Using the Internet to Teach Energy tnd Ecology On Line

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Teaching courses on line is spreading very fast. For example, our community college will offer courses for a complete AA degree (first two years of the university) soon. Teaching laboratories on line is challenging, but there's a chemistry course that uses household chemicals like baking soda and salt. With a computer and access to the internet by a phone line (modem and browser) students can take courses in anything. Students can be from anywhere, Brazil, Saudi Arabia and, hopefully, Cuba.

To earn degree credit a student must be enrolled at a college like Santa Fe that grants degrees. Entrance requirements are a high school degree or equivalent, an entrance exam, the TOEFL exam which tests English, and tuition (we can probably arrange scholarships). Our courses are all given in English, but probably there are some some in Spanish in South American countries.

From a faculty view, online courses are exciting but time-consuming. Each faculty can organize it his way, depending on course. Some are given by videotapes (lectures, music, movies) sent out by mail, some by videotapes on line, and some by text and projects on line. It can take an instructor a year to learn the technology and prepare the course. Then, when the content is set, more time is used to communicate with the students.

Since they do not meet in class to interact with the professor and other students, there are special methods of communication. Some of these are email, chat rooms, discussion forums and homepages. The course content includes picture sets, glossary and projects. Projects include reading certain chapters in the text and carrying out assignments to illustrate the important concepts. Exams are given on line.

In my course, Energy and Ecology, the text is "Environment and Society in Florida," by H.T. Odum, E.C. Odum and M.T. Brown. The course requires 8 projects in 16 weeks.

Part of the first project is to explain the first and second laws of thermodynamics using the diagram of an aquarium in Figure 1.

The last part of the course discusses ecological economics. One part of the project is to calculate emergy-dollar ratios. Since emergy is the sun's direct and indirect energy used to make an item, all inflows and storages can be measured in emergy. Then the emergies can be added to calculate the total value of the natural and economic systems.

For example, at this conference in Havana we estimated some of the main emergy resources per year supporting Cuba in 1995. On the left in Figure 2 is the use of indigenous emergy obtained by adding the renewable energies of sun, rain, wind, tides and currents and nonrenewable energies of oil, gas, stone and minerals from within Cuba (from MacLachlan-Karr's 1989 report). From the right is shown a preliminary estimate of the imported emergy of fuels, goods and services. Based on these rough estimates, the total emergy per year is about 9.5 E22 solar emjoules.

If you divide this by the gross national product in dollars for that year you obtain an estimate of the emergy-money ratio (sej/$). The diagram and calculation shown in Figure 2 were based on a published value of gross economic product, which apparently converted pesos to dollars according to the rate of exchange in 1995.

You can compare Cuba's emergy-dollar ratio to those of other countries listed in the following Table 1. Cuba has more emergy value per dollar than the world average. This estimated emergy-dollar ratio is useful to evaluate benefit or losses from international trade. If Cuba trades with a more developed country (with a lower emergy-dollar ratio), it is sending out more real value than it imports. If it trades with a country with a higher emergy-dollar ratio, it imports more value than it exports.

Table 1. Comparison of Emergy-Money Ratios Among Nations

State or Nation	Emergy/Money* E12 sej/$
Dominica	14.9
Ecuador	8.7
China	8.7
Brazil	8.4
Cuba	6.9
India	6.4
World	4.0
Mexico	3.3
Sweden	2.6
Italy	1.5
Florida	1.5
U.S.A.	1.5
Japan	1.4
Switzerland	0.5

*Values 1995 or before
sej = solar emjoules

The conclusion about online education is that it is a valuable alternative to classroom teaching under special circumstances. It is good for students who are older, working, have babies at home, or live far away from the college, as in Cuba. It is not so good for younger students who take courses as much for the sociability and sense of community as for the content. For a professor it takes more time than a classroom course but it has the advantage of a more open schedule.

Information about application for online courses
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Entrance requirements: high school graduate and ability to communicate in English. Equipment needed is a computer with Windows 95, a connection to the internet and a browser like Netscape 4 or above.

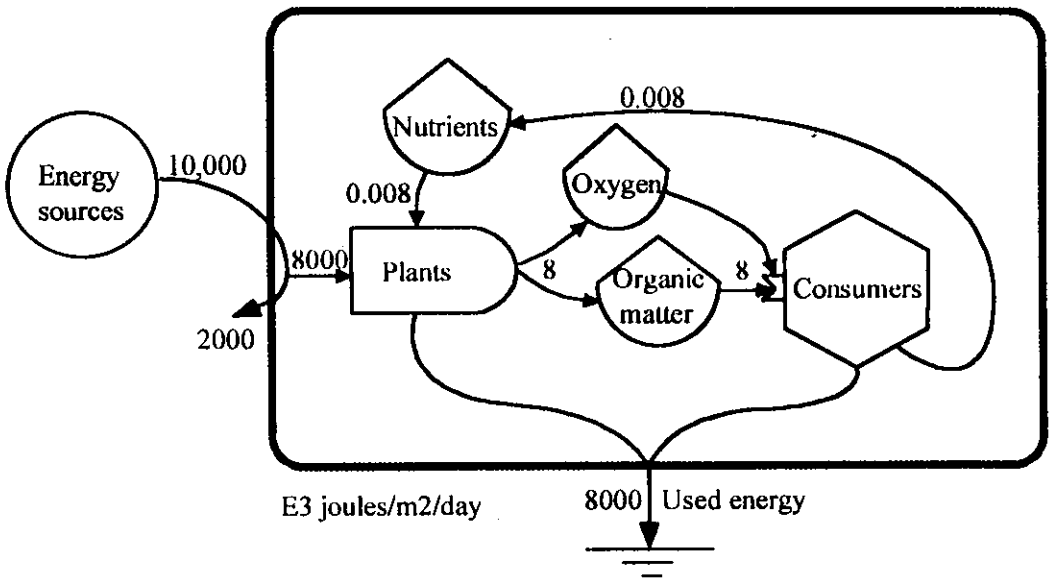
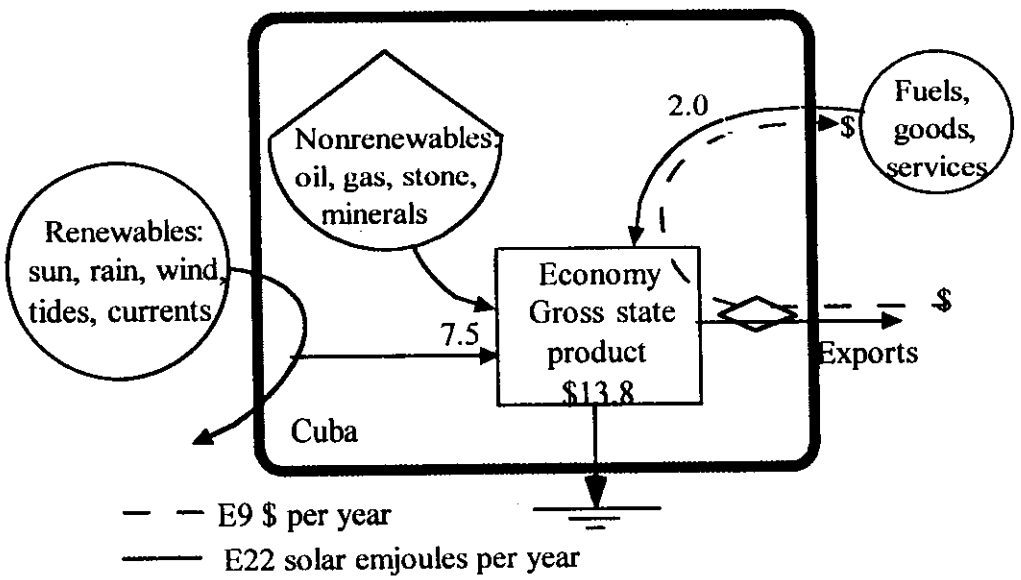


Figure 1. Systems diagram of an aquarium.



Emergy/money ratio for Cuba in 1995 =
9.5 E22 sej / $ 13.8 E9 = 6.9 E12 sej/$

Figure 2. Emergy basis for Cuba in 1995