ENERGY EFFICIENCY AND RENEWABLE ENERGY SOURCES: THE EXPERIENCE OF THE FEDERAL UNIVERSITY OF CEARÁ

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Abstract

This article wants to present the Electric Power Consumption Efficiency Program of Federal University of Ceará – PROCEN –, which is completely composed by teachers and students (of master's degree and graduation). It aims to make efficient the UFC's installations and to form qualified professionals in Energy Efficiency area.

Therefore, the program focus its efforts in: (a) to make efficient the UFC's installations, having in view the electric power consumption efficiency and, consequently, the costs reduction for the government; (b) to revive the energy saving conscience in professors and students, besides the ones concerned in university's administration and maintenance; (c) to study the energy renewable sources applicability at the energy efficiency projects.

Keywords: capacity building, education, energy efficiency and solar energy systems.

1. Introduction

PROCEN's history begins in 1992, when the disciplin "Introduction to Energy Saving" was created. Offered to the UFC's graduation students of Electric Engineering, it aims to alert the future engineers about the importance of energy saving, besides presents the most recent concepts related to this subject.

After the energetic crisis in 2001, PROCEN starts to have effective support of the university, assuming the coordination of the new CICE – Energy Saving Intern Comission – which looked for reach the goals of electric power consumption demanded by the state.

When the "blackout" was over, the need of creating a program to combat the electric energy losses at the dependences of UFC's *campi* was verified. Therefore, PROCEN was in charge visiting Pernambuco Federal University (where a program with the same goal was being developed since two years) and bring from there some experiences to implant an equal program at UFC.

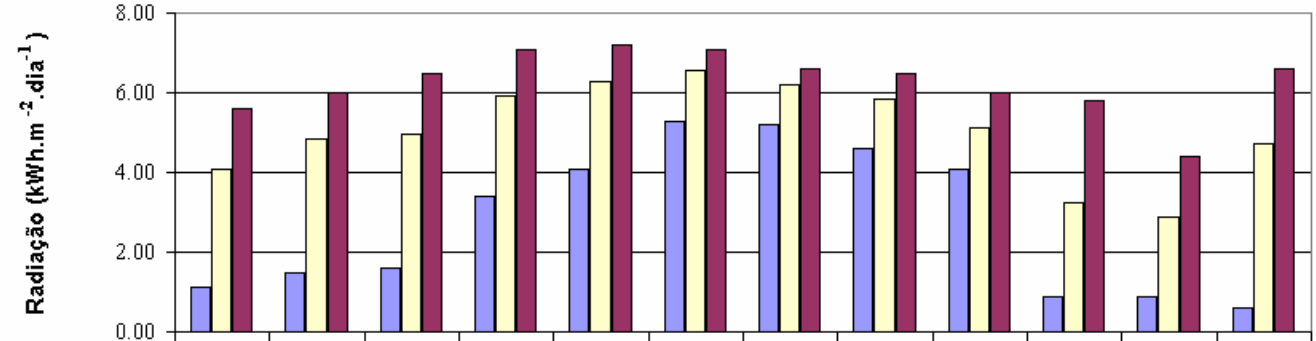
So, a first draft was elaborated and, after many technical meetings, it resulted in an agreement between the Brazil's Power Plants – ELETROBRÁS – and UFC. Under the guardianship of PROCEN, it aimed to electric consumption efficiency at the following buildings: Rector's Office, Sea Sciences' Laboratory (LABOMAR) and University Hospital Walter Cantídio (HUWC).

From this, PROCEN started having as goals: (a) to make UFC's installations efficient, looking for electric energy and public resources saving; (b) to contribute to the professionals' qualification at the energy efficiency area; and (c) to revive the energy saving conscience in professors and students, besides the ones concerned in university's administration and maintenance. For such, PROCEN have as its politics the working with graduation and master's degree students, believing that, by this way, to be stimulating the academic career development, besides working to the student qualification.

Still aiming the student's qualifying involved with the program and assure the energy saving at UFC's units, the program has guided its students also to research and analyze the viability in the renewable sources' use in the university buildings.

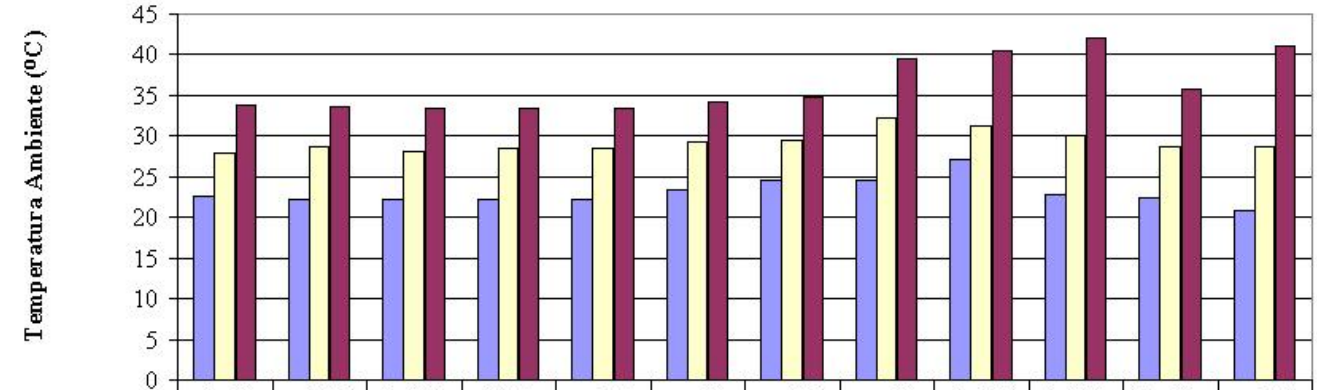
Among these sources, a special attention has been given to solar energy which, because of Brazil's Northeast climatic characteristics, presents a great potencial of use. The graphics in Figures 1 and 2

show, respectively, the values of global solar radiation (kWh.m^{-2}.day^{-1}) and ambient temperature (ºC) in the period of one year, between April of 2003 and March of 2004, from 5 A.M. to 6 P.M. [2]. The knowledge of these intensities is very important to the better use of solar energy, be it for electricity production (use of photovoltaic panels) or for water heating (use of collecting plates).



	abr/03	mai/03	jun/03	jul/03	ago/03	set/03	out/03	nov/03	dez/03	jan/04	fev/04	mar/04
Menor valor	1.10	1.50	1.60	3.40	4.10	5.30	5.20	4.60	4.10	0.90	0.90	0.60
Valor médio	4.07	4.84	4.95	5.92	6.28	6.56	6.22	5.84	5.13	3.25	2.87	4.73
Maior valor	5.60	6.00	6.50	7.10	7.20	7.10	6.60	6.50	6.00	5.80	4.40	6.60

Figure 1: Monthly values of global solar radiation for the period of April of 2003 – March of 2004 (5:00 – 18:00 hs) for the city of Fortaleza.



	abr/03	mai/03	jun/03	jul/03	ago/03	set/03	out/03	nov/03	dez/03	jan/04	fev/04	mar/04
Menor Valor	22.63	22.26	22.2	22.25	22.29	23.3	24.51	24.61	27.19	22.72	22.39	20.9
Valor Médio	27.97	28.64	28.13	28.44	28.54	29.32	29.53	32.18	31.15	30.16	28.6	28.73
Maior Valor	33.75	33.70	33.35	33.48	33.50	34.16	34.84	39.41	40.52	41.97	35.67	41.07

Figure 2: Monthly values of ambient temperature for the period of April of 2003 – March of 2004 (5:00 – 18:00 hs) for the city of Fortaleza.

2. Performance of PROCEN

The performance of PROCEN, talking about reaching its goals, is concentrated in three lead topics:

A. Energy saving at UFC's units

Aiming to save energy and public resources, PROCEN tries to develop electric energy efficiency projects for its many units, which shows the following working methodology:

Fase 1: data-collecting in field and elaboration of energy diagnosis, aiming to show the consumption profile and the electric energy economy possibilities in the many units of UFC;
Fase 2: elaboration of electric energy efficiency projects, detailing the actions to be developed and the expected economy;
Fase 3: financial viability analysis of the project;
Fase 4: stuff purchasing and executors firms contracting;
Fase 5: electric measures before implementation;
Fase 6: implementation accompaniment;
Fase 7: electric measures after implementation;
Fase 8: analysis of results.

So, since the beginning of 2003, PROCEN develops the following projects, shown in Table 1:

TABLE 1: Course os the developed projects by PROCEN

UNIT	STUDIED SYSTEMS	FASE
Campus of Pici	Public illumination	Fase 8
Labomar	Illumination and climatization	Fase 6
University Hospital	Climatization	Fase 6
Reitor's Office	Illumination and climatization	Fase 4
Pharmacy College	Illumination and climatization	Fase 2
Odontology College	Illumination and climatization	Fase 2
Maternity School	Illumination and climatization	Fase 2
Sciences Center	Illumination and climatization	Fase 1
Tecnology Center	Illumination and climatization	Fase 1

Figure 3: Electric measures at University Hospital.

Figure 4: Labomar's illumination system improvement.

B. UFC's users awareness

Aware of the importance of final user participation in energy efficiency, PROCEN tries to transmit knowledge regarding the electric energy saving to the whole local community and the staff responsible for the maintenance of UFC's installations through the accomplishment of lectures, technician courses and news elaborated and given for its team of professors and pupils. In this direction, it can be detached:

- lectures to Labomar's and HUWC's users and high school students, approaching the subjects:
  - Energy Saving Importance;

- How to save energy in our work/study environment;
- How to save energy in our house.

- 40 hours technician courses to the HUWC's maintenance team (HUWC), approaching the subjects:
  - Basic Electric Energy Concepts;
  - Lighting;
  - Electric Motors;
  - Water Pumping Systems;
  - Compressed Air Systems;
  - Drives.

Figure 5: Technician course realized at HUWC.

Figure 6: Group formed in the HUWC.

- maintenance of a electronic periodic (responsibility of a Social Communication trainee), sent by e-mail to the employees, professors and pupils of all UFC's departments, aiming to take electric energy saving tips and news about the projects developed by PROCEN and UFC's Electric Engineering Department[1].

C. Researches about the applicability of Energy renewable sources in UFC

Looking for the use of the region's solar potential, PROCEN developes researches about the possibility of these power plants use aiming to guarantee energy efficiency of UFC's units. As results of these researches, the following scientific articles can be detached[2]:

- Application of the PV Tecnology in Grid-connected Buildings: Study for the UFC's Rectory;
  - elaboration of a photovoltaic grid-connected pioneering project in the State of the Ceará, having as objective to act as complementary source of the electric net, besides serving as laboratory to this type of technology;
  - the proposal can contribute with 13% of the Rectory's electric energy consumption, supporting the whole load of artificial illumination, besides supplying, in operation, 36 MWh-year;
  - due the building to be tumbled by the historic patrimony and taking in account its representation in the State, the application of the project would bring an advertising accomplishes to the photovoltaic technology in the region.

- Study of Technical and Financial Viability of PV Powered Water-pumping Systems in the UFC;

[1] All the news already written, besides add information about PROCEN, can be found in its electronic page, at the address: www.dee.ufc.br/~procen
[2] Articles presented in IEEE/PES T&D2004 Latin America.

- to verify the applicability of high efficiency motor-bomb sets, fed by photovoltaics panels (without use of batteries), to be used for the pumping of the water proceeding from the existing wells in the *campus* of Pici (in a total of 25, which are not being used currently), objectifying the reduction of the water consumption from the conventional grid;
- it was verified that the *campus* of Pici, that has a daily water consumption of 543 m^3 , can be supplied entirely for the existing wells, that have capacity to supply 649 m^3 daily;
- in accordance with the calculated financial indices (investment's liquid present value percentage in relation to the VPL of the water supply cost's during the system's useful life equal to 2%), the option considered by the project revealed an excellent alternative for the water suppliment in the *campus* of Pici.

- Viability Study of Implantation of a Solar Water Heating System in the UFC's Maternity School.
  - the study objectives to substitute the water heating system currently in use (composed by electric taps spread by diverse points of the building) for one that makes use of the region's solar potential (solar water heating system using plain plate collectors);
  - it presents a relation of benefits and costs (RBC) equal to 1.32, showing that the benefits to be reached with the implantation of the project are bigger than its related costs, during its useful life;
  - it comes to positively contribute to the electric energy management program that is being realized in MEAC and that will be submitted as a master's degree dissertation.

3. Conclusion

More than an electric power consumption efficiency program, PROCEN is an educational program. Its biggest conquest is that one related to the awareness of the electric energy saving inside UFC: starting by the units' users (professors, pupils and servers), passing by the staff responsible for its maintenance and arriving, finally, to the engineers formed by the university.

Also believing in the region's renewable energy sources potential, PROCEN hugs as cause its spreading, through researches aiming at its use inside the UFC's units.

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