Interreg CENTRAL EUROPE
ENERGY@SCHOOL
European Union
European Regional Development Fund

UPGRADED DECISION-SUPPORT TOOLBOX FOR SCHOOL ENERGY GUARDIANS

N. OUTPUT O.T1.2

Version 02
11.12.2017

http://www.interreg-central.eu/Content.Node/ENERGYATSCHOOL.html

Edited by CertiMaC

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1. Energy@School - Project overview

The building sector has high potential for energy optimization being the most consuming one in EU. In terms of public buildings heritage, energy consumption in schools is the second highest expenditure of Municipalities total running costs. This sector offers potential remarkable achievements in terms of Energy Efficiency (EE), Renewable Energy Sources (RES) application and carbon footprint reduction and several disparities exist among Central Europe countries as for planning and implementing performances of proper sector-based strategies, action plans and managerial capacities.

With reference to the **public stock of buildings and infrastructures**, for sure educational facilities are an important opportunity to achieve substantial energy savings, as they constitute a relevant part of the overall amount of energy consumption and therefore of the expenses paid by the national budgets. Energy consumption in schools is the second most significant expense to total running costs and they account up to 70% of the thermal energy cost of Municipalities. Schools, being such an important line in energy-related budget, represent an important sector of public administration to tackle with reference to buildings' upgrade, retrofitting and renovation. Furthermore, schools are the best environment for behavior change and awareness raising of students and, indirectly, their families because they are the privileged place for the dissemination of culture and information as a whole and therefore also in the field of energy saving and efficiency. Consumption in schools can be quite variable depending on country, climate, building year of construction and type. However, considering an average energy use profile, consumes can be roughly divided as follows: 47% heating; 14% lighting; 10% cooling; 9% ventilation; 7% water heating; 4% PC; 2% refrigeration; 1% cooking; 1% office equipment; 5% other. It is estimated that just by making small changes in behavior, schools could save up to 20% of their energy use (and bills). This amount can noticeably increase if energy retrofit interventions are associated to behavioral changes (e.g. around 50% with 0.5 to only 2 years payback period).
Public building sector with reference to schools is therefore one of the main issues and there is concrete need to develop energy-efficient management for schools and strategies on how to improve the energy efficiency. There is also need to raise the awareness of school staff and students, and to involve them in the energy saving activities. People have a crucial role in this process, therefore they need to be supported and provided with the best available solutions.

Main ENERGY@SCHOOL objective is to increase the capacity of the public sector to **implement Energy Smart Schools**, by application of an integrated approach that **educate and train schools staff and pupils to become Senior and Junior Energy Guardians (EGs) who will engage on progressive and sustainable energy efficiency of buildings and an adequate transfer of a correct attitude towards energy consumption ("energy culture").** Thanks to a commitment to high-performance schools, many school districts are discovering that smart energy choices can have lasting benefits for their students, communities, environment. The key idea is to provide concrete technical Tools and Devices and

specialized trainings for School Planning Managers on financing opportunities, designing, operating & maintaining energy solutions. The innovative character lies in the active involvement of employees, experts, students, teachers, families in the process of transforming the school into an energy smart school through specific and targeted training and education activities.

The project will therefore address common barriers associated with energy smart-school management, it will develop and provide a Methodology & Approach usable and replicable within other school buildings, together with the necessary Tools, Devices & Protocols. In this way all parties involved in the energy decisions of a public school (technicians and ICT professionals, administrators, school employees Energy managers) can face in a coordinated manner the issue of Energy Efficiency by implementing effective and validated solutions.

The project will deliver:

- ⇒ 1 Common/Transferrable and 8 customized Strategies for Smart Schools,
- ⇒ 1 joint and 7 customized Energy Smart-school Management Plans,
- ⇒ 3 smart phones APPs for Energy Guardians,
- ⇒ 8 tested pilot solutions of EE & RES application in schools under direct contribution of Energy Guardians, in the form of Guidelines, Toolbox, Best Practices as reference documents and experiences to be capitalized far beyond the project end.
- ⇒ Training & education programs as adaptable & replicable models for capacity-raising and Energy Culture rooting.

ENERGY@SCHOOL expected results:

I. Optimization of energy consumption in schools,
II. Concrete and progressive increase of EE and RES use in schools not only thanks to technical application of smart solutions, but also to non-technical factors such as a better management capacity and responsible behavior toward energy use,
III. Increase of capacity of public sector to deal with increase of EE and RES use in schools thanks to strategy, action plans, tools (methods, approaches), trainings, pilot actions defined and implemented within the project,
IV. Increase in managerial and organizational competences as well as in human resources to ensure the progressive and sustainable energy efficiency and renewable energy se in public schools (trainings),
V. Creation of conditions for new job opportunities (trainings)
VI. Creation of “energy culture”, thus responsible attitude towards energy use, thanks to education and raising awareness activities, as it is demonstrated that amount of saved energy can noticeably increase if energy retrofit interventions are associated to behavioral changes

List of Project Partners

1 Union of Municipalities of Low Romagna Region, Lead Partner – Italy
2 CertiMaC s.c.r.l. - Italy
3 City of Bydgoszcz - Poland
4 ENERGY AGENCY OF SAVINJSKA, ŠALEŠKA AND KOROŠKA REGION - Slovenia
5 City of Karlovac - Croatia
6 University of Bologna - Dept of Industrial Chemistry - Italy
7 Municipality of the CITY Szolnok with County Rank - Hungary
8 Local Government of Town Újszilvás - Hungary
9 City of Stuttgart - Germany
10 Klagenfurt - Austria
11 Graz Energy Agency - Austria
12 City municipality of Celje - Slovenia

Responsible Partner of Thematic Work Package "Analysis phase and definition of Energy Guardians Smart-school Management Plans" and the present document: CertiMaC – Research Laboratory -Italy.

2. Introduction

Energy@School project is based on an integrated technical, applicative and educational approach allowing to effectively tackling Energy Efficiency and RES related issues in schools with a long-term vision, creating broader energy smart schools. For this reason, one of the main activity within project's purposes is to provide concrete technical Tools and Devices and specialized trainings for schools' staff and pupils to become Senior and Junior Energy Guardians. This innovative character lies to the active involvement of students, teachers and families in the process of transforming the school into an energy smart school, through specific educational activities.

In order to orientate EGs on decisions and actions they can or have to undertake for the optimization of energy consumptions and savings in their school, a set of programs and tools have been selected and analysed. Starting from the checklist of tools provided by D.T1.5.1 *("Report of existing decision-support tools"),* an upgraded Decision-support Toolbox for EGs has been carried out. Within the wide range of available tools, the most relevant ones have been selected to get used within Energy@School project. Thanks to the analysis of their contents and usability, the main representative tools have been identified, in order to be used by EGs. Indeed, these selected tools provide a wide range of guidelines, information, apps and behaviours' checklists to be undertaken in order to increase energy efficiency inside school buildings and they can be easily adapted and used within the aims of the project.

The selection of tools has been made also thanks the contribution of PPs, which have tested and analysed tools in own school-facilities, in order to verify the usability of tools in different territories. Thanks to PPs feedbacks about the usability of tools, this group of selected tools has been upgraded, taking into consideration possible improvements and changes that should be made to adapt them, in order to give support to EGs during EE interventions.

The Output contains a thorough description of five selected tools, highlighting how they can be concretely helpful to EGs for making decision and be adapted for any school-buildings' situation in each PPs country.

For each tool listed below, the link to the downloadable electronic form (free of use) is supplied.

3. Decision-Support tools: contents and usability

Within the wide range of available tools, thanks to the analysis of their contents and usability, the most relevant ones have been identified and selected to get used within Energy@School project. In particular, five tools have been checked and in depth analysed, in order to identify how they can concretely help EGs on decisions to undertake for optimization of energy consumptions in schools.

With reference to the contents, several main topics can be generally identified in the tools:

- General information
- Energy Policy
- Setting up an energy team
- Energy management self-assessment
- Energy Action Plan
- Education material
- Gaming

Tools, selected on the basis of their contents and usability within the project, are representative of each of these main topics. In particular, the five selected tools are referred to:

- **Energy Management Process – Guideline**
- **Guideline for Energy Action Plan**
- **Template for Energy Saving**
- **Saving Energy Teacher Guide – Educational Tool**
- **Energy Games for Kids**

3.1. Energy Management Process Tool - Guideline[1]

You can download the tool ready to be used here:
http://www.bathnes.gov.uk/services/environment/sustainability/schools

The aim of energy management process in school is to get the best conditions for learning with the minimum possible energy use. This will ensure minimum carbon emissions and maximum funds available for education. According to this, energy management process is how a school protects itself from rising energy prices, engages pupils and staff, provides a comfortable space for learning and integrates this work into the curriculum. The system comprises improvements to buildings and equipment, behavior change and energy awareness, policies and management processes and curriculum based learning. All these elements are necessary for a successful energy management system which will reduce energy school costs and carbon emissions, whilst creating a more comfortable learning environment and equipping pupils with the skills and knowledge they need for the future.

With reference to this issue, this tool provides several information about the energy management process, particularly taking into consideration behavioral changes and actions to be undertaken in order to achieve a good level of energy management in schools.

In order to assist EGs in setting up and running the energy management program in schools, several activities and guidelines are foreseen for teachers and students within this tool. The main steps to carry out a thorough energy management process are described below.

Thanks to the thorough information provided, this tool represents a suitable guideline for students and teachers, which can put in place these recommendations in own school and achieve important results in energy saving. These guidelines can be applied easily in any context and territory and for this reason they are very useful to EGs to carry out an energy management process in schools.

[1] The tool has been taken from "Energy Management in Schools – Program" developed by Bath and North-East Somerset Council (UK)

Energy Management Process

Graph 1 – Energy Management Process Tool – Main steps to implementation a good energy system in school

1. Set up your Energy-Team

The definition of pupils and staff which will play an active role in the energy management process in school is the first important step in order to achieve high results in energy saving. The process should involve the whole school, from students to teachers and principals.

Step 1: Decide which staff will be in your team and then open it out to self-selection or election by the pupils.
The Energy-Team usually consists of pupils with one teacher supporting them. It's possible combine it with the school council, but this group does need to include senior management staff as well.
Step 2: Educate your team about climate change and energy efficiency
Make sure they are really knowledgeable about the importance of energy and climate change, at an appropriate level for their age. It is important that pupils have significant input into the decision-making process.
Step 3: Set up the times and places for your team to meet, including when they will report to the management team and governors.
Your Team may not meet as a whole but one group could focus on building use (facilities and senior management) and one group focus on occupant use (pupils and teachers). The team should report to the Senior Management Team and Governing body on a regular basis.

What will Energy-Team do?
Your pupils' Energy-Team will be responsible for reviewing the current situation, developing an action plan, and monitoring, recording and reducing your energy use. They will particularly be responsible for communicating to your school, conducting switch off campaigns and measuring how much energy is saved or wasted by occupant behaviour.

Table 1 – Energy Management Process Tool - Several indications to set up the energy team

2. Self-Assessment – Review the Matrix

The Matrix is a very useful guide to quickly assess your current position on key sustainability topics and where you want to go.

Step 1	With your energy team and senior management reps, review each section of the matrix and discuss where you place yourself for each lever. Head teachers will have already completed this assessment as part of the energy survey and the results can be found within that document. However, it is very beneficial for your energy team to discuss this together so they understand the range of topics they are responsible for.
Step 2	Mark your score on the matrix alongside the date for the next review. This will make it easy to track improvements over time
Step 3	Prioritise which sections you would like to work on and include these in your action plan

Table 2 - Energy Management Process Tool - Several indications to make the Self-Assessment by reviewing the Matrix

Levers	Progress			
	weak	fair	good	excellent
Policy	No strategic approach or policy to deliver a low carbon school.	Basic strategy and energy policy in place but not implemented or followed	Formal energy policy and low level commitment. Energy and carbon prioritised.	Strong approach, taking advantage of national schemes, funding and community leadership opportunities. Senior Management Team committed to energy policy and action plan, with effective monitoring and prioritisation of actions.
Investment	No Investment in improving the energy efficiency of buildings	Only low cost measures taken	Short term payback projects carried out	A strategic approach to funding showing green approach in investment appraisal of all new build and refurb. At least 10% of the organisation's energy bill being invested in energy efficiency per annum.
Management	No defined delegation of responsibilities for energy management i.e lack of clarity on responsibility for controlling heating	Energy management responsibility identified but lack of authority, line management or co-ordination.	Energy co-ordinator responsible to senior management and governors	Energy management fully integrated into management structure with clear responsibilities and resources
Education	No teaching about energy efficiency	Some identification of opportunities for using the school to teach about energy efficiency	Co-ordinated approach to energy efficiency education, linked to the energy policy	Full involvement of pupils in energy management of the school, appropriate to pupils age

Picture 1 - Energy Management Process Tool – Matrix for the self-assessment. Part1

Levers	Progress			
	weak	fair	good	excellent
Involvement of Pupils in reduction of energy wastage	No attempt to involve pupils in reduction of energy waste.	Some use of posters, stickers, leaflets etc to remind pupils to switch off lights and appliances.	Regular, active campaigns led by pupils. No feedback provided on effect of campaign.	As 'good', but using AMR or OWL meters to feedback results of campaigns to pupils. Also including energy waste reduction into curriculum activities
Staff motivation and involvement	Minimal energy efficiency training.	Some energy efficiency training for some staff. Some consideration of staff's energy use in their own homes, for example distribution of Energy Saving Trust Advice Centre materials or equivalent.	Energy efficiency training included in induction and in refresher courses as part of coherent strategy. Regular energy efficiency campaigns for staff, covering energy use at work and at home.	Departmental targets set and staff aware of their contribution towards the target. 'Energy champions' scheme in place with one staff champion per year. Incentives and feedback for staff achieving targets.
Community Engagement	No attempt to engage parents in low carbon activities.	Occasional engagement with parents on curriculum linked activities such as homework or home energy projects	Ad hoc and one off events / work shops /open days for parents and wider community on carbon reduction work	Planned Programme of engagement and events for parents and local community, including working with local community groups
Information and Communication	No meter readings recorded, bills or AMR data analysed No communication of energy performance	Monitoring and targeting reports based on meter readings or AMR data or OWL readings, reports. Performance and plans for improvement communicated to all building users	Comprehensive system to set targets, monitor consumption, identify faults, quantify savings and incorporate into budgets	Progress, savings, future plans, and energy performance all communicated to all building users, parents and governors.
Equipment, including Catering and Science Teaching Equipment	No thought given to energy consumption of equipment in use.	High energy consuming equipment is identified and staff are encouraged to take measures to reduce consumption, by switching off or using low energy settings where possible.	As 'fair', with plans to replace current equipment with more efficient equipment at end of life.	As 'fair', with plans to replace current equipment before the end of its life, with calculations to show where this is more cost effective than using current equipment to the end of its life.
ICT	No green ICT strategy or policy in place or measures taken to reduce associated energy impacts.	Automatic switch off installed for computers.	Thin client* computers or laptops / tablets used or part of planned replacement where appropriate,	ICT teaching utilises school energy data and ICT is used to display energy data in conjunction with AMR data where possible
Use of renewables and low carbon technologies on own buildings	No consideration of use of renewables or low carbon technologies on own buildings.	Organisation is looking for opportunities to use renewables or low carbon technologies on its own buildings.	Renewables/low carbon technologies installed on own buildings (new and old) and organisation is actively looking for further opportunities to install more.	As Good but also monitor and measures renewable generation and feedback to school users and include in curriculum activities

Picture 2 - Energy Management Process Tool – Matrix for the self-assessment. Part 2

3. Write your Energy Policy

An energy policy is a written document stating the way the school will use energy and what targets it hopes to achieve. It should show how it intends to go about meeting such targets, state how it will involve pupils, what it expects of teaching and support staff and plan for how it will continue improving energy efficiency and reducing carbon emissions in the future.

The policy should be developed by the energy team in consultation with other teaching and support staff and pupils. Although members of the energy team should take the lead on developing the policy, consultation with other pupils and staff can be the first step in securing commitment from the whole school community.

Your energy policy summarises and communicates your energy management system. A good policy energy should include:

- Statement of commitment
- Clear and achievable objectives and targets for energy consumption
- Role, responsibilities and resources
- Action plan and the statement of the mechanism to implement it

4. Monitoring and Targeting

The most essential step in energy management is to monitor your energy use in order to identify targets for reducing it. Analysing and understanding your hourly, daily, weekly or monthly, annual use will immediately show you where energy is being wasted.

The Energy-Team can have a large role in monitoring and targeting by regularly checking for waste and communicating energy data to other school users. Pupils and staff are the best asset when it comes to energy efficiency and energy management. Thanks to the monitoring activities made by the Energy-Team, it will make savings overnight by cutting waste, e.g. by moving book cases away from the front of radiators. Using the available data to give information on energy use will ensure they concentrate on the most effective actions.

Which monitoring activities can Energy-Team do?
• Conduct a survey to find out how many lights / IWBs / monitors / appliances are left on unnecessarily during the school day. Identify any areas of good practice, and those where there is scope for savings • Conduct a survey to find out more about room temperatures around the school. Use a map of the school to colour code rooms which are too cold, too warm, and at a suitable temperature for learning • Design a questionnaire to gather pupils' and teachers' opinions on room temperatures. • Design a questionnaire, or carry out interviews, to find out about adults' knowledge of room temperature controls and how to use them. • Set up a suggestion box to allow all users of the building to feed in ideas about how the school could save energy

Table 3 - Energy Management Process Tool - Several indications to monitoring the process

5. Define the Action Plan

Your Energy-Team should write the action plan using the recommendations from your energy survey and from the results from your review of the Matrix. A good action plan should include:

- How you will continue to go about the monitoring and targeting of your energy use
- How you will review your energy policy and the other tasks mentioned in this guide
- The list and timescales for the energy saving projects you will be carrying out
- A top line target for energy reduction
- Your plans for switch-off campaigns and involving pupils

The Energy-Team, should discuss this energy audit and decide the best way to implement the actions suggested including how to involve all users of the school buildings in raising awareness of energy issues and implementing change.

Which planning activities can Energy-Team do?
• Appoint pupil energy monitors. Decide on their responsibilities e.g., switching off lights / monitors when leaving the room; reminding the teacher to switch off the interactive whiteboard; opening / closing blinds to make best use of natural light; monitoring room temperature. • Use coloured stickers on light switches and sockets to show which ones must be left on, and which can be switched off when not in use. • Conduct a teacher information session to ensure all staff know about the behaviours you want them to adopt and why. (Older pupils will be keen to 'train' their teachers, and staff are likely to respond more positively when requests for behavioural change come from their pupils.) • Conduct unannounced spot checks on empty rooms to see if lights / equipment is being turned off when not being used. • Consider ways to reward people for energy efficient behaviours, and to celebrate successes. • Raise awareness of the school's energy usage by running a 'low energy' day when you challenge to school to use as close to zero energy as possible for one day

Table 4 - Energy Management Process Tool - Several indications to define the action plan

6. Plan communication activities and behavior change

An effective energy management process needs to be communicated to all schools' users regularly. Visual, high level support gives a clear message to the school community. Everyone must know energy management process objective and be in agreement. If contractors are used for preparing food on site or cleaning the school, make sure energy efficiency behaviour and equipment is written into their contract. Regular slots in staff meetings, assemblies, a dedicated notice board or section of the school newsletter and permanent agenda item for Principals meetings can be a structured way to report the progress and results achieved.

Which communication activities can Energy-Team do?
• Display energy data (e.g. electrical/gas consumptions) in a pupil friendly format • Conduct assemblies to share your plans and motivate pupils and teachers to adopt energy efficient behaviours. Set a target that everybody can work towards together (e.g., a 10% reduction in electricity use / a 50% reduction in lights left on in empty rooms.) • Consider who else needs to be involved and how best to communicate with them e.g., cleaners, leaders of breakfast / after-school clubs, sports coaches, midday meal supervisors, office staff. • Design posters and signs to stick around the school. • Consider other ways of spreading the message e.g., composing a rap / making videos; using existing communications systems such as school newsletters.

Table 5 - Energy Management Process Tool - Several indications to the communications activities

7. Review and Report Progress

The most important part of communication is to make sure your report back to the school users on your and their progress. It is motivating to know that actions are making a difference.

Which activities can Energy-Team do?
• Ensure that reasons are given for any progress or no progress and report back along with new information and ways to reduce. • Ensure you review your action plan annually as your pupils leave and new pupils join. Ensure you review the targets set in the action plan and re-assess latest energy data. • Re-inforce messages as to why this is important, and how much everyone is doing in your school and other schools.

Table 6 - Energy Management Process Tool - Several indications to review and report process

3.2. Energy Action Plan Guide [2]

You can download the tool ready to be used here:

http://www.cibse.org/getmedia/082e52c7-b87a-404d-a4d1-68d0e8e0cf20/ECG73-Saving-Energy-in-Schools.pdf.aspx

All schools are responsible for managing their energy, although it is likely that most schools have historically given little attention to controlling energy costs. Behavioural changes in the management of schools can be an opportunity to give energy management a higher priority. Indeed, the way in which staff and pupils use a school can have a significant effect on its energy bill. By adopting good housekeeping practices, such as switching-off lights when not required, closing windows and regular checking of heating control settings, energy costs can be cut by at least 10%.

The implementation of an energy efficiency action plan is fundamental to manage the several activities foreseen for schools' staff and pupils, in order to improve energy saving into schools.

According to this matter, this tool provides guidelines and indications to improve energy efficiency in schools. It is written for individuals with responsibility for the day-to-day running of a school, purchasing of fuel and long-term planning and budgeting for energy costs. It will, therefore, benefit headteachers, principals, premises managers and energy managers.

The Guide provides, in particular, specific indications, a checklist of preliminary actions to undertake and a template for implementing a successful energy action plan, highlighting also the importance of the monitoring activities that have to be taken at the end of the process.

The information provided in this tool represents a useful guide to energy managers, in order to carry out an efficient energy action plan within schools. The Guide is particularly suitable for pupils, thanks to its easiness of use and understanding, and can be applied by Junior EGs for energy saving, in any context and territory. It represents, therefore, a good support to orientate EGs on decisions/actions to be undertaken for energy efficiency improvement in schools.

[2] The tool has been taken from "Saving Energy in Schools – Program" developed by the "Energy Efficiency Best Practice programme" (UK)

Headteacher

School energy manager

Caretaking staff

Energy monitors

ACTION PLAN

You can start reducing the energy costs of your school by implementing an 'energy action plan'. Although the plan will vary from school to school, it is likely to consist of actions and activities to monitor energy use, analyse data, identify areas of high consumption, implement good housekeeping measures and recommend energy efficiency improvements.

An 'energy survey' should be considered for inclusion in the energy action plan. This involves going round the school and making a list of energy-consuming equipment and its use.

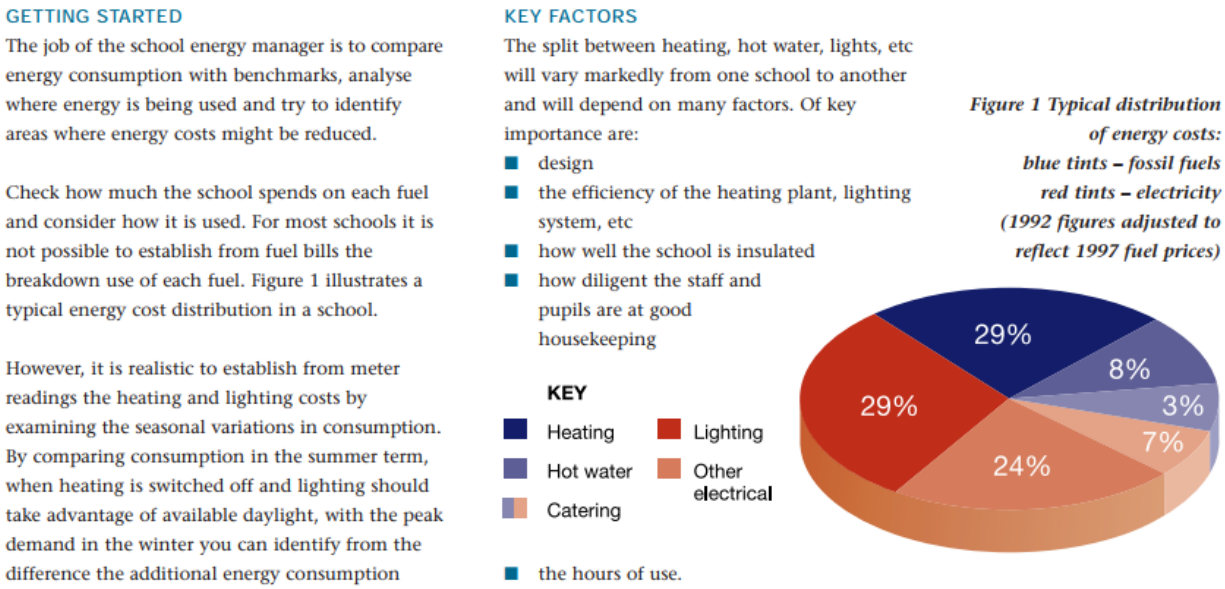
THE SCHOOL ENERGY MANAGER

Newly designated school energy managers can readily make significant energy savings when the school buildings or boilers are in a poor state. The worse things are, the easier it may be to find ways to improve them. Savings of 10-15% are readily achievable in most schools and it is not unknown for a conscientious manager, teacher or governor, acting as energy manager, to reduce a school's energy bill still further[6,7].

Wherever your starting point, improvement is always possible by:

- motivating staff and pupils to adopt good housekeeping practices
- ensuring that the heating system is running at optimum efficiency and that there is a regular programme of checking thermostats and time switch settings, boiler maintenance and so on
- identifying where investment can achieve worthwhile energy savings, eg more energy-efficient light fittings, or zoning and better controls for the heating system.

Picture 3 – Energy Action Plan Guide. General information about the importance of improve an energy action plan. Source: "Saving Energy in Schools – Program"



GETTING STARTED

The job of the school energy manager is to compare energy consumption with benchmarks, analyse where energy is being used and try to identify areas where energy costs might be reduced.

Check how much the school spends on each fuel and consider how it is used. For most schools it is not possible to establish from fuel bills the breakdown use of each fuel. Figure 1 illustrates a typical energy cost distribution in a school.

However, it is realistic to establish from meter readings the heating and lighting costs by examining the seasonal variations in consumption. By comparing consumption in the summer term, when heating is switched off and lighting should take advantage of available daylight, with the peak demand in the winter you can identify from the difference the additional energy consumption required to heat and fully light the school.

KEY FACTORS

The split between heating, hot water, lights, etc will vary markedly from one school to another and will depend on many factors. Of key importance are:

- design
- the efficiency of the heating plant, lighting system, etc
- how well the school is insulated
- how diligent the staff and pupils are at good housekeeping

KEY

Heating
Lighting
Hot water
Other electrical
Catering

- the hours of use.

Figure 1 Typical distribution of energy costs: blue tints – fossil fuels red tints – electricity (1992 figures adjusted to reflect 1997 fuel prices)

Picture 4 - Energy Action Plan Guide. General information about the key factors of an energy action plan. Source: "Saving Energy in Schools – Program"

In order to implement a successful energy action plan, a checklist of preliminary actions to be undertaken can be very useful for EGs to use in schools. Table 7 shows a checklist of actions that can be taken by EGs at the beginning of the planning. Moreover, Table 8 shows an example of format to develop concretely an energy action plan, taking into consideration in particular the list and timescales for the energy saving projects that it will be carrying out and the achieved results.

Gain the support of the headteacher and Principals	✓
Appoint a "school energy manager". This could be a school administrator, bursar, school manager, teacher, principal or interested parent	✓
Secure the cooperation of the caretaking staff. Their experience is important in the setting up and execution of an energy action plan	✓
Nominate pupils to act as energy monitors in each class. They will be responsible for turning off lights and equipment, closing windows, etc..	✓
Involve the whole school. This may take the form of project work, theatre groups, poster competitions, in order to increase energy awareness among pupils and staff	✓
Identify and secure support and finding	✓

Table 7 – Energy Action Plan Guide. Checklist of preliminary action for implementing a successful energy action plan

Date Action Plan was developed: …			Action Plan developed by: …		
Topic	**Action**	**Target/ Measure**	**Timescale/ Deadline**	**Responsibility**	**Evaluation of action & Actual result achieved**

Table 8 - Energy Action Plan Guide. Template for develop an Energy Action Plan

WHERE ENERGY IS WASTED

It is worthwhile undertaking a regular energy walk-round, to check for any maintenance problems, unnecessary waste and future investment opportunities. For this, it is best to ask the headteacher (or deputy), bursar or school administrator, the school energy manager (if different), the caretaker and perhaps an energy specialist from the local authority to discuss plans. See Good Practice Guide 57, 'Conducting an energy walk-round. A guide for school energy managers, headteachers and governors'[9].)

MONITORING

Measuring energy consumption by taking meter readings is an essential part of managing energy costs. Regular monitoring can be useful to:

- check fuel bills are correct when authorising payment
- measure changes in consumption due to the introduction of new plant and equipment or energy-awareness campaigns
- establish typical weekly or monthly consumption of electricity, gas, coal, water, etc so that you can spot abnormal consumption
- check if spending is consistent with budget allocation.

The first step is to find the meters and establish the purpose of each one. Remember that caution may need to be exercised, for example, when meters are housed in areas that are unsuitable for pupils to enter. There may be several electricity meters for different tariffs, 'head' meters (used for payment) and sub-meters (to check how much fuel is used in a part of the school). For example, many school kitchens have a sub-meter to enable fuel for catering to be costed separately. Check that meter reference numbers correspond with those on the fuel bills. Start a regular meter-reading programme and consider organising a supervised rota of school pupils to help.

FUEL PRICES AND CLIMATE

Fuel prices and the external climate change from year to year. It is a simple matter to compare consumption in terms of kWh, litres, etc. This avoids the distortion of fuel price movements, but an adjustment must still be made for the external climate if you wish to make an accurate year-on-year comparison[2,5].

The total deregulation of the gas and electricity markets means that consumers are no longer limited to purchasing gas and electricity from their regional supply or distribution companies. Many schools are already benefiting from deregulation, including most secondary schools. Deregulation creates competition between the supply companies and provides the consumer with greater purchasing options. Schools should take advantage of this situation, by securing the most appropriate tariff or contracts. It is advisable to seek professional help when negotiating for a better tariff structure.

Avoid the danger of lower costs per kWh leading to complacency and, even worse, resulting in increased consumption levels. Cheaper tariffs should be used to cut energy costs in conjunction with energy efficiency measures and good housekeeping.

HOURS OF USE

The effect of extending the hours of use of a school can be seen in figure 3. The normal hours of use of your school are not likely to vary much from one year to the next. However, with LMS, more schools are hiring out their buildings. Taking weekly meter readings will allow the average energy cost for the school to be calculated. This can then be used to estimate the amount to charge to cover the cost of heating and lighting during the extra hours of use.

When the heating system is controlled within different areas (zoned), only provide out-of-hours heating to the areas being used, not to the whole school.

Picture 5 – Energy Action Plan Guide. Information about monitoring. Source: "Saving Energy in Schools – Program

3.3. Templates for Changes[3]

You can download the tool ready to be used here:
http://www.enviroschools.org.nz/energy_efficient_schools_large.pdf

Knowing where school's energy comes from and how staff and students use it, is a crucial first step to understand what changes can be made. Energy efficiency is a broad issue that needs to be tackled on many fronts. It's not a task that it can tick off and put aside. It requires a change of attitude, planning small steps, and taking action. Making change to a school's energy-efficiency practices may be coordinated by the principal, property manager, caretaker, or a teacher. However, successful schools tend to involve the whole school and involve students throughout the process.

According to this, the tool provides several templates for the implementation of "towards-changing activities" that can be taken both by teachers and students, in order to foster the behavioural change and improve energy efficiency in schools. In particular, checklist of "housekeeping" measures and template for the develop of an energy audit process in schools are provided. Using energy-audit information, staff and students can make informed decisions on how to manage the school's energy use. Moreover, several templates that represent planning tools to help schools become more energy efficient, are provided. They can assist EGs to map their school's energy use and then to plan change.

The tool aims to assist students, teachers, principals, caretakers and energy managers to improve energy efficiency, move towards sustainability and model good energy-efficiency practices, making behavioural changes and specific "day-to-day" measures and activities.

Information, activities and template provided are easily applicable in any school context and territory and suitable both for teachers and students which can collaborate in the energy action planning, in order to achieve important energy saving results. The templates can be easily used in any school context or territory, thanks to their simple and useful content.

Energy Audit Template

An energy audit is an important first step towards changing both energy consumptions and behaviors with negative relapses on energy efficiency. It may be an across-the-school audit or it may focus on selected areas, and it may be conducted by staff and students or it may involve a professional energy expert.

[3] The tool has been taken from "Energy-efficient Schools – Enviroschools Program" developed by Enviroschools Foundation, in partnership with EECA – Energy Efficiency and Conservation Authority – and NERI – National Energy Research Institute – in New Zeland

In particular, the audit process includes several “day-to-day” energy practice, that could be part of a staff member’s role and it could be performed by students. Indeed, students should be involved in the audit process as it is a significant learning opportunity.

To become more energy efficient, it is important to know how energy is currently being used. This template assists schools to determine their energy use and type. It will provide the base information for improving both energy efficiency and energy sustainability.

Ideally, students use the template as part of their learning. Improving energy efficiency is a gradual process. Once you have identified what energy you use and where/when and how, making change may be best done by choosing two or three priority areas. This involves changes to technology and changes to practice.

A starting point could be to monitor how much energy your school uses. Consider all energy sources, e.g. electricity, gas, coal, firewood, solar, wind, and wood pellets for a calendar year in terms of amount of each fuel used and supply costs. The next step may be measuring the energy use of specific electrical items. This can be as simple as determining the draw (wattage) and hours of use of each item.

Energy use	Detail	How many	Load [Watts]	Time on [Hours per day]	Use [kW per day]	Energy Source [Fuel type]	Renewable energy [Y/N/Mixed]
Lighting	Low-energy lamps High-energy lamps						
	Lighting organization	Good ¤		Could be improved ¤		Poor ¤	
Heating	Boiler/radiators Coal stoves Gas heaters Electric heaters Air conditioning Swimming pool						
Equipment	Computers Printers Photocopiers Projectors Whiteboards Faxes TVs						

	Video recorders Speakers Lawn mowers Power tools Pool filter pump Fridges Dishwashers Microwaves						
Hot Water	Storage cylinders Kitchen instant Kitchen jugs Coff ee machines						
Transport	Vans Buses Staff who car pool, walk, bike, bus, or train Students who car pool, walk, bike, bus, or train						

Table 9 – Templates for Changes. Energy Audit Template

Simple fix Template

A school can immediately improve its energy conservation through simple "housekeeping" measures and simple fixes. Then, by using energy-audit information, staff and students can make informed decisions on how to manage the school's energy use. Several main housekeeping measures to be undertaken by students are described in the following template (Table 10).

Not lighting and heating unused space Leaving lights on to save money is myth. Even fluorescent lights should be turned off when they are not required for 10 minutes or more. Research suggest this can save 8-20% of lighting costs.	✓
Clear labelling of switches to make it easy to light a specific area of a room.	✓
Closing doors and windows to retain heat. However, it's important to provide adequate ventilation to limit CO2 levels in classrooms.	✓
Developing a school culture of energy efficiency is important, but a backup is to appoint energy monitors who carry out set tasks on a daily basis and report back on everyone's performance.	✓

Daily use of a pool cover is probably the single greatest energy-management technique for pools. Pool covers may be left off when the pool is not in use, including by outside groups using the pool.	✓
Turning equipment off when it isn't in use, e.g. the computer monitor typically uses 67% of the total energy used by the computer system. Check that everyone is aware that screen savers don't save energy. Equipment may be turned off during the summer break, e.g. fridges may be emptied and switched off.	✓

Table 10 – Templates for Changes. Checklist of housekeeping measures to improve energy efficiency in schools.

Energy Use	Check	Yes/No	Priority (High/Medium/Low)
Lighting	• Is there over lighting in any rooms? • Are low-energy bulbs used throughout? • Are lights turned off when not in use?		
Heating	• Do all opening windows close tightly, especially louvers? • Are exterior doors closed during winter, e.g. are they fitted with spring-loaded closures? • Are there draughts around and under doors? • Do heaters have timers or thermostats? • Is the heating 20°C or lower?		
Equipment	• Is equipment turned off at the wall overnight? • Are computer monitors turned off when not in use? • Is the back of the fridge well ventilated and clear of dust? • Are the fridge temperatures set in the range 2-5°C? • Are the fridges defrosted? • Is the dishwasher used on the economy cycle and only when full?		
Hot water	• Do old hot-water cylinders have cylinder wraps? • Do showers have low-flow heads (less than 10 litres/minute)? • Is hot water in the range 50-55°C at the tap? • Do any hot-water taps drip? • Are all hot-water pipes lagged? • Is the swimming pool covered when not in use?		
Transport	• Is there a student-transport scheme, e.g. walking school bus or car pool? • Is there a staff car pool scheme?		
Other			

Table 11 – Templates for Changes. Simple-fix: useful guide to energy action planning

Long-term planning template

After the 'simple fixes', many major inefficiencies that may take up to 10 years to change are likely to remain. They may include both energy inefficiency and the use of energy sources that severely damage the environment.

Energy Efficiencies	Scheduled	Comment
Control systems • Can heating be centrally controlled? • Are switches easily accessible? • Does switching enable specific areas only be lit? **Lighting** • Are the fittings appropriate? • Is light saving technology in place: timers, dimmers, or occupancy detectors? • Do interior paint colours minimise lighting requirements?		
Insulation **Are the following insulated:** • Ceilings? • Windows – double glazing? • Underfloor? • Walls?		
Solar water heating • Is the swimming pool heated by solar power?		
Boiler • Does the boiler use renewable energy? • Does the boiler have a timer and is it working properly? • Has the boiler been tuned in the last year (does it smoke, run hot, or run erratically)?		
Does all equipment have a: • High energy-efficiency rating? • Manual switch-on / automatic switch-off system?		
School transport energy • Are school vehicles efficient energy users? • Is there a transport plan?		

Table 12 – Templates for Changes. Longer-term planning template: Checklist of energy efficiencie

Month	Check	✓	Comments
January	• Swimming pool filter pump is only running when needed • Insulation in the ceiling and around the hot water cylinder and pipes is in place and dry • Water at hot water taps is in the range 50-55°C		
February	• Heating system is set to provide room temperatures in the range 16-20°C • Swimming pool filter pump is only running when needed • Turn on hot water cylinders		
March	• Swimming pool filter pump is only running when needed • Window and door seals are in good condition • Boiler and radiators are opening properly; flue pipe and stack aren't corroded		
April	• Swimming pool filter pump is only running when needed • Turn hot-water cylinders off for the holidays		
May	• Boilers is operating only when needed • Other heating is operating only when needed • Room temperatures are maintained		
June	• Boilers is operating only when needed • Other heating is operating only when needed		
July	• Boilers is operating only when needed • Other heating is operating only when needed		
August	• Boilers is operating only when needed • Other heating is operating only when needed		
September	• Boilers is operating only when needed • Other heating is operating only when needed • Turn hot-water cylinders off for the holidays		
October	• Boilers is operating only when needed • Other heating is operating only when needed		
November	• Shut down heating system • Swimming pool cover is in good condition • All pool users, including after-hours users, cover the pool after use • Swimming pool filter pump is only running when needed		
December	• Swimming pool filter pump is running only when needed • Turn hot-water cylinders off for the holidays • Total school year energy usage is compared to the previous year		

Table 13 – Templates for Changes. Energy-efficiency schedule: checklist of action to be taken during schools' period.

3.4. Saving Energy Teacher Guide – Educational Tool[4]

You can download the tool ready to be used here:
http://www.need.org/files/curriculum/guides/Saving%20Energy%20Teacher%20Guide.pdf

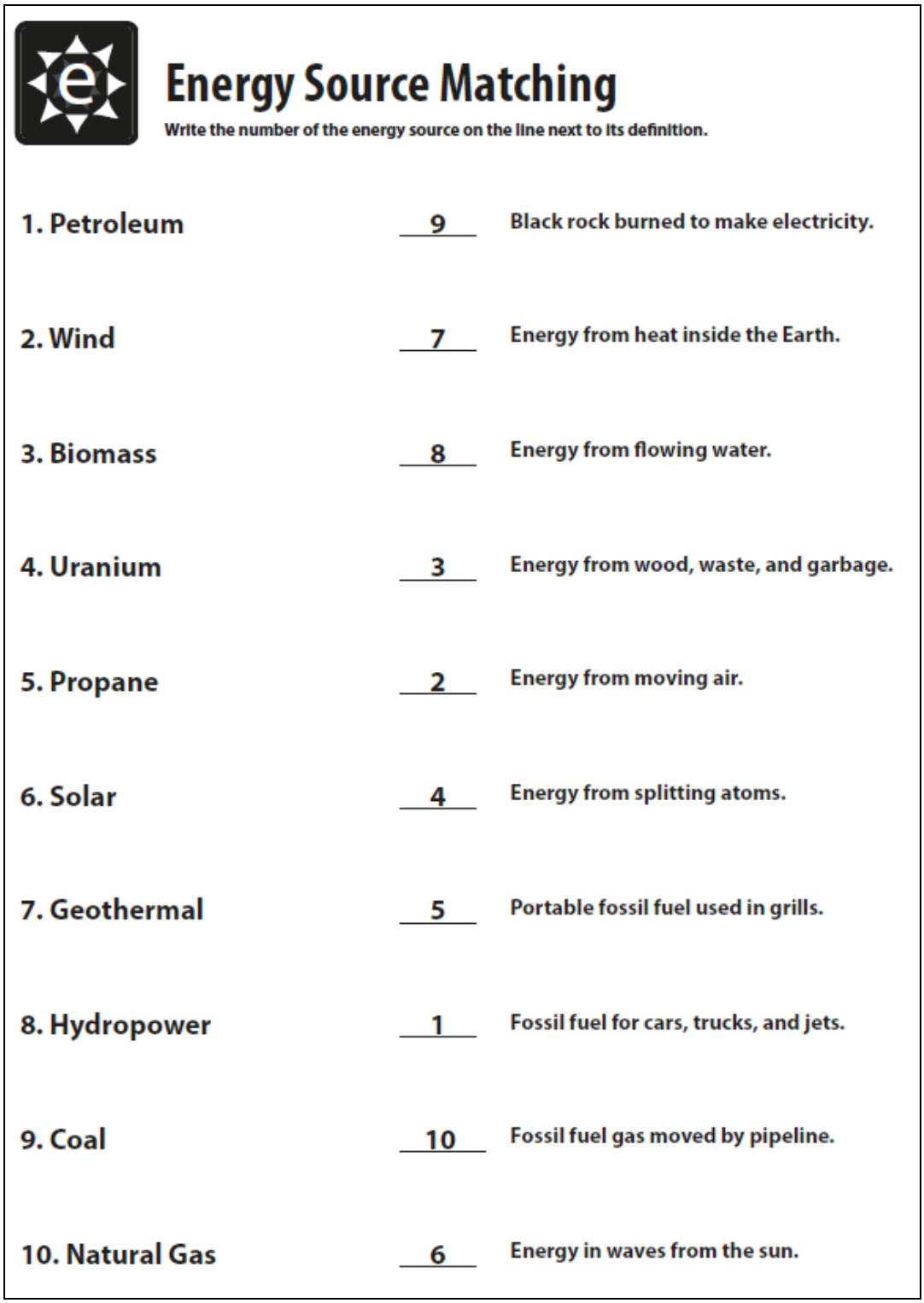
An educational and practice approach to implement energy efficiency in schools, is the first important step to move toward energy saving. In order to achieve energy efficiency in school, it is necessary to change the behavioural of its users, starting from the students.

This tool aims to help teachers to improve the energy behaviour and support students in saving energy both at school and at home. According to this, the tool provides educational materials for teachers, in order to instruct students on the way to improve energy efficiency. The material can support teachers during lessons and are suitable particularly for children. It can be use also as educational material both for junior and senior EGs, in order to improve their educational background on energy efficiency.

The worksheets provided in this tool allow teachers to assess students' activities and provide students with data to compile regarding overall energy conservation behaviours.

Worksheets and technical datasheets are very useful to educate students and they are easily applied in any school context. The educational materials start from a generical overview on what is energy, how it can be used in school and the way to measure it taking into consideration the main energetic uses, as the heating/cooling system, water heating, lighting.

[4] The tool has been taken from "Saving Energy ah home and school. Teacher guide" developed by NEED – National Energy Education Development Project – in Unite States.



Energy Source Matching

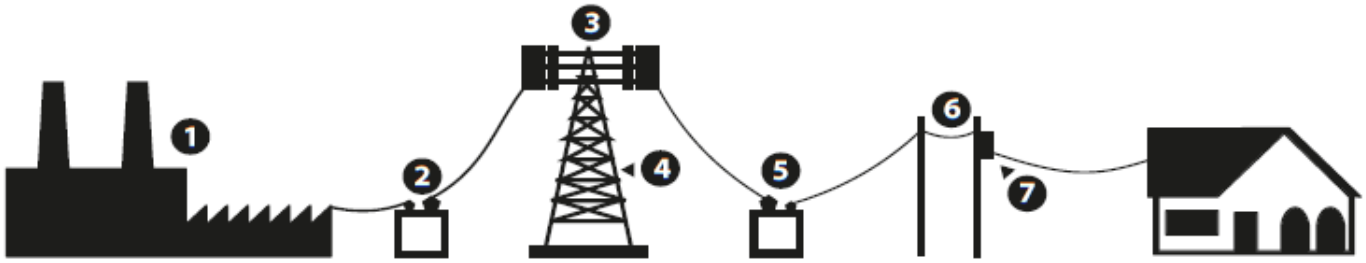
Write the number of the energy source on the line next to its definition.

1. Petroleum	9	Black rock burned to make electricity.
2. Wind	7	Energy from heat inside the Earth.
3. Biomass	8	Energy from flowing water.
4. Uranium	3	Energy from wood, waste, and garbage.
5. Propane	2	Energy from moving air.
6. Solar	4	Energy from splitting atoms.
7. Geothermal	5	Portable fossil fuel used in grills.
8. Hydropower	1	Fossil fuel for cars, trucks, and jets.
9. Coal	10	Fossil fuel gas moved by pipeline.
10. Natural Gas	6	Energy in waves from the sun.

Picture 6 - Saving Energy Teacher Guide. Educational activities on what is energy - Worksheet: energy source matching

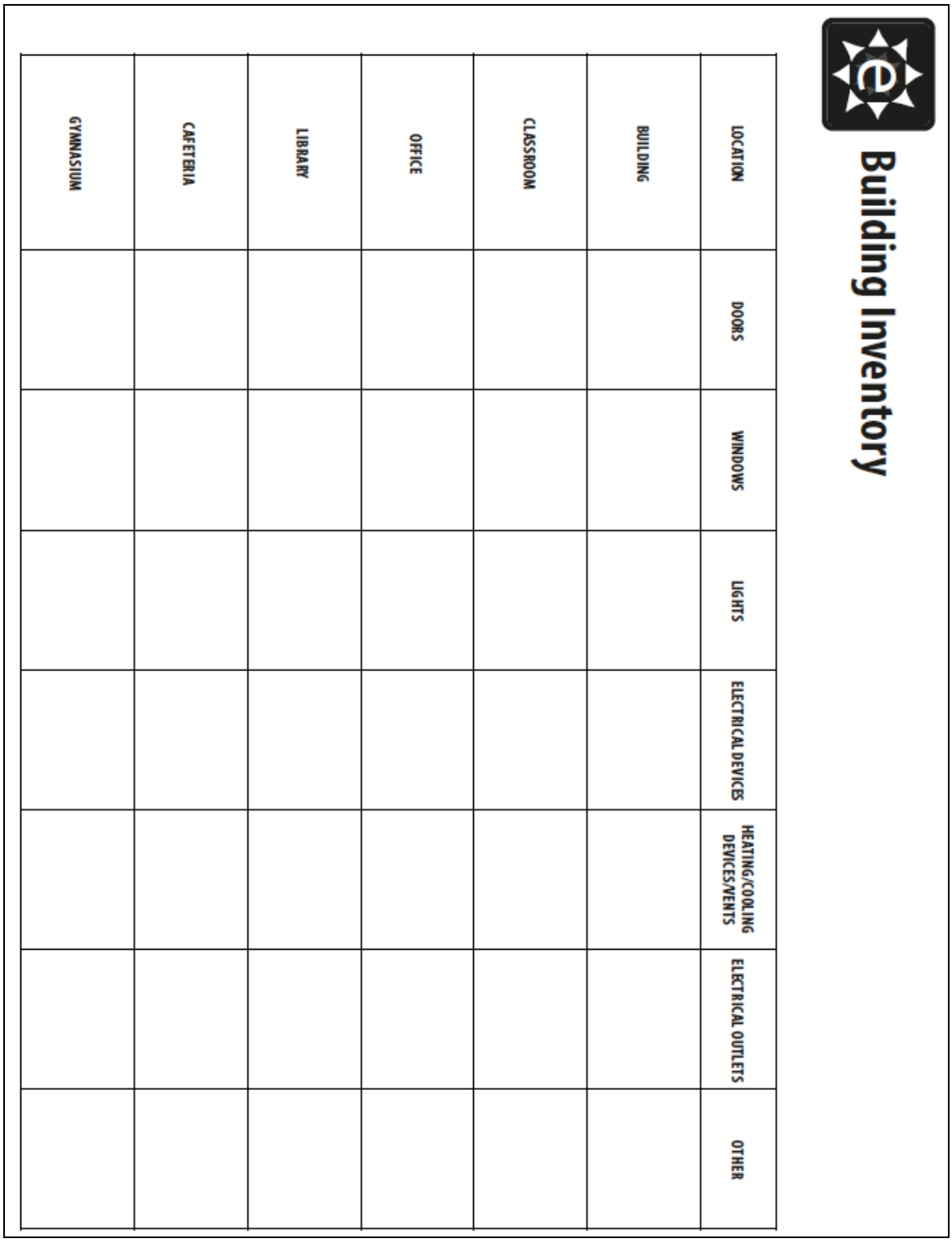
Transporting Electricity

Explain what each of the components numbered below does to get electricity from the generator to the consumer.



1. **Power plant:** generates electricity
2. **Step-up transformer:** increases voltage to reduce transmission loss
3. **Transmission line:** transports high-voltage electricity over long distances
4. **Power tower:** holds or carries transmission lines
5. **Step-down transformer:** lowers voltage for smaller distribution lines
6. **Distribution line:** carries lower voltage electricity to homes and businesses
7. **Neighborhood transformer:** lowers voltage to the voltage used by appliances in homes and businesses (120 and 240 volts)

Picture 7 - Saving Energy Teacher Guide. Educational activities on what is energy - Worksheet: transporting electricity from the generator to the consumer

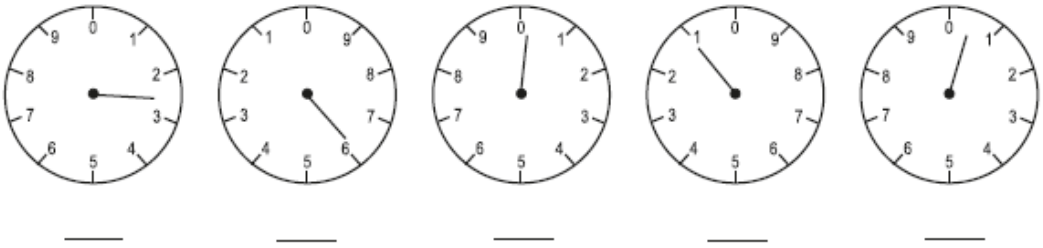


Picture 8 - Saving Energy Teacher Guide. Educational activities on where energy is used – Worksheet: building inventory

Reading an Electric Meter

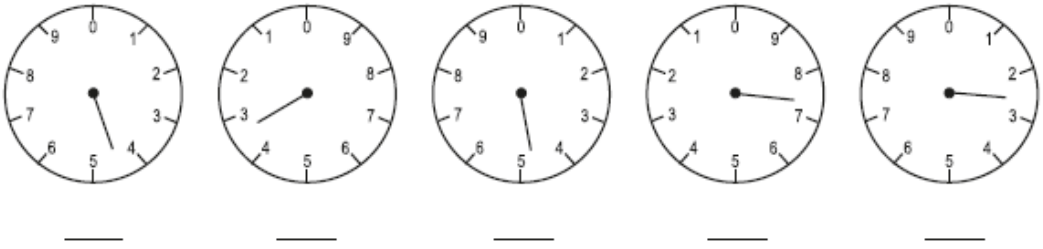
The meters below show the readings for the first and last days of January. See if you can determine how much electricity was used during the month. Read the meter dials and record the numbers on the lines below the dials. If the pointer is between two numbers, **always record the smaller number**.

On January 1, the electric meter looked like this at school:



_____ _____ _____ _____ _____

On January 31, the electric meter looked like this at school:



_____ _____ _____ _____ _____

Electricity is measured in kilowatt-hours (kWh). One kWh is measured as one kilowatt (1,000 watts) of power consumed for one hour.

How much electricity was used in January at school? Let's find out. Subtract the January 1 reading from the January 31 reading to find the kilowatt-hours of electricity that were used during January.

January 31 reading = _____

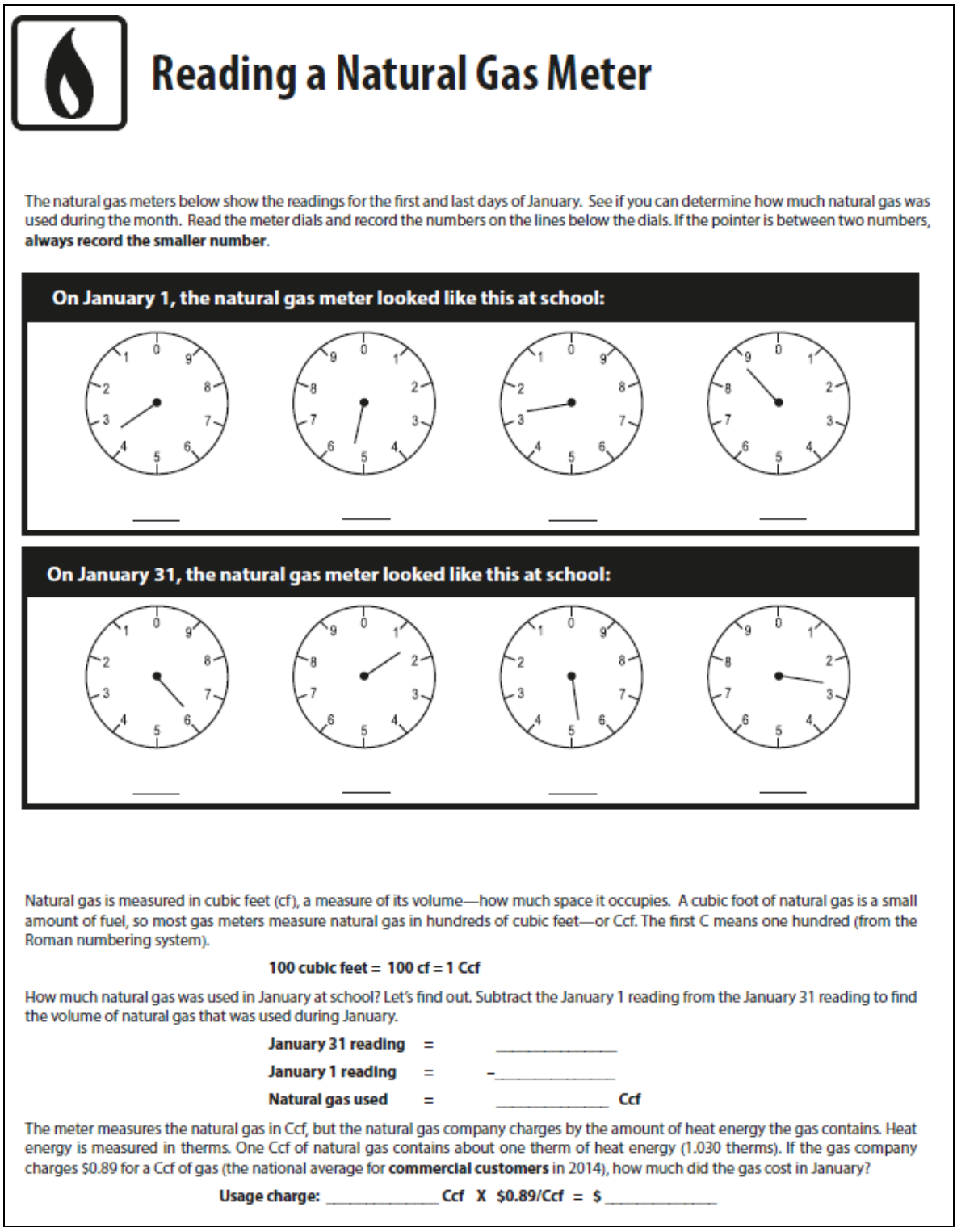
January 1 reading = – _____

Electricity used = _____ **kWh**

If the power company charges $0.10 for every kilowatt-hour of electricity that is used (the national average for **commercial customers** in 2014), what is the cost of the electricity that was used in January? Let's find out. Multiply the kilowatt-hours of electricity used by the cost per kilowatt-hour.

_____ **kWh** **X** **$0.10/kWh** = **$** _____

Picture 9 - Saving Energy Teacher Guide. Educational activities on measuring the energy used in school – Worksheet: reading an electric meter



Reading a Natural Gas Meter

The natural gas meters below show the readings for the first and last days of January. See if you can determine how much natural gas was used during the month. Read the meter dials and record the numbers on the lines below the dials. If the pointer is between two numbers, **always record the smaller number**.

On January 1, the natural gas meter looked like this at school:

_____ _____ _____ _____

On January 31, the natural gas meter looked like this at school:

_____ _____ _____ _____

Natural gas is measured in cubic feet (cf), a measure of its volume—how much space it occupies. A cubic foot of natural gas is a small amount of fuel, so most gas meters measure natural gas in hundreds of cubic feet—or Ccf. The first C means one hundred (from the Roman numbering system).

100 cubic feet = 100 cf = 1 Ccf

How much natural gas was used in January at school? Let's find out. Subtract the January 1 reading from the January 31 reading to find the volume of natural gas that was used during January.

January 31 reading = _____

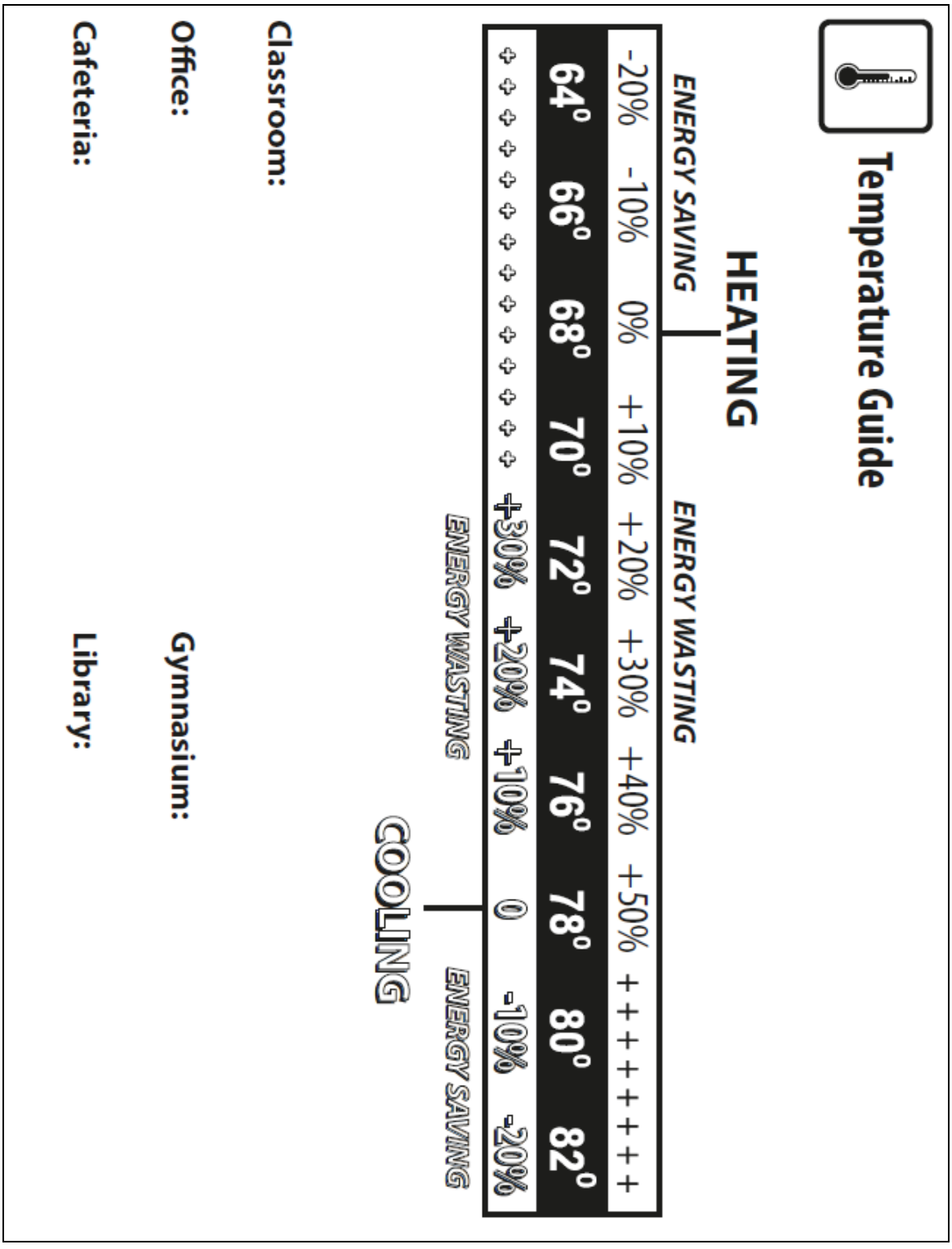
January 1 reading = –_____

Natural gas used = _____ **Ccf**

The meter measures the natural gas in Ccf, but the natural gas company charges by the amount of heat energy the gas contains. Heat energy is measured in therms. One Ccf of natural gas contains about one therm of heat energy (1.030 therms). If the gas company charges $0.89 for a Ccf of gas (the national average for **commercial customers** in 2014), how much did the gas cost in January?

Usage charge: _____ **Ccf X $0.89/Ccf = $** _____

Picture 10 - Saving Energy Teacher Guide. Educational activities on measuring the energy used in school - Worksheet: reading a natural gas meter



Picture 11 - Saving Energy Teacher Guide. Educational activities on heating and cooling system used at school - Worksheet: reading the temperature [Temperature is expressed in °F]

Facts of Light Answer Key

All bulbs provide about 850 lumens of light.

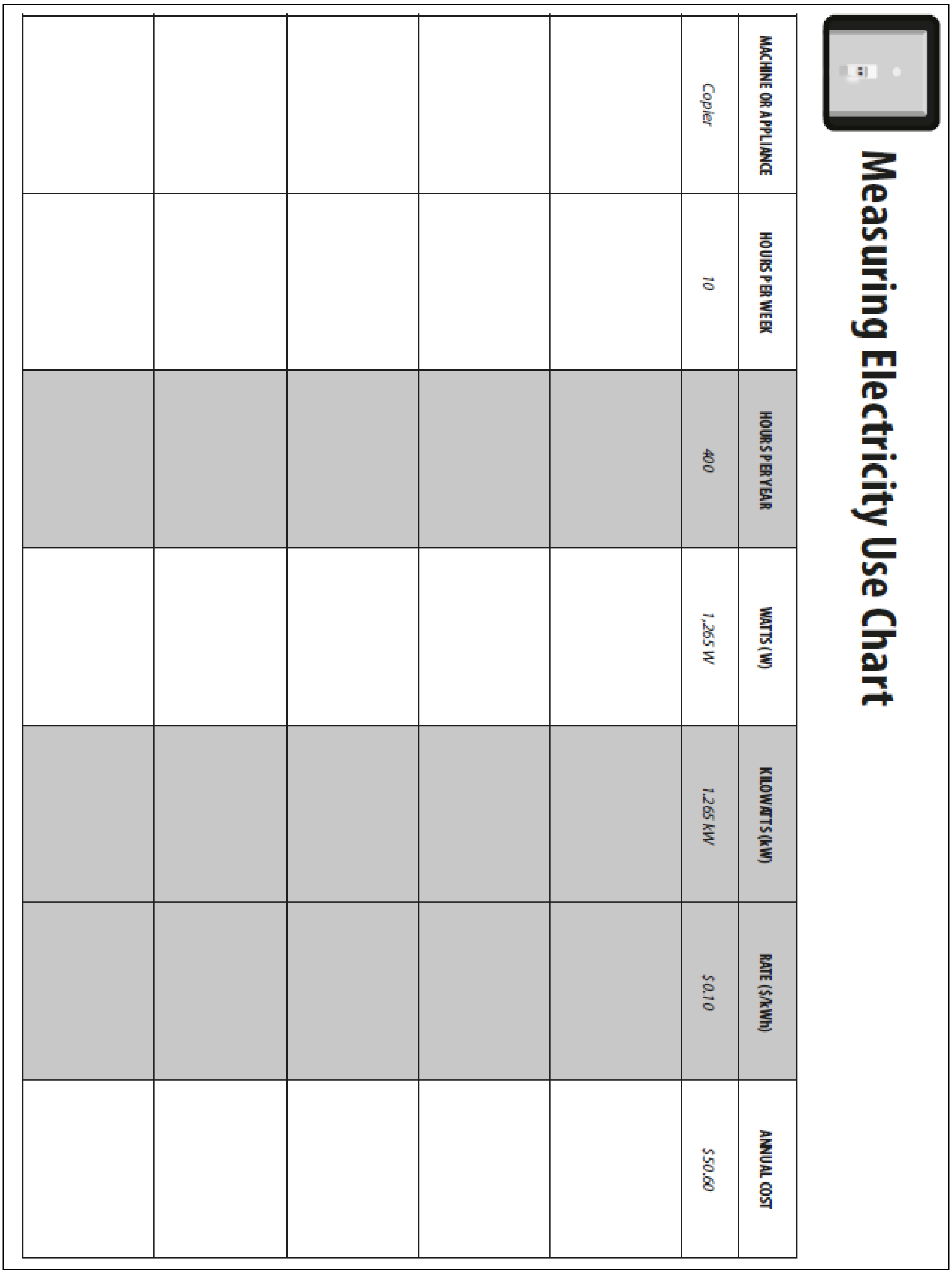
COST OF BULB		INCANDESCENT BULB	HALOGEN	COMPACT FLUORESCENT (CFL)	LIGHT EMITTING DIODE (LED)
	Life of bulb (how long it will light)	1,000 hours	3,000 hours	10,000 hours	25,000 hours
	Number of bulbs to get 25,000 hours	**25 bulbs**	**8.3 bulbs**	**2.5 bulbs**	**1 bulb**
x	Price per bulb	$0.50	$3.00	$3.00	$8.00
=	**Cost of bulbs for 25,000 hours of light**	**$12.50**	**$24.90**	**$7.50**	**$8.00**
COST OF ELECTRICITY		**INCANDESCENT BULB**	**HALOGEN**	**COMPACT FLUORESCENT (CFL)**	**LIGHT EMITTING DIODE (LED)**
	Total Hours	25,000 hours	25,000 hours	25,000 hours	25,000 hours
x	Wattage	60 watts = 0.060 kW	43 watts = 0.043 kW	13 watts = 0.013 kW	12 watts = 0.012 kW
=	Total kWh consumption	**1,500 kWh**	**1,075 kWh**	**325 kWh**	**300 kWh**
x	Price of electricity per kWh	$0.125	$0.125	$0.125	$0.125
=	**Cost of Electricity**	**$187.50**	**$134.38**	**$40.63**	**$37.50**
LIFE CYCLE COST		**INCANDESCENT BULB**	**HALOGEN**	**COMPACT FLUORESCENT (CFL)**	**LIGHT EMITTING DIODE (LED)**
	Cost of bulbs	$12.50	$24.90	$7.50	$8.00
+	Cost of electricity	$187.50	$134.38	$40.63	$37.50
=	**Life cycle cost**	**$200.00**	**$159.28**	**$48.13**	**$45.50**
ENVIRONMENTAL IMPACT		**INCANDESCENT BULB**	**HALOGEN**	**COMPACT FLUORESCENT (CFL)**	**LIGHT EMITTING DIODE (LED)**
	Total kWh consumption	1,500 kWh	1,075 kWh	325 kWh	300 kWh
x	Pounds (lbs) of carbon dioxide per kWh	1.23 lb/kWh	1.23 lb/kWh	1.23 lb/kWh	1.23 lb/kWh
=	**Pounds of carbon dioxide produced**	**1,845.0 lbs carbon dioxide**	**1,322.3 lbs carbon dioxide**	**399.8 lbs carbon dioxide**	**369.0 lbs carbon dioxide**

Picture 12 - Saving Energy Teacher Guide. Educational activities on lighting – Worksheet: cost of electricity and environmental impact for each type of bulb

Light Bulb Comparison

	INCANDESCENT BULB	HALOGEN	COMPACT FLUORESCENT (CFL)	LIGHT EMITTING DIODE (LED)
Brightness	850 lumens	850 lumens	850 lumens	850 lumens
Life of Bulb	1,000 hours	3,000 hours	10,000 hours	25,000 hours
Energy Used	60 watts = 0.06 kW	43 watts = 0.043 kW	13 watts = 0.013 kW	12 watts = 0.012 kW
Price per Bulb	$0.50	$3.00	$3.00	$8.00

Picture 13 - Saving Energy Teacher Guide. Educational activities on lighting – Worksheet: light bulb comparison



Measuring Electricity Use Chart

MACHINE OR APPLIANCE	HOURS PER WEEK	HOURS PER YEAR	WATTS (W)	KILOWATTS (kW)	RATE ($/kWh)	ANNUAL COST
Copier	10	400	1,265 W	1.265 kW	$0.10	$50.60

Picture 14 - Saving Energy Teacher Guide. Educational activities on machines to measure the energy used at school - Worksheet: template to measuring electricity use

3.5. Energy Game for Kids [5]

You can download the tool ready to be used here:

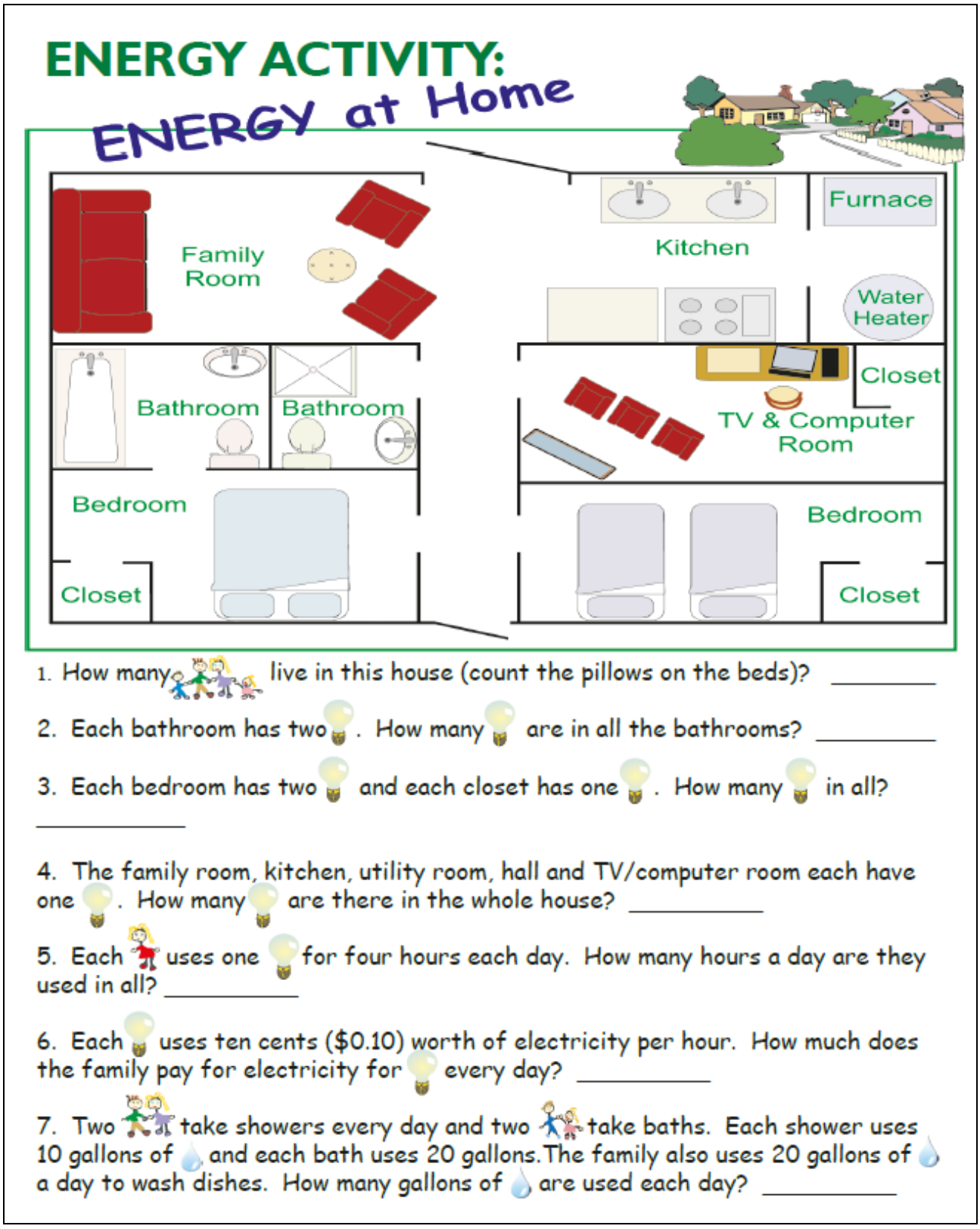
https://www.eia.gov/kids/index.cfm

Fun is one of the most powerful tools we can use to motivate positive behaviour change. Turning something into a game – using the features of games to accomplish a real-word objective – is called now "gamification". Games actually are able to encourage positive behaviour changes and gamified activities are meant to motivate and help the players to perform real-word actions. Gamified solution transforms every day activity into game-like experiences. Several studies individual game mechanism have demonstrated that they significantly influence behaviour.

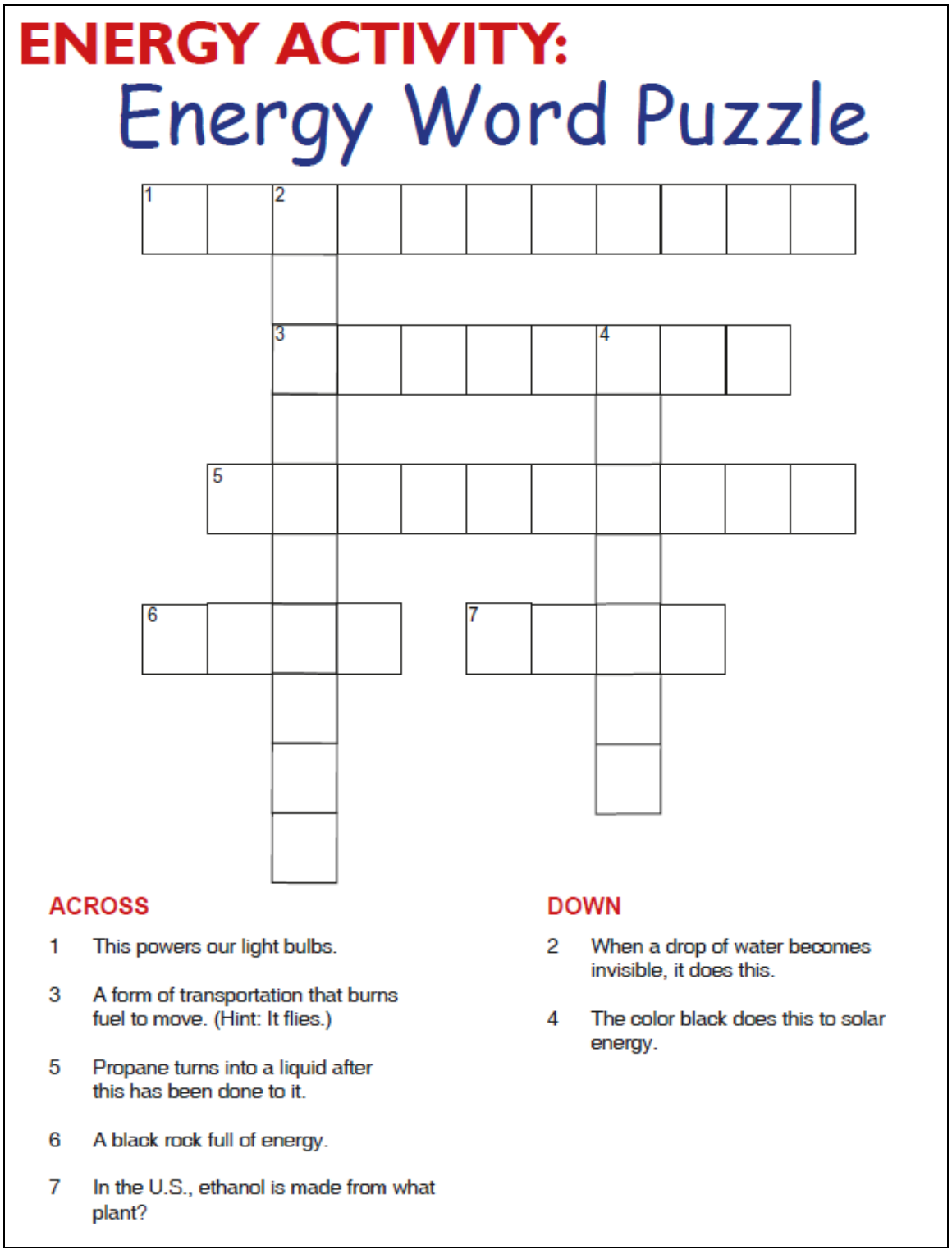
According to this matter, gamified solutions to improve energy efficiency and motivate behaviour change are very useful. In particular, energy efficiency games are used for kids and pupils in schools, to educate them toward energy efficiency. In an energy efficiency game, players may have adventures and rack up the higher scores, but those achievement are not ends in themselves but a means of encouraging them to really save energy.

For what concerns kids, several educational game and activities on energy efficiency are available. In particular, within the wide range of games, puzzles, crosswords and word-search activities are the most usable for kids. EGs can easily use this games during school activity to educate children to energy saving.

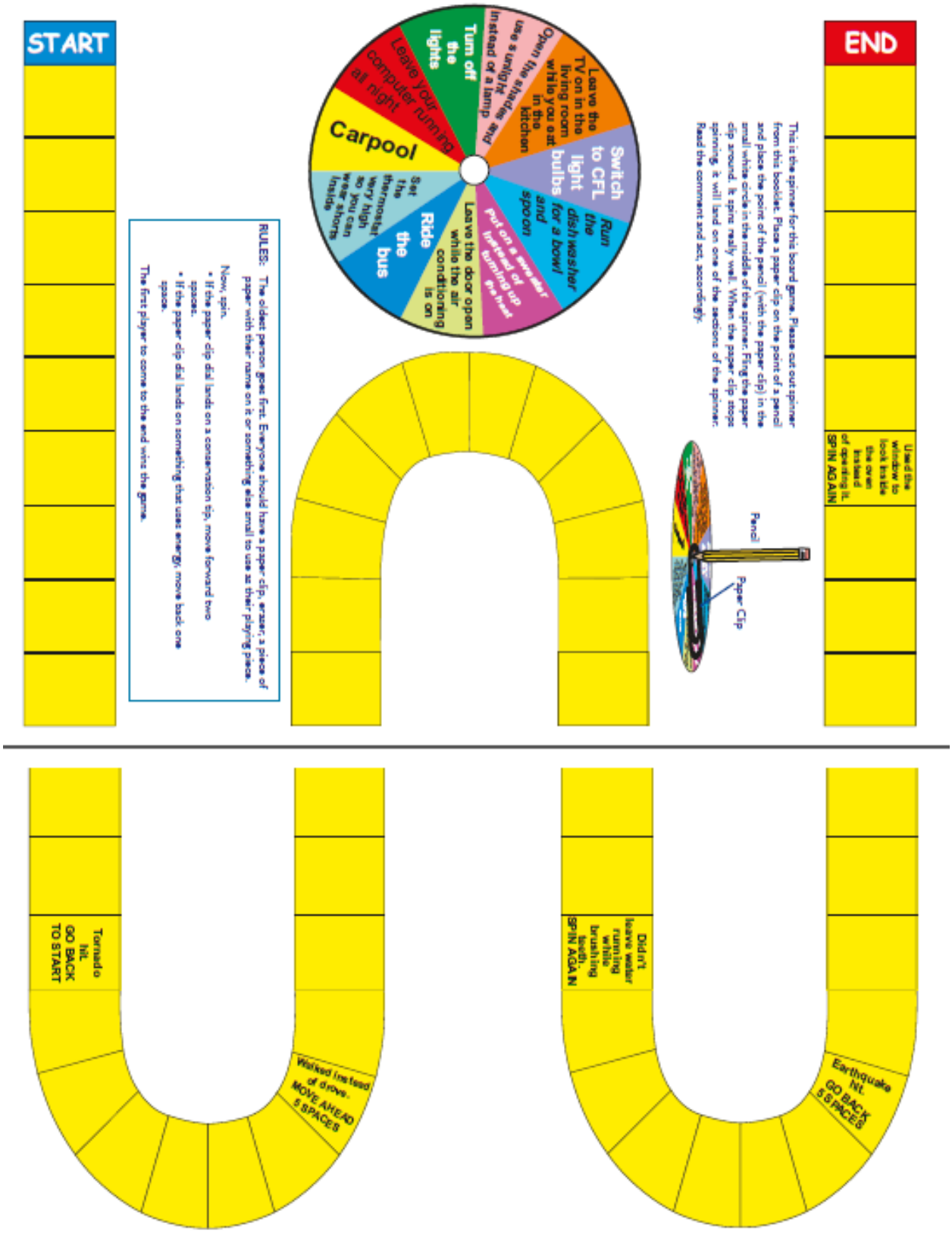
[5] This tool has been taken from "Energy Kids" developed by U.S. Energy Information Administration in USA



Picture 15 – Energy Game for Kids. Activity to educate children on energy efficiency

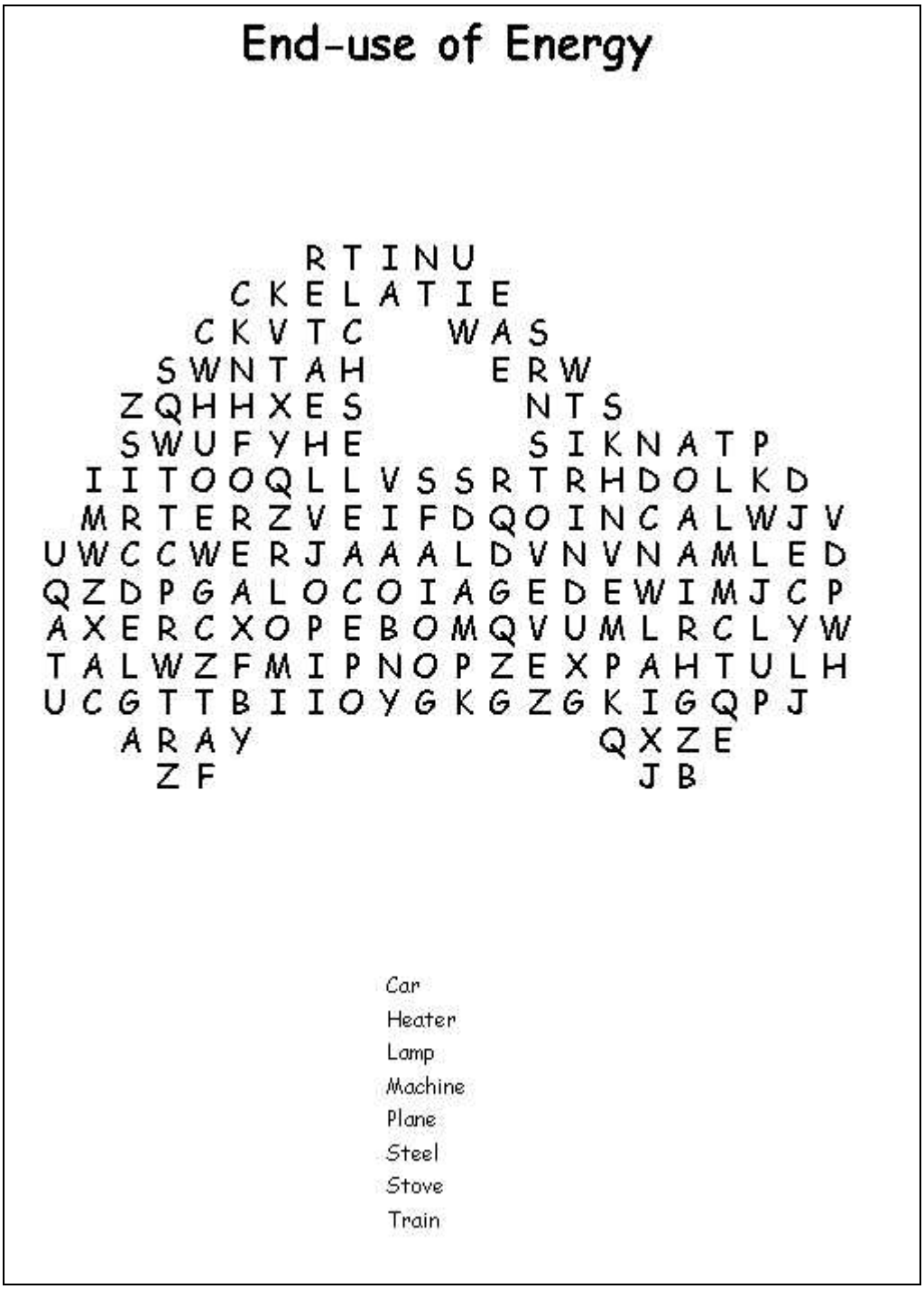


Picture 16 - Energy Game for Kids. Energy word puzzle



Picture 17 - Energy Game for Kids. Energy Game. Rules: If the paper clip dial lands on a conservation tip, move forward two spaces, otherwise move back one space

Picture 18 - Energy Game for Kids. Word-search: electricity



Picture 19 - Energy Game for Kids. Word-search: end-use of energy

Moreover, there are a lot of free games available online, that can be easily download and use by EGs during school activities, suitable also for children and, some of them, for adults. It is possible to find them at the link below.

For Children:

- http://www.energyhog.org/childrens.htm
- http://www.hydroquebec.com/learning/jeux.html
- https://wonderville.org/resources
- https://www.energystar.gov/index.cfm?c=kids.kids_index
- http://www.enercities.eu/project/projectpage.html
- http://www.glasslabgames.org/games/SC
- https://www1.eere.energy.gov/education/games/eere.html
- http://www.cwndesign.co.uk/funergy/game/index.html

For adults:

- http://www.energy.gov.on.ca/en/empowerme/powerplay/
- http://www.electrocity.co.nz/
- http://climway.cap-sciences.net/us/index.php