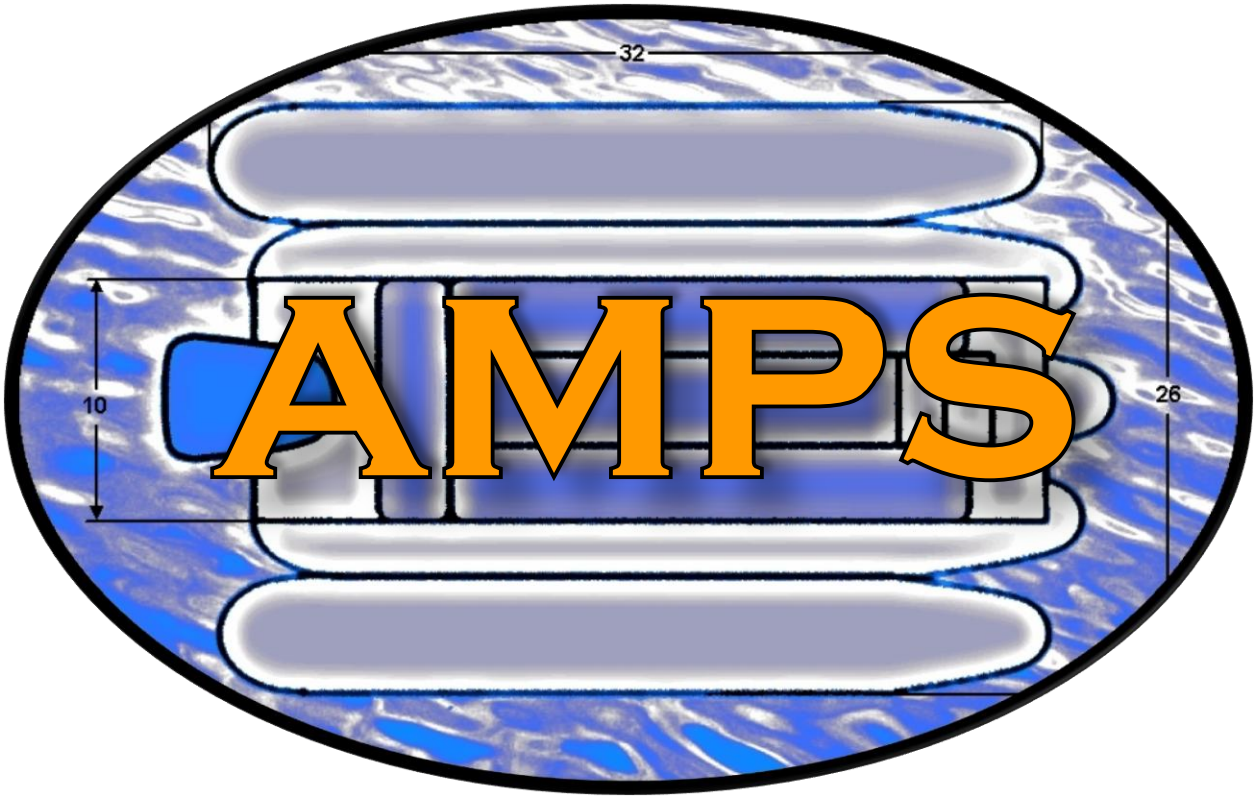
Alternative Motorboat Propulsion System- Glen Canyon



THE UNIVERSITY OF ARIZONA®

January 17, 2009

AMPS Team

Tom Cleary
Clint McGill
Jose E. Cardenas
James Downing

Sponsors

Grand Canyon River Outfitters Association
Colorado River Discovery
University of Arizona

Design Process

- Customer Needs
- Functional Requirements and Constraints
- Preliminary Designs
- Design Deliberation
- Final Design
- Safety
- Budget
- Design Implementation

We Want Change

- No fossil fuels
- More Environmentally Friendly
  - Less Noise
  - Lower Emissions
  - Lower Spill Damage

But We Don't Want Change

- Reliable
- Durable
- Safe to operate
- Get back upstream in 1 hour

Functional Requirements

FR	Importance	Metric	Target
Propel Boat Upstream	5	hours	1 hours
Propel Boat Downstream	4	hours	3 hours
Operate Quietly	3	dBA*	55 dBA

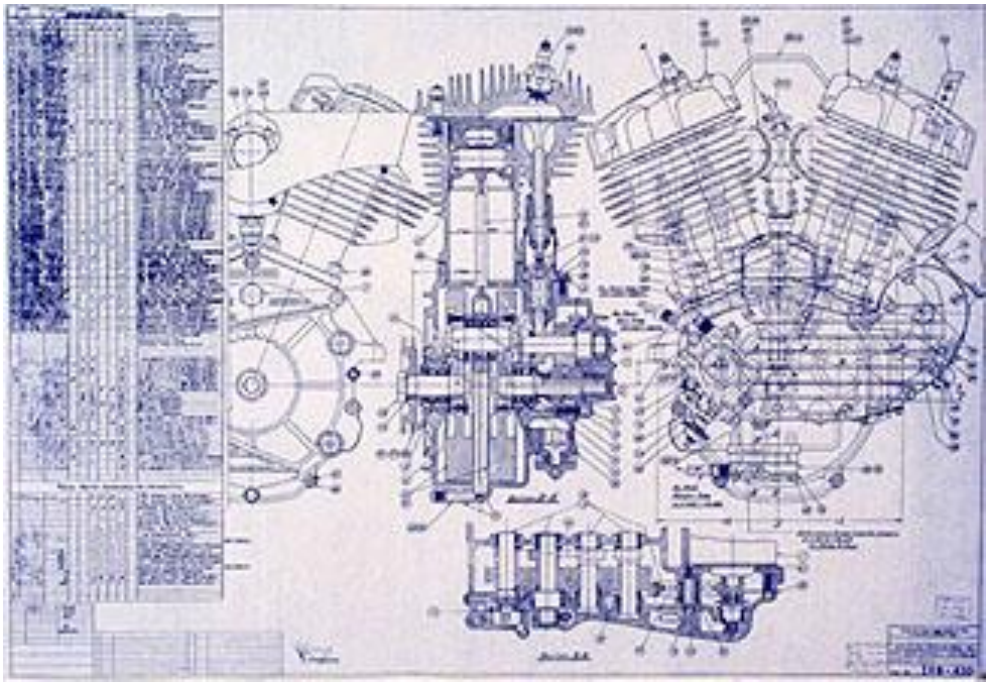
Constraints

- Use no fossil fuels
- Interface with existing rafts
- Maintain reliability and durability

Questions

Design Ideas

- Electric
- Ethanol
- Hybrid



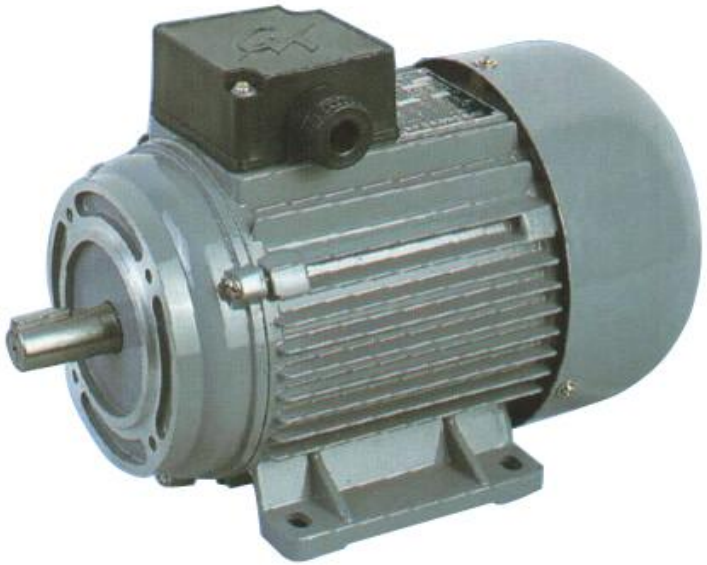
Electric Motor

Pros –

- Silent operation
- Reliable
- High Efficiency

Cons –

- Energy storage
- Weight
- Shock danger near water



Ethanol Engine

Pros –

- Clean running
- Water Soluble
- Comparable Cost

Cons –

- Noisy
- Special Modifications

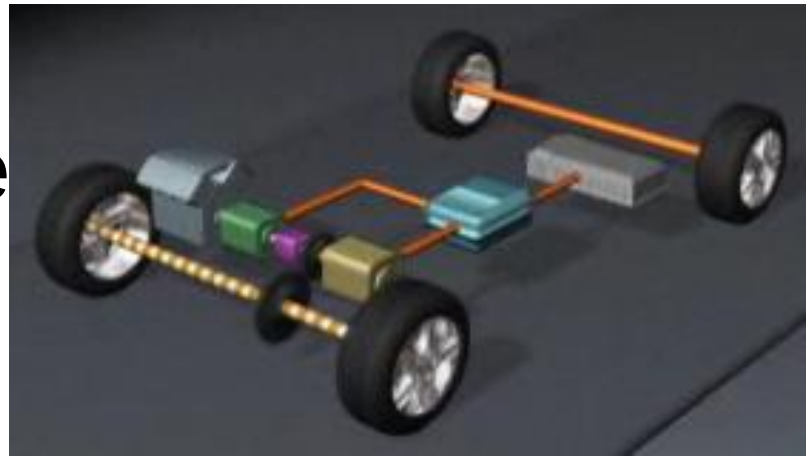
Ethanol-Electric Hybrid

Pros –

- Quieter than engine
- Easier storage
- Less weight issues
- Still clean running

Cons –

- High Complexity



Design Deliberation

Research

Thought experiments

Budget considerations

Design Deliberation

Storage Medium	Energy Density (MJ/kg)	Weight factor vs gasoline	Dollars/W-h
Gasoline	46.4	100.00%	n/a
Ethanol	30	64.66%	n/a
Pb acid Battery	0.146	0.31%	0.17
Li ion Battery	0.46	0.99%	4.27
Li thionyl chloride Battery	2	4.31%	1.16

Dual System

Ethanol/Electric Hybrid

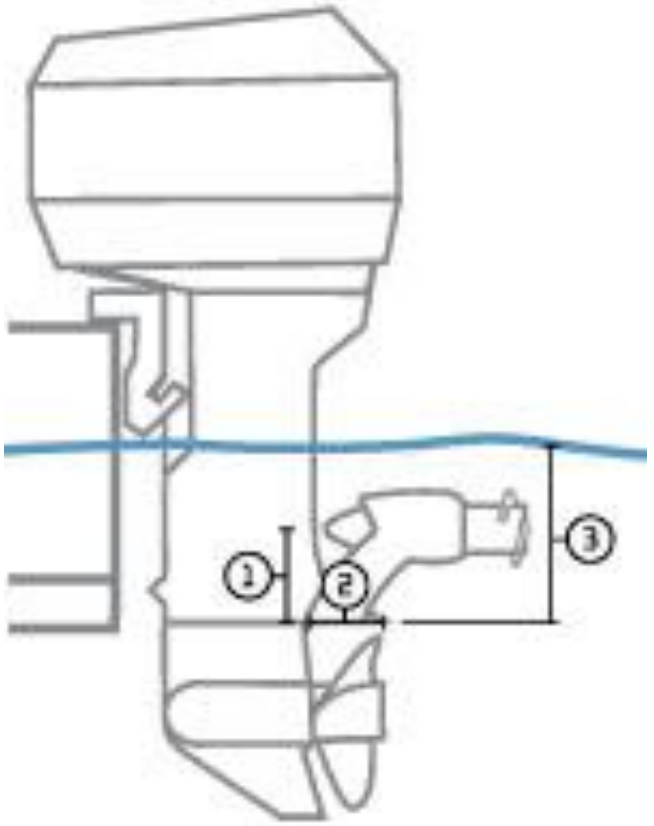
TRIZ

Switch

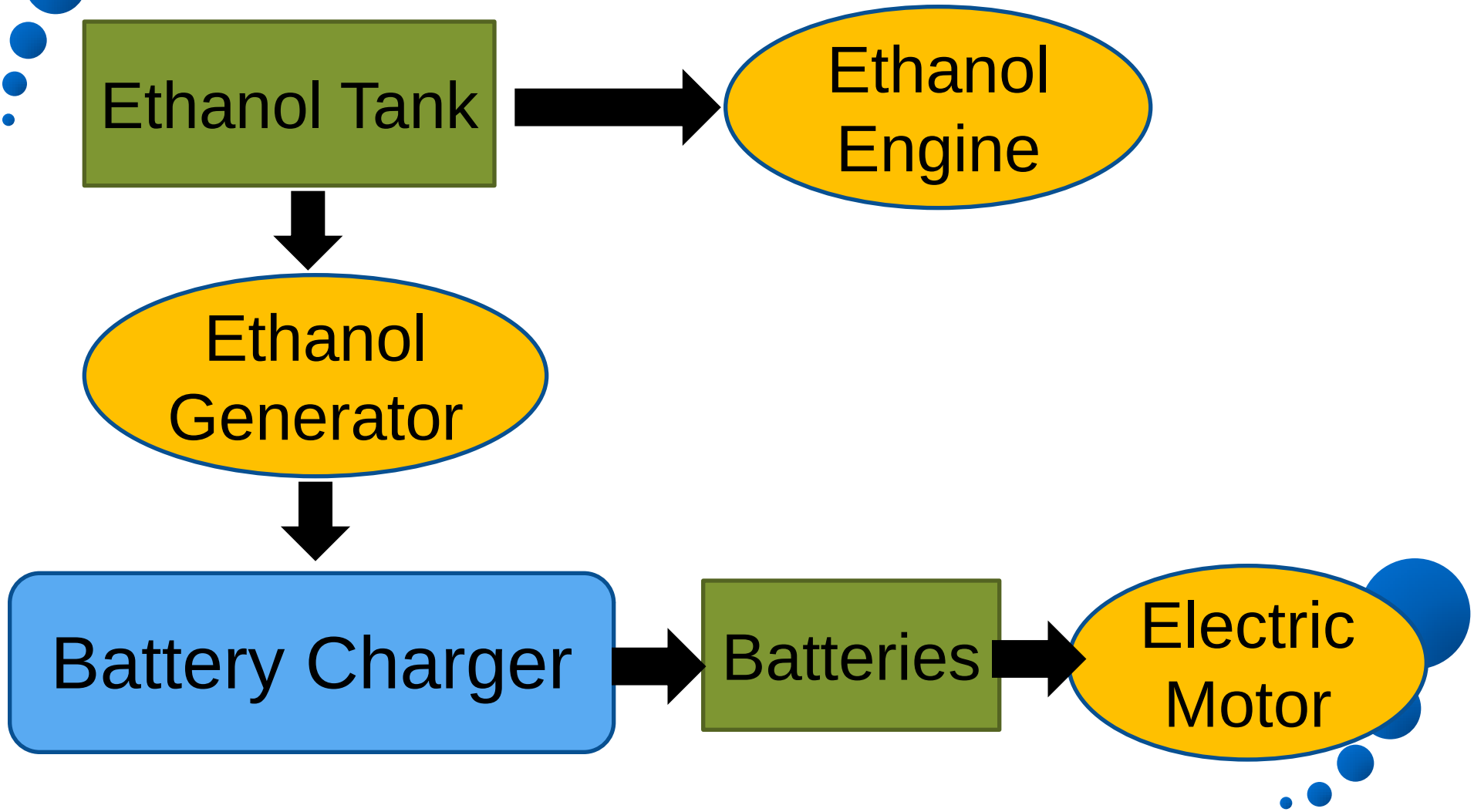
Ethanol

Electric

Generator



System Overview



Ethanol

- More eco-friendly
- Slightly less power than gasoline

Ethanol Tank

- 6 gallon tank
- Supplies generator and ethanol engine

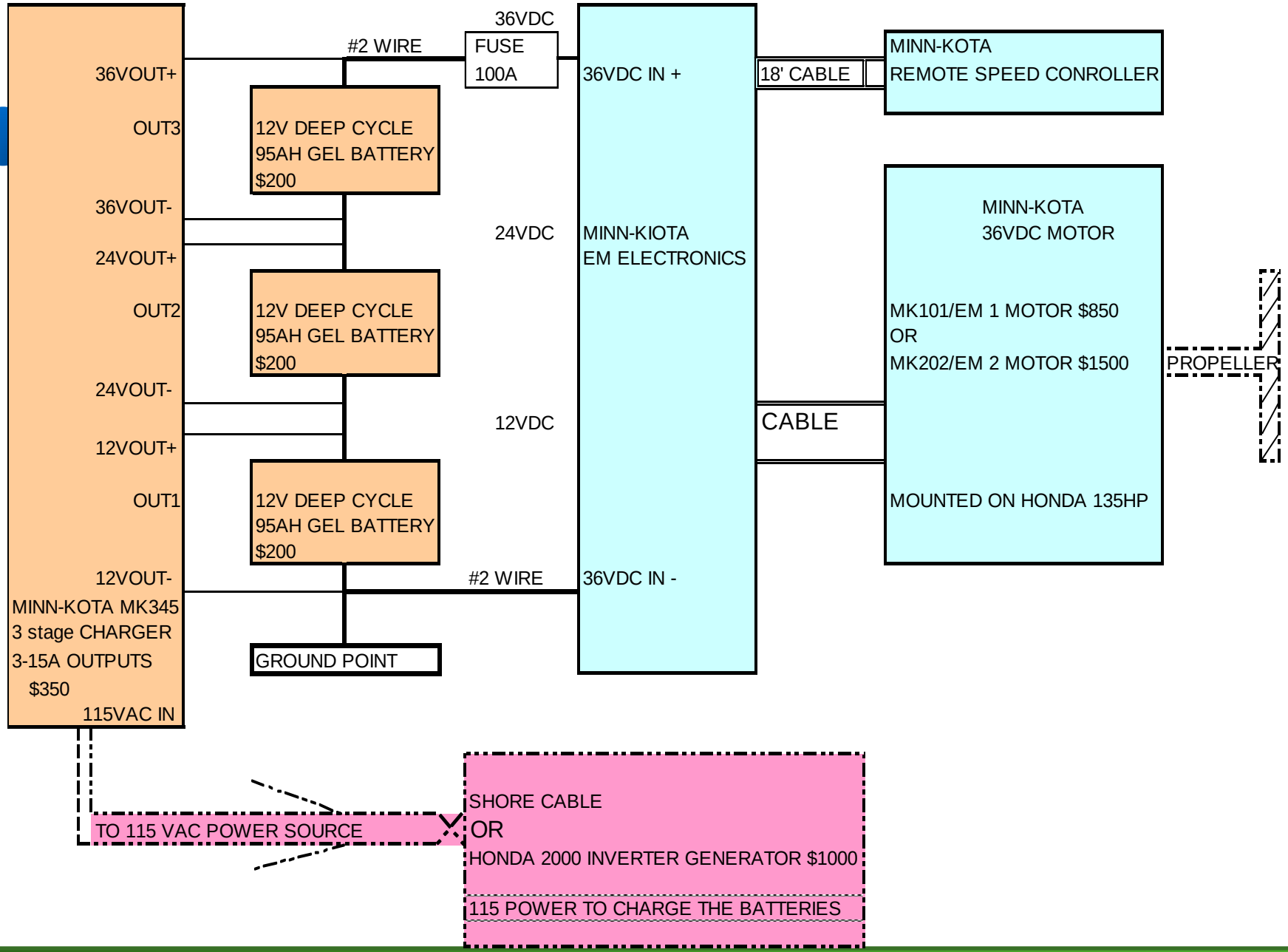
Ethanol Engine

- Upstream Use
- Honda 135 Hp converted to ethanol
- 80% power of gas

Ethanol Generator

- Downstream Use
- Quiet
- 2500 W AC

GLENN CANYON ALTERNATE PROPULTION ELECTRONICS.



Batteries

- Gel cell deep cycle
- Each battery provides 15A
- Current is reduced in three steps to prevent overcharging of the batteries

Battery Charger

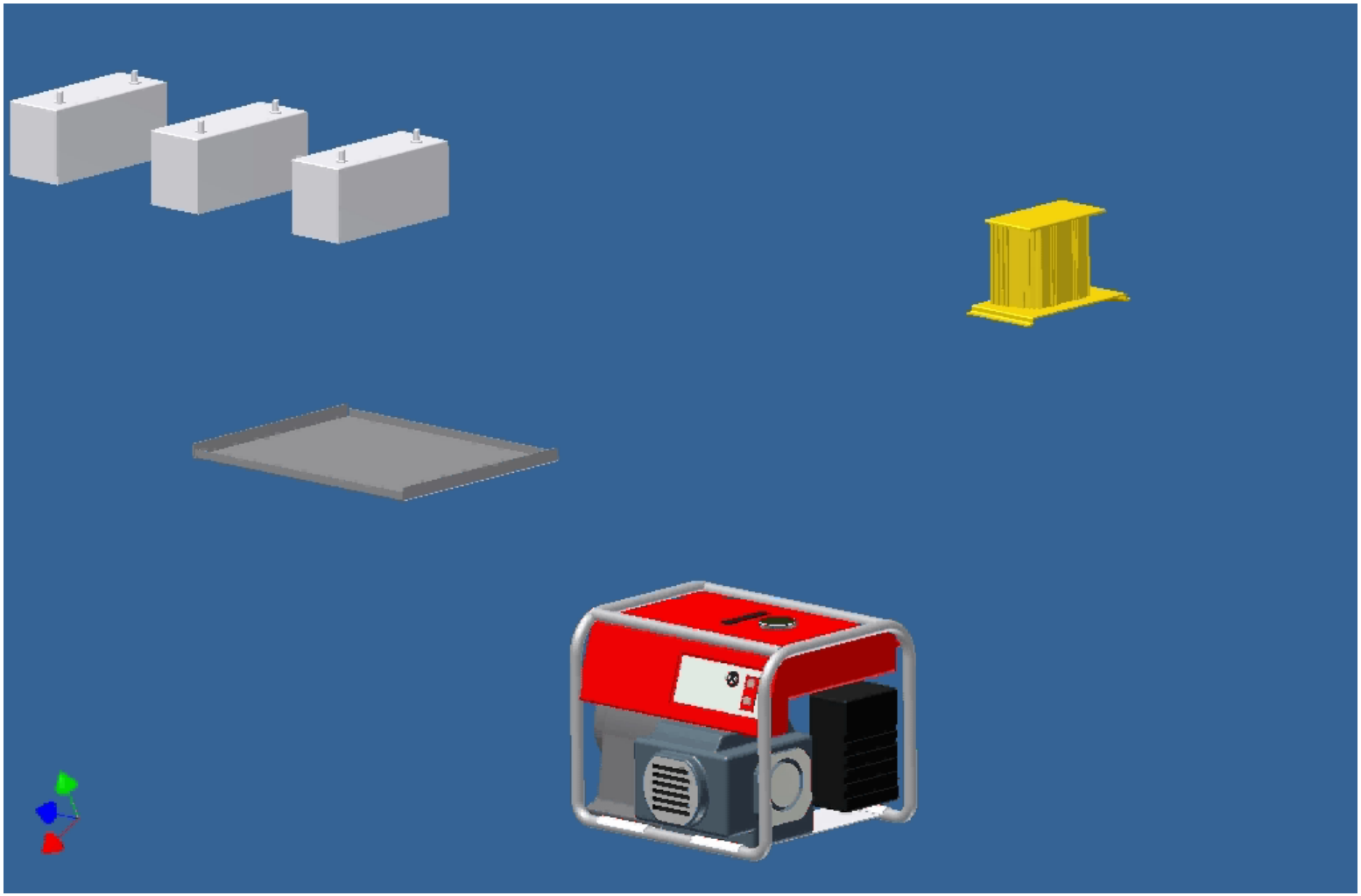
- Powered by a 115VAC generator
- Connected from generator
- Charge time estimated to be 4-6 hours
- Three - stage charger (bulk, absorption and maintenance)

Electric Motor

- Minn-Kota electric motor
- Mounts on the ethanol engine prop
- 36VDC motor
- Sealed against water

Questions

Design Layout



Failure Mechanism Analysis

Item	Function	Potential Failure Mode	Potential Cause	Effect	Current Control
Batteries	Power electric motor	Run out of power to electric motor	Not enough batteries	Drop in power, total loss of power	Supplement with generator to charge batteries
Electric motor	Provide power to propeller	Break electric motor	Burn out, crack on rock	Motor stops working	Very hard to do with location - if does happen, use main motor
Electrical connections	Connect batteries, generator, and electric motor	Electric short	Water in system	Electrical system stops working, potential injury	Insulate electrical system
Propeller	Convert mechanical power to thrust for boat	Broken propeller	Hit a rock	Drop in power	Swappable propeller parts
Outboard motor	Provide large power to propeller	Main motor breaks	Hit a big rock	Loss of upstream travel	Swap boats

Safety

- Sealed electrical connections
- No exposed moving parts
- No harmful chemicals left unsealed/ unprotected (battery acid, fuel, etc)
- Gel Cell batteries
- All components secured
- Flame retardant box
- No spill fuel connections

Bill of Materials

Material	Quantity	Price ($)
Electric Motor	1	1500
Charger	1	350
Batteries	3	350
Generator	1	2000
Conversion Kit	2	300
Sound Box	1	200
Miscellaneous		400
Total		$5750

Conclusion

Customer wants:

- Eco-friendly system
- Reliability

Solution:

- Ethanol and Electric system
- Redundancy

Questions