Project Deliverable C: Design Criteria and Target Specifications

GNG 1103 – Engineering Design

Faculty of Engineering – University of Ottawa

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Introduction:

After meeting with the client, the following document was created to address the client's needs and requirements by interpreting them into the design criteria. Using the specified criteria such as the interpreted functional and non-functional needs will help lead our design in the right direction since it gives an idea of what the design should and shouldn't have given our certain constraints such as a limited budget. The allocation of the priorities among the client's needs will also further help aid the direction of our design as will the benchmarking. Through prioritizing, we distinguish what is mandatory in order for the design to be effective as possible. We increase the effectiveness of our design by comparing our own design alongside well thought out designs and we develop an analysis based on our comparison. The target of this document is to assist us in developing the most efficient design for the client.

1. **Design criteria**

Number	***Interpreted Need***	***Design Criteria***	***Priority***
1	Solar panel should be able to be mounted continually when it is extended	-panels should have a sturdy mounting mechanism which allows the panels to be connected with others.	★★★★☆
2	Must be able to function through various weather conditions	-panels should be tilted at a angle so the snow could fall off. -Use a roof rake. -windshield wipers.	★★★★★
3	Store solar energy created during the daytime	-energy needs to be stored in batteries so it can be used other times.	★★★★☆

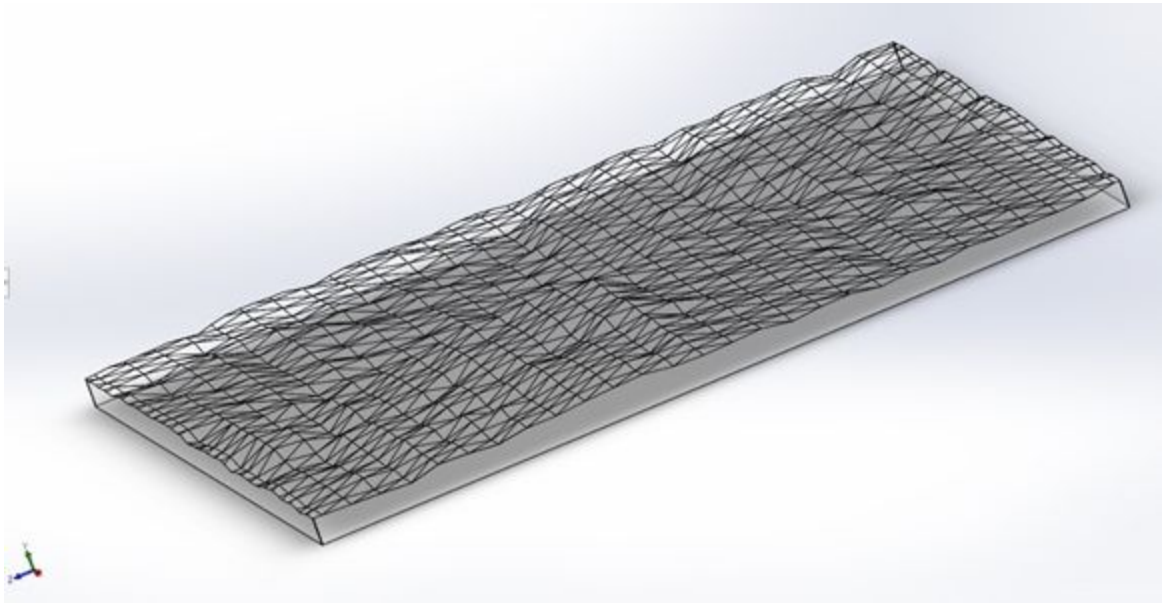
4	Maintain usage in times with low light	-During the daytime hours, battery banks store energy throughout the day in order to be utilized at night.	★★★★☆
5	Solar panels should generate enough energy to power	- Lights - heating - water heating - small refrigerator - miscellaneous power outlets.	★★★★☆
6	Able to share energy between neighbouring sheds (collective energy bank)	-must have storage battery where all the energy is stored.	★★★☆☆
7	Satisfy building code requirements (regulations involving solar panels)	-must communicate with project manager	★★★★☆
8	The solar should be child-safe (preventing children from injuring themselves or causing damage).	-no sharp objects -no exposed wiring that children could come in contact with	★★★☆☆
9	Solar panels must provide benefits regardless of the location	Whatever things are considered obstacles to the solar panel shouldn't reduce its effectiveness.	★★★☆☆
10	Maneuverable; Can be installed anywhere on the shed	-easily able to take apart. -universal fitting components	★★★☆☆
11	Central heating control system (Not easily accessible by children)	Solar energy should be converted to heat energy.	★★★☆☆
12	Solar panels easily removable and reconstructed, and transported (resistant to damage)	One needs to be able to easily take off the solar panel when replacements are needed	★★★☆☆
13	Heat insulation	-efficiency (no loss of heat energy) -Good material that can trap heat	★★★☆☆

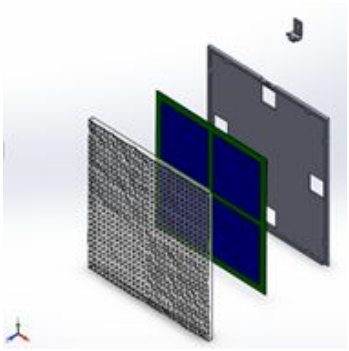
14	Inexpensive	-Budget must be kept to a maximum of $100 -focus on functionality, not aesthetics	★★☆☆☆
15	Removal of snow or minimizing snow buildup	Water hose can be used to spray off the snow or heat tape that ensures snow will be melted eventually	★★★★★

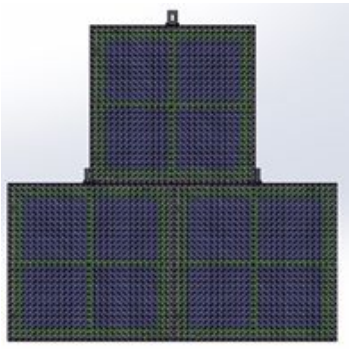
2. Benchmarking

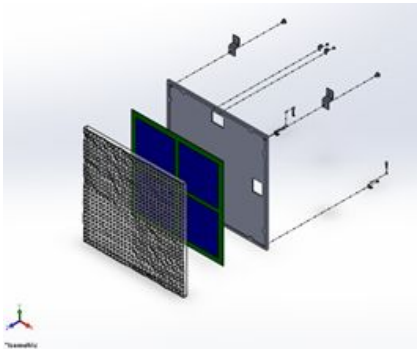
RoCo Industries Solar Panel Design

Our team took inspiration from a solar panel project conducted by one of our group members previously. A textured layer of glass (fused quartz, acrylic, or tempered glass) was designed over top of a custom RoCo Ind. solar panel technology, to give an aesthetic look of any material wanted by the client (stone, brick, wood, etc.). A mounting device was also designed by the team, which can be modified to fit our groups needs when connecting several panels together consecutively. This solar panel design excels in providing an attractive approach to solar energy, in which some aspects can be taken and translated over to our own project.



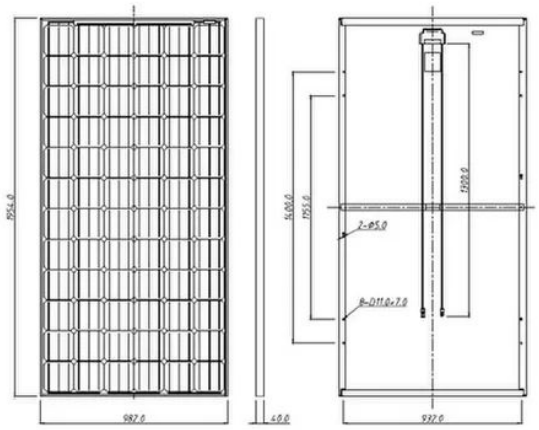






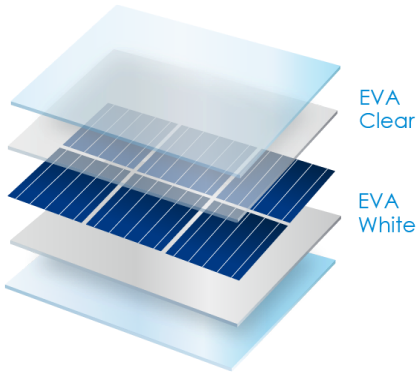
Canadian Solar CS6X-305M

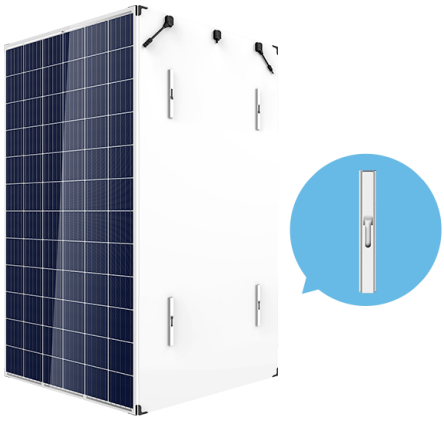
The Canadian Solar CS6X-305M solar panels are easy to maintain, give you strong solar efficiency and possess a pronounced rectangular design that will appeal to a number of customers. Canadian Solar is a relatively young company but has already established itself as a reliable manufacturer of quality solar products that it sells to customers in 50 countries. There are some pros and cons in investing in these panels. The pros are the panels are self-cleaning in many cases. Cons are there are relatively few options for contacting the company compared to some other solar panel manufacturers.



Trina Solar DUOMAX-PEG14:

The heat-strengthened dual-glass design of DUOMAX 72-cell reduces micro-cracking, UV ageing, degradation and corrosion, which makes it ideal for uncompromising weather conditions. It has 0.5% annual power degradation, higher lifetime energy production, and 30-year linear power warranty**.** Gecko Grip enables installers to rapidly and reliably mount DUOMAX modules with most current racking methods which improves installation speed and portability.The module's split junction box allows reduction in the cable lengths, while the higher voltage lowers the overall energy losses from the system and increases the energy produced for the same land area and string lengths by up to 50%.





Benchmarking table

Specifications	**Importance**	*RoCoIndustries SolarPanel Design*	CanadianSolar CS6X-305M	TrinaSolar DUOMAX-PEG14:
Weather resistance	**4**	unspecified	self-cleaning glass surface	heat-strengthened dual-glass design
Efficiency	**5**	*material dependent -ranges from most efficient (tempered glass) to least efficient (acrylic) *-as a conceptual design, values of efficiency have not been calculated*	-15.9% efficiency	-0.5% annual power degradation -17% efficiency
Maintenance/ warranty	**4**	-maintenance proves to be costly, as required materials sacrifice longevity for aesthetic -warranty of material present, however warranty of the solar panel concept cannot be determined	-Relatively few options for contacting the company -10 Year Product Warranty	30-year linear power warranty
Module conjunctions	**5**	prioritizes easy installation through an efficient mounting mechanism	unspecified	Gecko Grip enables installers to rapidly and reliably mount the modules
Cost	**2**	*material dependent *~$200USD-$1000USD*	$\sim 220\ USD$	$\sim 300\ USD$
Average Points		28/4 = **7**	32/4 = **8**	47/5 = **9.4**

Green = 3 **Yellow = 2** **Red = 1**

3. Engineering design specifications

Design specifications	Relations (=, < or >)	Value	Units	Verification method
Functional requirements				
Ease of assembly	=	yes	N/A	Analysis
Can withstand harsh Canadian weather*				
• Temperature (winter)	=	-30	°C	Testing
• Temperature (summer)	=	35	°C	Testing
• Snowfall	=	350	cm	Analysis, testing
• Wind	=	55	km/h	Analysis
• Humidity (relative)	=	99	%	Analysis, testing
Energy saving	=	yes	N/A	Testing, analysis
Can generate enough energy and save excess energy to be used when in low light to power the shed year-round for 4 people	>	0.71	GJ/m^2 per year	Testing
Can share excess energy between sheds	=	yes	N/A	Testing
Satisfy building code requirements				
• *[Refer to CSA Electrical standards for photovoltaic systems: Appendix A]*	=	yes	N/A	Inspection by professional
Maneuverable	=	yes	N/A	Analysis
Child-proof	=	yes	N/A	Analysis
Constraints				
Budget	<	100	CAD	Estimate, final check
Size	=	4x8	feet	Final check
Time	<	January 7- April 5		Professor/client

				approval
Non-functional requirements				
Aesthetics	=	yes	N/A	Analysis
Product life	>	1	year	Estimate, test

*****based on approximate average high Ottawa weather statistics in recent years (see references)

Conclusion

Given the requirements by our client Sandra Cocea, our team analyzed numerous aspects of the Solar Panel project, such as design necessities/criteria and non-/functional requirements. A table was created to assess all the preferences given to our group by the client, as well as various codes/conditions that our final product must adhere to. By pulling inspiration from current technology and conceptual ideas, our team created a list of benchmark designs which have potential functions that we can incorporate into our own project. It was imperative that our team considered the overall construction of the shed (automation component, etc.) when listing our own requirements and constraints. Understanding this, it was important that our team consulted with the other groups to discuss how our solar panel design can be incorporated to the overall concept of the shed.

Prioritized design criteria:

Functional requirements

- must be able to function through weather conditions (snow, hail, rain, cold, heat, wind
- store solar energy created during the daytime, and maintain usage in times with low light
- able to be mounted continually when the shed is extended
- the shed should be accessible for people with special needs, like physical handicaps.
- solar panels should generate enough energy to power: lights, heating, water heating, small refrigerator, and miscellaneous power outlets.
- The solar should be child-safe (preventing children from injuring themselves or causing damage).
    - Hardwear should be concealed. For example, wires should be out of reach.
- Satisfy building code requirements (regulations involving solar panels)
- Solar panels must provide benefits regardless of the location
- Can be installed anywhere on the shed
- Able to share energy between neighbouring sheds (collective energy bank)

Nonfunctional requirements

- Aesthetically appealing
- Seamless design
    - solar panels that can be manipulated to look like a brick wall (glass texturing, etc.)
- placement of the solar panels (along the side/top of the shed, etc.)
- Cost effective (ex. For people with low budgets who want to do the same)
- Non-intrusive (ex. Noiseless solar panels)

Constraints

- Dimensions: 4x8 feet
- windows (2 x 2 feet)
- accommodate a family of 4
- Budget (around 500 cad)

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*majority of information provided came from meetings with the manufacturer of RoCo Ind

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