.

Project Implementation

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| **Project Milestones** | **2010** | | | | | | | | | | | | | | | | **2011** | | | | | | | | | | | | | | | |
| **September** | | | | **October** | | | | **November** | | | | **December** | | | | **January** | | | | **February** | | | | **March** | | | | **April** | | | |
| **Design Phase** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| Team Commitment Statement |  | 9 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| Preliminary Research |  |  |  |  |  |  |  |  | 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| Problem Statement |  |  |  |  | 7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| Obtain Sponsorship |  |  |  |  |  |  |  |  |  |  |  |  | 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| Concept Generation |  |  |  |  |  |  |  |  | 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| Concept Evaluation |  |  |  |  |  |  |  |  | 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| GIS Testing and Analysis |  |  |  |  |  |  |  |  |  |  | 12 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| Design Report |  |  |  |  |  |  |  |  |  |  |  |  | 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| Detailed Drawings |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 4 |  |  |  |  |  |  |  |  |  |  |  | |
| **Fabrication Phase** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| Acquire ATV |  |  |  |  |  |  |  |  |  |  |  |  | 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| Acquire Electric Systems |  |  |  |  |  |  |  |  |  |  |  |  | 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| Assemble System into ATV |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 31 |  |  |  |  | |
| Testing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 31 |  |  |  |  | |
| Result Analysis and Conclusions |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 31 |  |  |  |  | |
| Working Prototype |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 6 |  |  |  | |
| Oral Presentation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 7 |  |  |  |  |  |  | |
| Prepare Exhibition Presentation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 6 |  |  |  | |
| Final Paper |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 8 |  |  |  | |

Financials

There is absolutely a critical date by which the funding is required. Since this project is a core Mechanical Engineering course in itself, there are assignment deadlines throughout this semester. For example the design evaluation report is due in a couple of weeks. This requires us to have already come up with our design which requires knowledge of which components can be bought and implemented into our design. Thus, we need this funding AS SOON AS POSSIBLE.

**Detailed expenses:**

|  |  |
| --- | --- |
| **Expense Description** | **Estimated Cost** |
| Electrical DC motor(s) | $3700 |
| Electrical motor controller(s) | $1900 |
| 4 to 6 lead-acid batteries | $1400 |
| Various components (i.e. Wiring, relays, switches, etc.) | $1000 |
| ATV Chassis | $2000-3000 |

Maintenance costs and operations costs are to be covered by the Gault Nature Reserve. Our goal as a team is simply to design and build a functional and dependable electric ATV for the reserve. The standard maintenance of the vehicle beyond the delivery date will be out of our hands.

**Detailed revenues:**

|  |  |  |
| --- | --- | --- |
| **Revenue Source** | **Amount Requested** | **Confirmed?** |
| Sustainability Projects Fund | $6000 | No |
| Gault Nature Reserve | $2500 | Yes |

Please note that even though the Gault Nature Reserve will be supplying us with $2500 as opposed to the previously expected $2000, we still require the $6000 from the SFD if we are to obtain a proper ATV chassis.

Additional Information

This project is both an effort to reduce the Gault Nature Reserve’s carbon footprint as well as a required course for all Mechanical Engineers. We are eager to fulfill this goal and hope that the Sustainability Fund Committee approves our funding request.