Energy Resources & The Environment: Impacts & Future Alternatives

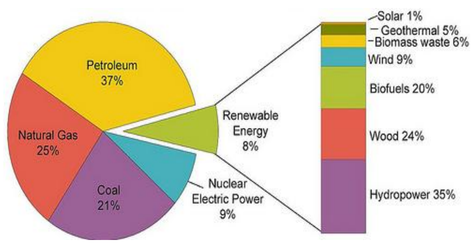
Melody M. Lopez[1], Palma Botterell[2], William Orem[2]

Department of Biology, University of Puerto Rico, Mayaguez, PR[1], U.S. Geological Survey,MS 956, National Center, Reston, VA 20192[2]

Introduction

Energy Resources are an important part of any modern society. The United States is one of the largest users of the World's energy resources, and every year the needs keep increasing.

Figure. 1 US Energy Consumption.



US Energy Administration Annual Energy Review 2009.

To get a better picture of how the use of these energy resources is affecting the environment, especially water quality, we analyze samples for conductivity, nutrients and nonpurgeable organic carbon (NPOC).

Nutrient analysis is run for phosphate and nitrate levels using colorimetry. These nutrients are supplemental chemicals that are applied to crops to stimulate growth. Excess nutrients are carried via streams. High values of either of these nutrients can alter the growth of the vegetation in the environment.

NPOC measures the concentration of all organic carbon bonded to organic molecules in the sampled water. This is important because, organic carbon can readily bind with other elements producing compounds, such as methylmercury, that can be both harmful to the environment and public health.

The USGS Eastern Energy Resources Science Center conducts research into the environmental effects of energy resources and new alternatives for cleaner, more sustainable energy practices. The two projects in which I worked are: (1) the study of contamination in the Florida Everglades, specifically Shark River Slough; and (2) methods for microbial conversion of coal to methane.

Shark River Slough

Shark River Slough is located in the central and southern regions of the Florida Everglades. Sloughs are main routes of moving water through the Everglades, and Shark River is one of the main sloughs within the Everglades. Over the years the Everglades has received the discharge of fertilizers and pesticides used by the Everglades Agricultural Area. Due to the excess of nutrients there has been an overgrowth of plants and algae that are not natural to this environment.

Figure. 2 Theoretical cycle of methyl in the Everglades.

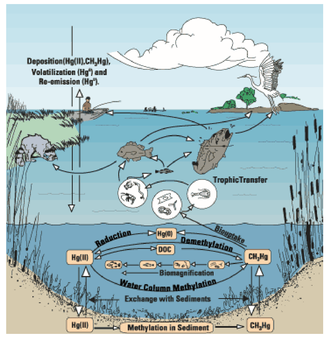


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Figure 3. Calibration curves for PO_4 and NH_4 for Shark River. Sept. 2010 samples.

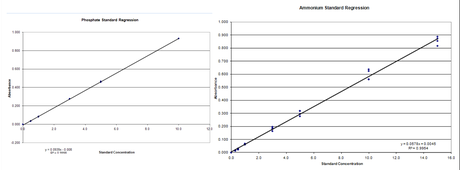


Table. 1 Concentrations for PO_4 and NH_4 for Shark River. Sept. 2010 samples.

Sample	PO4 Concentration (µg/l)	NH4 Concentration (µg/l)
S.R. gun 1	13.69	5.674
S.R gun 2	8.642	167.9
S.R gun 12	1.565	679.5

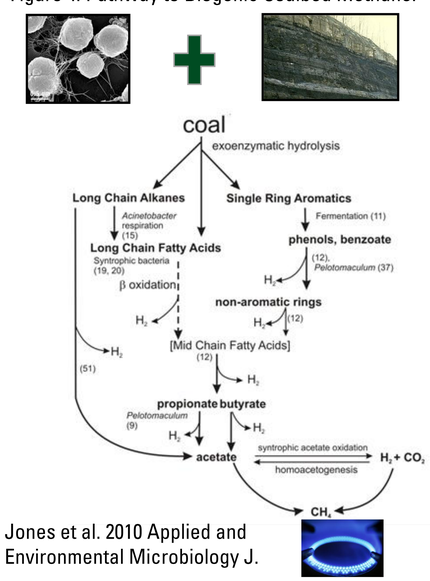
Table. 2 NPOC concentrations for Shark River. Apr. 2011 samples.

Sample	NPOC (ppm)
Gun - 1	15.64
Gun - 2	15.12
Gun - 3	14.96

Biomethanogenesis

Coalbed methane is an important emerging energy resource. With the help of anaerobic microbial degradation of organic coal geopolymers to stimulate natural gas production, we can reinvigorate existing coalbeds and provide a cleaner alternative to fossil energy utilization.

Figure 4. Pathway to Biogenic Coalbed Methane.



Jones et al. 2010 Applied and Environmental Microbiology J.

Figure. 5 Calibration curves for PO_4 and NH_4 for biomethanogenesis study. Feb. 2011 samples.

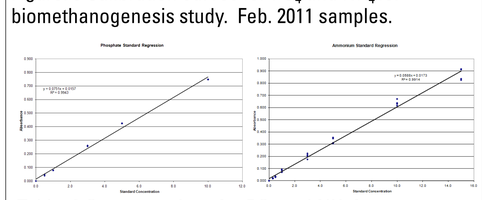


Table. 3 Concentrations for PO_4 and NH_4 for biomethanogenesis study. Feb. 2011 samples.

Sample	PO4 Concentration (µg/l)	NH4 Concentration (µg/l)
BIT M2 MIC 1-A	10733.5	10725.2
BIT M2 MIC 1-B	10620.3	10513.0
BIT M1 MIC 1-A	4182.27	7455.70

Table. 4 NPOC concentrations for biomethanogenesis. Feb.2011 samples.

Sample	NPOC (ppm)
BIT M2 MIC 1B 2.15.11	40.67
BITM2 WBC 2A 2.15.11	45.95
BIT M2 WBC 2B 2.15.11	15.19

Conclusions

Shark River Slough:

To help restore the Florida Everglades close to its original form, we have to understand where and how the chemicals are affecting the environment. Phosphates and nitrates were normally present at low levels prior to agricultural development, at approximately 10 parts per billion (ppb). They began entering the Everglades at concentrations that exceeded these levels; around the 1990s they reached 150 ppb. Agricultural practices are currently being modified to minimize chemical runoff into the Everglades and improve the water quality situation. Today's nutrient levels have thus been reduced to approximately 30ppb.

Biomethanogenesis:

Analysis of the samples can help us get a better idea of what nutrients are being used or are needed in order for the microorganisms to more successfully convert coal geopolymers to methane gas. Microbial methanogenesis is a pioneering method of producing and recovering natural gas that, with further studies, can become a possible economical alternative to help solve the energy crisis.

General:

Studying energy resources can help us find both solutions for old problems and new ideas for better, cleaner energy alternatives.

Literature cited

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Acknowledgments

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