Pielar Panel

March, 2019

Ibrahim Eren Bisen

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CREATING A HOME-MADE PIEZOELECTRIC CRYSTAL

Piezoelectricity is fascinating. When we researched about them, we have found out that we could create our piezoelectric crystals too. In this experiment, we have tried to create a Rochelle salt. Step by step I am going to explain them. Step 1. We have put 200 grams (7 oz) of cream of tartar into 250 milliliters (one cup) of water. Stirred it so that the cream of tartar particles is suspended in the water. Step 2. With a saucepan was larger than the container from step 1 and placed the container into the larger saucepan. placed water in the saucepan. Step 3. placed the whole thing on a stove and heated it until the water in the saucepan is just simmering Step 4. added about a half teaspoon of sodium carbonate in the inner container and stirred It will bubble up every time. Stirred it until it didn't bubble anymore. Step 5. placed more sodium carbonate and stirred again. Repeated this step until you put some in and it didn't bubble. This repetitive cycle has taken us as long as 50 minutes. Step 6. We got a second container and a coffee filter. Poured the hot solution in the container through the coffee filter into the second container. Step 7. Once it was all in the second container, we next heat the filtered solution again, evaporating away some of the water until we had had less than you started with. The purpose of this is to concentrate on the solution. Step 8. placed the solution in a cool place and left it there for a month. At the and we have failed to the crystal because we forgot to turn baking soda into the washing soda.

CREATING A HOME MADE PIEZOELECTRECITY CRYSTAL PICTURES

Pictures taken by Ibrahim Bisen

CREATING THE PIEZOELECTRCITY PANEL

After designing the Pielar panel on paper the next step was to model the piezoelectric panel that we have created. Initially, our idea was to create the piezoelectric panel out of wood but after modeling the piezoelectric panel on Autodesk 3ds max we have come to the conclusion that there were too many small details in the design since our prototype was small. After a good amount of research, we have found two ways of creating the piezoelectric panel. The first way would be using a CNC machine to create it out metal or wood but when we look at the design, we wanted it to be very light then we turned to our second way of creating the piezoelectric panel 3d printing. Using 3d printing was in our advantage with 3d printing we could print a panel that was so light and extremely stable at the same time.

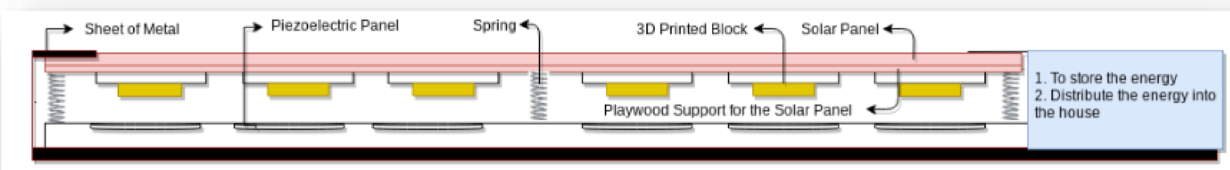

Diagram Created by Jose Carbajal

EXPLAINING THE MODEL

There are 3 parts of the model which are where solar panel stands where piezoelectric panel stands and “mother board” stands. In the image provided below the smallest piece would be the cap of the motherboard and where our led light is and where the buttons to continue the electric circuit. The second biggest piece would be where the solar panel stands; the six circle holes that around are the where springs will stand after connecting the panel and solar panel, The eighteen cylinders that is evenly distributed around the 2nd part aligns with the piezoelectric panels that is the main piezoelectricity panel that we have created, after printing the pieces we have applied small amount of silicon on top of every cylinder with this silicon if there is and hard matter hits or falls on top of the Pielar panel it protects it from any possible damage that might be taken to the piezoelectric panels. 3rd would be where our circuit is. 6 holes around the bottom panel is for inserting the springs. Eighteen 15-millimeter radius circles are where the piezoelectric panels are inserted. The two lines throughout the panel is where all the circuit and cables go through. piezoelectric panels are inserted. The two lines throughout the panel is where all the circuit and cables go through.

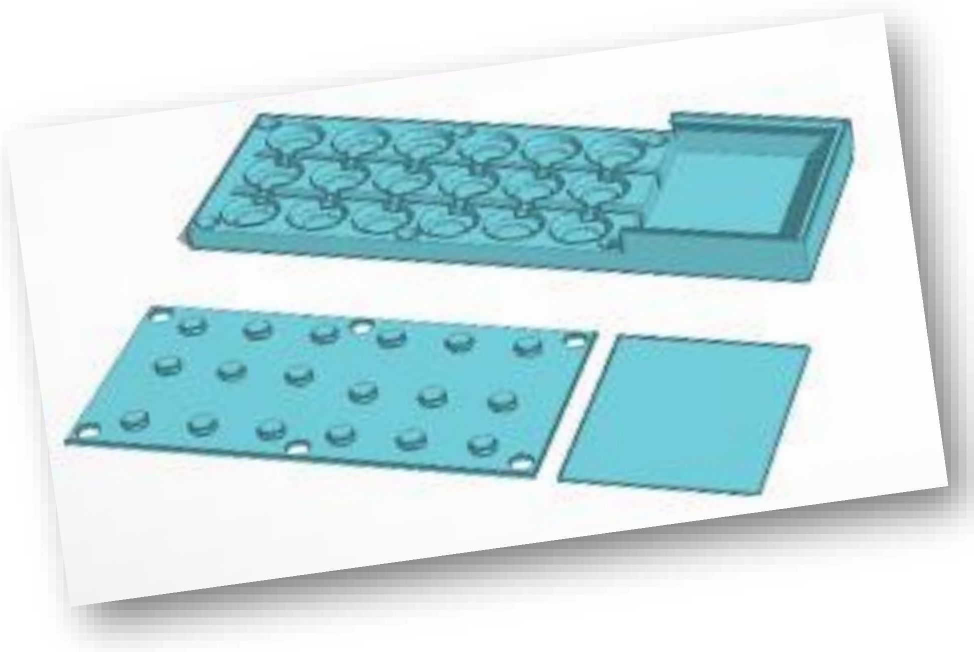

Diagram Created by Ibrahim Bisen

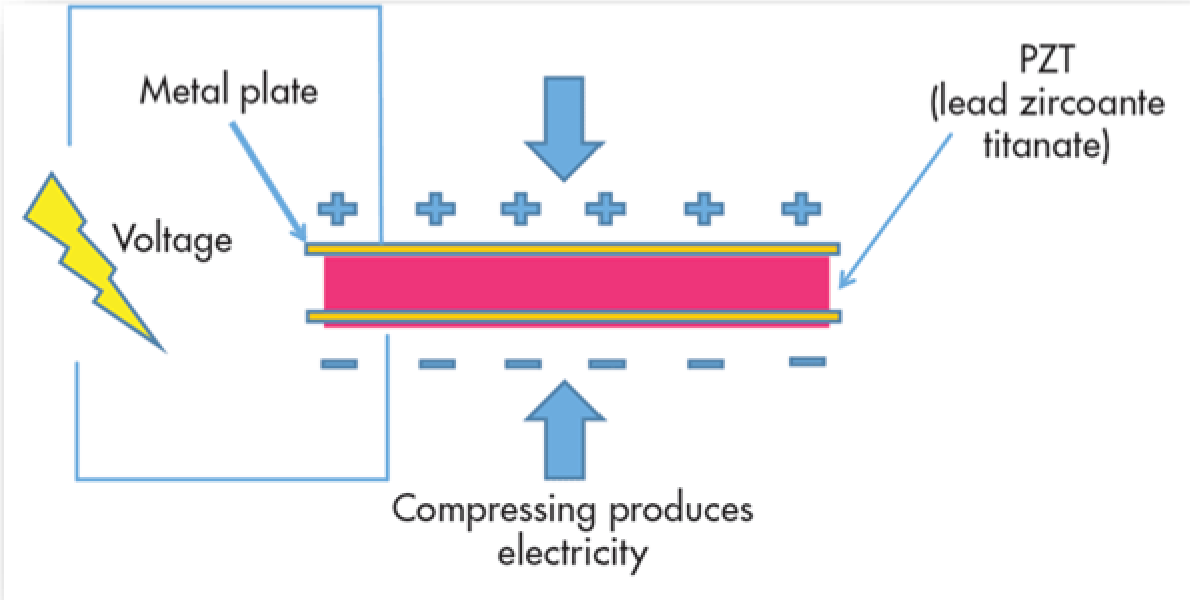

Diagram Created by Ibrahim Bisen

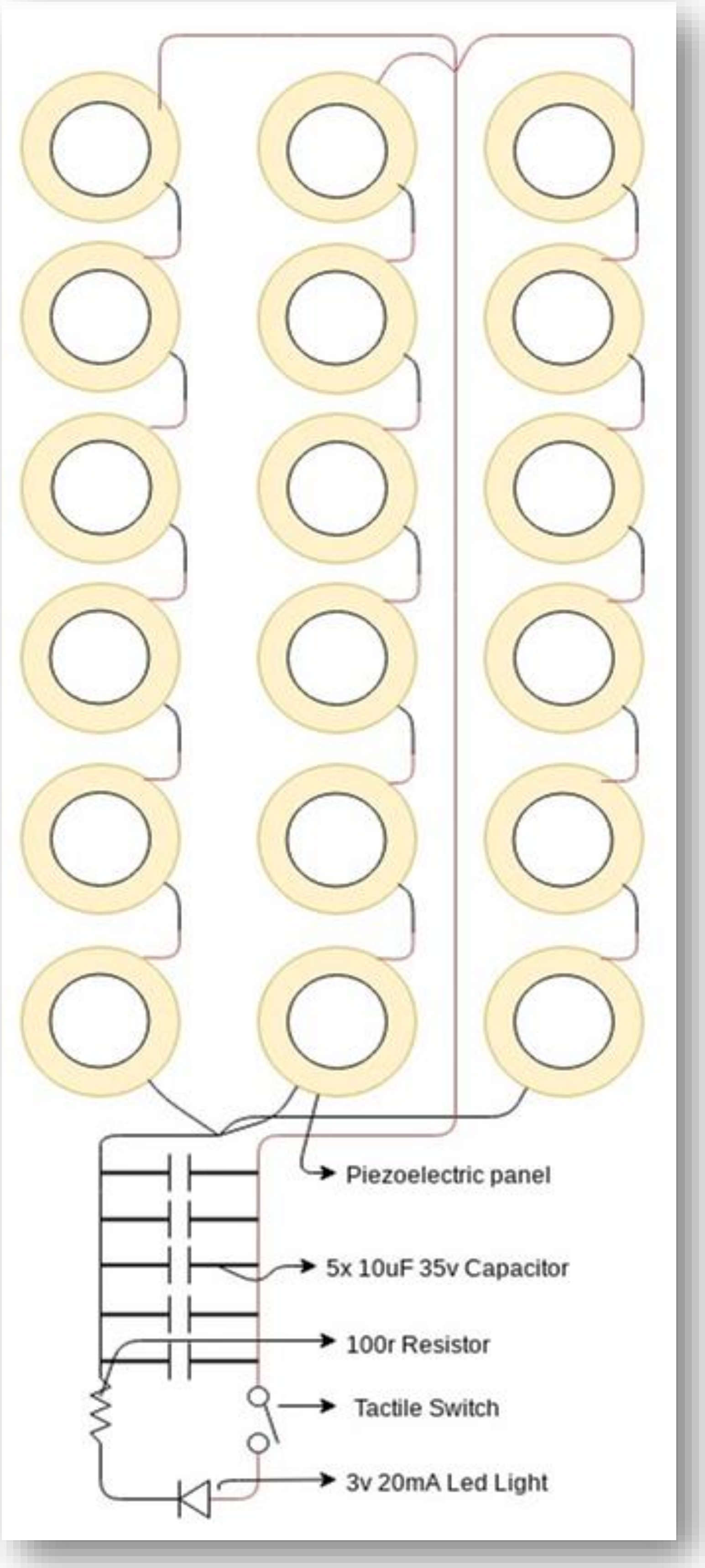

Diagram created by Ibrahim Bisen

GRAPHS AND TABLES

		Austin			Philadelphia		
Avarage Monthly Rainfall Per Square Foot	January	4.1 cm			7.5 cm		
	April	6.3 cm			9.0 cm		
	July	5.5 cm			12.3 cm		
	October	8.1 cm			10.4 cm		
Avarage hourly Sunshine Per Month	January	161 Hours			157 Hours		
	April	209 Hours			225 Hours		
	July	313 Hours			259 Hours		
	October	215 Hours			201 Hours		
		Water Drops Per Square Inch	Amount of Energy Produced per Piezoelectric Panel		Water Drops Per Square Inch	Amount of Energy Produced per Piezoelectric Panel In a	
	January	81 Drops	24.30	Joule	150 Drops	45.00	Joule
	April	126 Drops	37.80	Joule	180 Drops	54.00	Joule
	July	110 Drops	33.00	Joule	246 Drops	73.80	Joule
	October	162 Drops	48.60	Joule	208 Drops	62.40	Joule
Amount of Produced ELectrical Energy From the Solar Panel	January	603.75 Joule			588.75 Joule		
	April	783.25 Joule			843.75 Joule		
	July	1173.5 Joule			975.25 Joule		
	October	806.25 Joule			753.75 Joule		
Amount of energy that is created by one water drop is 0.3. There might always be changes in the percepation amount and sunlight amount. These numbers are based on last 30 years avarage percepitation from World Meteorlogical Organization.							

	Our Solar Panel								Percentage of Efficiency Improvement Between The Normal Solar Panel and Our Solar Panel	
	Austin				Philedelphia				Cities	
	Total energy produced in that state from preception		Total energy produced in that state from our solar panel		Total energy produced in that state from preception		Total energy produced in that state from our solar panel		Austin	Philedelphia
January	88.57	Joules	561.91	Joule	303.75	Joule	759.45	Joule	**18.7%**	**66.7%**
April	214.33	Joules	828.79	Joule	437.40	Joule	1,098.90	Joule	**34.9%**	**66.1%**
July	163.35	Joules	1,083.57	Joule	816.97	Joule	1,578.43	Joule	**17.8%**	**107.3%**
October	354.29	Joules	986.39	Joule	570.02	Joule	1,160.96	Joule	**56.1%**	**96.5%**

Tables made by Ibrahim Bisen

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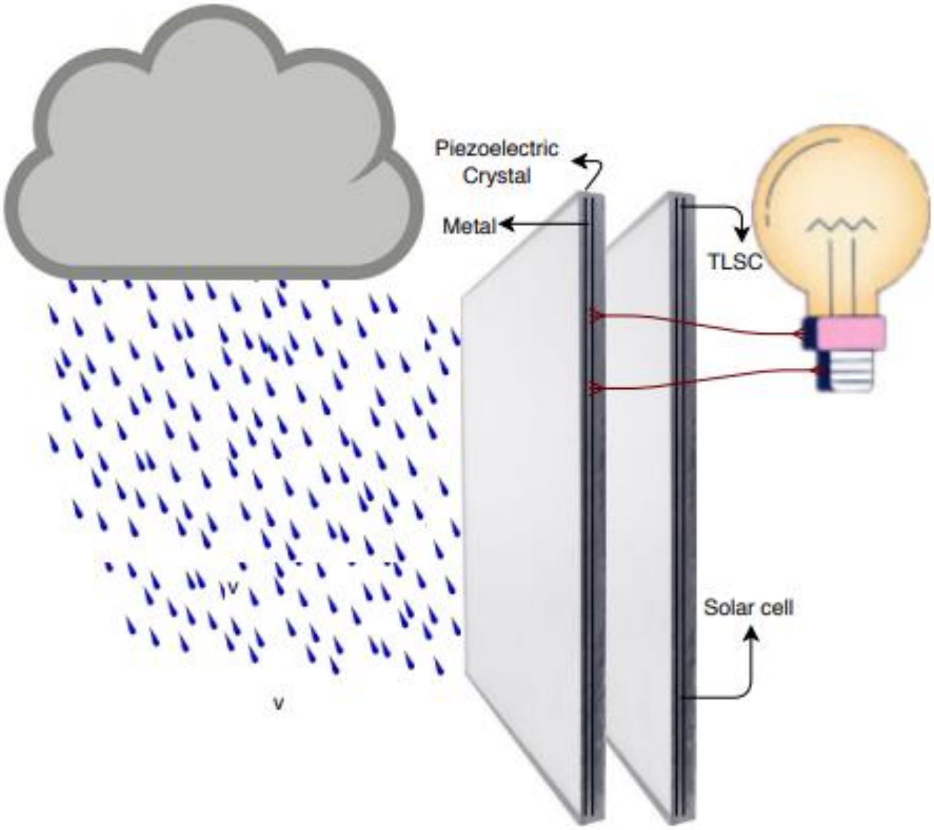
	Total energy produced in that state from preception		Total energy produced in that state from our solar panel		Total energy produced in that state from preception		Total energy produced in that state from our solar panel		Austin	Philedelphia
January	218.70	Joule	822.45	Joule	405.00	Joule	993.75	Joule	**36.2%**	**68.8%**
April	340.20	Joule	1,123.45	Joule	486.00	Joule	1,329.75	Joule	**43.4%**	**57.6%**
July	297.00	Joule	1,470.50	Joule	664.20	Joule	1,639.45	Joule	**25.3%**	**68.1%**
October	437.40	Joule	1,243.65	Joule	561.60	Joule	1,315.35	Joule	**54.3%**	**74.5%**

Tables made by Ibrahim Bisen

DIAGRAM OF HOW THE PIEZOELECTRICITY CRYSTAL INTEGRATED TLSC



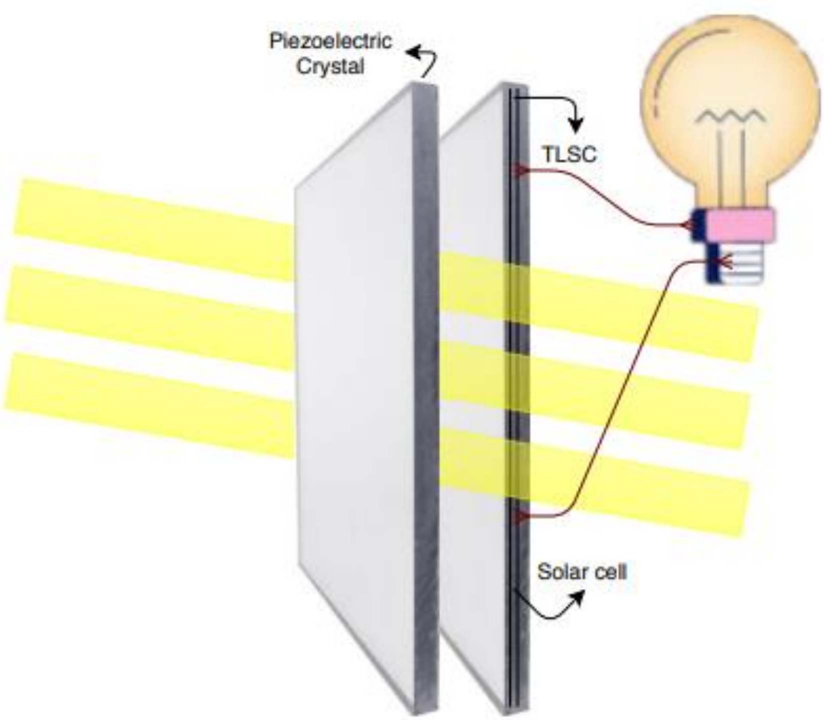
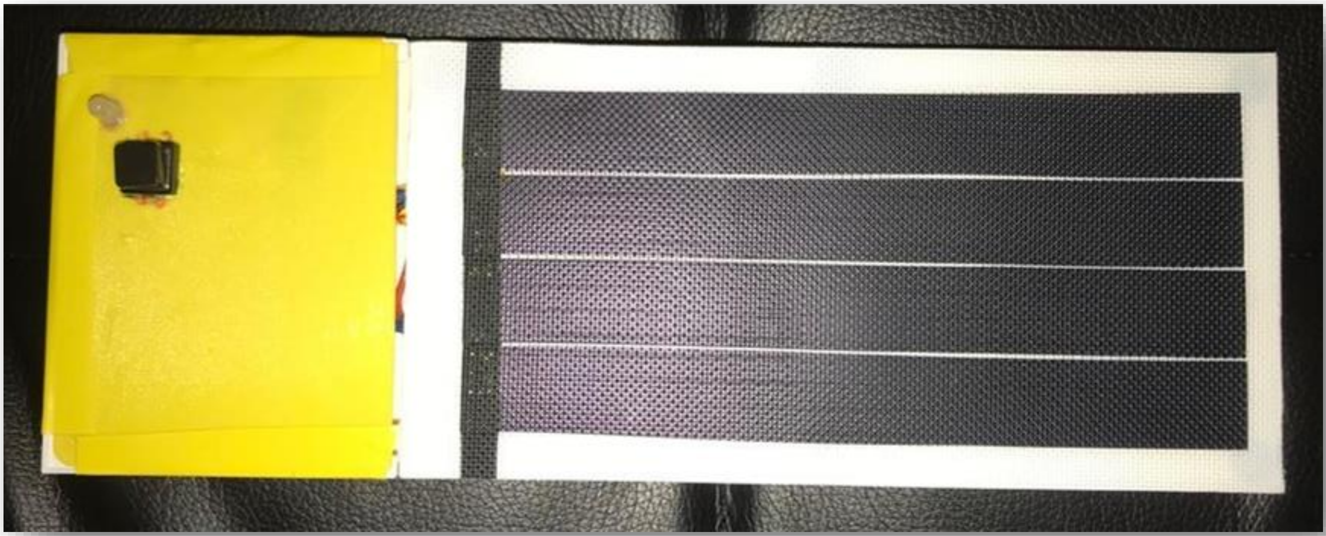


Diagram Created by Jose Carbajal Tables made

INITIAL START OFF WORK FOR THE PROJECT

When we have started this project our main question was What keeps solar panels from being efficient and how can we increase the efficiency upon an existing solar panel, without a tremendous cost? As we progressed through the project, we have found extremely fascinating material about solar panels. But our initial idea was to create the first Pielar panel. Pielar Panel looks like a normal solar panel, but it is just thicker due to having the piezoelectric panel at the bottom of the solar panel. The process of producing electrical energy with Pielar panel is more simple basically when pressure is applied to the solar panel by any kind of precipitation it will cause the move the solar panel vertically every time solar panel moves vertically the silicon type of material that is underneath the solar panel will hit the series of the piezoelectric panels which will cause it to produce electrical energy. Electrical energy that is produced by the Piezoelectric panel sis carried out by the cables throughout the Piezoelectric panel.



Picture Taken by Ibrahim Bisen

SOLAR PANEL TYPES

We can put solar panels into 3 general categories which are 1st generation, 2nd generation, and 3rd generation. 1st generation solar panels are the traditional types of solar panels made of monocrystalline silicon or polysilicon and are most commonly used in conventional surroundings. 2nd generation solar panels are different types of thin film solar cells and are mainly used for photovoltaic power stations, integrated into buildings or smaller solar power systems. 3rd generation solar panels include a variety of thin film technologies but most of them are still in the research or development phase. Some of them generate electricity by using organic materials, others use inorganic substances. CdTe would be a primary example of an inorganic substance. All of these categories would be an extremely broad category and all of these categories have other sub-categories in them. 1st, 1st generation type solar panel is Monocrystalline Solar Panels (Mono-SI) and Polycrystalline Solar Panels (Poly-SI). Monocrystalline Solar Panels are made out of Monocrystalline silicon the purest and most natural silicon type is this one. The silicon's high purity causes this type of solar panel has one of the highest efficiency rates, with the newest ones reaching above 20%. Monocrystalline panels have a high-power output, occupy less space, and last the longest. Of course, that also means they are the most expensive of all the solar panels. Another advantage to consider is that they tend to be slightly less affected by high temperatures compared to polycrystalline panels. Monocrystalline solar panels are the most common solar panels at the consumer level. Another 1st generation type solar panel is Polycrystalline Solar Panels (Poly-SI) has a blue, speckled look. They are made by melting raw silicon, which is a faster and cheaper process than that used for monocrystalline panels. this leads to a lower final price but also lower efficiency (around 15%), lower space efficiency, and a shorter lifespan since they are affected by hot temperatures to a greater degree. The first type of 2nd generation solar panel is Thin-Film Solar Cells (TFSC) Thin-film solar panels are manufactured by placing one or more films of photovoltaic material (such as silicon, cadmium or copper) onto a substrate These types of solar panels are the easiest to produce. They are also flexible—which opens a lot of opportunities for alternative applications—and is less affected by high temperatures. The main issue is that they take up a lot of space, generally making them unsuitable for residential installations. Moreover, they carry the shortest warranties because their lifespan is shorter than the mono- and polycrystalline types of solar panels. However, they can be a good option to choose among the different types of solar panels where a lot of space is available. The 2nd type of 2nd generation solar panel would be the Amorphous Silicon Solar Cell (A-Si). The amorphous silicon solar cell is among the different types of solar panels, the one that is used mainly in such pocket calculators. This type of solar panel uses a triple layered technology, which is the best of the thin film variety. Just to give a brief impression of what “thin” means, in this case, we’re talking about a thickness of 1 micrometer (one-millionth of a meter). With only 7% efficiency rate, these cells are less effective than crystalline silicon ones—that have an efficiency rate of circa 18%—but the advantage is the fact that the A-Si-Cells are relatively low in cost. As I have mentioned before 3rd generation solar panels are the most efficient solar panels, but they are also in the research stage this means they are not used by any place. With that said 1st type of 3rd generation, the solar panel is biohybrid solar cell. It has been discovered by an expert team at Vanderbilt University. The idea behind the new technology is to take advantage of the photosystem 1 and thus emulate the natural process of photosynthesis. but only by combining the multiple layers of photosystem 1, the conversion from chemical to electrical energy becomes much more effective (up to 1000 times more efficient than 1st generation types of solar panels). The 2nd type of 3rd generation solar panels is Cadmium Telluride Solar Cell (CdTe). Among the collection of different types of solar panels, this photovoltaic technique uses Cadmium Telluride, which enables the production of solar cells at relatively low cost and thus a shorter payback time (less than a year). Of all solar energy technologies, this is the one requiring the least amount of water for production. Keeping the short energy payback time in mind, CdTe solar cells will keep your carbon footprint as low as possible. The only disadvantage of using Cadmium Telluride is its characteristic of being toxic if ingested or inhaled. In Europe especially, this is one of the greatest barriers to overcome, as many people are very concerned about using the technology behind this type of solar panel.

TYPES OF SOLAR PANELS PICTURES

Solar Cell Type	Efficiency-Rate	Advantages	Disadvantages
Monocrystalline Solar Panels (Mono-SI)	~20%	High efficiency rate; optimised for commercial use; high life-time value	Expensive
Polycrystalline Solar Panels (p-Si)	~15%	Lower price	Sensitive to high temperatures; lower lifespan & slightly less space efficiency
Thin-Film: Amorphous Silicon Solar Panels (A-SI)	~7-10%	Relatively low costs; easy to produce & flexible	shorter warranties & lifespan
Concentrated PV Cell (CVP)	~41%	Very high performance & efficiency rate	Solar tracker & cooling system needed (to reach high efficiency rate)

https://www.greenmatch.co.uk/blog/2015/09/types-of-solar-panels

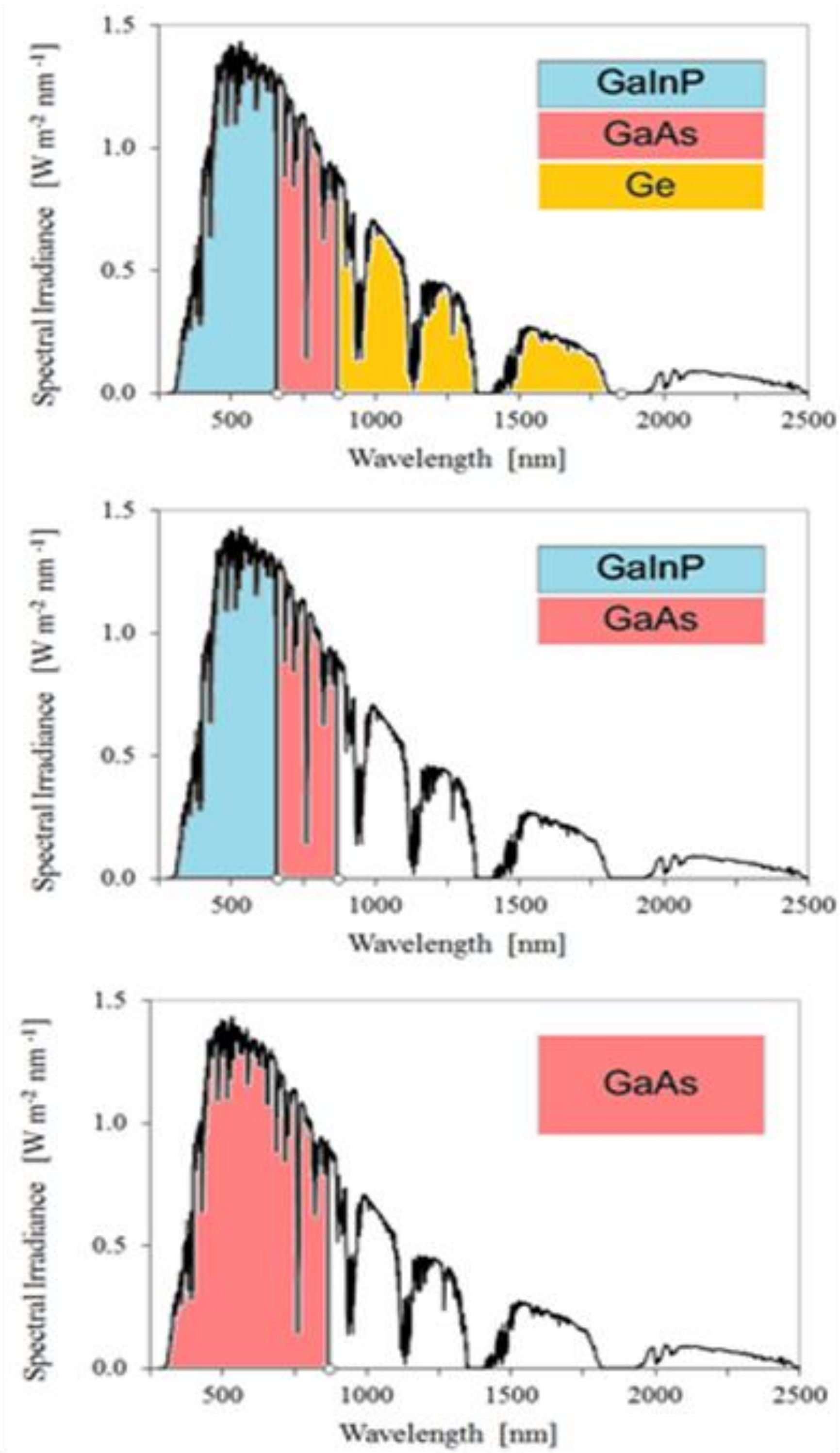
SINGLE CRYSTALLINE SILICON - PV MODULE

POLYCRYSTALLINE SILICON - PV MODULE

AMORPHOUS SILICON THIN FILM - PV MODULE

http://www.engineeringbookspdf.com/basics-of-solar-cell/

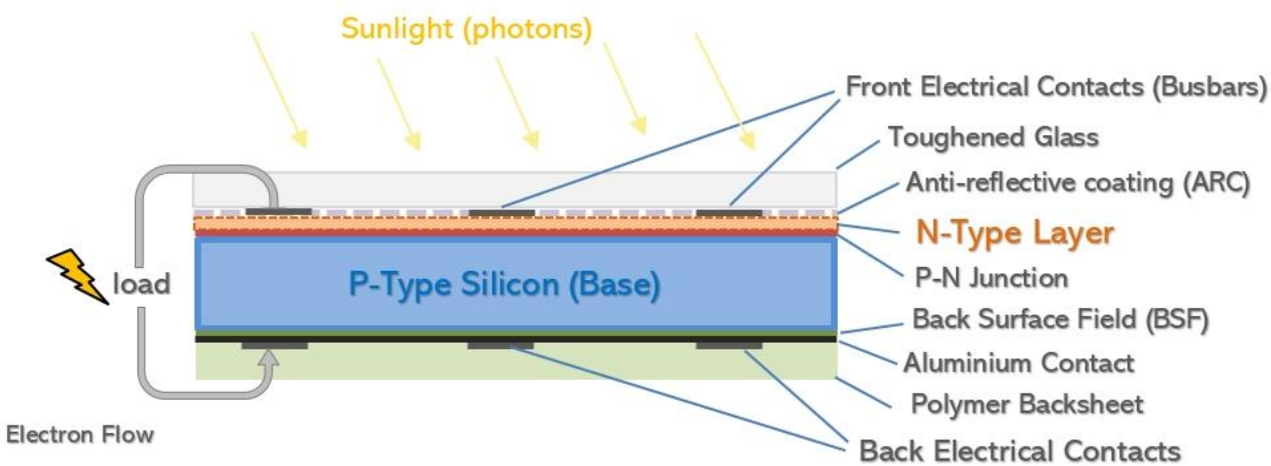
THE 3RD GENERATION SOLAR PANEL OBSERVABLE SOLAR SPECTRUM



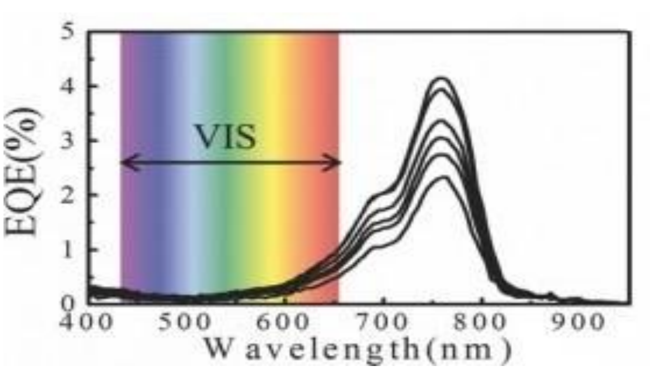
https://www.cheetah-exchange.eu/pv_technologies.asp?i=32

WHAT ARE JUNCTIONS AND TYPES OF JUNCTIONS

There multiple the of solar cell junctions which are a p-n solar junction and multi-junction solar cell. Multi junction solar cells are. Multi-junction (MJ) solar cells are solar cells with multiple p-n junctions made of various semiconductor materials. Each material's p-n junction will produce an electric current in response to different wavelengths of light. The use of multiple semiconducting materials allows the absorbance of a broader range of wavelengths, improving the cell's sunlight to electrical energy conversion efficiency. Traditional single-junction cells have a maximum theoretical efficiency of 33.16% Theoretically, an infinite number of junctions would have a limiting efficiency of 86.8% under highly concentrated sunlight. Currently, the best lab examples of traditional crystalline silicon (c-Si) solar cells have efficiencies between 20% and 25%, while lab examples of multi-junction cells have demonstrated performance over 46% under concentrated sunlight. Commercial examples of tandem cells are widely available at 30% under one-sun illumination and improve to around 40% under concentrated sunlight. However, this efficiency is gained at the cost of increased complexity and manufacturing price. To date, their higher price and higher price-to-performance ratio have limited their use to special roles, notably in aerospace where their high power-to-weight ratio is desirable. In terrestrial applications, these solar cells are emerging in concentrator photovoltaics (CPV), with a growing number of installations around the world. Tandem fabrication techniques have been used to improve the performance of existing designs. In particular, the technique can be applied to lower cost thin-film solar cells using amorphous silicon, as opposed to conventional crystalline silicon, to produce a cell with about 10% efficiency that is lightweight and flexible. This approach has been used by several commercial vendors, but these products are currently limited to certain niche roles, like roofing materials. And p-n junctions are boundary or interface between two types of semiconductor materials, p-type and n-type, inside a single crystal of semiconductor. The "p" (positive) side contains an excess of holes, while the "n" (negative) side contains an excess of electrons in the outer shells of the electrically neutral atoms there. This allows electrical current to pass through the junction only in one direction. The p-n junction is created by doping, for example by ion implantation, diffusion of dopants, or by epitaxy (growing a layer of crystal doped with one type of dopant on top of a layer of crystal doped with another type of dopant). If two separate pieces of material were used, this would introduce a grain boundary between the semiconductors that would severely inhibit its utility by scattering the electrons and holes. p-n junctions are elementary "building blocks" of semiconductor electronic devices such as diodes, transistors, solar cells, LEDs, and integrated circuits; they are the active sites where the electronic action of the device takes place. For example, a common type of transistor, the bipolar junction transistor, consists of two p-n junctions in series, in the form n-p-n or p-n-p; while a diode can be made from a single p-n junction. A Schottky junction is a special case of a p-n junction, where metal serves the role of the p-type semiconductor.



https://www.cleanenergyreviews.info/blog/solar-pv-cell-construction



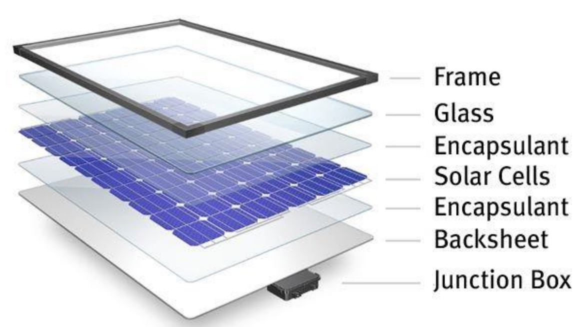
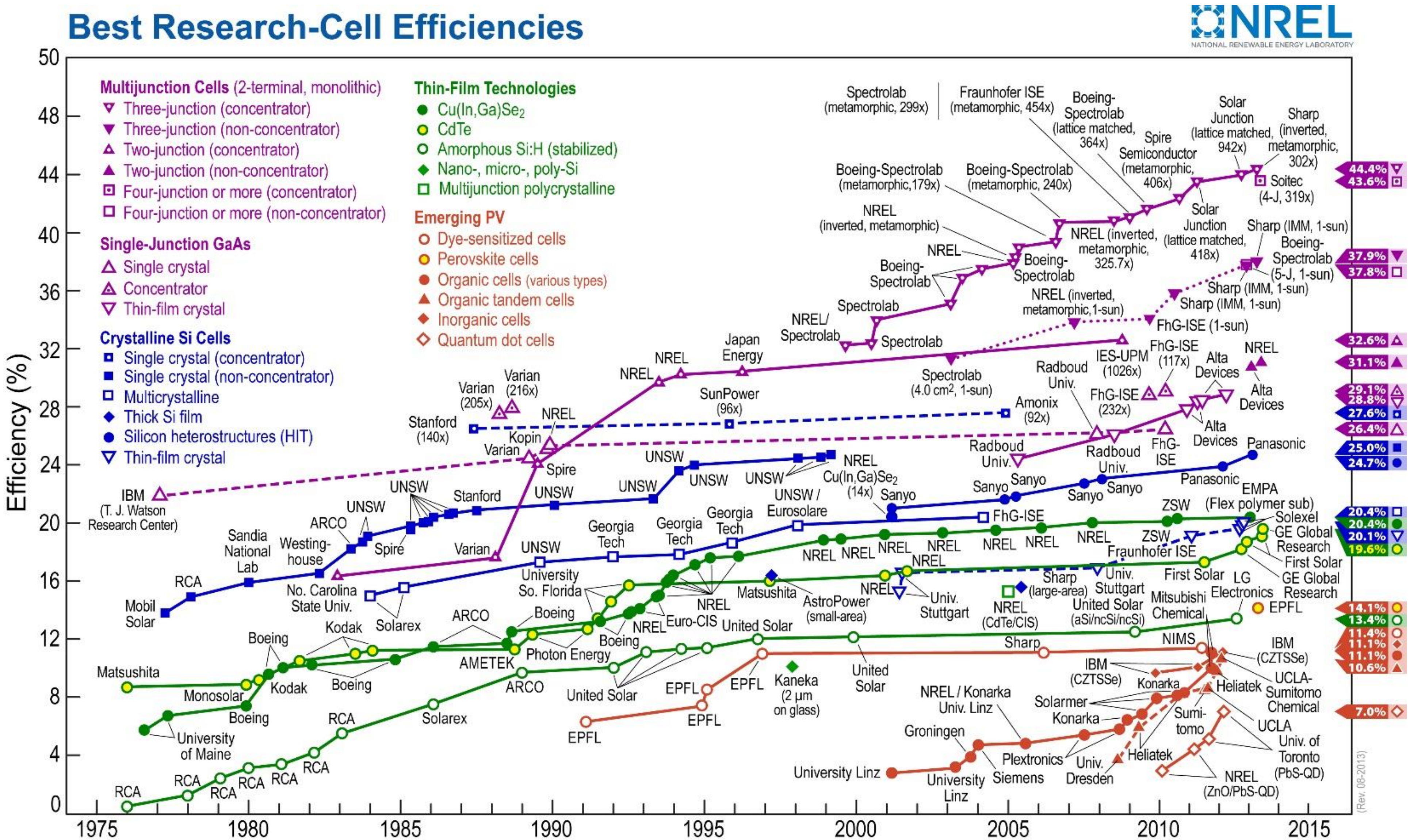


Diagram Created by unknown on https://www.extremetech.com

Diagram created by Good Energy Cooperation UK on https://www.goodenergy .co.uk/how-do-solar-panels-work/



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