



**Everything that
our goblin ENIX
knows about**

The pamphlet that goes with the game

Imprint

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Introduction

One can play the ENIX game quite well without having read this accompanying pamphlet. The moment will certainly come, however, when the boys, girls and even the adults will like to know more. What are these six renewable forms of energy - sun, wind, waves, water, biomass, geothermal heat - all about? What exactly is shown on the 72 Action Cards and how do the illustrations relate to these six forms of energy?

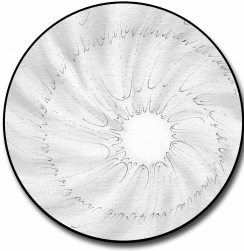
Our goblin ENIX knows all about this and has written down all his knowledge in this pamphlet. Every form of energy is briefly described. Then, the illustrations on the Action Cards that correspond to the particular forms of energy will be explained. No matter whether used for looking up things during the game or for reading afterwards - our goblin ENIX says: Knowledge is fun!

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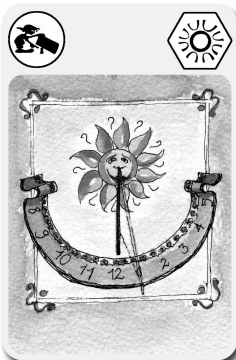
The individual explanations are arranged according to the number of points on the cards. The → symbol refers to subsequent explanations of other pictures.

Sun



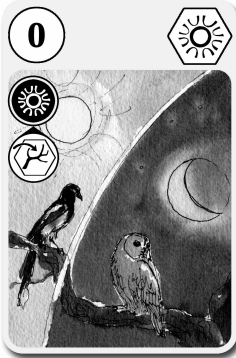
For several billion years now, the sun has actually been that which scientists are still trying to find out about: a nuclear fusion reactor. Through the fusion of atomic nuclei, a small part of the sun's mass is converted into energy – all according to Albert Einstein's formula: $E=mc^2$. Only a small part of the radiated energy actually reaches the earth. Nevertheless, this amount would still be able to meet mankind's energy demands - as predicted for the year 2100 - ten thousand times over. – A part of the solar radiation is, by the way, converted into other forms of renewable energy: Wind, hydropower, biomass.

Sundial (ENIX goblin symbol)



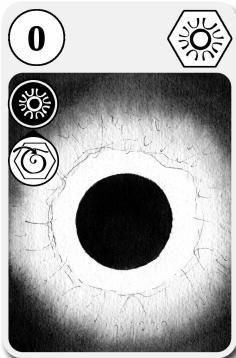
In the old days, we used to tell the time by making use of the sun's position: If the sun was exactly in the south, it was 12 noon. Later, mean solar time (local time), which evened out seasonal differences, was introduced. Also, time zones were created within which all places have the same time. – Cleverly thought-out sundials took all this into consideration and could be read precisely – exact even to fractions of a minute!

Day and night (natural phenomenon)



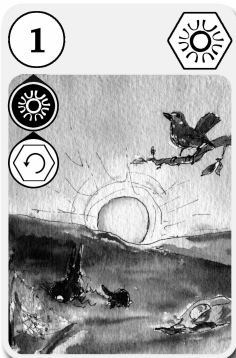
"What is more important: the sun or the moon?" - "The moon because it shines at night; during the day it's light anyway..." - We know, of course, that this is not true: Without the sun there would be no daylight. The earth itself, however, is responsible for the rhythm of day and night: Because it turns on its own axis once every 24 hours, we always go from being either in the sun's light or on the dark side.

Total eclipse (natural phenomenon)



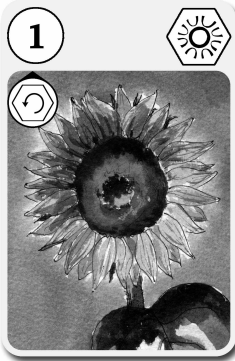
About every one and a half years, the inner shadow of the moon moves over earth in a band that is up to 200 kilometres wide and many thousands of kilometres long. In this band the sun is completely concealed for short time. During total eclipses, the sun's so-called corona can be seen and investigated – the possibilities for doing this from the earth are otherwise quite limited. - In Europe, the last time a total eclipse could be seen was on 18th August 1999.

Sunrise (natural phenomenon)



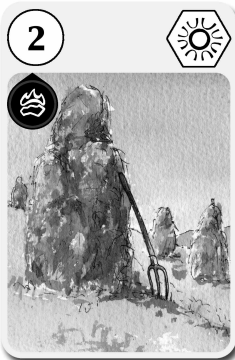
It starts to get light in the east. A lot of songbirds start their morning concert. The sun comes up over the horizon, still coloured red because of its light being scattered in the earth's atmosphere. From the moment the sun's edge can be seen, it takes more than two minutes before we see the sun completely. So close to the horizon, by the way, it appears to us to be larger than when it's high in the sky - this impression only originates in our brain, - as a so-called optical illusion.

Sunflower (nature-orientated use)



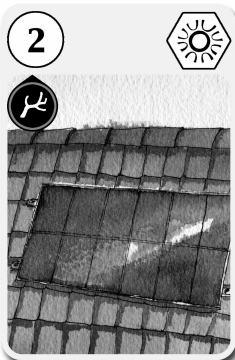
The sunflower does not only look like the sun: Just like every plant which contains chlorophyll, the sunflower also uses the energy of solar radiation for its own growth. And: it follows the sun with its head. A substance which controls the growth of the plant is mostly deposited on the shady side of the plant. In this way, this side of the stalk grows faster than the side exposed to sunlight, so that the blossom leans over towards the sun.

Drying hay (nature-orientated use)



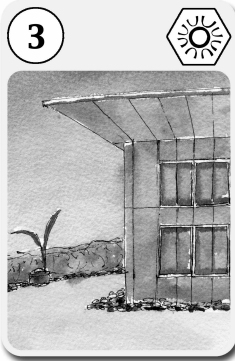
Hay is green forage which is dried in order to preserve it for use in feeding cattle in the winter season. In the case of ground drying, the grass is left lying in long rows (swathes) after it has been mown. In the following days, it is repeatedly turned over using a hay tedder so that it dries better: For every 100 kilograms of green forage, about 60 kilograms of water have to be evaporated.

Photovoltaic panels (technical use)



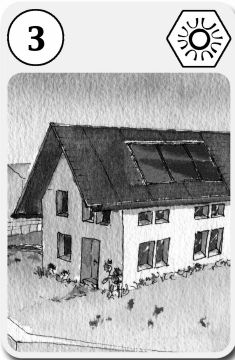
Photovoltaic panels are made of solar cells. These are thin wafers of so-called semiconductor material, usually silicon. This is the same material from which the "chips" for computer processors and similar electronics items are made. Electrical charge carriers in the semiconductor are freed by the sunlight shining on the cells. In this way, electrical energy is produced from light. Today's solar cells are long-life products (guarantee usually lasts for a period of 20 years).

Solar architecture (technical use)



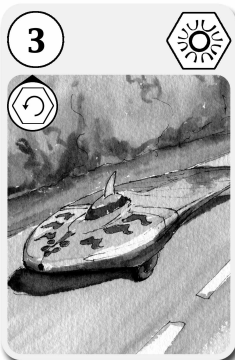
In the case of solar architecture, the architect plans the house in such a way that the heat provided by the sun is used optimally. Solar houses or "passive houses" normally have large windows on their south-facing side which let the winter sun shine well into the house whilst, however, keeping the high-standing summer sun out. Floors, walls or ceilings made of brick, concrete or even dried mud store the heat and provide a well-balanced atmosphere for living in.

House with solar collector (technical use)



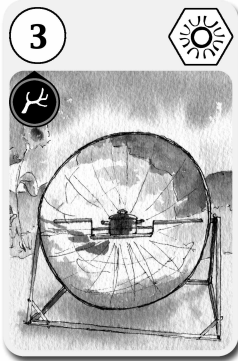
Solar thermal collectors consist of a black-coloured absorber sheet metal that is fitted with tubes in which a frost-proof water-glycol mixture is heated up by the sun. The heat is then transferred to a water storage boiler. The solar collector supplies a major part of the energy that is required for heating up the hot water needed for washing up, taking a shower or washing laundry. The collector can also be combined with the space heating system.

Solar vehicle (technical use)



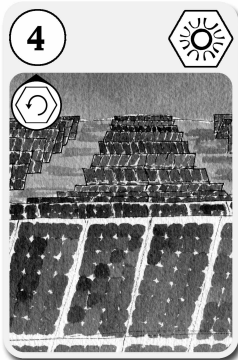
Solar vehicles belong to the "Formula 1", as it were, of electric vehicles. New technologies can be tried out in these vehicles under racing conditions and then be used in an adapted form in everyday vehicles. Usually, electric vehicles for everyday use are themselves not fitted with solar cells or only with very few. Their batteries are charged from a normal power socket - with "eco-power", produced by → photovoltaic power plant, for example.

Solar cookers (technical use)



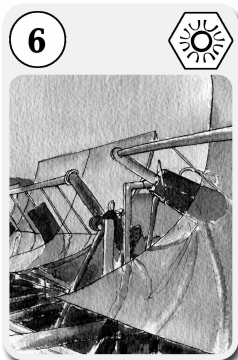
The solar cooker shown is built using concentrating techniques: A reflecting surface in the form of a parabolic mirror focuses the sun's radiation at a focal point. A black-painted pot is placed at this point. Using a simple mechanical system, the mirror can always be made to follow the sun's position. Reaching 300°C, such solar cooking apparatus (reflector cookers) attain higher temperatures than the simpler solar cooking boxes.

Photovoltaic power plant (technical use)



A photovoltaic power plant consists of thousands of solar cells (→ photovoltaic panels). Its power is specified in "kilowatt peak". This is the power which can be delivered under optimum conditions (clear sky, sun shines at right-angles to the solar cells). The actual power delivered is dependent on the time of day and the yearly rhythm of the seasons as well as on weather conditions.

Solar thermal power station (technical use)



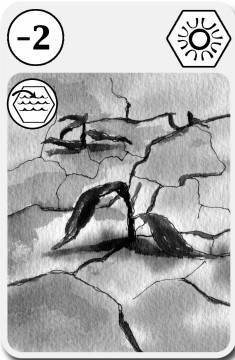
In a solar thermal power station, electricity is produced indirectly using heat: There are various different types of power station; one of them functions like this: Reflecting elements concentrate the sunlight onto an absorber tube. In this, oil is heated up which in turn heats up a steam boiler. The steam thus produced drives a steam turbine which in turn drives a generator for electric power production.

Heat that makes you sweat (harmful effect)



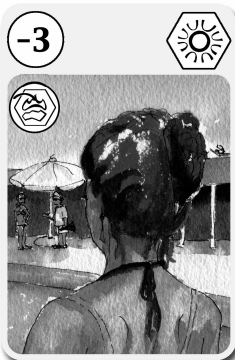
Sweating is healthy - it can, however, also be unpleasant. Sweat is used basically to regulate the body's temperature: Sweat on the skin evaporates and thus has a cooling effect. This is aided by light wind but also by absorbent clothing (wool burnouses worn in desert nations). - On the other hand, sweating can also have psychological causes ("breaking out in a cold sweat").

Drought (harmful effect)



Drought results from a lack of rainfall and long periods of hot, sunny days. Drought makes plants wither. Members of the UNO's IPCC committee (Intergovernmental Panel on Climate Change) warn us of famines that will threaten us as a result of climate change: Agricultural yields in Asia would sink; in Australia and New Zealand water could get scarce. Many millions of people would be affected by this.

Sunburn (harmful effect)



Sunburn is an inflammation of the skin which is caused by the ultra-violet (UV) fraction of sunlight when an excessive amount of exposure to the sun occurs. Sunburn can happen if the pigmentation of the skin, which normally blocks out the UV-A radiation and the more energetic UV-B radiation, is inadequate. This is especially the case for people with very light-coloured skin and when one lies in the sun too long when sunbathing.

Wind



Wind results primarily from the different degrees of warming of the earth's surface – Wind is, therefore, an indirect product of solar energy. - The global (world-wide) wind systems are caused by the different amounts of solar radiation in the polar, moderate and tropical regions of the earth. Moreover, they are influenced strongly by the earth's rotation. There are, however, also regional wind systems, such as the mountain / valley winds or the sea / land winds on the coast, for example. These result from the flanks of mountains warming up and cooling down more rapidly than the valleys; the same applies to dry land as compared to the sea.

Eagle (ENIX goblin symbol)



The king of the birds just glides along over the mountains: Its broad wings make it possible for a golden eagle weighing up to 4.5 kg to circle slowly, making use the smallest up-draught. Feathered legs, powerful claws and a strong hooked beak are further body features of this bird of prey, which hunts small mammals and birds.

Sand dunes (natural phenomenon)



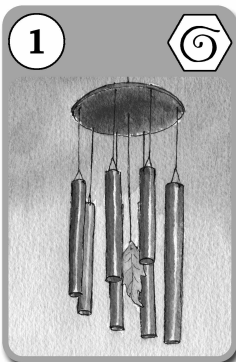
Fine sand is picked up and swept away by the wind. If the wind-speed drops, the sand is deposited and piles up. This can happen for example around obstacles such as hills, stones or even only tufts of grass. Free dunes can, however, also be found on open, vegetation-free surfaces.

Falling leaves (natural phenomenon)



In the moderate and cold climate zones, deciduous trees lose their leaves in autumn. These break off at a pre-defined break-point and leave behind a leaf scar. – In casting off its leaves the tree benefits from reduced fluid losses caused by evaporation. In this way, no danger exists of the tree dying of thirst in winter when the ground is frozen.

Wind chime (nature-orientated use)



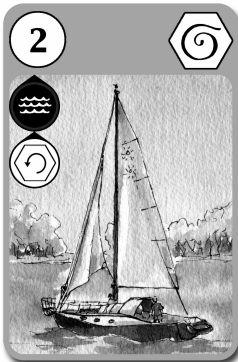
The metal tubes of different length are harmoniously tuned to different pitches. The wind either makes the tubes themselves knock together or moves a wooden pendulum which then strikes the tubular chimes.

Drying laundry (nature-orientated use)



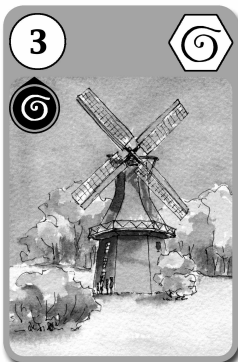
What actually happens when laundry is dried in the open? At the laundry's surface, water evaporates and is absorbed by the air. The wind carries the moist air away. Therefore, in order to function properly, wind is needed and the air must not already be saturated with humidity. Furthermore, warm weather is favourable because warm air can absorb more moisture than cold air.

Sailing boat (nature-orientated use)

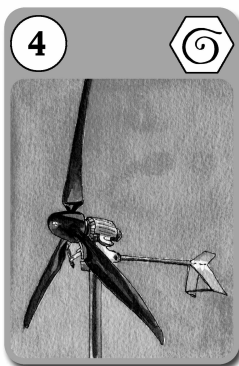


The wind blows into the sails and drives the boat forward. Why, however, can the boat also sail diagonally or even at a small angle against the wind? Under the boat, a board - the so-called centreboard - is fitted parallel to its keel. As a result, the boat is guided as if it were on rails, as it were. By careful adjustment of the sails, the desired course can be held for almost every direction of the wind.

Windmill (technical use)

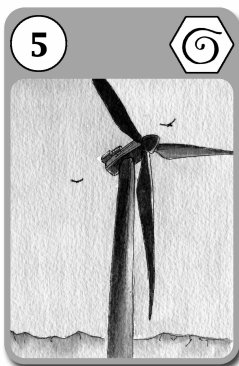


Since the first millennium before Christ, the principles of windmills have been known. They have provided mechanical energy and, for example, have driven millstones for the grinding of grain or have been used to raise water. The large windmill sails can even make use of low wind speeds.



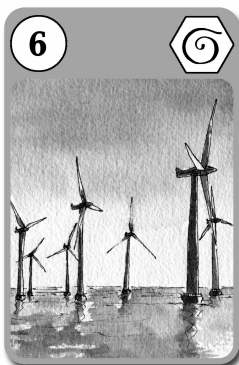
Light-wind turbine (technical use)

Light-wind installations already make use of relatively weak winds: A average yearly wind-speed of 2.5 to 4.5 m/s is sufficient for practical operation. – Light-wind turbines are relatively small installations with mast heights below 20 m. They blend into the landscape in an inconspicuous way. The power generated can be fed into the grid or can supply buildings that have no connections to mains electricity.



Large wind turbine (technical use)

Large wind turbines are practicable at sites with a yearly average wind-speed of 5 m/s and more. These plants feature tower heights of up to 100 m and set an accent in the landscape that can be seen over a wide area. Consequently, they can be considered as a form of human landscaping, just like cities or other technical constructions. The electricity generated is fed into the public electricity grid.



Off-shore wind park (technical use)

This expression is used for a group of wind turbines that are erected in the sea at some distance from the shore. Wind conditions are normally considerably better here than on the coast itself. This justifies the higher costs for the underwater foundations and the electricity cables that have to be laid on the sea-floor.

Storm (harmful effect)



According to the scale for wind forces laid down by the British admiral Sir Francis Beaufort, we speak of a storm when "Beaufort 9" is reached. This corresponds to a wind-speed of over 75 km/h (21 m/s). Damage and destruction can already be caused by such wind-speeds. - By the way: During a storm, the propeller blades of wind turbines are turned to a so-called sailing position so that they are protected against wind damage.

Tornado, hurricane, typhoon (harmful effect)



Destructive cyclones and whirlwinds originate in the same way as the more harmless low-pressure areas in our latitudes: Because of the earth's rotation, the winds are deflected until they form a swirl, in the northern hemisphere in the counter-clockwise direction, in the southern hemisphere clockwise. Wind-speeds of more than 200 km/h (55 m/s) can even carry off cars. In the "Eye" of the storm, the winds are only weak.

Waves, Tides, Ocean currents



*Here, we summarise several different phenomena: 1.) The often huge **waves** on the seas are built up by the wind which blows for many kilometres over the water's surface and, in this way, sets them in motion. 2.) The energy of the **tides** results from the rotation of earth (→ high and low tides). 3.) The fixed (i.e. continuous) **ocean currents** - such as the Gulf Stream - result from very similar mechanisms to those causing the wind: The polar and the tropical seas are warmed up to a different degree, thus giving rise to compensating currents.*

Dolphin (ENIX goblin symbol)



Dolphins are exceptionally intelligent, socially highly developed sea mammals. Legend tells that Aphrodite, the Greek goddess of love, was carried to land by a dolphin after her birth. In actual fact there are reports of people being saved from drowning by dolphins.

Ring-shaped waves (natural phenomenon)



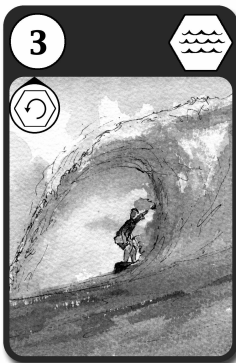
A raindrop hits the surface of water or we throw a stone into a pond: In both cases water is displaced at the point of impact. As a result, the height of the water all around this point is increased a little, after which the water even further out rises too: A wave develops which then spreads out in a circular form and gently decreases in height as it propagates.

Pond with small waves (natural phenomenon)



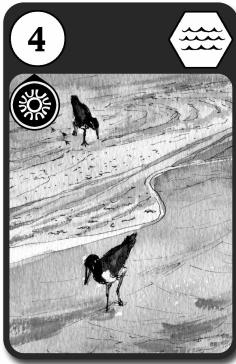
These waves are caused by the wind just like the big waves in the sea. When the wind blows regularly, the waves form straight lines: these are so-called linear waves. Depending on wind velocity as well as on the size and form of the pond, different geometrical patterns result. - One could watch this show for hours, particularly if the surroundings are reflected in the pond!

Surfing the waves (nature-orientated use)



Riding the waves or surfing has its origin in Polynesia: The surfer lets the breakers carry him or herself on his or her surfboard to the shore. The surfboard consists of balsa-wood or plastic and is about 2.50-2.80 m long and about ½ m wide. The idea is to let oneself be carried along on the crest of a wave for as long as possible. - In wind-surfing, the surfboard is additionally fitted with a sail.

High and low tide (natural phenomenon)



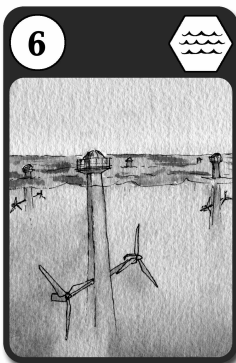
The effect of the moon's gravity is not the same all over the earth: On the side facing the moon, it is stronger than on the opposite side. Therefore, the seas form tidal "mounds" under which the earth turns. Explained in this rather simplified manner, this is how the tides are created. - As a result, by the way, the earth's speed of rotation is continuously being very slightly reduced: Over thousands of years, our days are getting longer by just fractions of a second!

Breakers (natural phenomenon)



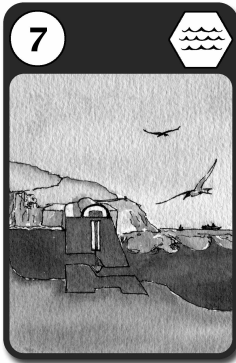
In the case of strong wind or as a wave strikes the shore, its crest can collapse in the direction of its motion. Such "breakers" can be quite dangerous for small ships because people can be swept away by the surge of water or the ship can even be filled up with water.

Sea-current power station (technical use)



The propellers shown are to be found under the surface of the sea and make use of the energy of ocean currents. These currents can be tidal currents or permanent (continuous) ocean currents. Unlike classical → tidal power plants, such power plants can be built so that they do not essentially interfere with shipping.

Tidal power plant (technical use)



In a classical tidal power plant, the water in a river estuary is dammed up. The different water levels at high and low tide are then used in a similar way to an artificial reservoir. one main problem is presented by the fact that suitable sites are often important ports, too. A concrete dam would interfere with shipping considerably. The only European tidal power plant built up to now has been in operation on the Rance estuary (Bretagne, France) since 1966.

Surf (natural phenomenon)



Surf is the name we give to waves as they hit the coast. This can happen on a flat shore where a wave runs aground, is slowed down and breaks or as it abruptly hits a cliff. In both cases, energy is set free, producing both noise (the roaring of the breakers) and, on the other hand, removing sand or solid rock - thus shaping the coast.

Storm tide (harmful effect)

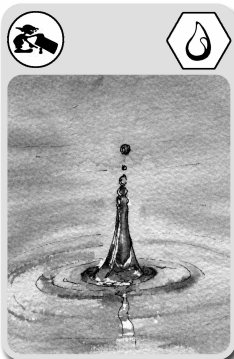


Storm tides occur when a normal tide is amplified by storm winds blowing from the sea towards land. Storm tides can be even more dangerous if they occur at the same time as a so-called spring tide. These occur when the sun, moon and earth are all in a line and the pull of the sun supports that of the moon (opposite: neap tide). (→ High and low tide)

Hydropower



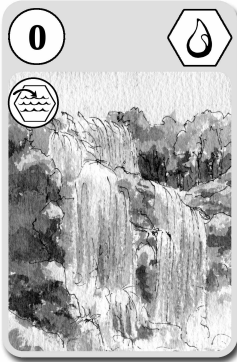
The so-called water cycle is kept going by the sun: Water evaporates due to the heat of the sun, especially from the surface of the sea. The moisture is then carried in the form of clouds by the winds and returns in the form of rain at a different location. If the rain falls on high ground, for example in the Alps, it exhibits so-called potential energy: On its way down through the valleys to the sea, the water can do work. - Therefore, mountainous countries with sufficient rainfall are particularly suitable for making use of hydropower (Switzerland, Austria, New Zealand, Peru and others).



Water droplets (ENIX goblin symbol)

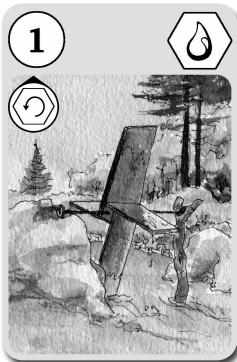
Water is, no doubt, the most intensely investigated fluid. In spite of its simple chemical formula, H_2O , it has many amazing qualities: That it is at its heaviest at $+4^{\circ}C$ stops lakes from completely freezing up. That water could possibly have a kind of "memory" is still the subject of research. In any case, water is very significantly involved in the development of life. – Anyway, let us simply enjoy the beauty of these water droplets!

Waterfall (natural phenomenon)



If a stream or a river falls over a steep slope, we speak of a waterfall. Such steep slopes and sudden drops are the result of erosion (removal of rock material by wind, water or glaciers) or movements of the earth's crust. - In the case of larger waterfalls, it is tempting to make technical use of their energy, of course. The unique beauties of nature should, however, be preserved.

Toy water-wheel (nature-orientated use)



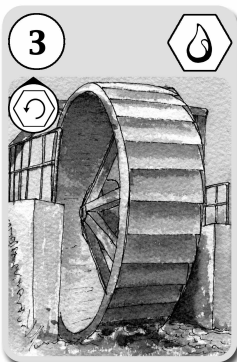
This small water-wheel will fit into every child's rucksack, it is quick and easy to assemble and can soon splash about in a stream, mounted between two forked sticks or on suitable stones as a footing. The water may also fall on the vanes from above or they can be driven by a jet of water: the little mill wheel keeps on turning and can drive a hammer or a merry-go-round. At home, it can be driven by a garden hose or using a watering can.

Undershot water-wheel

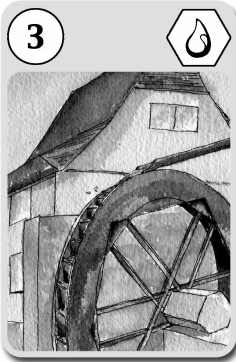
and

Overshot water-wheel

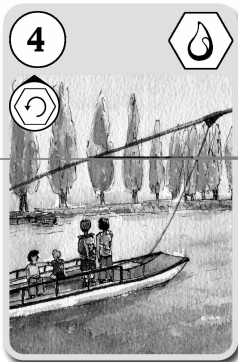
(technical use)



Since early times - for the first time around 200 BC - the energy of water has been used technically. Water-wheels were built on streams so that the water flowed through underneath them: undershot water-wheels. Or one fed the water over the wheel, usually using a

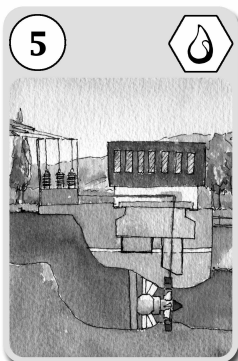


trough made of wood: overshoot water-wheels. In both cases, machines were driven via belts. Old mills, sawmills and similar installations can, therefore, often be found beside a stream or river. Only later did one learn how to transmit the energy in the form of electricity to any location one wanted.



Current-driven ferry boat (technical use)

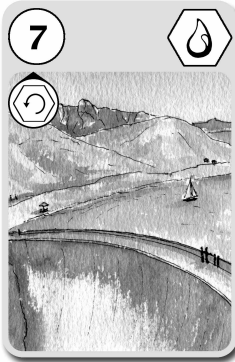
The ferry boat shown needs no engine: It hangs on a cable. In turn, this cable slides along a second cable that is strung across the river. The man or woman in charge of the ferry moves a lever to which the cable is attached over to the ferry's port or starboard side – that is to the left or right side of the boat. As a result, the ferry boat lies at an angle to the flow of water and is thus driven by this across the river in the desired direction.



Power stations on rivers (technical use)

Low-head power stations use the energy of the flowing water of rivers. For this purpose, a barrage is often built across the river. The water flows through one or more turbines (in the picture, a so-called Kaplan turbine is shown); each turbine drives a generator for the production of electric power. – Low-head power stations with their barrages can also make a contribution to flood control (→ floods).

Reservoirs (technical use)



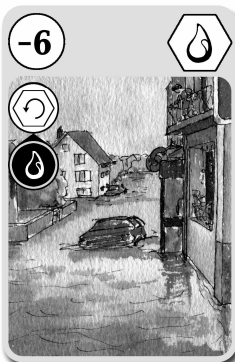
The water contained in these (usually man-made) reservoirs can be tapped as required and be used to generate electricity in one or more power stations. The lake is filled by natural inflow, with additional water fed in through tunnels or even by pumping up water electrically. In this way, surplus energy can be stored and made available again at a later point in time.

Pelton turbine (technical use)



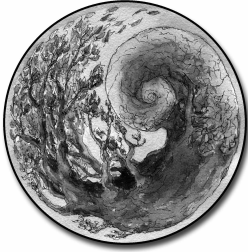
The Pelton turbine uses the kinetic (motion) energy of falling water: A jet of water from one or several nozzles hits cup-shaped buckets mounted on the turbine's runner-wheel thus making it turn. The Pelton turbine is used in hydropower stations with very large heights of drop but not all too large water flows, often in connection with reservoirs.

Floods (harmful effect)



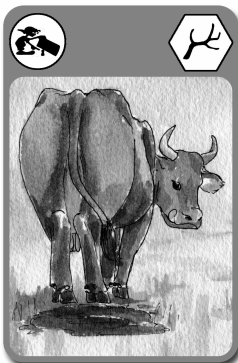
As a result of long periods of rain or the rapid melting of snow, rivers can overflow their banks. Natural and artificial storage which temporarily holds back the water serve as protection against flooding. Examples of such storage are flood-plain forests which may - and should - be sporadically flooded and also power station dams. Furthermore, in built-up areas, rainwater should be allowed to seep away instead of being fed into the sewage system.

Biomass



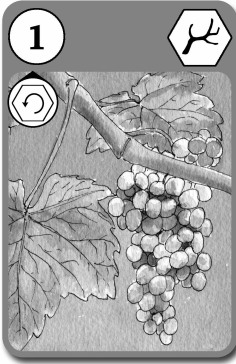
Biomass is the name given to the matter of which living beings are made: plants, the bodies of animals and people and, also, their excrements. Many vegetable substances - wood, oils - are combustible and can, therefore, supply energy. Others - e.g. animal and human excrement or non-woody vegetable matter – can be fermented and so produce biogas that can be burned. - In the final analysis, all biomass comes from plants: With the aid of chlorophyll, they use solar energy to form high-energy substances such as glucose (a kind of sugar) and starches.

Cow pat (ENIX goblin symbol)



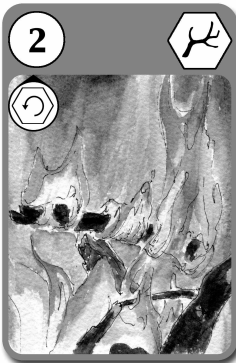
Who has never put their foot in one of these tender, steaming pancakes - which are also known affectionately as "alpine pizzas" - when hiking? Even this kind of biomass is also valuable - as a fertiliser or for the generation of biogas. By the way: Our forefathers used cow pats and horse manure as heating fuel.

Bunch of grapes (nature-orientated use)



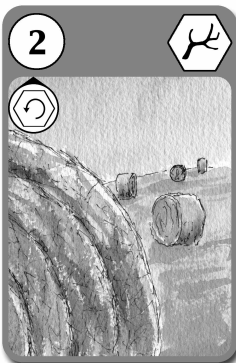
Wine growing (viniculture) demonstrates the connection between sunlight and the creation of biomass especially well: Good wine vintages can almost always be guaranteed in years that are especially sunny. In such years, a lot of sugar is formed in the grapes - the vintager (wine grower) speaks of high Oechsle degrees. This is also why vines are preferably planted on south-facing slopes which are optimally oriented towards the sun.

Open fires (nature-orientated use)

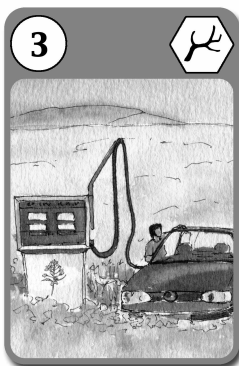


What processes goes on in a wood fire? Hydrocarbons are driven out of the wood by the heat of the fire in the form of inflammable gases. Together with the air's oxygen, they burn to CO₂ (carbon dioxide) and steam. The yellow luminescence of the flames is caused by glowing soot particles, by the way. The residual charcoal glows on, providing heat for a long period of time. In the end, a mound of unburnable mineral substance is left: ash.

Bales of straw (technical use)

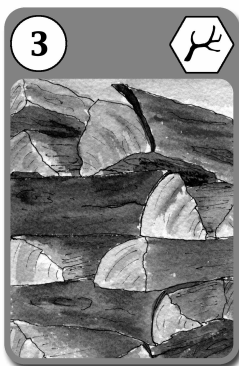


The empty stalks that remains after threshing corn is what we call "straw". In areas of intensive cereal cultivation, it can be sensible to use this straw as a fuel. In its pressed form in bales with a 1.3 m × 1.2 m × 2.3 m format, it has an energy content of approximately 2,000 kWh, equivalent to 200 litres of heating oil.



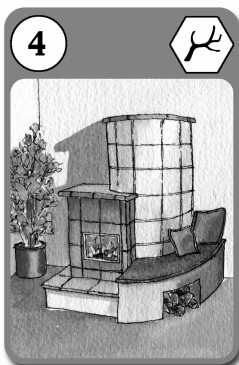
Rape-seed oil extraction (technical use)

Rape is a plant with yellow blossoms which belongs to the family of the Cruciferae. An oil extracted from its seeds serves as basis for lubricants, hydraulic oils, colours and detergents; it can also be transformed into a fuel similar to diesel. By-products include glycerine and rape-cake, which is used as fodder for cattle.



Firewood logs (technical use)

Firewood logs are a form of firewood that mostly originates from the thinning-out of forests. It is supplied in 33 cm or 50 cm long pieces, either as round wood or already split. It can only be burned perfectly when well dried and should, therefore, be stored for at least two years in a place that is protected from the rain.



Tiled stove (technical use)

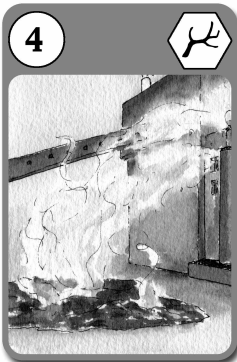
A tiled stove stands in the living room and gives off its heat to the room directly via its warm surface. It is normally fired with → firewood logs. It gets its name from the ceramic tiles from which it is made. These act as heat storage elements and give off heat long after the fire has gone out.

Wood pellets (technical use)



Pellets are about as big as an oblong pill. They consist of untreated wood wastes (forestry wastes, wood shavings, sawdust) which are ground, compressed and extruded as small “worms”. Pellets are used as a fuel in fully-automatic heating units. Compared to → wood chippings, they have the advantage of having a regular form and constant size thus enabling firing installations to be operated without trouble.

Fermentation of biomass (technical use)

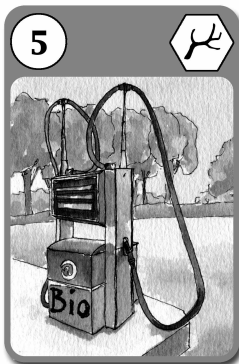


Fresh green wastes, animal excrement, abattoir wastes, food left-overs and similar substances can, under the exclusion of air, be fermented. In this way, so-called biogas can be generated. This gas has a composition similar to that of natural gas and can similarly be used for firing, driving cars or for the production of electrical power. - Afterwards, all that remains is compost which can be used as a fertiliser.

Wood chippings (technical use)

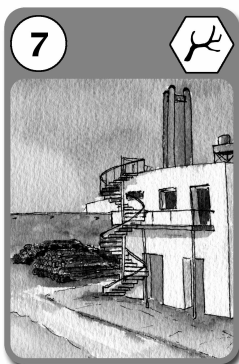


Firewood can be hacked mechanically to make so-called wood chippings. The machines that do this are mobile, so the work can be done on the spot in the forest. - Furnaces fired with wood chippings work fully automatically. They can be designed so that even fresh chippings burn perfectly without the necessity of drying them in advance (green chippings furnaces).



Bio-diesel service station (technical use)

Bio-diesel is produced from rape-seed oil (→ rape-seed oil extraction). A cultivated area of one hectare (10,000 m²) supplies, for instance, 1,100 litres of bio-diesel per harvest. This is completely sufficient for a private car's annual fuel consumption. - By the way: Biodiesel has virtually the same characteristics as normal diesel oil and can, therefore, be employed for every type of diesel motor.



Wood-fired thermal power station (technical use)

Electricity can also be generated using wood as a fuel. The simplest way to do this is to generate steam with a wood-fired boiler that then drives a steam turbine. The waste heat is employed to heat buildings located in the vicinity (so-called local district heating scheme) or it can be fed into a larger district heating system.



Forest fire (harmful effect)

Forest fires result from lightning strikes, spontaneous combustion of dried-out forest vegetation, human negligence or arson. They have fatal ecological results, in particular those fires in summer in which the whole humus layer is destroyed right down to the mineral underground. Forest fires mostly occur during dry periods; they are extremely dangerous for human beings and animals because they can spread at very high speed.

Geothermal heat



As in the sun, energy from atomic nuclei is also released inside the earth. Here, however, it is not fusion that takes place. On the contrary: Heavy atomic nuclei like, for example, uranium disintegrate into lighter ones. Once again, part of the matter is converted into energy according to Einstein's formula $E=mc^2$. For this reason, the temperature in the earth's crust increases on the average by about 3°C per 100 m depth. - On the whole earth, just as much energy flows to the earth's surface as mankind will need - according to forecasts - for the year 2100.

Dragon (ENIX goblin symbol)



The dragon is a fire-spouting fabulous creature conceived by human beings. It often embodies evil that must be overcome by the legendary hero; a beautiful princess often waits as a reward. Other stories, however, also tell of the wisdom of the dragons which can bring great benefit to the human race.

Geyser (natural phenomenon)



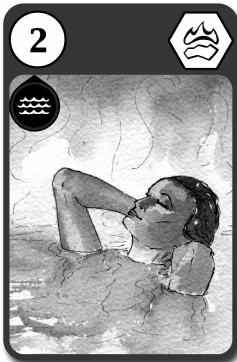
This Icelandic word is used for the hot fountains in volcanically active areas which emit fountains of water and steam from water-filled craters, usually at regular intervals. The eruptions occur as a means of releasing increasing underground steam pressure. Around the geysers, minerals are deposited and form so-called sinter. There are geysers, for example, in Iceland, in the Yellowstone Park (USA), New Zealand, Kamtschatka (Russia), Japan.

Natural cellars (nature-orientated use)



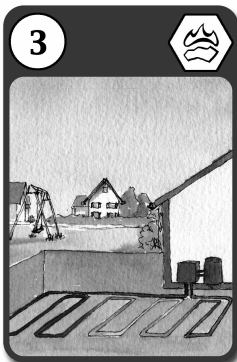
A room, similar to a cellar, built into the earth balances out the daily and annual fluctuations of temperature: It is warmer than the outside air in the winter and cooler in summer. Such a cellar is, therefore, excellent for the maturing and storage of wine, cheese and similar products.

Thermal spa (nature-orientated use)



A thermal spring is a warm or hot spring which contains minerals that often have healing effects, too. Thermal spas have been known since the 5th century BC. They often also serve as a social meeting place, as in ancient Rome or, today, in Iceland.

Geothermal register (technical use)



A geothermal register uses the same effect as the → natural cellar. It consists of pipework that is buried at frost-proof depth (at least 1.30 m) in the ground. In these pipes, fresh air for a ventilation system can be chilled in summer, for example, and pre-heated in winter. Or water that is used as a heat source for a heat pump can be pre-heated (→ house with bore-hole heat-exchanger).

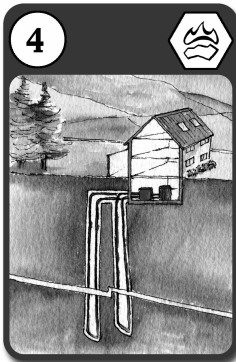
Hot spring (natural phenomenon)



In volcanically active areas, hot springs can often be found. They sometimes contain sulphur - which is recognisable by the yellow sulphur deposits and, last but not least, by the typical sulphur smell (hydrogen sulphide smells of bad eggs). By the way: In the Icelandic capital of Reykjavík, most houses are connected to a district heating system whose heat comes from such hot springs.

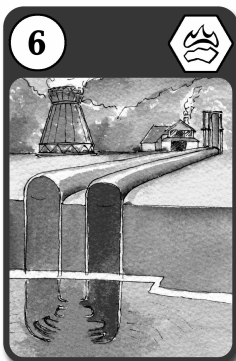
House with bore-hole heat-exchanger

(technical use)



Here, water is circulated in a bore-hole that is at least 50 m to 100 m deep. The water, slightly tempered by geothermal heat, is fed to a so-called heat pump. This is driven by electricity or gas and extracts heat from the water and gives it off at a higher temperature again. Heat pumps are employed to heat houses, preferably using an underfloor heating system as this runs at lower heating water temperatures.

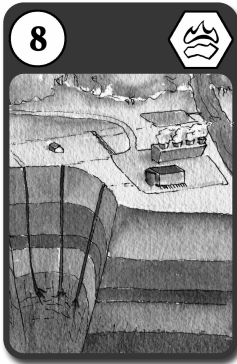
Geothermal power station (technical use)



Geothermal power stations exist, for example, in Iceland and Italy. They use extremely hot springs in which water or steam that stand under pressure are available and exhibit temperatures far above 100°C. Electric power is generated by means of steam turbines.

Deep Heat Mining = Hot Dry Rock

(technical use)



These English expressions mean exactly what they say. Power stations working on these principles are not dependent on hot springs and can also be built outside volcanically active regions. Water is pumped through hot rock crevices several kilometres deep under the surface. The heat of the water returning is used to generate steam and run a steam turbine.

Lava eruption (harmful effect)



Lava is melted, red-hot rock which reaches the earth's surface during a volcanic eruption. Depending on viscosity of the lava stream, a lot of different forms result when it cools down: Pancakes, pa-hoe-hoe and clot lava in the case of low viscosity lava and block lava in the case of more viscous lava. Pillow lava is formed when lava erupts underwater.

Volcanic eruption (harmful effect)



Volcanic eruptions always present a danger to human beings and animals: The direction taken by destructive lava-flows is often unpredictable; poisonous vapours can be emitted, ash rains down and flooding can be caused by melting glaciers. No other natural event can change a landscape so quickly. This is so unique and fascinating that volcanic areas have often become a centre of attraction for both researchers and tourists.

