Energy Audit

Why do an Energy Audit?

Have you ever wondered how energy efficient your school is? An energy audit can help you find out where your energy is going and how you can improve your school's efficiency and therefore improve the environmental footprint of the school. Environmental Audits are recommended in the NSW Environmental Education Policy for Schools (2001).

This energy audit focuses on electricity and will provide students with a snapshot of the electricity use in their school. It involves reviewing past energy bills, collecting and analysing data and establishing a set of base line information which schools can use to trace their improvements. Students are involved in collecting and analysing data, identifying areas of concern and developing and implementing strategies to decrease energy use.

Who should be involved?

Students from years 4 and above are sufficiently skilled to participate in an energy audit. Older students will be able to conduct the audit more thoroughly. Staff representatives should include teaching staff, administrative staff and grounds staff.

What will the energy audit tell us?

The energy audit will give us information about your school's use of electricity and about how much CO_2 is being produced by the school over a day, week, month, and year.

How will we do it?

The full energy audit includes 5 steps. These can be done separately if necessary but will fit comfortable into a half a day to a day depending on the size of your school.

1. Energy audit introduction

- Discuss the information in the Energy Audit Fact Sheet
- Relate this to your school environment
- Discuss the Global Warming Poster

2. Energy desk top audit

- Analyse the energy bills to find out real costs paid in previous 12 months and patterns of use in different months and how they compare with previous bills.
- In addition to money costs look at kilowatt hours used and amount of greenhouse gases produced. This information should all be on your bills

3. Energy walk-through audit

- Count all electrical items in the school
- Estimate the duration of use for each item (hours/days)
- Calculate wattage & the cost ($/greenhouse gases) for each item

4. Presentation *(optional)*

- Present the information found through steps 2 and 3.

5. **Energy recommendations and Action Plan**
    - Compare the results of the audit with the information from the bills
    - Make recommendations for decreasing the energy use in the school
    - Identify actions that could be taken to achieve improvements

What you need to do the audit

- Approval from the Principal
- A small team of students, between 12 and 30
- Apply to clerical staff for copy of energy bills for a 12 month period
- Map of the school showing every room
- Data collection sheets for lights and appliances
- A Risk Management Plan to assure the safety of students
- A notice to alert everyone in the school about the energy audit day (If there are exams or other important events it may be good idea to pre-count the items in rooms prior to the day)

Energy Audit Fact Sheet

Short talking points

- Electricity is only one form of energy
- Producing AND using electricity produces $C0_2$
- $C0_2$ is carbon dioxide, a "greenhouse gas"
- Every kWh used = 1kg $C0_2$ = size of a fridge
- "Non-renewable energy sources" are those of which we have a limited supply
- How does our school use energy and how does contribute to greenhouse gas emissions?

Greenhouse effect

Imagine that there is a thin blue line around the earth.
The space between the thin blue line and the earth's crust is filled with gases, forming a layer around the earth. We call this layer "the atmosphere" and when we look up at it we call it "the sky".

This layer acts like a "blanket" around the earth. Without this layer the earth and all its living things would be exposed to the harsh outer-space environment. This blanket protects the earth from both freezing temperatures in outer space and harmful radiation. If we didn't have this blanket we would not survive. The distance from Sun, and the thickness of the "blanket" is perfectly balanced. It is often called the **"greenhouse effect"** because it protects the earth in the same way that greenhouses protect plants.

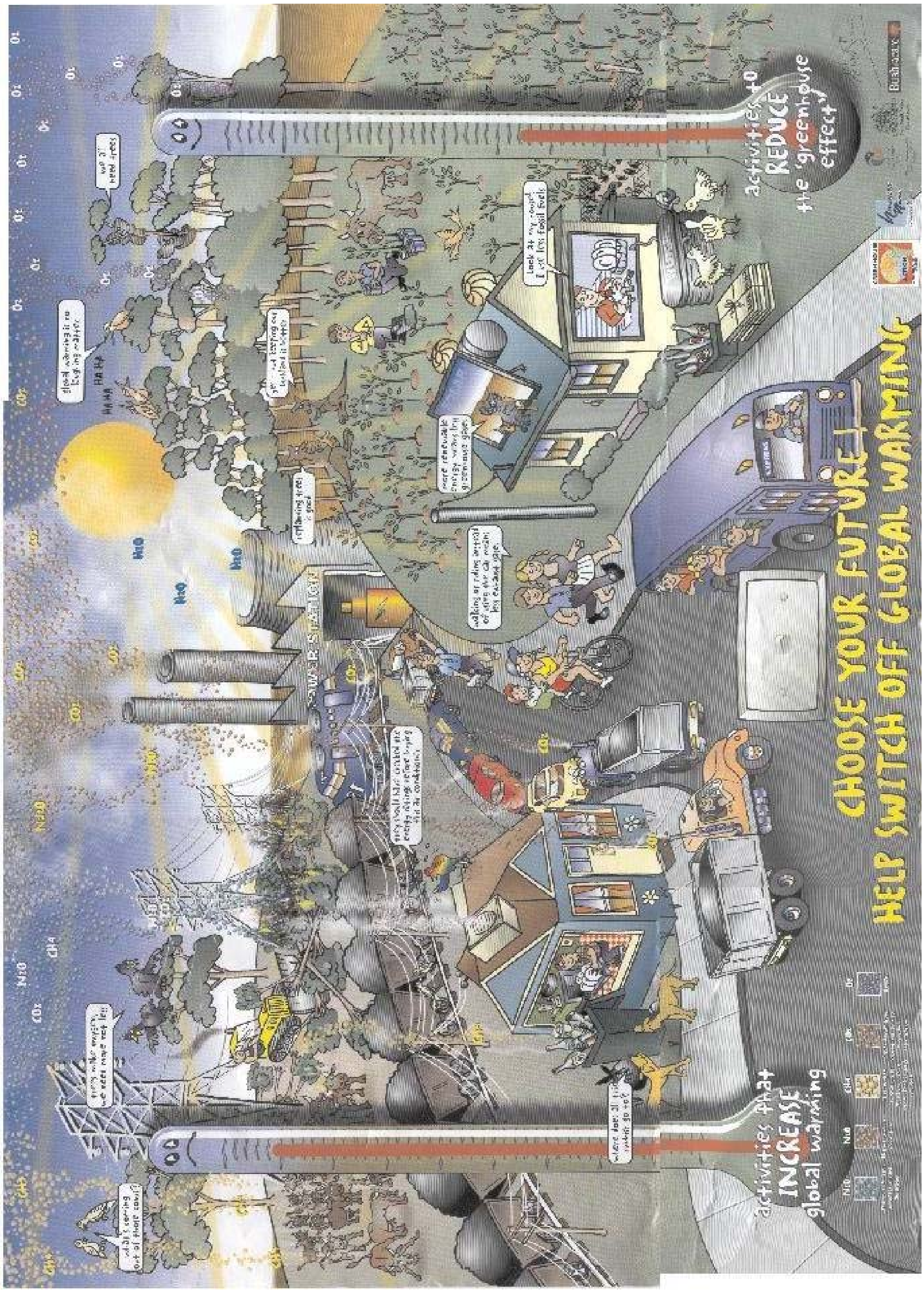
Global Warming

Some of the activities on earth are damaging that protective layer by sending up too much **$C0_2$** or sending up other types of gases that are not good for the atmosphere. Too many **"greenhouse gases"** makes the atmosphere heat up. This is called **"global warming".** One such activity is burning fossil fuels (old trees, old carbon stored in the ground) to make electricity.

Global warming may be a big problem, but there are many little things we can do to make a difference. If we try, most of us can do our part to reduce the amount of greenhouse gases that we put into the atmosphere. Many greenhouse gases come from things we do every day. Whenever we use electricity, we help put greenhouse gases into the air. So using less electricity can help. Using electricity is not wrong. We just have to be smart about it. The school energy audit will help us find ways to use less electricity and cut down on the amount of greenhouse gases we are sending into the atmosphere every day

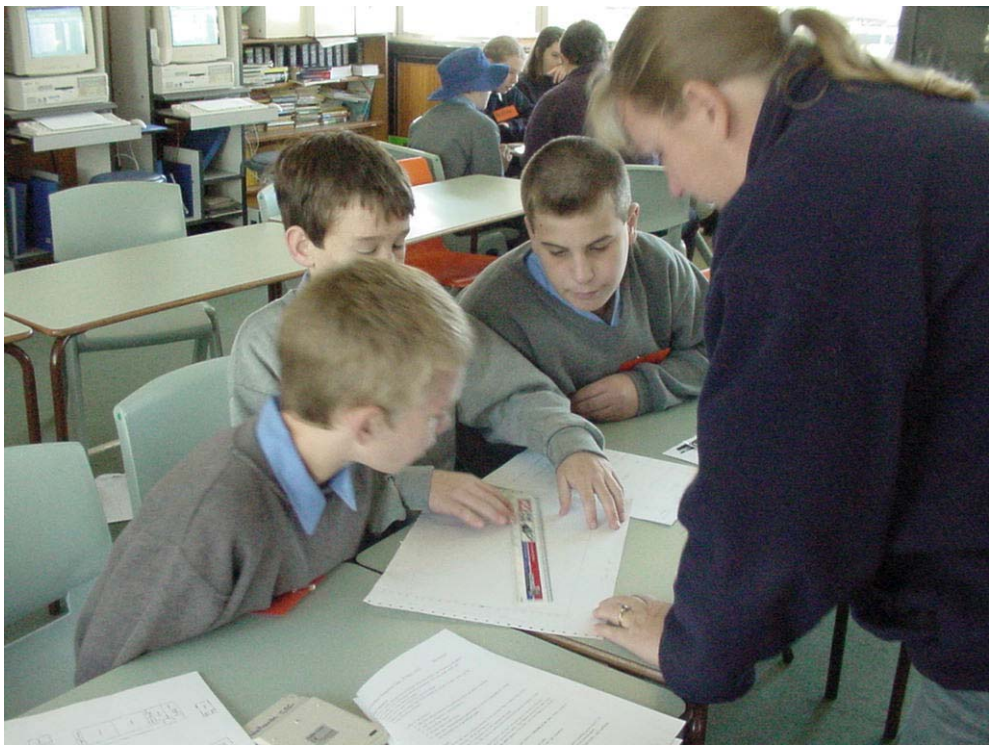
Find out more about global warming and climate change by visiting this excellent web site. http://www.epa.gov/globalwarming/kids/greenhouse.html

Global Warming Poster
This poster has two sides – one shows 'good' activities and the other shows 'bad' activities. Find the differences. Follow the trail from the activities to the energy source.


CHOOSE YOUR FUTURE!
HELP SWITCH OFF GLOBAL WARMING
activities that INCREASE global warming
activities to REDUCE the 'greenhouse effect'
POWER STATION

2. Energy desk top audit

The desk top review uses the energy bills for a 12 month period to find out real costs paid annually and patterns of use in different months. The Bill team can calculate the total amount spent on energy for the year, identify the trends for energy consumption in different months and identify any “mysteries” that need further investigation. For instance, students might find out from the bills that the costs for energy are much the same in January as they are during a month when students are present. This would be worth investigating. Energy bills should provide information on charges, amount of energy used, $C0_2$ produced and comparison with other pay periods.



<u>The Bill Team</u>

- Review Bills from the last 12 months and collect the following information into the table provided
- Make a simple graph to show the differences between different months or seasons
- Look for mysteries, electricity use that does not fit with the season or the school use during the year

Desk top audit table

The information collected here will help build a picture of your school's total electricity usage. Use the electricity bills for a 12 month period to fill in the boxes below. If bills are paid on a monthly basis, put three bills together to make up for a quarter of the year. Ask the School Administration and Support Staff (SASS) if it is possible to obtain electricity bills for a 12 month period. Use the information from your schools electricity bills to fill out the table below.

Estimate how many people are in your school on most days **(A)** _____ 🧍

Billing periods (from-to).	**No of Days**	**Electricity cost for each period ($)**	**Amount of Electricity used/period (KWh= kilowatt hour) (1 KWh = 1 kilogram of CO_2) ($C0_2$ =carbon dioxide)**
		(C)Total cost for year $	**(D)Total energy usage for year_____KWh/ Kg of CO_2**

Average cost per day of electricity (E).

(C) $ _____ ÷ 365 days = (E) $_____

Average yearly cost per person

(C) $ _____ ÷ (A)_____ 🧍 = $_____

Average amount per day of kWh used (F)

(D) _____KWh ÷ 365days = _____ KWh or Kg of CO_2 /day (F).

Average use of KWh per person per day

(F)_____KWh ÷ _____ 🧍 = _____ KWh or Kg of CO_2/ 🧍 / day (H).

If one Kg of **CO_2** (a major greenhouse gas) takes up the space of an average household fridge, how many fridge size blocks worth of CO_2 went into the atmosphere per person from your school in the last year. Use the formula **D ÷ A**. Write your answer here: _____ fridge sized blocks / 🧍 .

Can you identify any totals from the table that don't make sense: for instance are there any periods that would have included holidays? Does the electricity use reflect this?

Energy walk-through audit
The walk through audit allows students to get an idea of where and how energy is being used in the schools by locating the number and type of appliances and estimating their usage. For instance, some objects (like urns) are used irregularly, others are used constantly (like freezers and fridges). Estimating usage is not easy for students so they may need to get help from teachers/staff/volunteers how often particular objects are used.

- count all electrical items in the school
- estimate the duration of use for each item (hours/days)
- find the wattage & cost for each item using the Energy Ready Reckoner

Procedures:

- Introduce the data collection sheets and reinforce protocols: Use a Tally method and fill in a single collection sheet per group.

- Remind students to approach all classes and offices with courtesy and do their best to collect the information without interrupting others.

Students work in teams to visit all areas of the school grounds to collect information on the numbers of lights and appliances in place. Look at map of school and decide how many teams and which areas they will cover (how many teams depends on how many kids and size of school). To ensure there is no double counting, it works well to have one team totally dedicated to lights and 2-3 teams collecting other appliances, either in different sections of the school or collecting for different categories: eg, computers

Counting lights
Students visit their designated areas of the school to count every light bulb and tube in the school – fluorescent, incandescent, floodlights, inside and outside. Some light fixtures can have two or more bulbs or tubes so ensure that these are counted and not the light fixtures themselves. Students also estimate how long per day and/or how many days in a week the lights were used.

Counting appliances
Students visit their designated areas of the school to count every electrical object other than lights. Telephones are not included unless they are the cordless variety or have an answering machine attached to them. Appliances are counted even if they are not in use. Appliances that are not on are accounted for with the usage estimation the students do.

What to do when students return to the base

- Turn tallies into whole number
- Complete the useage columns for each item category
- Where there is more than one team counting appliances or lights, combine numbers from all sheets to form master sheet, or one overall set of results

NOTE: To download a copy of the Energy Calculator go to http://www.wetlands-e.schools.nsw.edu.au/ and click onto Sustainable Schools Program. On a school computer create a folder called "Audits" and save this with the file name ***(School name)*** **Energy Audit** ***DD/MM/YY*****.**

Data collation and analysis

The information gathered about lights and other appliances is put into The Energy Calculator spreadsheet. The spreadsheet gives the student the name of the appliance and the kWh. It asks for the number of items, the hours used per day, the number of days per year and the average wattage of each item. The wattage of the item is obtained from the **Electrical Appliance Running Costs** sheet. Students use the data they collected to fill in the number of appliances. Other information is gathered from the Energy Ready Reckoner or is estimated by students.

8.1 COST CALCULATOR: ELECTRICAL EQUIPMENT									
	Appliance	Number of appliances	Average Wattage	Hours used per day	kWh used per day	Approx. Cost per day (based on 10c/kWh)	Number of days used per year	kWh used per year	Approx. cost per year
eg.	Computer	1	300	6	1.8	$0.18	2	3.60	$ 0.36
1	Inside -				0	$0.00		0	$ -
2	Fluorescent lights	363	40	6	87.12	$8.71	200	17,424	$ 1,742.40
3	Incandescent				0	$0.00		0	$ -
4	Outside -				0	$0.00		0	$ -
5	Fluorescent lights				0	$0.00		0	$ -
6	Floodlight	45	90	10	40.5	$4.05	365	14,783	$ 1,478.25
7	Fans	49	100	6	29.4	$2.94	90	2,646	$ 264.60
8	Air conditioners	12	1000	8	96	$9.60	150	14,400	$ 1,440.00
9	Heaters				0	$0.00		0	$ -
10	Computers	70	100	6	42	$4.20	200	8,400	$ 840.00
11	Printers	14	300	1	4.2	$0.42	200	840	$ 84.00
12	Photocopiers	2	250	3	1.5	$0.15	200	300	$ 30.00
13	Refrigerators	3	260	24	18.72	$1.87	323	6,047	$ 604.66
14	Freezers	2	160	24	7.68	$0.77	323	2,481	$ 248.06
15	Hot water Units	1	2400	24	57.6	$5.76	320	18,432	$ 1,843.20
16	TV	4	200	1	0.8	$0.08	200	160	$ 16.00
17	Video	2	45	1	0.09	$0.01	200	18	$ 1.80
18	Microwave oven	5	1300	0.5	3.25	$0.33	200	650	$ 65.00
19	Stove	2	2400	0.5	2.4	$0.24	200	480	$ 48.00
20	Overhead projector	6	200	1	1.2	$0.12	200	240	$ 24.00
21	Radios	10	45	1	0.45	$0.05	200	90	$ 9.00
22	Jug/kettle	1	1800	0.2	0.36	$0.04	200	72	$ 7.20
23	Pottery kiln				0	$0.00		0	$ -
24	Other	1	750	24	18	$1.80	100	1,800	$ 180.00
25					0	$0.00		0	$ -
26					YEAR TOTALS OF SHEET -			89,261.70	$ 8,926.17

Students fill in only the white columns. The grey columns appear automatically as soon as students have filled all the necessary columns. The program automatically calculates the kWh used per day, the cost per day, the kWh used per year and the cost per year for each object. It also calculates the totals for each year so it provides a good cross reference against the energy bills. It also provides a breakdown cost for each item and it is easy to see where the energy costs go.

Comparing the bill figures and the walk through audit figures

The information taken from the bills is “real” information. It is actual figures on the amount of electricity the school has used, the amount of money the school has paid for that electricity. The figures from the Energy Calculator are only estimates. The Energy Calculator is not a true statement of use, but it can help us find the “hot spots” for energy use in the school.

Energy Ready Reckoner

Appliance	Average Watts	Est cost per hour (c)
Air Conditioner (small)	1000	12.6
Air conditioner (med)	2300	29.0
Air Conditioner (large)	3200	40.3
Air conditioner (ducted)	5000	63.0
CD Player	100	1.3
Clock	6	0.1
Computer (with monitor)	100	1.3
Computer with monitor and printer)	300	3.8
Dishwasher	2400	30.3
Fan (exhaust)	40	0.5
Fan (ceiling)	100	1.3
Freezer (250 l)	160	2.0
Freezer (400 l)	230	2.9
Fry pan	1200	15.1
Heater (oil filled)	2000	25.2
Heater (fan)	1500	18.9
Heater (space)	6000	75.6
Hot water service	4800	35.8
Jug	1800	22.7
Lamp (infrared)	300	3.8
Lamp (ultraviolet)	300	3.8
Lighting - Fluorescent	40	0.5
Compact fluorescent	11	0.1
Incandescent	25	0.3
	60	0.8
	100	1.2
Floodlight	250	3.2
Microwave Oven	1300	16.4
Mini Oven	600	7.6
Mixer (food)	110	1.4
Oven (cooktop)	1500	18.9
Oven	2400	30.3
Overhead projector	200	2.5
Pencil sharpener	20	0.2
Photocopier	250	3.2
Radio/cassette	45	0.6
Refrigerator (average)	260	3.3
Sewing machine	75	0.1
Television	200	2.5
Toaster	1200	15.1
Urn	1800	13.8
Video recorder	45	0.6
Washing machine	900	11.3
Water heater (boiling)	2400	30.0

Energy Audit
School Light Survey

Names of Students:_____

Area	Type of light (Tally results)		Estimated hours used			
	Fluorescent Tubes	Incandescent Bulbs	Floodlights	Per Day	Per Week	Days per year
Classrooms						
Office						
Staffroom						
Library						
Hallways						
Toilets						
Outside buildings						
Outside paths						
Outside covered areas						

Energy Audit
School Appliance Survey

Names of Students:

Item	***Use tally system for counting items***			
	Number of items	Hours per day	Hours per week	Days per year
Fans				
Air Conditioners				
Heaters (not gas)				
Computers				
Printers				
Photocopiers				
Freezers				
Hot Water Units				
TV's				
Video/DVD				
Microwave oven				
Stove				
Overhead projector				
Jug/Kettle				
Pottery Kiln				
Others				

4. Presentation

It is useful for students to present their findings and suggestions to the school using posters and a series of prepared speeches. These posters can be simply done on the day or be given more time on a later occasion.

5. Energy recommendations

- Compare the results of the audit with the information from the bills
- Make recommendations for decreasing the energy use in the school
- Identify actions that could be taken to achieve improvements

Students review the information they have gathered, identify strengths and weaknesses and workshop possible solutions. These are developed as recommended actions aimed at achieving environmental improvements. In the case of the energy audit they would be aimed at using less energy and becoming energy efficient.

Action Plans and the School Environmental Management Plan

Although students are not in a position to develop an action plan for the school, they can put forward recommendations. These can be forwarded to a representative environment committee to be incorporated into an action plan that forms part of the School Environmental Management Plan. School Environmental Management Plans are recommended in the NSW Environmental Education Policy for Schools (2001).

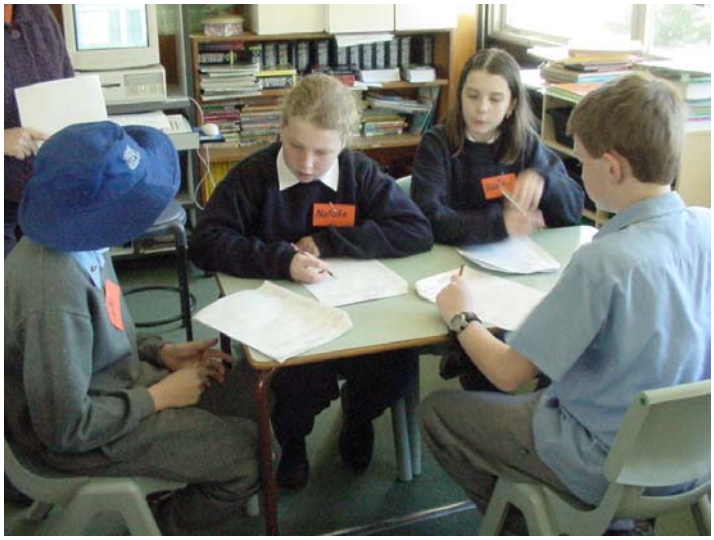
Steps for Action Planning

1. SUMMARISE:
Why am I concerned about the issues?
What do we know about the situation?
What are the possible explanations?
Prioritise the problem areas.

2. ESTABLISH A VISION:
What would you or your group like to do about this issue?
What do we feel like doing?
What are the difficulties and dangers?
What is the thinking task?
What do we know about the situation?
What ideas can we think of?

3. ESTABLISH SOME GOALS:
How will you know when you've got there?
What are the good points?
Can we summarise the good points?

4. DEVELOP AN ACTION PLAN:
What actions are needed to get there?
What are the weaknesses?
How can we overcome them?



5. IDENTIFY REQUIREMENTS:
What people and resources do we need?

6. DECIDE ON A TIME FRAME:
Set a time frame to achieve each goal.
What are the good points?
What are the difficulties?

7. IDENTIFY WAYS TO MONITOR PROGRESS:
How will you work out whether you are on track to achieve your goals?