Project Number: 2019-1-PL01- KA201-065027

Dr. Rita Scully

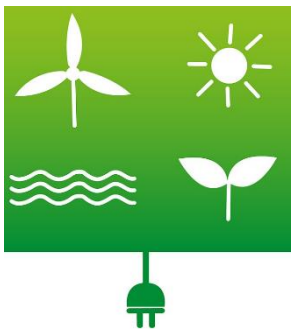
Renewable Energies – Video 2 of 2

Introduction To The Contents

Hello my name is Dr. Rita Scully and I'm a lecturer in Limerick Institute of Technology in Ireland.
This video is on Renewable Energies. It is the second of 2 videos.
I will introduce and explain geothermal, solar energy, I will also explain semiconductors, and some of the specific aspects of the periodic table that are relevant to this discussion.
The first video on Renewable Energy discusses the Energy inside the Earth and compares renewable and non-renewable resources. It also looks at the advantages and limits of renewable energies.

Key Words

In this video, a number of key words will be used
Energy: can be defined as the ability to move or change matter. Put another way, energy is the ability to do work.
Renewable energy: will never run out and in most cases, it is replaced as quickly as it is used e.g. Wind, Solar, Hydro.
Non-renewable energy: are used faster than they can be replaced. Examples would be gas, oil, and peat.
Periodic Table: This is a tabular display of the elements arranged by atomic number.
Solar Power: is energy, electricity in particular, generated by the sun.
Geothermal Power: is electricity generated by the heat in the earth.



What You Know

In order to assist your understanding of this Video it would be useful to review 2 other videos first:
video 1 for:

- Greenhouse Effect

video 8 for:

- The Biogeochemical cycle

Introduction

The Periodic Table

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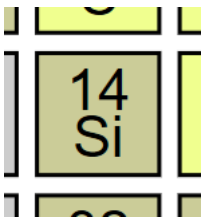
This is a tabular display of the elements arranged by atomic number, electron configuration, and recurring chemical properties. The structure of the table shows periodic trends. The 7 rows of the table are called periods, generally have metals on the left and non-metals on the right. The columns are called groups they contain elements with similar chemical behaviours. The organisation of the periodic table can be used to determine relationships between the various element properties, and to predict chemical properties and behaviours of undiscovered or newly synthesized elements.

Group → / Period ↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57 La *	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89 Ac *	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og
			*	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
			* *	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	

For solar power a number of elements from the periodic table are used. There are 3 elements that we will look at in relation to solar power.



Silicon

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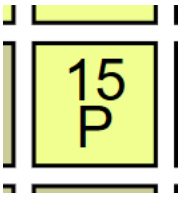
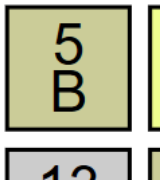


Phosphorous



And Boron

What we want to know

Solar Power:

Photovoltaic cells are the main units that are manufactured to create electricity.

Each photovoltaic cell is a sandwich made up of two slices of semi-conductor material, usually silicon.

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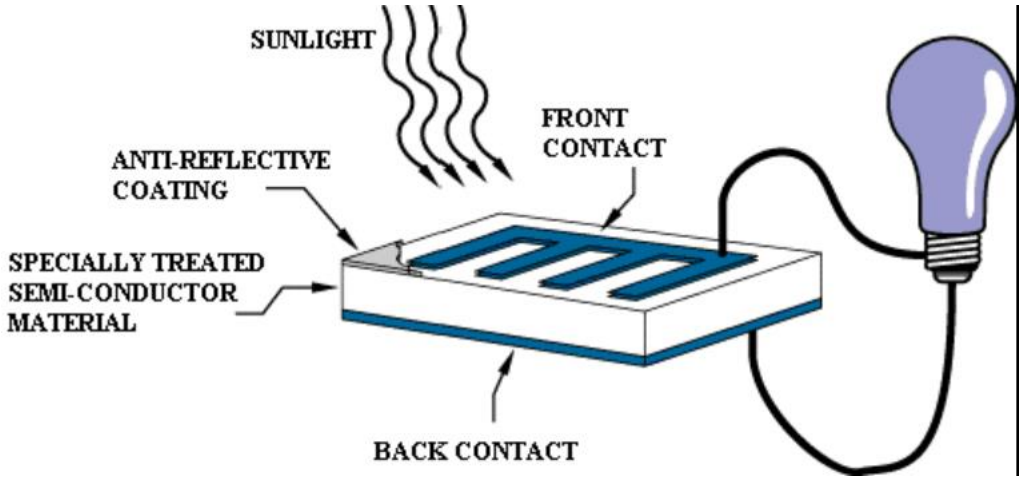

To generate a current, photovoltaic cells need to establish an electric field.

An electric field occurs when opposite charges are separated. To get this field, manufacturers "dope" or cover the silicon with other materials, giving each slice of the sandwich a positive or negative electrical charge.

Phosphorous is used on the top layer of silicon, which adds extra electrons, with a negative charge. Boron is used on the bottom layer which results in fewer electrons, or a positive charge. This creates an electric field at the junction between the silicon layers. Sunlight adds the energy to force the electrons to move and cause the current to be generated.

Solar panels generate a direct current of electricity. This is then passed through an inverter to convert it into an alternating current that can then be funnelled into the National Grid or used by the homes or business.

Solar panels react to the visible light spectrum. This means, if it's light enough to see, there's enough light for solar panels to start generating electricity. But the stronger the sunlight, the better.

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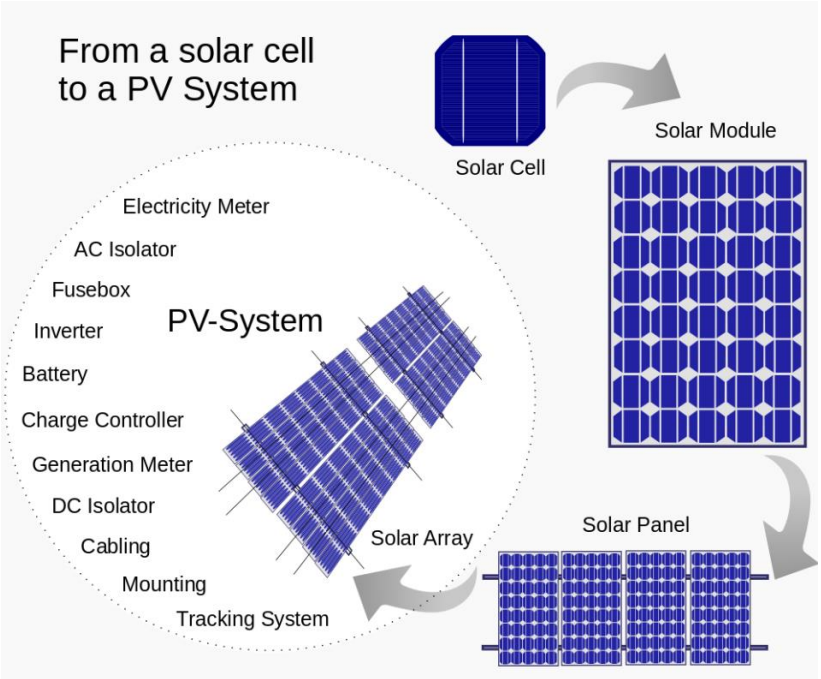

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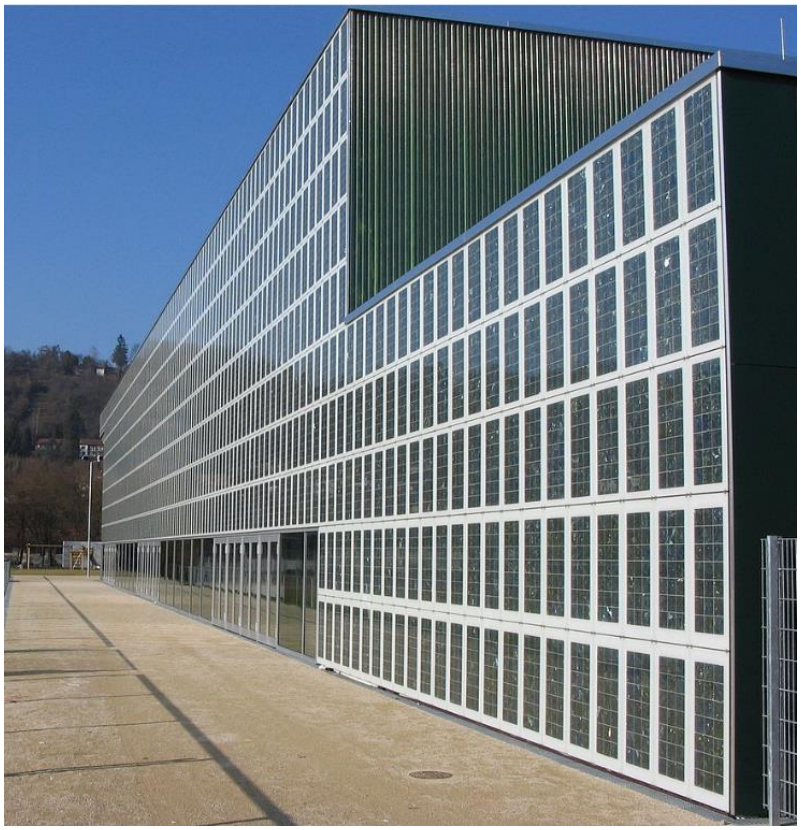

Here we can see one solar cell or photovoltaic cell is created into a module, those modules are then attached in a panel. And then that panel can be produced in many different ways. In some instances, they can be constructed on water are referred to as solar farms.

Just to consider the scale of this image here. We're seeing a truck. So this is a vast area of solar panels, generating electricity for a national grid. In other instances they can be incorporated directly into a building, so that it provides the electricity for both that building and if additional electricity is produced it can feed into the national grid in that country.

Have you seen solar panels used in any other situations?

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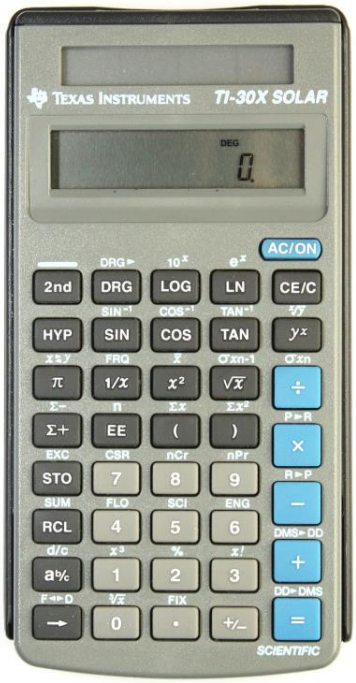

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What about a solar powered calculator or solar powered streets or traffic signs. We see solar lights attached to public lighting systems. We often see them in houses. And more and more we're seeing them incorporated into hybrid powered cars.

Look around, see can you identity any other applications of solar power.

Geothermal:

Now we're going to look at geothermal power.

Geothermal energy can be captured through:

- Geothermal power plants is where the heat is taken from deep in the earth and it generates steam to make electricity.
- Geothermal heat pumps, can tap into the heat of the Earth much closer to the surface to provide heat for individual buildings.

Geothermal Power Plants

Geothermal power does not require the burning of any fossil fuels. The hot water or steam that's used is returned to the ground after it has lost its heat. It can be used again, so that makes it a renewable energy source.

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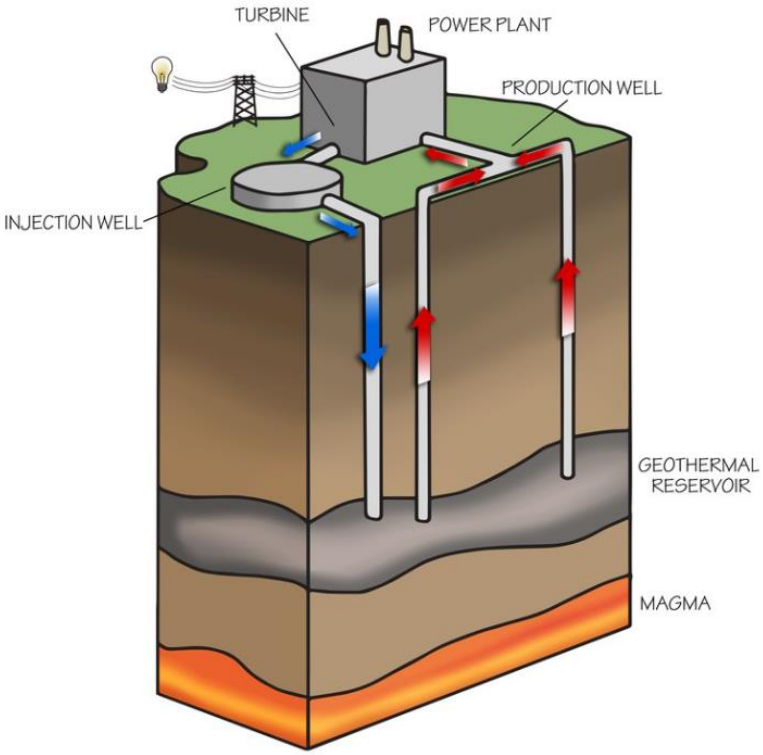
The geothermal power plant, the wells are drilled 2 to 3 Kms into the Earth to pump steam or hot water to the surface. They're often found in an areas where there lots of hot springs, geysers, or volcanic activity. Because these are places where the Earth is particularly hot just below the surface.



Geothermal power plants use steam to produce electricity. The steam comes from reservoirs found a few Kilometres or more below the earth's surface.

The steam rotates a turbine to generate the electricity. The hot water is pumped from deep underground under high pressure. When the water reaches the surface, the pressure is dropped, which causes the water to turn into steam. It is the steam that turns the turbine, this is connected to a generator that produces electricity. Once the steam cools off in a cooling tower it condenses back to water. The cooled water is pumped back into the Earth so that the process can commence again.

Here the red lines show hot water steam coming from underground. And the cold water being returned back in to the system.

Geothermal Heat Pumps

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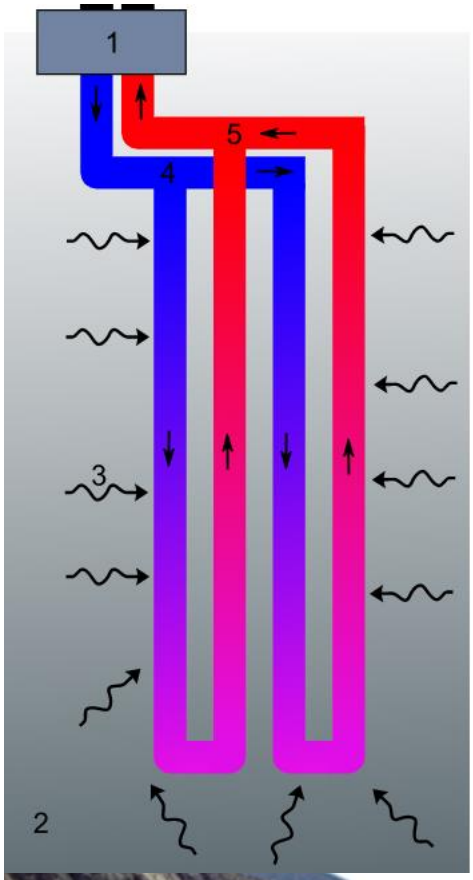

They are used for many things from heating and cooling homes are heating and cooling swimming pools. This is the same type of system, but just on a much smaller scale for an individual building here. The water is pumped just below the surface, often only a few meters deep, where the temperature is a constant 10 to 16°C. During the winter, the water or refrigerant absorbs warmth from the Earth, and the pump brings this heat up to the building. In the summer, this can often be reversed so that it can help cool the building.

Here you can see the loops, of the pipes going in, under the ground. So we can see that it's at quite a shallow level. But, even at that depth, once it's filled back in with clay the temperature will retain between 10 and 16 degrees. So that on a hot day the system is reversed. Cool refrigerant or water can be brought to cool the building. And our cooler days, the refrigerant or water can be brought up to heat the building.

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Have you seen other uses of Heat Pumps?

They're very common fridge, or refrigerator is an example of a heat pump.

Another example is a dryer.

And a third is air conditioning units. All of these use heat pumps, on a much smaller scale. But the same method is applied in each of these products, that's used in relation to a heat pump for an entire building or a geothermal power plant for an entire region.

What You Have Learned

The Periodic Table

This is a tabular display of the elements arranged by atomic number

Photovoltaic cell is a sandwich made up of two slices of semi-conducting material

Phosphorous is used on the top layer of silicon, which adds extra electrons, with a negative charge.

Boron is used on the bottom layer which results in fewer electrons, or a positive charge

Photovoltaic cells are grouped into panels which can be used on signs, house etc or solar farms

Geothermal energy can be captured through:

- Geothermal power plants, which use heat from deep inside the Earth to generate steam to make electricity.
- Geothermal heat pumps, which tap into heat close to the Earth's surface to heat water or provide heat for buildings.

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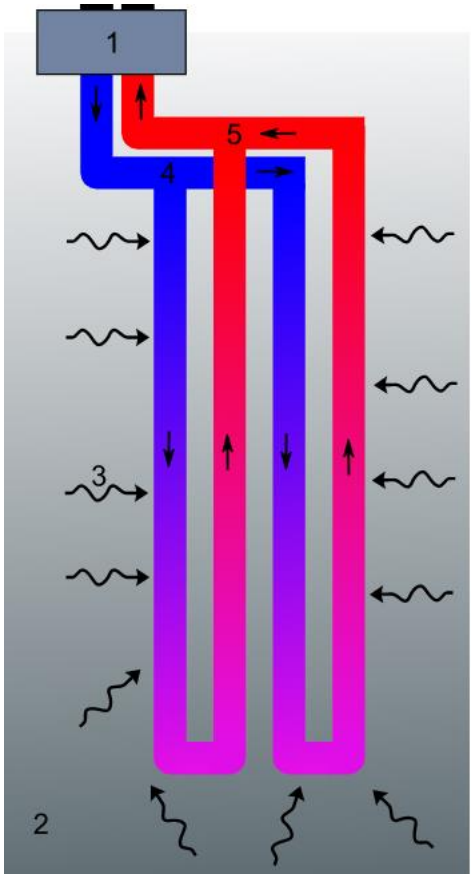
Glossary

Energy: can be defined as the ability to move or change matter. Put another way, energy is the ability to do work 1

Geothermal heat pumps: can tap into the heat of the Earth much closer to the surface to provide heat for individual buildings 9



Geothermal power plants: is where the heat is taken from deep in the earth and it generates steam to make electricity. 9

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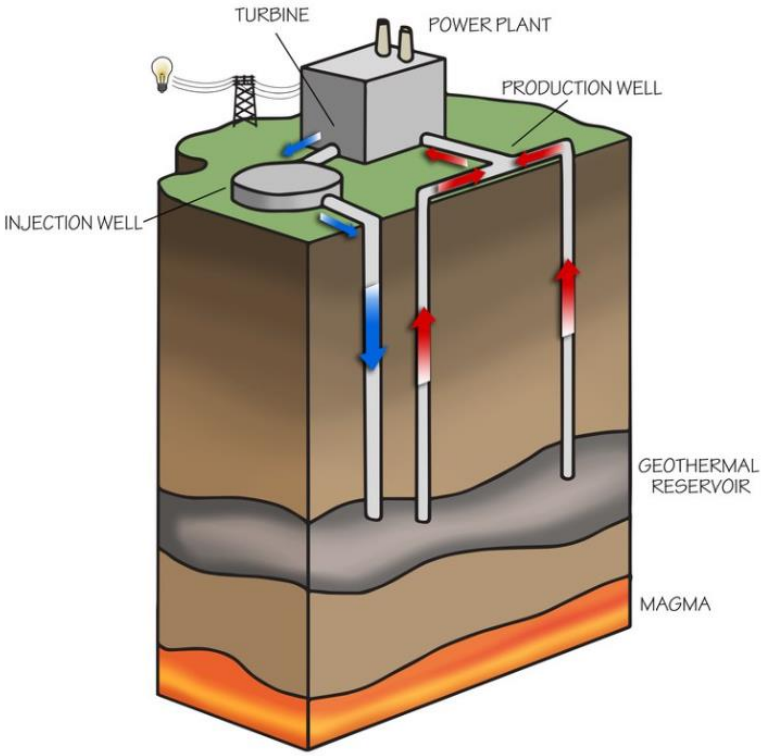

Geothermal Power: is electricity generated by the heat in the earth 1

Non-renewable energy: are used faster than they can be replaced. Examples would be gas, oil, and peat. 1

Periodic Table: This is a tabular display of the elements arranged by atomic number.....1

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5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57 La *	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89 Ac *	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og
			*	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
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Photovoltaic cells: Each photovoltaic cell is a sandwich made up of two slices of semi-conductor material, usually silicon.....4

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Renewable energy: will never run out and in most cases, it is replaced as quickly as it is used e.g. Wind, Solar, Hydro ..1

Solar Power: is energy, electricity in particular, generated by the sun 1

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