Exploring Energy in our Daily Life - Unearthing Connections

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When we think of energy and energy conservation more often than not we think mainly of electricity. This is largely a function of the innumerable appliances and gadgets that – consciously or unconsciously – help us get through a typical day in our lives. We become conscious of energy only when there is a power cut in summer or we see an increase in the electricity bill at the end of the month or we run out of cooking gas! There is also a disconnect in the way we relate to energy. In our private and public spaces we rarely ask the questions - what forms of energy do we use? Where does it come from? How are lights and fans (and sometimes even air conditioning), in many urban homes, housing complexes, offices and shopping malls, available 24x7 even when there is a power crisis in the State and country? How is energy consumption related to what we choose to eat? How we go to work or for a holiday?, etc. However at school, work, in a social setting, in conferences and seminars, we often have discussions on the crises caused by global warming and climate change, the need for renewable energy technologies, using mass transport versus driving a car etc. Often we seem to have these discussions without drawing the connections between personal consumption patterns and the larger issues of energy such as its impact on the surrounding environment and its contribution to one of the most profound phenomenon facing the planet – climate change. It somehow seems to be a problem that is out there – a function of poor Government policies, corruption, overconsumption by "the rich", a problem created by developed countries etc.

This article explores some simple ways by which the school space can be used to try and reduce this disconnect. The article is based on my experience with urban students in a residential school located in a rural setting – the Rishi Valley Education Centre (RVEC). This is an 80 year old institution that resides in a semi-arid ecosystem in the Rayalseema Region of Andhra Pradesh. The nearest town, Madanapalle, is approximately 20 kms away. Our neighbours are small farmers and pastoralists whose livelihoods are dependent on a fragile ecosystem that receives very little rainfall ranging from about 55-75 cms annually. Electricity is erratic with 6-8 hours of no grid power in peak summer. Energy and water are thus scarce and precious.

Understanding energy in the school space

Like in most schools, understanding the various theoretical concepts related to energy is typically done as part of science curriculum. Applications of energy and its relationship with the environment is through Environmental Studies. Energy is often a favourite theme in projects that students carry out as part of their curricular requirement in Science and Environmental Studies.

At the Rishi Valley Education Centre (RVEC), students explore various aspects of energy through readings, projects and hands-on activities in Science, Environmental Studies and as part of the General Studies course in Class XI. Exploring renewable energy technologies through projects is a particular favourite among both students and teachers.

Understanding concepts of renewable energy and their importance from an ecological and economic context for the present and future is very important. However to make an informed choice of the most appropriate technology(ies) to be used at a given location it is important to understand the quantity and quality of energy consumed and energy usage patterns. A simple tool that can help generate this information is the energy audit[1]. The information from the audit can be pictorially

[1]An energy audit is a tool that is used to (i) systematically document the various sources and quantitites of energy used, practices adopted for energy usage and measurement, and (ii) periodically review and evaluate energy usage.

represented through eco- maps[2] to understand energy consumption patterns. Students of Environmental Studies at RVEC use this tool extensively for projects. Some students have also explored energy usage patterns in the neighbourhood (comprised of small farmer and pastoralist households) through household surveys and interviews. Comparing this information with energy consumption patterns on campus revealed the differences in urban and rural energy usage patterns.

Both audits and eco-maps are simple tools that are versatile and can be used anywhere by anybody. All it needs is a pencil, paper and planning! Every time these activities have been carried out, students and adults have been surprised at how all-pervasive energy is in our lives and yet how little we think about it.

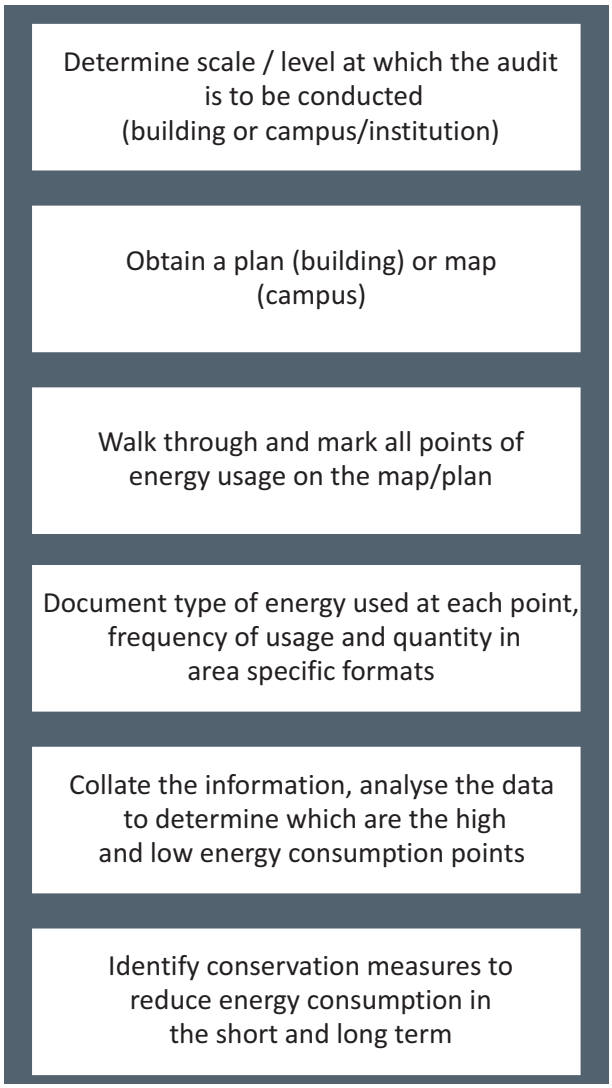
This article will focus on how the energy audit can be used not only as a tool to understand energy consumption and develop energy conservation measures but also stimulate a larger discussion on energy.

Energy audits – some experiences

The first step in conducting an energy audit is to decide the scale – will it be a house or building or will it be conducted for a campus or institution. To do this one needs to find out the various points of energy usage, types of energy used, frequency of usage, compute the quantity used, and determine the efficiency of energy use. There are several excellent resources available on how to carry out such an audit[3]. What is important however is to first articulate the reason for the audit – is it only to know how much energy is being used, where energy is being used, in what forms? Or is it a means to reduce energy consumption or put in place a programme to conserve energy? For example, students have carried out energy audits of their homes or the buildings in which they live to understand the amount of energy used. At the RVEC campus, a group of students and some interested teachers wanted to increase energy conservation efforts on campus and thus used the energy audit as a tool to collect quantitative data on energy usage.

The broad approach that was followed is outlined in Figure 1. While it is ideal to carry out follow up audits annually, the frequency with which audits may be conducted is a function of how long it takes to implement conservation measures identified in the previous audit. The follow up audit is typically done to assess how effective the conservation measures have been in reducing energy consumption.

Figure 1: Step-by-Step approach to conducting an energy audit



To share the findings of such an audit a map of the school or plan of a home can be used and areas of high and low energy consumption can be colour coded and displayed effectively. For example red to

[2]An eco-map for energy is a pictorial representation of energy usage at a given location. It could be created for a house or for a community.

[3]The Green Schools Programme. A Manual to Assess the Environmental Performance of the Community. Centre for Science and Environment. New Delhi. 2011. This is a step-by-step guide for energy, water and waste audits.

show areas of high energy consumption and green to indicate low energy consumption or efficient energy usage points (say CFL lamps replaced incandescent lamps).

The school energy audit carried out by students and teachers provided both direct and indirect learnings. Some of the direct learnings include:

- appreciating the importance of accurately measuring energy consumption. Very early in the audit it became clear that some of the electricity meters were not accurate and hence the data was not reliable. Thus the need for good quality electricity meters at various locations to measure the amount of electricity consumed on campus emerged as a priority action item - what we cannot measure we cannot conserve;
- becoming aware that energy is consumed in various forms e.g., electricity for home classroom and street lighting, to run computers, for cooking, laundry and pumping groundwater for daily use on campus etc. LPG is used for cooking, fuelwood for heating water, solar energy for heating water and lighting the campus at some locations and diesel for transportation of people, produce, and other goods and services needed at the school;
- finding out that it takes three diesel generators to ensure 24 hours uninterrupted power supply on campus, given the erratic grid supply. This helped understand how much and how frequently diesel was consumed for the generators;
- that there are more than 20 inverters on campus to keep the computers operational through the working hours which means somebody has to maintain them and that at the end of their lifetime they have to be replaced. What also became clear was that there is potential for hazardous waste generation since the inverter has acid batteries;
- that the office administrator optimises the transportation from school to the nearest town to conserve fuel;
- understanding that increasing efficiency in transmission of energy and in its use is critical in enabling energy conservation. To ensure efficient energy usage, electrical infrastructure (including wiring) must be periodically reviewed to minimise transmission losses. Efficiency of all electrical appliances e.g., laundry washing machines, large kitchen ovens, the kinds of lighting devices used, must be regularly checked through a preventive maintenance programme.

Some of the findings of the audit led to direct action. For example installation of new electric meters particularly at points of high power consumption on campus so that accurate data can be obtained based on which more detailed studies can be done to reduce energy consumption. It also led to the creation of a preventive maintenance inspection checklist for equipment used in public areas like the solar water heaters, laundry washing machines etc. Students used this checklist to inspect the devices once a term and provided the report to the maintenance crew on campus for action where necessary.

Another outcome of this audit was that building level energy usage information (both quantity and frequency) was made available for the first time. This was useful for the campus site engineer and the maintenance staff to identify peak electricity loads. The information on peak loads in turn was used in estimation of energy requirement and distribution on campus when RVEC decided to build a solar power plant. The applications of an audit are, thus, manifold.

Going beyond the audit

The information generated by the audit lends itself to many extensions – starting from the individual and extending to the larger community. Personal consumption practices get highlighted – one suddenly realises how many appliances one uses in daily life. It could range from battery powered and electric toothbrushes, blenders for juices, soups and chutneys, to motors and pumps to bring water to taps, inverters to run computers and so on. This could be used to develop a personal energy conservation plan.

In towns and cities the use of energy to cool offices and homes is a significant issue. The information on heating and cooling homes and offices can be used to discuss issues around urban planning and relevant architecture. For example, poor urban planning, lack of adequate green cover and building with glass, steel and concrete has led to our cities and towns becoming 'heat islands'. We then need air conditioning to cool them, leading to greater demands for energy. Students could then be asked to question why concrete-glass buildings are inappropriate for a country like India. This could

then lead to small projects on alternative architectural forms such as vernacular architecture and using local materials which are more energy efficient.

Tracing the source of energy is another interesting activity that students can take up from the audit. Where is the electricity coming from? Is it hydro, thermal or some other form e.g., solar, wind etc. How far is the generation point? Electricity Department officials could be interviewed to understand more about some of these issues. Where is the fuel for the vehicles used coming from? Where is the nearest fuel station? What is the cost of fuel? What percentage of energy comes from various sources at the State and National level? and several other questions can be explored to understand the energy situation both locally and nationally.

This activity can be the basis for discussions on conservation measures – reducing the number of appliances, increasing energy efficiency through better appliances (where needed), better wiring to reduce transmission losses, optimising fuel usage during transportation through use of public transport etc.

The fact that energy is needed to draw water for drinking and other uses and to grow food can trigger discussions on the interconnectedness of everything around us – reinforcing the point that conserving water means conserving energy as well, and reducing food wastage means conserving water and energy. Understanding fuel consumption in transporting food can bring about discussions on the need to eat more locally and seasonally. The idea of embedded energy in food produced using petrochemical based fertilisers and pesticides can be introduced. The idea that fossil fuels are needed to produce these chemicals and therefore the need for sustainable agriculture can also be discussed.

What starts off as an accounting and measuring activity can be expanded to understand and show how our actions are inextricably linked to what happens to our resources and how energy is at the heart of it all. The versatility of this simple tool depends on the imagination of the learner – teacher or student.

Table 1: Sample formats used in the RVEC energy audit

A. Household electrical equipment data sheet

Water heater - How do you heat water in your home? What is the length of operation and frequency of use?

Appliance	**Capacity**	**Length of operation (minutes)**				**Frequency of use**		
Geyser		15	30	60	Any other	Once a day	Twice a day	Any other
Gas-based heater								
Immersion rod								
Wood fired boiler								
LPG stove								
Any other								

B. Lighting and fan

Facilities

Device	Quantity	Model	Frequency of use[#]	Duration of operation[**]
Tubelights				
CFL				
LED Lights				
Fans				
Coolers				

[**]State the timings when these devices are turned on e.g. Lights 7:00 pm to 10:00 pm etc.
[#]Seasonal usage pattern e.g. Coolers /fans in summer etc.

Similar formats were prepared for other activities like washing, cooking, agriculture, etc.

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