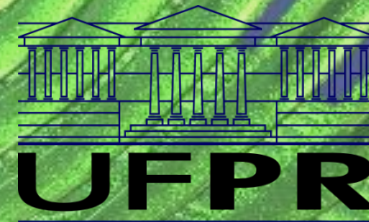




International Team 11

Design and Development of a Gas Coupling Unit for Trigeneration and Algae Photobioreactor Systems





International Team 11

Team Members:

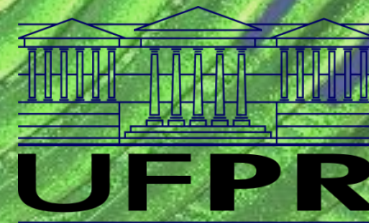
Richard Carter

Felipe Meress

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Scope Revisited

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- Use CO₂ for photosynthesis in Photobioreactor.
- Sequester CO₂ from the exhaust stream.
- Couple exhaust with Photobioreactor via a scalable system.
- Perform Life Cycle Analysis on American system.



Why???

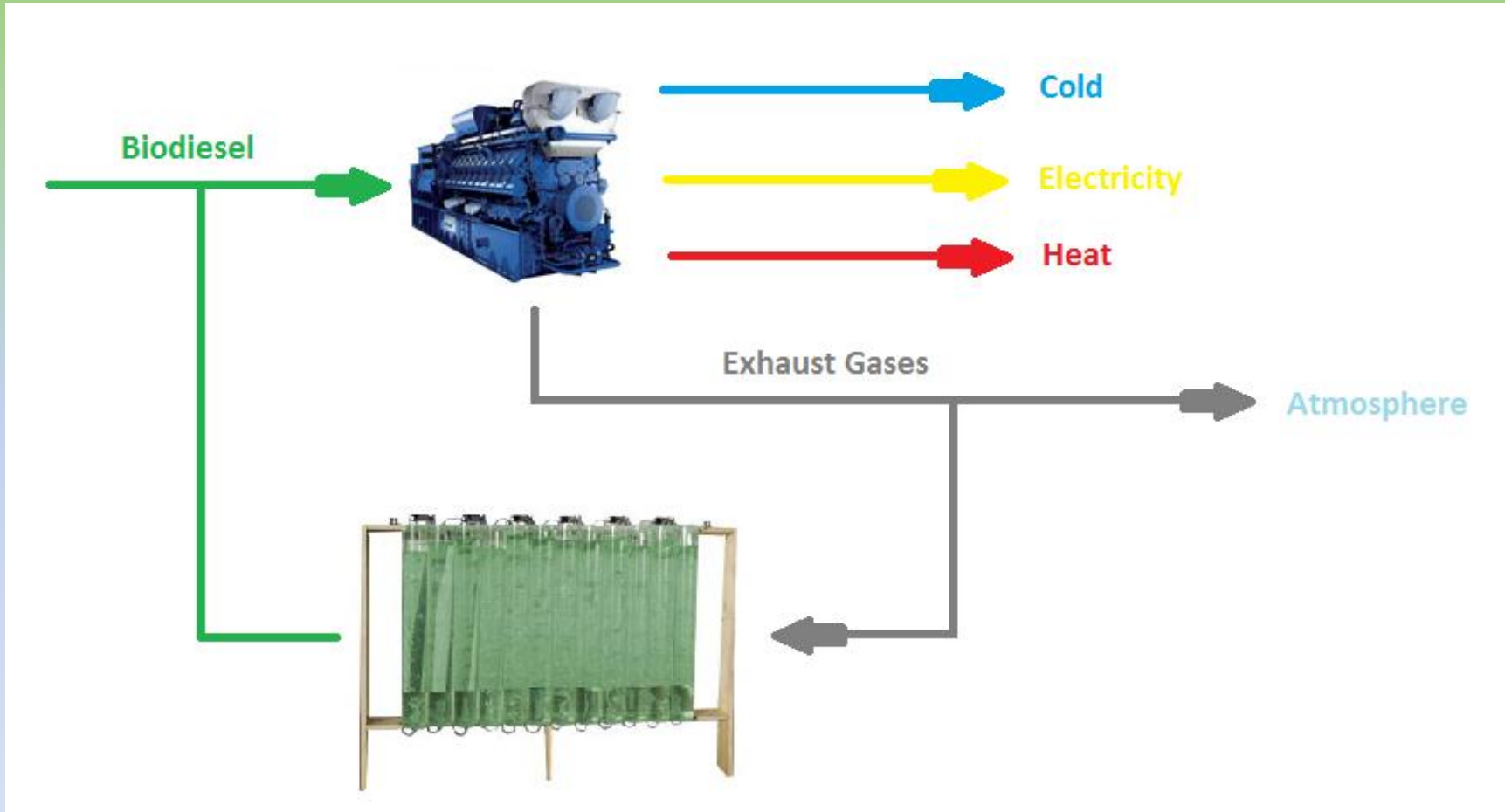


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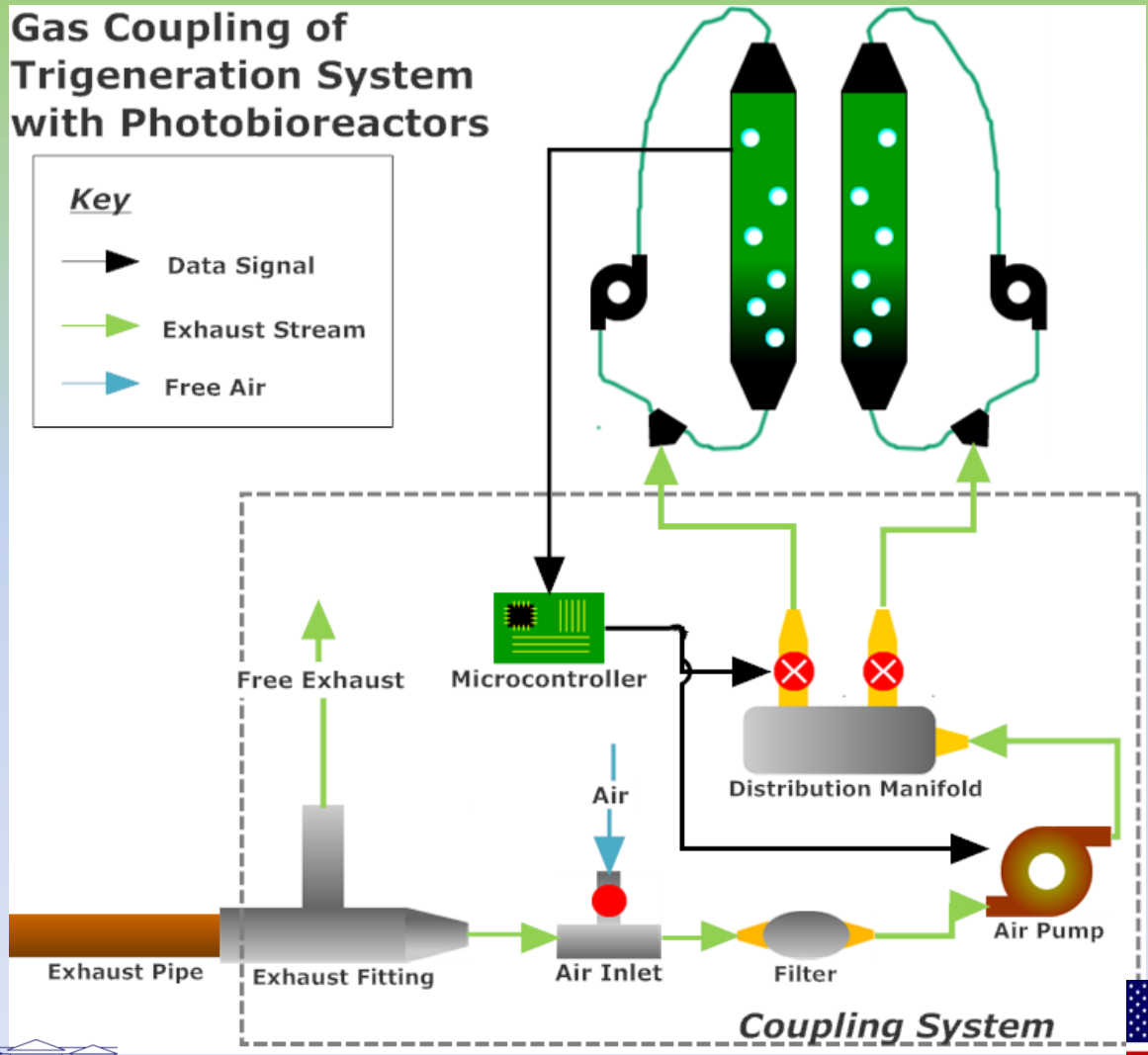
- Consume the CO₂ produced during the combustion;
- Use the exhausts gases to increase the algae growth;
- May produce Biodiesel by the algae fat;
- Sustainability;



What is the idea?



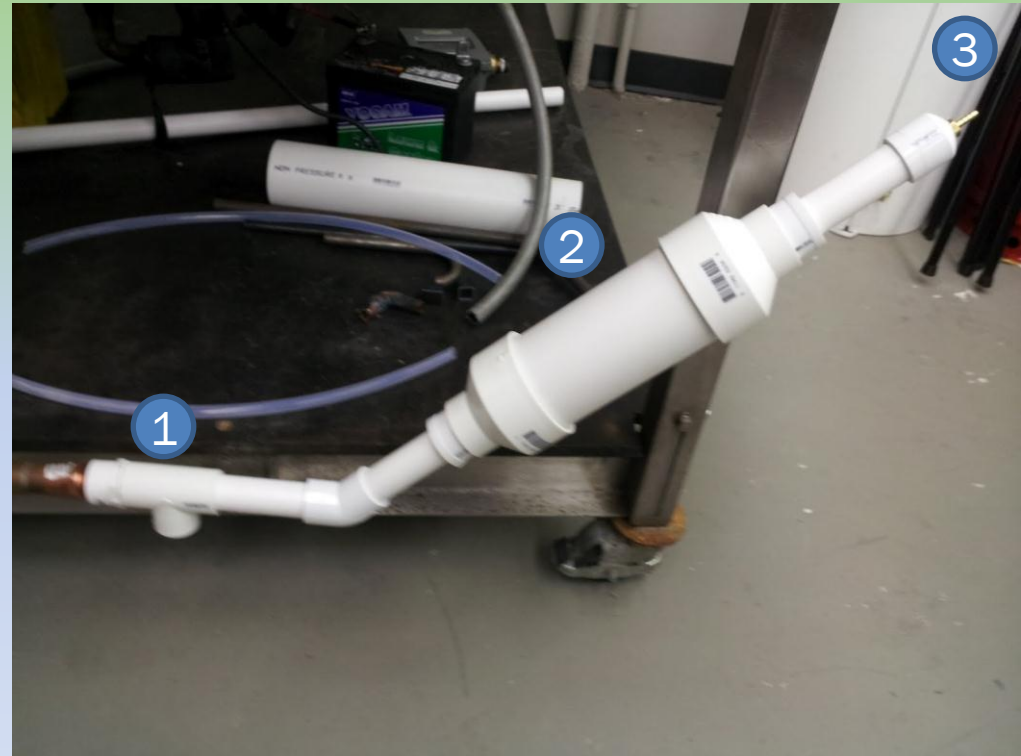
System Coupling



System Coupling

■ The first downstream part of the coupling device is shown

1. Condensate/excess gas outlet
2. Particulate filter
3. Hose barb leads to air pump



Life Cycle Analysis

- LCA will be carried out on:
 - FSU's Photobioreactor array.
 - FSU's Trigeneration system.
 - Coupling System.

- LCA performed last semester on UFPR's large photobioreactor yielded:
 - Environmental impacts due to materials used in production.
 - Viability of structure design.
 - Land use necessary to meet standard biodiesel production.



What has been completed since the last presentation

- Refrigerator has been attached to the trigenerator using new installed piping.
- pH sensors were checked. Three pH sensors were not used properly during the last senior design project, therefore all pH sensors must be replaced.
- Exhaust gas temperature was checked (Infrared Temperature Sensor and Thermocouples). Steady state: 39-40° C.
- Air pumps and diffusers received.
- Coupling system parts were purchased and cut to size; the coupling system framework was assembled.



What has been completed since the last presentation

- All components have been ordered.
- Yet to receive some components:
 - Water pump
 - pH sensors
 - Solenoids
- New algae supplier selected due to ordering problems
 - New Supplier- Carolina Biological Supply Company
- Back-up Algae cultures have been inoculated
 - *Chlorella vulgaris* and *Scenedesmus*
- Website updated
 - New content, photos, minor fixes



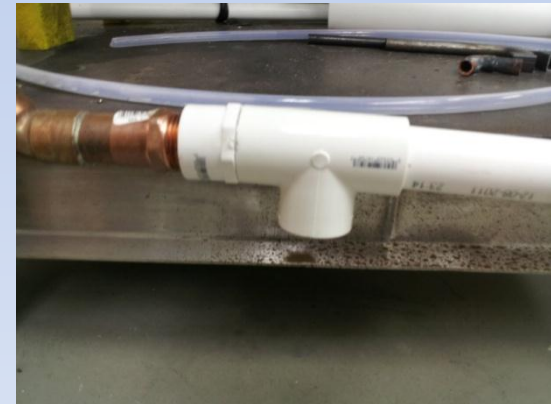
Potential Problems, Solutions

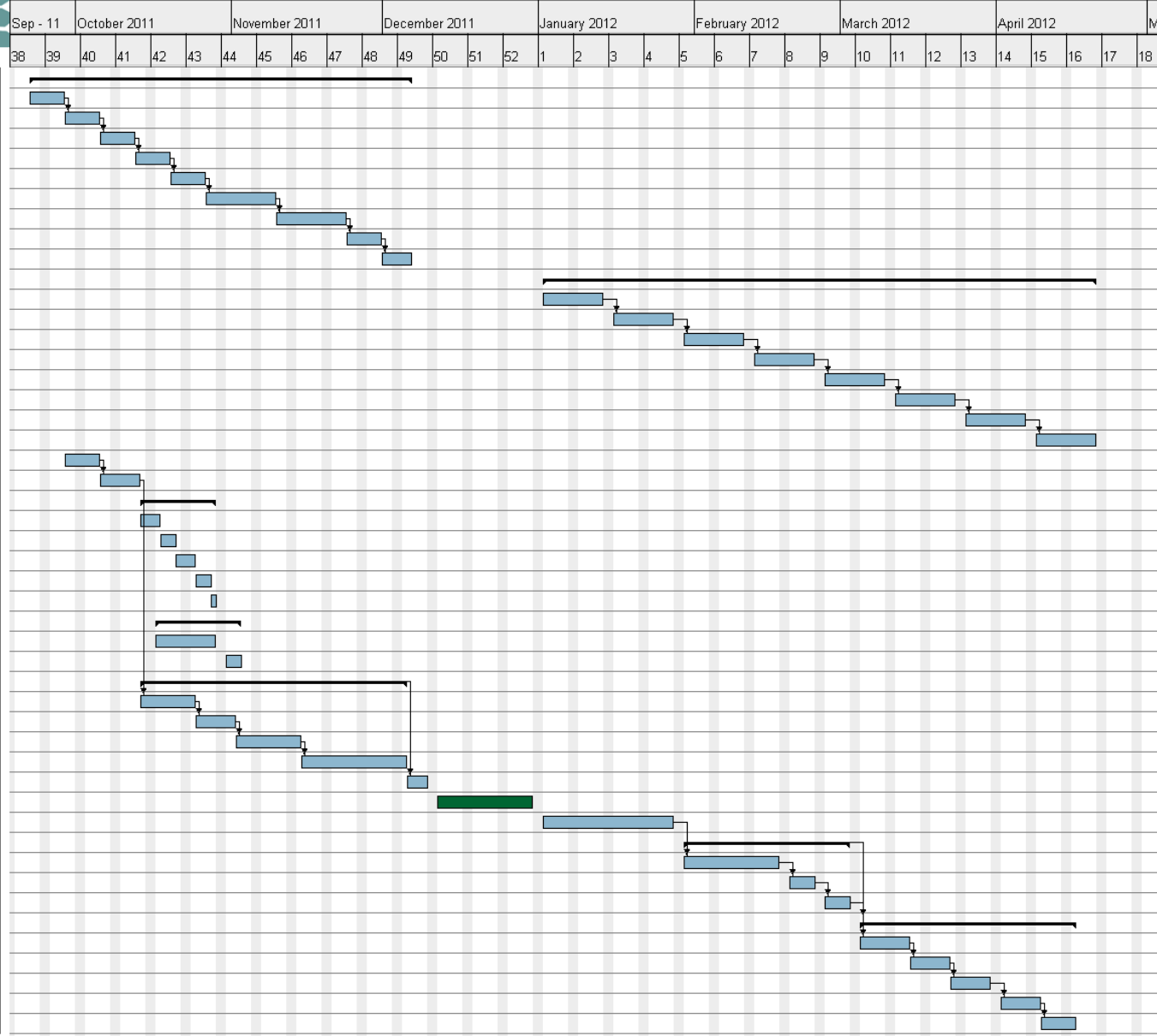
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- Unwanted/harmful chemicals in exhaust stream
 - Nitrous oxides (NO_x)
 - Algae will consume, not threatening to parts
 - Unburnt hydrocarbons (C_xH_y)
 - Harmful to air pump and algae
 - Some will condense in H/X and be expelled upstream
 - Sulfur dioxide (SO_2)
 - Can form sulfuric acid in water with catalyst NO_2 , potentially lethal to algae
 - Water vapor (H_2O)
 - Harmful to air pump, most will condense and be expelled upstream
- Catalytic converter will not be effective on our system

Possible solution: filter the exhaust stream through plain water upstream of photobioreactor

Hydrocarbons and water will condense and drain at this outlet





Item	Quantity	Price	Total
Hiblow USA GP 40 Linear Air Pump 40 lpm @ 1.7 psi, 4 psi max.	2	\$101.38	\$202.76
Shurflo Water Pump	1	\$70.00	\$70.00
Aquamedic Photobioreactors	2	\$80.00	\$160.00
Neptune Systems Order (PM1, pH probes x4, temp probe)	-	\$284.67 +\$40.00sh	\$324.67
UTEX Algae agar culture	2	\$30.00+ \$10.00sh	\$80.00
Carolina Biological Supply Co. Algae Cultures	2	\$7 + \$10 +\$17 +\$16	\$50.00
Biodiesel Supply Store & Chemicals Stainless Steel ¼" Solenoid, AC	2	\$50.33	\$100.66
Polyester Air Filter Media Pads Package of 6 - 2" thick pads	1	\$10.85	\$10.85
PVC Pipe, barbs & fittings	-	\$40.00	\$40.00
Inline Diffusers	4	\$32.99	\$131.96
		TOTAL:	\$1,170.90



Next Tasks

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- Inoculate new algae cultures
- Analyze exhaust stream, measure %CO₂
- Calibrate pH sensors upon arrival
- Set up controllers
- Finish assembly of coupling system
- Mount other Photobioreactor and prepare for inoculation



QUESTIONS ???

