Spring 2010

IPRO It takes a team!
INTERPROFESSIONAL PROJECTS PROGRAM

EnPRO 354

[PROJECT PLAN]

Small-Scale Desalination for Global Solutions

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I. Introduction

Freshwater is one of Earth's most precious resources and is now increasing in scarcity. Global warming induced climate change is now changing rain patterns and causing record drought, growing global populations are increasing demand, and the individual demand per person is increasing and human populations urbanize and adopt modern plumbing. The biggest contributor to increasing demand for water is mismanagement and pollution. However for this project we will be focusing on water quantity rather than quality.

The areas of the world most immediately affected by this are in the poor and underdeveloped nations. However in time, India, China, and other developing or wealthy nations that are already struggling to meet their water needs will see demand far outstrip their supply. The following is a list of examples: the African continent, both North Africa and sub-Saharan, is experiencing water crises right now; many African nations like Algeria will double their population by 2025 and southern Africa is largely agricultural and is considered the bread basket of the continent; in Syria, there are currently 800,000 water refugees; throughout much of South America, freshwater comes from melting snow and glaciers that runs down from the mountains; due to climate change, the ice and snow are now melting faster than it can be replenished. Closer to home, countries like Mexico, Cuba, and Haiti are struggling to provide clean water to their citizens.

This brings us to the focus of this project. EnPRO 354 is tasked to develop a business plan for a small-scale desalination unit that can be a solution to this growing global crisis. Because of the earthquake in Haiti, we have decided to use that country as our context for the design. We believe that if we design a viable, cost-effective, and sustainable desalination unit that can meet the needs of the communities in Haiti, it will ready for use throughout the rest of the world and will serve as an example for the rest of the world.

II. Team Charter

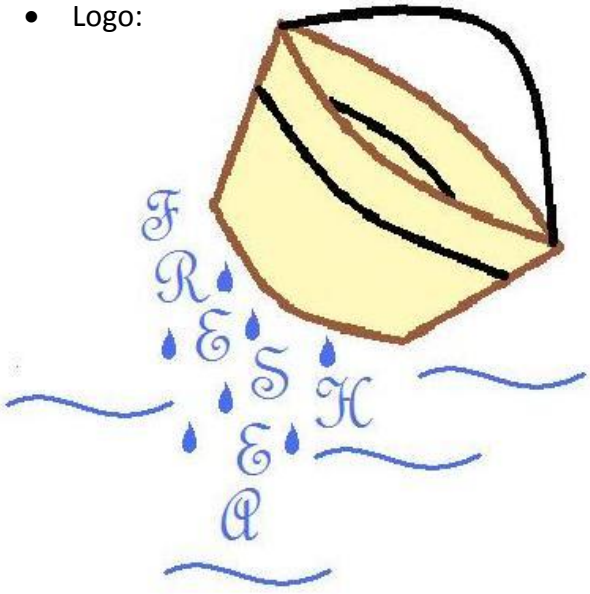
1. Team Information

Our team roster, detailed with academic year, major, minor, contact information, our expectations for the semester and the IPRO program along with individual strength and weaknesses.

Name	Year/Major	Contact Info	Strengths	Weaknesses	Expectations
Paul Adamczyk	3rd Year Chemical Engineering	padamcz1@iit.edu [redacted]	Very organized, timely, good time management; efficient w/Excel/Word	Lack confidence in presenting skills; minimal business/marketing knowledge	Become well-versed in desalination technology and need. Learn about business planning
Bonnie Au	3rd Year Biomedical Engineering	bau@iit.edu [redacted]	Creativity, teamwork skills, some leadership skills	Problem solving skills	Attract interested philanthropists to accept our business plan
Brent Bijonowski	3rd Year Chemical Engineering	bbijonow@iit.edu [redacted]	Computer programming	Tend to overload myself with work and writing	Learn how to write business plans, and how to market an item
Daniel Fanelli	4th Year Business Administration	dfanelli@iit.edu [redacted]	Good writing skills, familiar with Word, Excel, Google SketchUp	Time management, accounting, and science	Not building a prototype but to lay foundation for future EnPROs
Edlira Hoxha	3rd Year Business Administration	ehoxha@iit.edu [redacted]	Teamwork skills, deliver work on time, leadership skills	Not completely fluent in English; Don't have experience in presentations	Improve presentation skills, to obtain research skills, and creation of an impressive business plan
Monika Krauszowska	3rd Year Biochemistry	mkrauszo@iit.edu [redacted]	Bilingual, strong background in biology and chemistry	Lack creativity	Learn how to work in a large group to solve a problem
Nga Pham	3rd Year Biology	npham1@iit.edu [redacted]	Organizing information and setting them up for presentation, timeliness	Not very confident with writing complicated documents or presenting ideas	Learn teamwork qualities; learn how to organize and manage a team project
Aamir Rauf	3rd Year Mechanical Engineering, Business Minor	arauf@iit.edu [redacted]	Creative, team player, good problem solving skills	Tend to overload myself	To improve my skills as a team player and better understand the designing and marketing aspect of a product
Hannah Schlessinger	3rd Year Civil Engineering	hschless@iit.edu [redacted]	Good at communication, organized, precise. Physics, math and engineering background. Proficient on Microsoft Office Suite (especially Excel)	Lack experience in sales and marketing	Improve team working skills and better understand the process of researching, designing and marketing a product
Brian Wolber	4th year Business Admin and INTM	bwolber@iit.edu [redacted]	Classroom entrepreneurship experience; previous IPRO experience; have written 3 business plans	Public speaking	Improve project management skills via being active team leader; create working product and business plan

2. Identity

- Name: FreshSea
- Motto: *"Taking the salt out of water, one shaker at a time"*
- Logo:



3. Purpose and Objectives

Freshwater supplies worldwide are diminishing as population and consumption increases, pollution rises, and global warming, along with its effects on climate change, progresses. The purpose of this EnPRO is creating a business plan addressing this issue and a solution to it.

The mission of EnPRO 354 is to come up with a cost-effective, compact and sustainable unit to deliver freshwater to communities from a salinated source. Our vision is that the small-scale desalinating stations will be examples for the rest of the world and be used globally.

- Our objectives are to…
  - Identify the problem
  - Decide on a target market
  - Decide on the scale of the project
  - Create a budget
  - Determine what desalination technology we're going to use
  - Choose an energy source to power the technology
  - Design a viable device and provide evidence of that viability
  - Identify potential funding sources
  - Create a business plan around this technology and the need it addresses.
  - Win 1st place in our IPRO track.

III. Background

A. The purpose for our team project is to provide potable drinking water to underdeveloped countries that do not have access to fresh water. Our main concern right now is Haiti, a country that has recently been hit with a massive earthquake that has leveled its capital city. Even before this natural disaster, Haiti was one of the poorest and least developed countries in the western hemisphere, with four out of five people living in poverty. We believe that if a working prototype was developed, Haiti would provide a good testing ground. From there, the *FreshSea* desalination unit could be expanded to sub-Sahara Africa.

B. One of the most prominent problems facing EnPRO 354 is how the desalination technology will be powered. Since much of the country is surrounded by a body of water, a hydraulically powered machine could be a viable option. However, since the climate seems to be very volatile in the area, problems will arise with only one type of technology. There are two rainy seasons, one in spring to early summer and another October-November. Because of severe deforestation, Haiti suffers from periodic droughts and floods. Tropical storms are also common. Any technology that we end up using for this project will need some sort of maintenance, be it maintenance of semi-permeable membranes in reverse osmosis or making sure that the multi-stage flash desalinator is in working order.

C. Several novel desalination technologies have gained widespread acceptance for their abilities to effectively desalinate water. Some are deemed better than others based on certain characteristics, but the bottom line is that a certain technology and specific method are chosen because of circumstance. Desalination technologies fall into two major categories that describe the basic process of how water is desalinated. The first is thermal technology, in which thermal energy (heat) is used to evaporate water to a purer form, which is immediately followed by condensation. Specific methods that use this technology are multi-stage flash distillation, multi-effect evaporation, vapor compression distillation, solar distillation, and geothermal distillation. The other major category is membrane technology that uses selective membranes to filter water to a

purer state. Some methods that place themselves in this category include reverse osmosis, nanofiltration, electrodialysis, electrodialysis reversal, and forward osmosis.

D. Utility sized desalination facilities have shown to have frequent issues. One example is in Tampa Bay, Florida—a location that is only running into more and more problems due to drought. The desalination plant there has come in over the budget and opened six years later than scheduled. Due to failing several performance tests and the last firm taking ownership of the plant, Tampa Bay Water, have gone bankrupt. This plant also had to be shut down on multiple occasions because of malfunctions. There were problems with the plant's pretreatment process, filters and membranes. Although some desalination plants have fallen short of their expectations, there have been plants in other places around the world that have successfully incorporated seawater desalination into their communities. For example, the city of Perth in Australia has been using a reverse osmosis desalination plant successfully since 2006 and there is talk of building a second plant. This city has been using renewable energy from the Emu Downs wind farm that even though it adds up to the operating costs of the plant has become widely accepted by the community because water supply is being increased without adding to carbon emissions. Another plant, the Ashkelon seawater reverse osmosis plant based in Israel, has also achieved great success. It is the largest desalination plant in the world, delivering 330,000 m^3 of water a day and produces about 13% of the country's consumer demand at the lowest price for desalinated water. "The plant's output increased gradually over years since its inception. It produced 101 million m^3 in 2006, 104 million m^3 in 2007 and 111 million m^3 in 2008."

E. The desalination process can have several externalities on the surrounding environment and we as a team developing this project have certain responsibilities. The following is some ethical issues that may arise:
    a. Possible harm to marine life
    b. Improper use of somebody else's intellectual property
    c. Abandoning the end-user
    d. Taking advantage of the investors and the end-users,

e. Properly disposing of salt waste product from the desalination process
f. Negatively affecting the local fishing industry

F. The successful application of a desalination process would result in increased fresh water for communities and agriculture. Access to fresh water can reduce disease and increase the productivities of agriculture, thus creating social-value, economic growth, and a higher standard of living.

G. The proposed implementation of the desalination unit depends greatly on our success of creating a viable desalination unit design. Our hope is that the design is completed by the end of the project and that the IPRO office continues our EnPRO to a second semester. From there, the unit can enter a development stage where the team actually makes the prototype. If the design works and desalinates water with the expected results, seek funding to expand the program and move to a real world test area like Haiti or sub-Sahara Africa.

H. A global water shortage is imminent. Nations in dry regions like sub-Saharan Africa are already dealing with a fresh water shortage. The higher demands for water from a growing population combined with increasing temperatures and evaporation of fresh water have led to a decrease in potable water. Many companies have jumped on the opportunity to pioneer water desalination technologies to try to mitigate future problems and help in the regions currently experiencing a water shortage. Currently, solar-powered and hydroelectric reverse osmosis pumps, solar evaporation systems and other technologies exist to meet community and personal needs for desalination. These companies however are building utility sized stations that are sometimes not affordable for poorer and underdeveloped countries.

I. See appendix A and B

IV. Team Values

The following is a list of our expected and ethical behavior that will help lead to the success of EnPRO 354.

1. Deliver your work on time.
2. Show up on time for meetings and actively participating in discussions.
3. Respect your classmates; listen to their ideas/suggestions instead of waiting for your turn to speak.
4. Speak up… When something bothers you talk to either your teammate or team leader.
5. In case of conflict with someone then the one should try to solve the problem directly with the particular person.

Whether it's a personal conflict or a simple disagreement about design, certain steps should be followed or performed to maintain a high productivity and attitude while pursuing this project.

- If you have a problem, speak up. If you don't want to say it publicly, say something to the team leader of your sub-group leader. If that doesn't work, talk to the professor advising this project.
- If you have a difference in opinion regarding how the project should be done and you don't get your way, accept that this is a team effort and sometimes the team will disagree.
- When an issue arises, the team will discuss it and then make their decision by vote or general consensus.
- If the team cannot come to an agreement, then the team leader will have to make final decision.
- When we need to get in contact with a team member, we can do so by email, cell phones, or even instant messaging.

V. Project Methodology

1. Work Breakdown

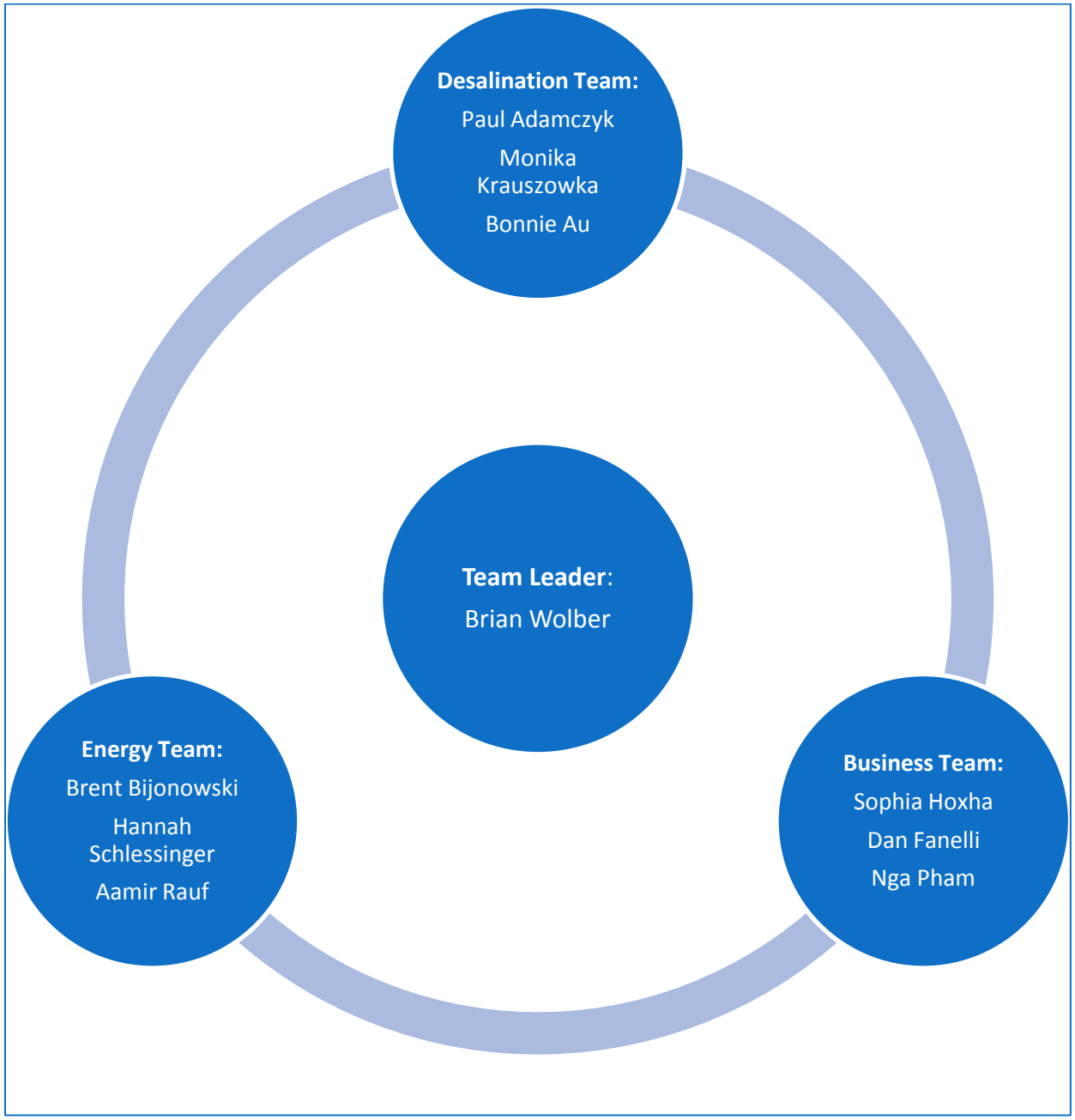
A. EnPRO 354's ultimate product is a business plan addressing a need and the solution it addresses. In this case, a small-scale desalination unit that tackles diminishing water supplies across the globe, especially in the poor underdeveloped countries. We have broken the team down into 3 subgroups: an energy team, desalination team, and business team.

1. The desalination team is tasked with researching desalination technologies and developing a design that can meet the needs of our target market and the scale we decided to focus on. For EnPRO 354, we are aiming at providing freshwater to 2,000 people, roughly 500 families.
2. The energy team is tasked with finding the best source of power to meet the energy needs of our desalination unit. It is preferred that we find a source that is renewable.
3. The business team will be focused on development of the business plan. The business majors in EnPRO 354 have experience in entrepreneurship and the drafting of business plans.
4. The Team Leader is tasked with keeping the *FreshSea* team on schedule and ensuring the successful completion of team goals. The Team Leader will assist the sub-groups in their work and help mediate the collaboration between teams.

B. Team Structure

Instead of a typical top-down hierarchy, we decided that for EnPRO 354 we can better illustrate our structure in a circle. All three teams need to work in together, share information, and act as a single team to produce the best solution to this dire global need.

Faculty Advisor: David J Mogul, PhD



C. Gantt Chart

	12-Jan	19-Jan	26-Jan	2-Feb (Project Plan 2/5)	9-Feb	16-Feb	23-Feb	2-Mar (Midterm Pres 3/3)	9-Mar	16-Mar	23-Mar (Ethics Report 3/26)	30-Mar	6-Apr (FR draft 4/9)	13-Apr (brochure + poster 4/19)	20-Apr (FP pres 4/22)	27-Apr (Final Report 4/30)
DELIVERABLES																
Project Plan																
Midterm Reviews																
Ethics Reflection Report																
Final Report/Business Plan Draft																
Brochure, Poster																
Final Presentation, IPRO Day																
Final Report/Business Plan																
DESAL TECH TEAM																
Research desalination technology																
Determine market population																
Research consumption of market																
Research agriculture in Haiti																
Choose best technology																
Choose desalinating capacity																
Maintenance & operating costs																
Assess disposal options of waste																
Decide optimal installation locale																
Design Desal Unit																
BUSINESS TEAM																
Market Research																
Culture Research																
Financing Research																
Team Description																
Startup Expenses & Capital																
Product Description																
Executive Summary																
Compile Business Plan																
ENERGY TEAM																
Research energy technology																
Determine necessary output																
Research target infrastructure																
Choose energy source																
Determine size of power unit																
Perform Cost Estimation																
Design Power Source for Desal																

2. Expected Results

The ultimate goal of EnPRO 354 is to create a professional business plan that address the world's diminishing supply of freshwater and our solution to it. These are our expected results:

- To have a viable product design that will be ready to move to a prototype production phase, possibly by a follow-up IPRO in the next semester.
- A great business plan that wins over nonprofit organizations, foundations, and other charitable investors.
- To win 1st place in our IPRO track.

As a team of various backgrounds and specialties, we all hope to gain better experience in presentations and public speaking, market research, business plan development, and a better understanding of desalination and renewable energy technologies.

3. Budget

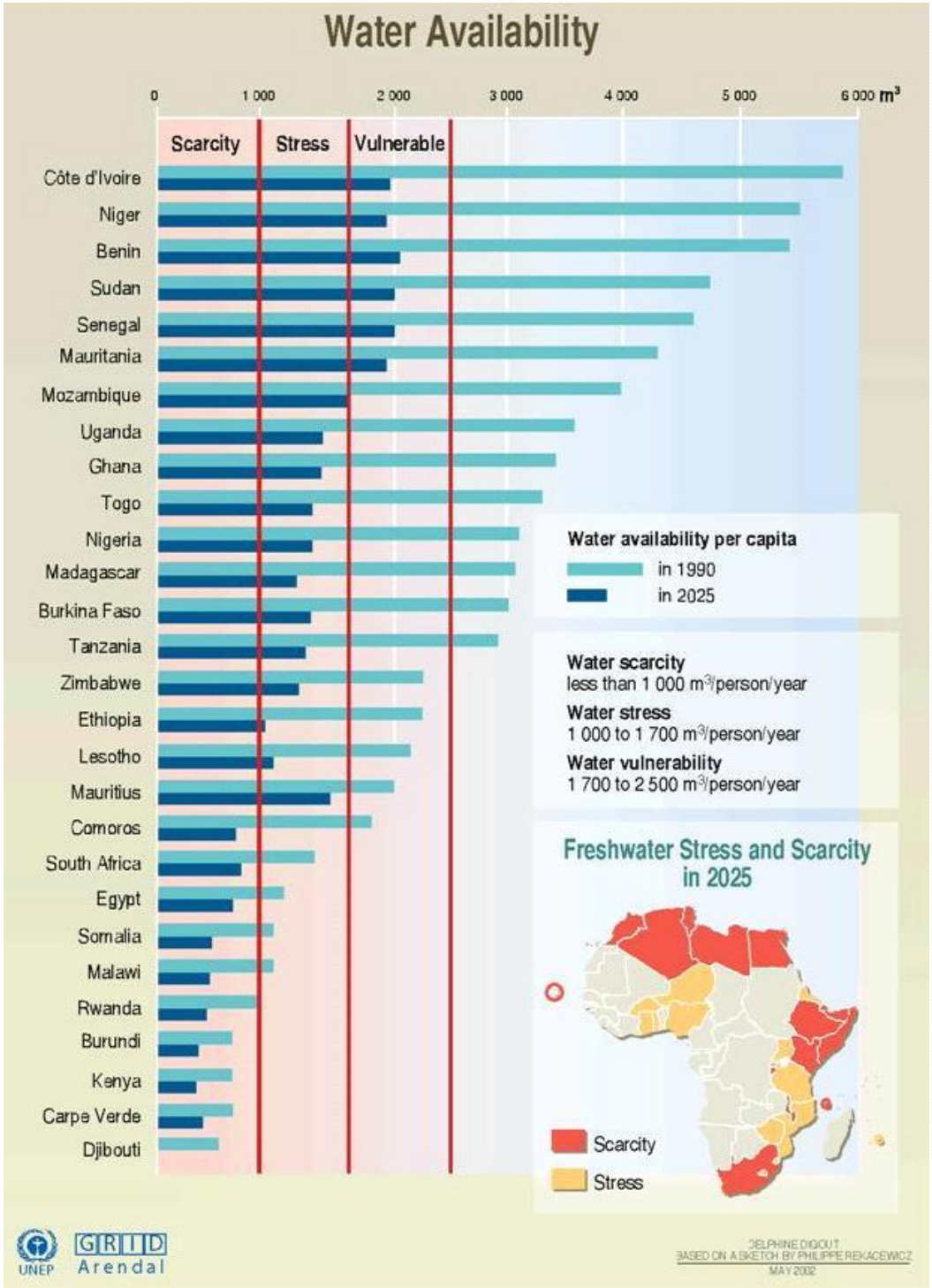
Activity	Cost	Description
Materials	$200	Construction scale model of desalination unit for IPRO day
Transportation	$70	Parking + mileage for field trip
Total Costs	**$270**	

4. Designation of Roles

A. Minute Takers – Nga Pham
B. Agenda Maker – Brian Wolber, team leader
C. Time Keeper – Brian Wolber, team leader
D. iGroups Moderator – Hannah Schlessinger

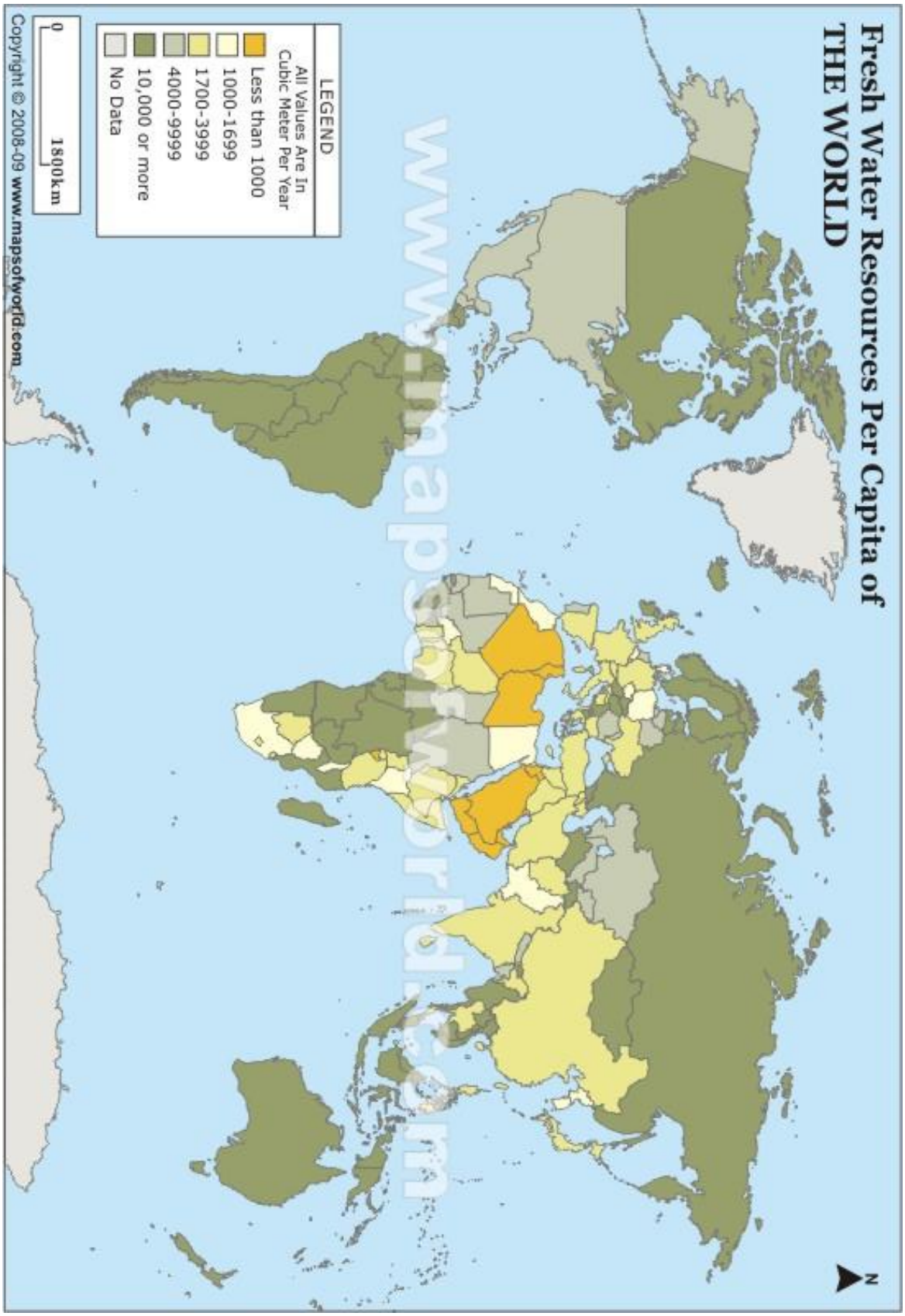
VI. Appendix

A.



Source: United Nations Economic Commission for Africa (UNECA), Addis Abeba ; Global Environment Outlook 2000 (GEO), UNEP, Earthscan, London, 1999.

B.


Fresh Water Resources Per Capita of THE WORLD
LEGEND
All Values Are In Cubic Meter Per Year
Less than 1000
1000-1699
1700-3999
4000-9999
10,000 or more
No Data
0
1800km
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