



VeraSol

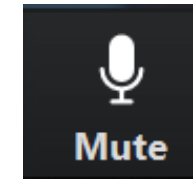
Quality Standards for Off-Grid Refrigerators

Webinar

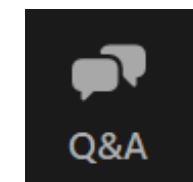
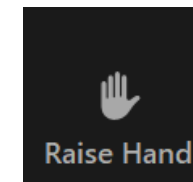
March 31, 2022

Housekeeping

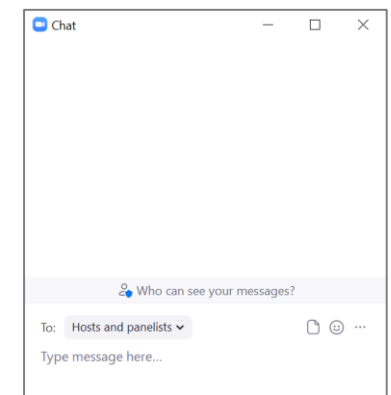
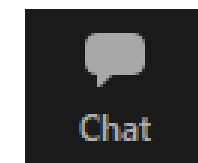
- Please mute yourself using the button at the bottom of the screen when not speaking



- If you would like to ask a question or make a comment, please
 - Raise your hand by clicking on the button at the bottom of your screen
 - Type your questions into the Q&A box



- To start, please type in a few words about yourself (name, affiliation, role, etc.) and what brings you to this webinar today in the chat box



Agenda & Speakers



Agenda

- Why quality standards for off-grid refrigerators
- Intro to the draft VeraSol policy for certifying refrigerators
- Preliminary overview of testing and certification process
- Changes to the daily energy service calculation
- Q&A

Speakers



Elisa Lai

Manager

CLASP



Meg Harper

Senior Research Engineer

Schatz Energy Research Center



Riley Macdonald

Associate

CLASP



Tom Quetchenbach

Research Engineer

Schatz Energy Research Center

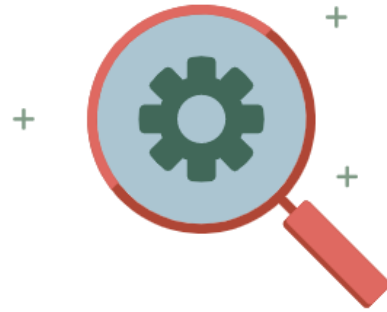
Introduction

- What is VeraSol?
- Why quality standards for off-grid solar refrigerators?

VeraSol supports the growing global market for modern off-grid solar solutions with a comprehensive suite of quality assurance services.



Enable Smarter Decisions



Reduce Risk



Increase Impact

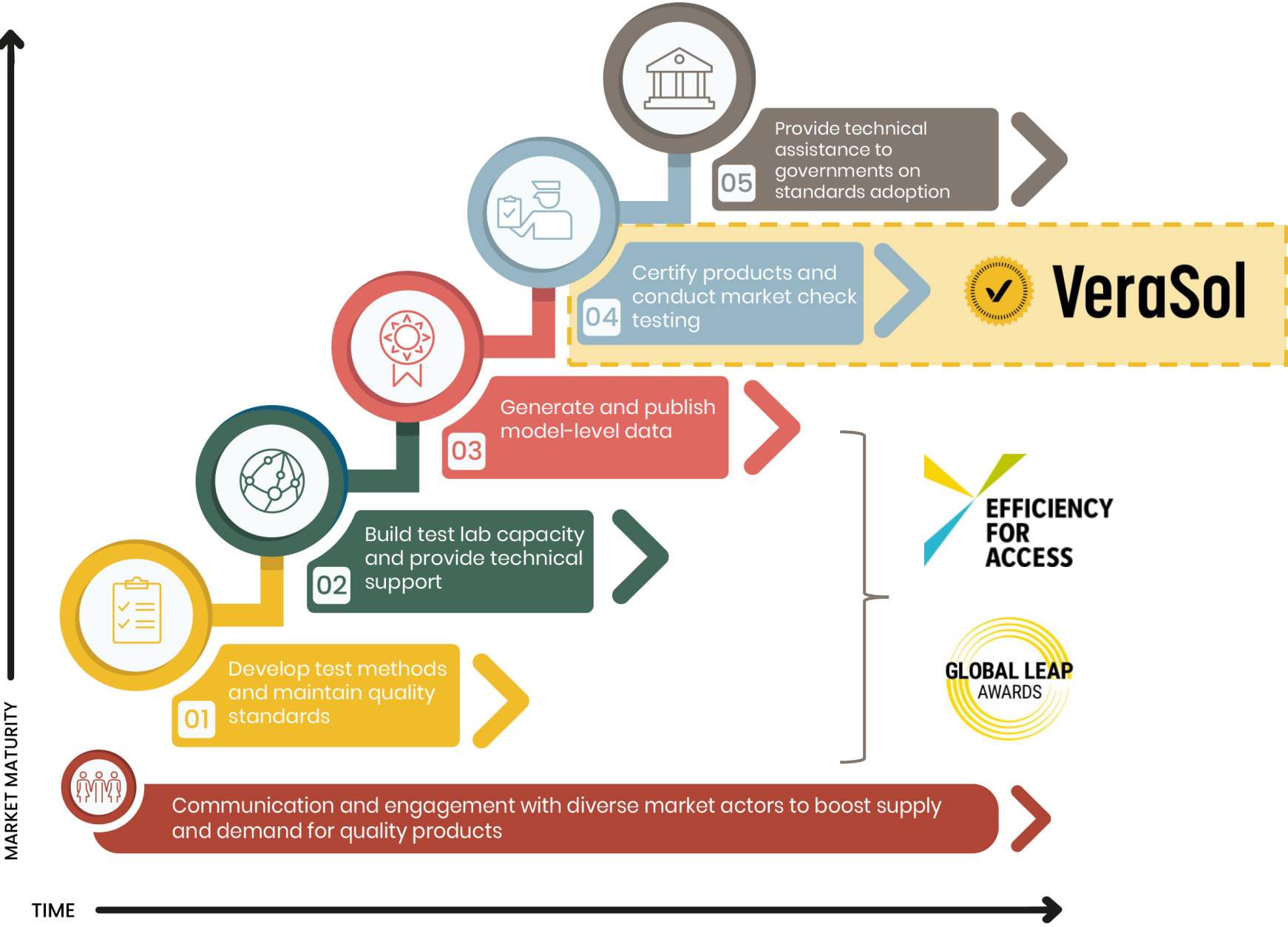


Improve Efficiency

Program supported by



Program Components



As a technology & markets mature, QA needs evolve.



Certification Services



Today there are currently over 190 solar energy kits that are certified by VeraSol.



Pico-solar products: **95**



Solar home system kits: **53**

Solar home system kits with refrigerators

Standalone refrigerators

Potential new certification service

Quality standards overview

Intro to the draft VeraSol policy for
certifying refrigerators

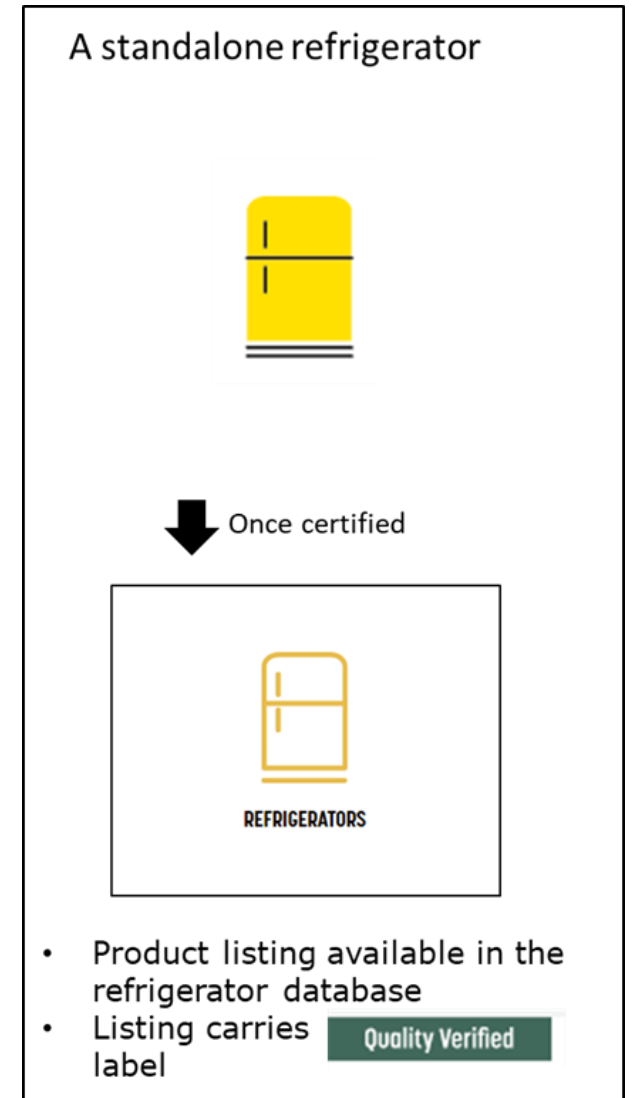
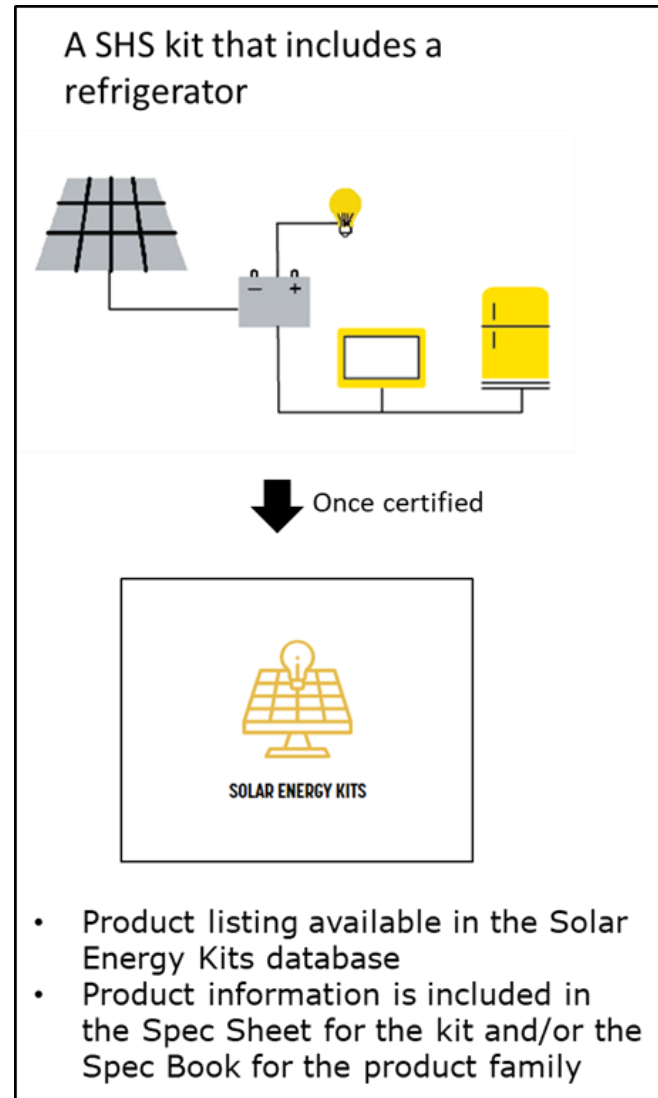
Scope

Refrigerators and freezers for use on off-grid energy systems and mini-grids

May be included with a solar home system (SHS) kit, or certified as a standalone refrigerator

Excluded (for now):

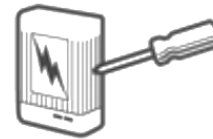
- SHS kits with AC refrigerators
- Solar direct drive refrigerators
- Vaccine refrigerators and ice pack freezers for medical purposes (these are covered by WHO PQS)



What do the Quality Standards cover?



- Truth-in-advertising & performance requirements



- Health & safety



- Quality & durability



- Consumer information & warranty



Truth in advertising (TIA)

Truth in advertising is the basis of the standards. Test results from the Global LEAP Off- and Weak-Grid Refrigerator Test Method will be used to check all advertised claims.

- All numeric specifications are accurate within 15%.
This includes:
 - Temperature ratings
 - Use classes
 - Volume
 - Power and energy consumption
- All advertised features are functional
- No statements should mislead buyers or end users



Reporting requirements

The product and consumer-facing material shall be marked with:

- Manufacturer/Vendor name or trademark and model number
- Compartment volumes
- Refrigerant type (chemical name, formula, number) and total mass
- Temperature classes / Use classes, such as:
 - Fresh food: 4°C
 - One-star freezer: -6°C
- If cannot maintain $\leq 4^{\circ}\text{C}$, a notice about temperature-sensitive foods

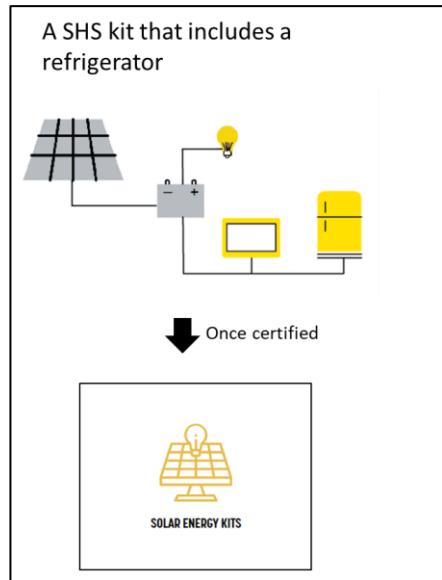


Reporting requirements

The product and consumer-facing material shall be marked with:

- Daily energy consumption (Wh/day)
- Rated voltage or voltage range (and nominal battery voltage, if applicable)
- Nature of power supply (AC or DC)
- Average power (W) or current (A) for each applicable use case
- Maximum current (A)

Run time requirements (refrigerators in kits only)

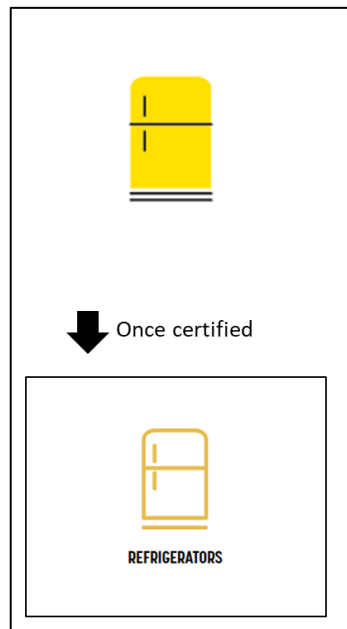


- The solar run time of a refrigerator included with an SHS kit shall be at least 24 hours.
- The SHS kit shall present at least one combination solar run time profile with all included appliances. The solar run time of the refrigerator must be at least 24 hours in any advertised combination.
- The SHS kit shall present the full-battery run time of the refrigerator when powered by the kit's battery in the absence of any other loads
- Runtimes will be evaluated using an adaptation of the "Energy Service Calculations" from IEC TS 62257-9-5, the test methods for SHS kits



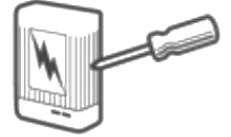
Performance requirements


- All *refrigerators* shall maintain a temperature $\leq 12^{\circ}\text{C}$ @ 43°C ambient
- All *freezers* shall maintain a temperature $\leq 0^{\circ}\text{C}$ @ 43°C ambient
- Pull-down time shall be less than 8 h (with 15% tolerance \rightarrow 9.2 h)



- Minimum Energy Performance Standards (MEPS) will apply to refrigerators tested as “standalone” appliances only
 - Refrigerators that are only certified with SHS kits are exempt from the MEPS requirement as the SHS kit is presumably sized to meet the energy requirements of the refrigerator

Health and Safety



- AC-DC power supplies must meet safety standards (if applicable)
- Lead (except in batteries), mercury, cadmium, hexavalent chromium, PBBs, and PBDEs may not be included
- Flammable refrigerants shall be marked and include relevant warnings 
- All refrigerants & foam blowing agents must meet environmental regulations
- Refrigerators must meet the requirements of [IEC 60335-1](#) and one of the following:
 - [IEC 60335-2-24](#),
 - [IEC 60335-2-75](#), or
 - [IEC 60335-2-89](#)



Quality and Durability

All refrigerators must:

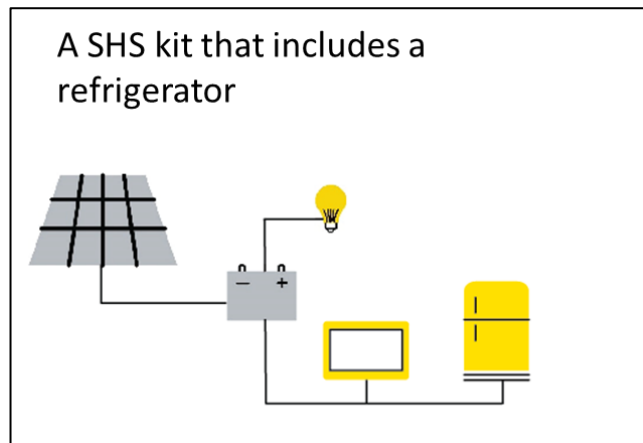
- Receive a rating of **Good or Fair** on the packaging, user safety, design and durability, maintenance and repairability and environmental impact considerations sections of the Global LEAP quality assessment
- Meet the requirements of [IEC 60335-1](#) and one of the following:
 - [IEC 60335-2-24](#),
 - [IEC 60335-2-75](#), or
 - [IEC 60335-2-89](#)(These cover both safety aspects and quality and durability)



Consumer Information

All refrigerators must:

- Be covered by a 2-year warranty
- Be labeled with the date of manufacture (or a serial number with a traceable date)
- Include a user manual covering installation, use, and maintenance



- Include instructions on how to connect the refrigerator, if included with an SHS kit. [Note, only certain connector types are permitted as described in IEC TS 62257-9-8, the standards for SHS kits.]

Overview of testing & certification process

There are two main pathways for refrigerator certification

Standalone refrigerator



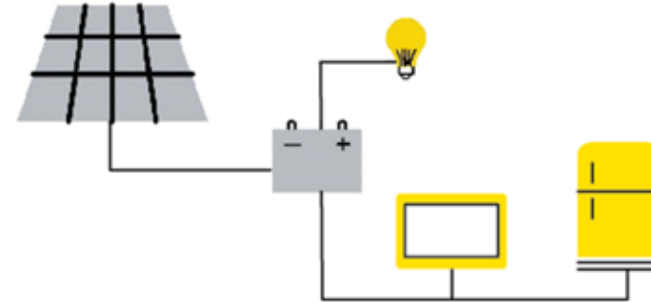
Once certified



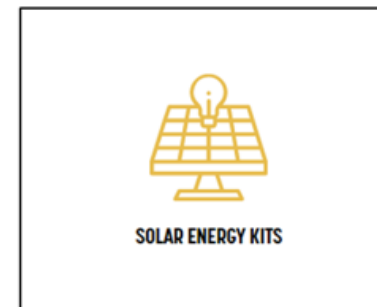
- Refrigerator listed on refrigerator database
- Refrigerator has a QV label

Quality Verified

SHS kit or product family with refrigerator



Once certified



- Refrigerator listed on solar energy kit database with its certified SHS kit
- Refrigerator information included on Spec Sheet or Book

Refrigerator and SHS certification process



VeraSol



Contact VeraSol



Complete Paperwork



Sample and Ship Products



Test Products



Receive Results



Public Product Listing



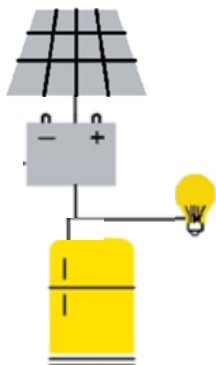
- Submit refrigerator product info
- Sign VeraSol agreement and agreement with refrigerator test lab

Random sampling of 2 refrigerators from a minimum stock of 20

Conducted to [Global LEAP Test Method](#) and evaluated to VeraSol refrigerator standards

Receive evaluation results and any corrective measures needed for certification

Listed on VeraSol refrigerator database



- Submit SHS product info
- Sign VeraSol agreement and agreement with SHS test lab

Random sampling according to VeraSol's Sampling Policy


Conducted to IEC TS 62257-9-5 and evaluated to IEC TS 62257-9-8

Listed on VeraSol database for solar energy kits, optional listing on refrigerator database

Database listing

Refrigerators will be listed on VeraSol's product database for standalone refrigerators, the solar energy kit database as a part of a SHS kit or family, or both

Standalone refrigerator



REFRIGERATORS
Quality Verified

14 SAMPLE LOCATION

4 RETAIL PRICE [USD]


52 BRAND

CLEAR ALL APPLY FILTER

Product Type	Solar Direct Drive Refrigerator	Product Type	Multi-Temperature Refrigerator
Model Number	ID565X	Model Number	BD-208
Tested Total Capacity [L]	61	Tested Total Capacity [L]	193
Power Supply Type	DC	Power Supply Type	DC
32C Ambient Temperature: Energy Consumption [kWh/24h]	0.147	32C Ambient Temperature: Energy Consumption [kWh/24h]	0.401
Autonomy: Rising Time [hours]	105.6	Autonomy: Rising Time [hours]	1.38
Retail Price [USD]	N/A	Retail Price [USD]	N/A

COMPARE

SHS kit or family with refrigerator



SOLAR ENERGY KITS
Quality Verified

1 POWER SUPPLY TYPE

4 AVAILABLE DAILY ELECTRICAL ENERGY

4 NUMBER OF LIGHT POINTS

3 APPLIANCES

67 BRAND

CLEAR ALL APPLY FILTER

SOLAR ENERGY KITS
Azuri Technologies, Ltd.
TV300-24 Solar Home System


Brand	Azuri Technologies, Ltd.
Product Name	TV300-24 Solar Home System
Model Number	A2002754
PV Module Maximum Power [W]	54

SOLAR ENERGY KITS
Sinoware Technology Co., Ltd.
Solar Reading Lamp


Brand	Sinoware Technology Co., Ltd.
Product Name	Solar Reading Lamp
Model Number	SunAwada
PV Module Maximum Power [W]	0.62

COMPARE

Both



SOLAR ENERGY KITS
Quality Verified



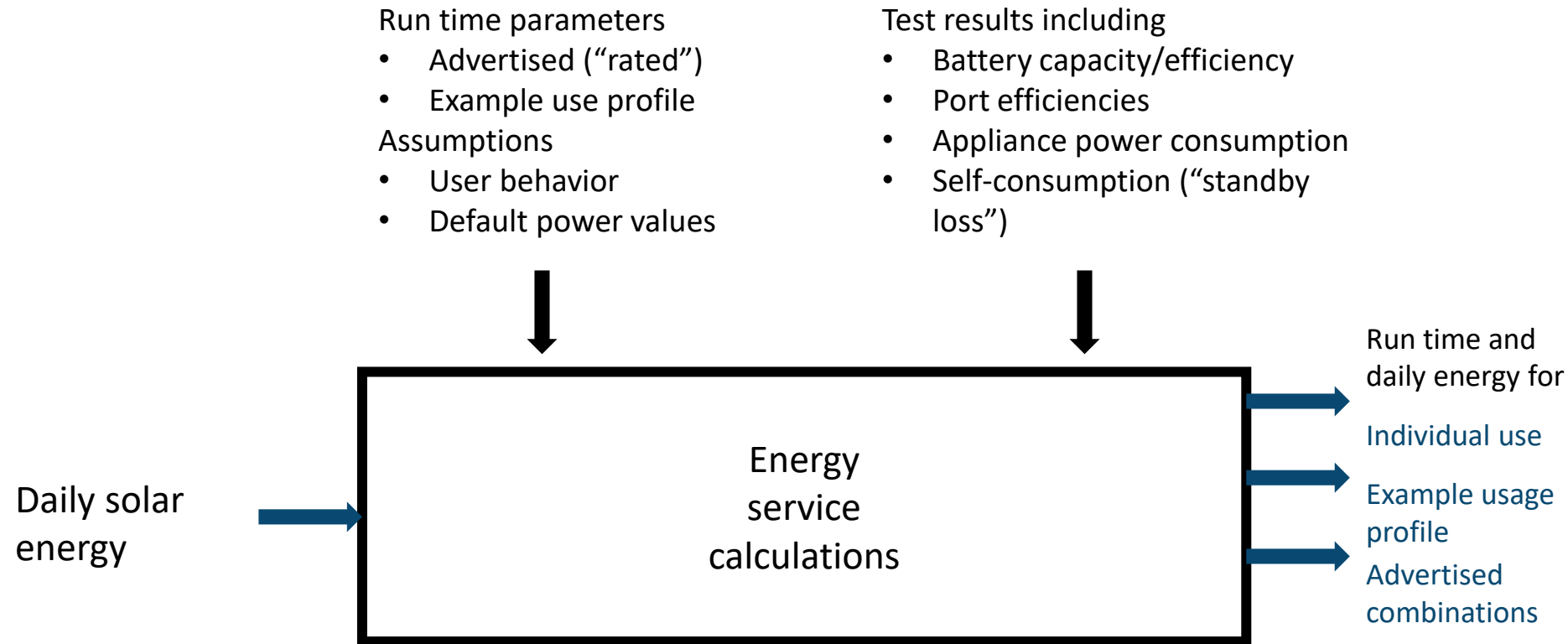
REFRIGERATORS
Quality Verified

- What if I already tested my refrigerator with VeraSol? Can I get it certified?
 - Potentially. For an additional fee, VeraSol can evaluate the existing results towards the standards. Additional testing may be required
- What are the costs?
 - Companies will pay a VeraSol certification fee, which covers product sampling, test results review, and maintenance of the database listing. Companies are also responsible for providing the product samples, shipping, and the test lab fee
- How long is the certification valid for?
 - The certification is valid for two years. To recertify a refrigerator, manufacturers must sign a renewal agreement with VeraSol and submit documentation confirming that no changes have been made to the product since the prior testing

Energy service calculation

- What is energy service calculation(ESC)?
- What are the changes to ESC for SHS kits with a refrigerator?

ESC overview



ESC is a model that estimates run time and energy service based on test results and assumptions.

ESC results

PERFORMANCE DETAILS					
			Run time after a typical day of solar charging (assuming 5kWh/m ² /day)		
	Appliance ^a	Description	Used alone ^b	Used in combination ^c	Featured Combination (Fan and all lights)
included in kit	Main lighting unit	2 LP100 lamps and 2 LP200 lamps totalling to 1200 lumens and 10 W power consumption.	9.5 hours	5.5 hours	3.1 hours
	Fan	table fan	8 hours	4 hours	4.5 hours
sold separately	Mobile phone	basic phone (3.7 Wh battery)	30 full charge(s)	20 full charge(s)	3 full charge(s)
	Television	20" diagonal	5.5 hours	3.2 hours	2 hours
	Radio	portable (3 Wh battery)	5.1 hours	3.6 hours	1 hours

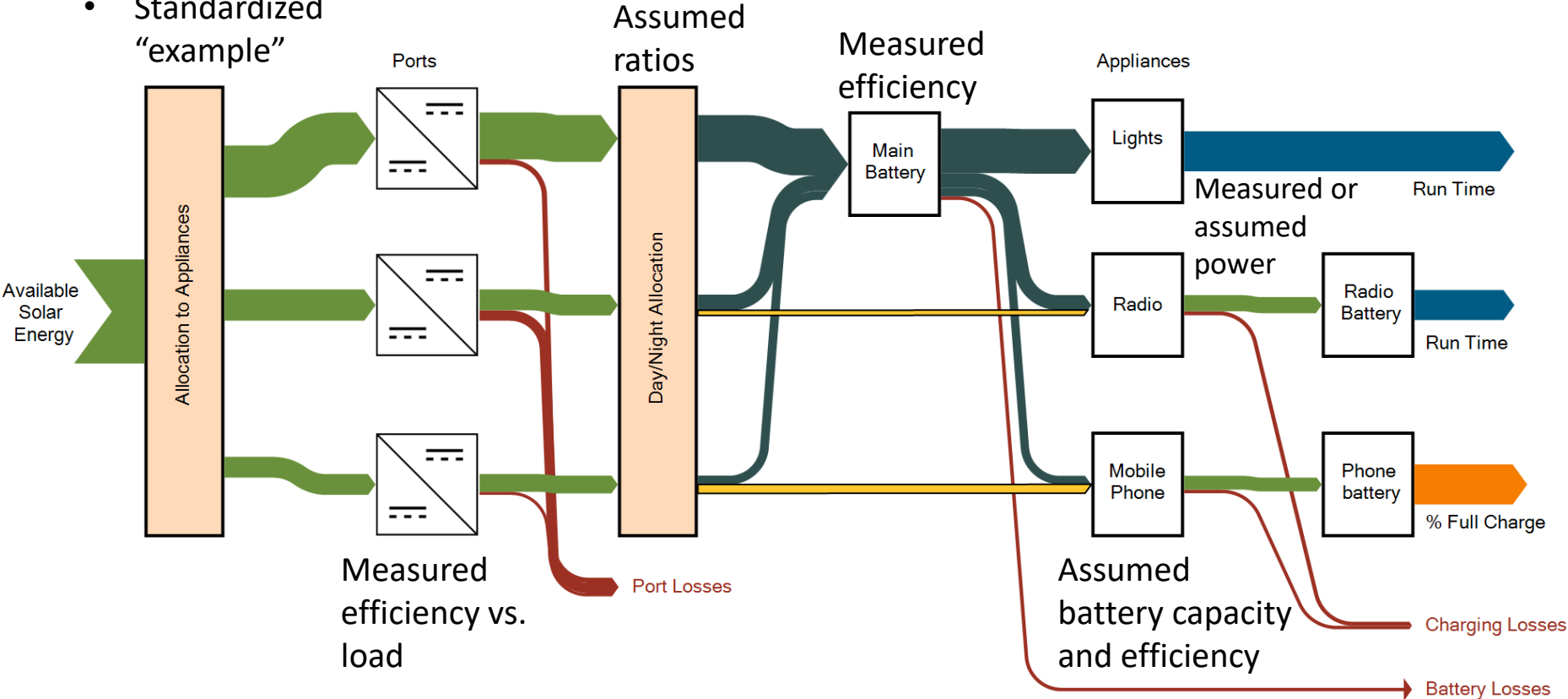
Available daily electrical energy ^c (Wh/day)	115
(Additional energy may be available for daytime use of appliances.)	
Performance measure	Brightness setting: Bright
Lighting full battery run time ^d for main unit (hours)	10

The run time and daily energy values on the VeraSol spec sheet are from the ESC.

Inside the black box

Multiple scenarios:

- Advertised
- Standardized "example"



Changes for refrigerators

General principles and assumptions

- The run time of a refrigerator is the duration when it is actively maintaining its temperature.
- A refrigerator is assumed to be a constant-power load (the compressor) that cycles on and off.
- The duty cycle and compressor power are assumed to be constant throughout the day.
- Minimum solar run time for refrigerators: **24 hours**

Changes for refrigerators

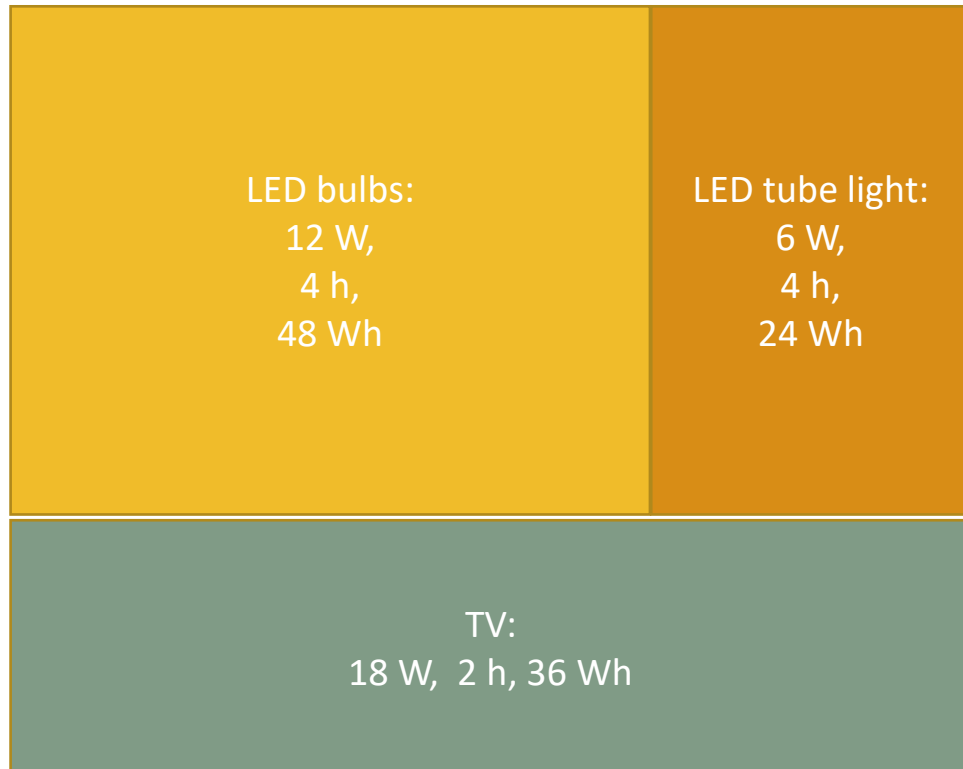
Topic	Without refrigerators	With refrigerators
Energy allocation	Energy is allocated proportionally	Energy is allocated to refrigerators first
Standby loss (self-consumption)	Estimate assumes 15 hours of self-consumption	Estimate assumes self-consumption equal to refrigerator run time

standby loss: power consumed by the product when all appliances are turned off

Energy allocation

without refrigerators

Advertised/example use: 108 Wh



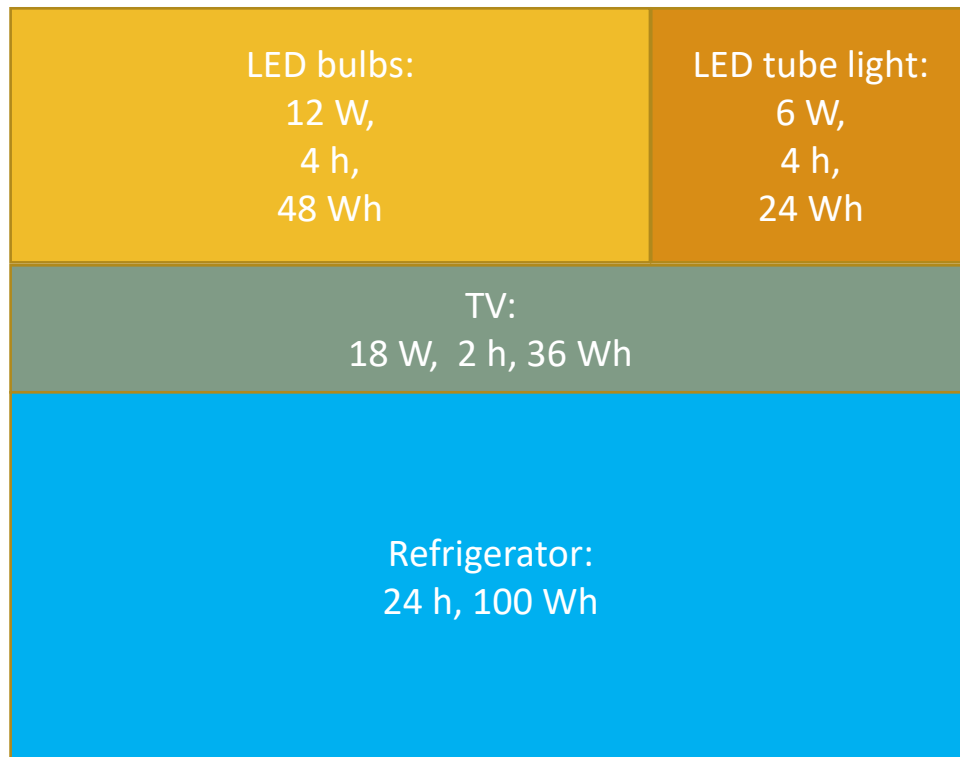
Measured available energy: 81 Wh



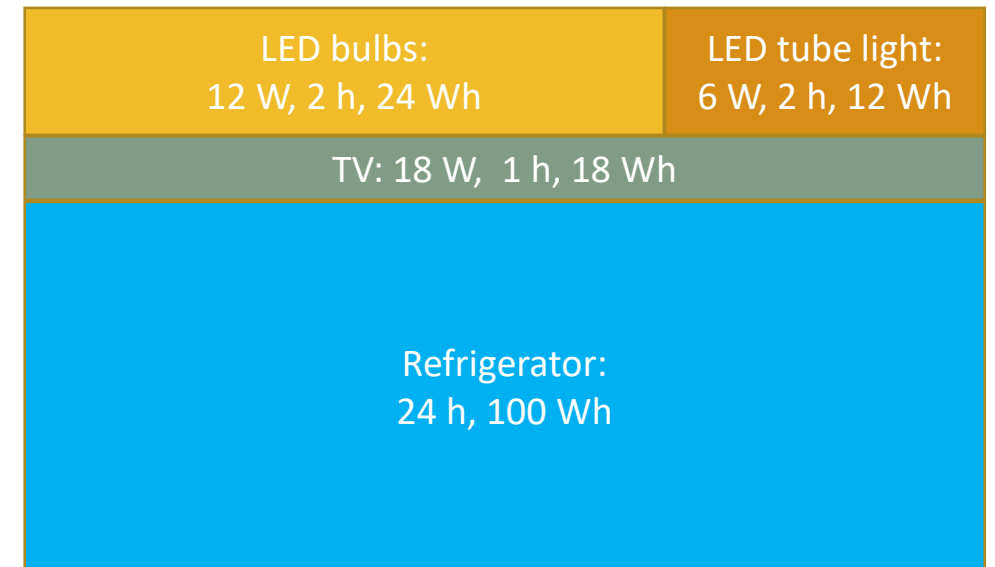
Energy allocation

with refrigerators

Advertised/example use: 208 Wh



Measured available energy: 154 Wh



Impacts of changes

- Energy allocation
 - Refrigerator run time will equal the advertised/example value if the product can support it
 - Run time for other appliances will be reduced by the refrigerator, more than if proportional allocation was used
- Standby loss
 - Run time and energy service will be reduced, especially for products with high self-consumption.
 - The effect will be minor unless the **refrigerator run time is long** or the **self-consumption is high**.
 - Results should more accurately reflect actual performance when a refrigerator is used.



Questions to audience

1. Should we include a **global warming potential (GWP) limit** for refrigerants and foam blowing agents to encourage climate-friendly refrigerants?
2. Currently, the **Minimum Energy Performance Standards (MEPS) only apply to standalone refrigerators**. Should they also be required for refrigerators sold with an SHS kit?
3. For refrigerators included with SHS kits or SHS kit families, it is required that the "solar run time of the refrigerator in any advertised combination shall be at least 24 hours." Is this **24 hour solar run time requirement** appropriate?

Provide review & feedback





Requirements for VeraSol Certification of Refrigerators

Draft Version 0.1
March 2022

The following document lists proposed requirements for refrigerators¹ to be certified through the VeraSol program. The VeraSol team is seeking stakeholder feedback on the proposed framework and requirements prior to offering certification services for refrigerators.

Eligible refrigerators are those intended for use on, and/or compatible with, off-grid energy systems (e.g., low-voltage DC systems, solar home systems (SHSs), and AC or DC mini-grids). Products should be designed to function safely and effectively within the voltage swings that are common in solar-charged, battery-based distributed energy systems. Most products will be designed for either a nominal 12 V or 24 V DC application (for SHSs or DC mini-grids) or a nominal 110-240 V AC (for AC mini-grids), but other voltages are eligible.

Once finalized, these requirements would apply both to refrigerators included with a VeraSol-certified SHS kit and to those tested for certification as standalone appliances.

- A refrigerator included in an SHS kit would be included on the Spec Sheet for the kit and listed with the SHS kit under the "Solar Energy Kits" section of the VeraSol website: <https://data.verasol.org/products/sek>. Similarly, a refrigerator that is listed in an SHS kit family, but not included in a fully tested SHS kit, will be included on the Spec Book for the family and listed under the "Solar Energy Kits" section of the website. (See Figure 1.)
- A refrigerator tested as a standalone appliance would be included in the list of tested refrigerators on the VeraSol website: <https://data.verasol.org/products/ref>. Certified refrigerators in this list would be distinguished from non-certified appliances with a label on their listing. (See Figure 2.)
- A refrigerator that is included in an SHS kit may also be listed in the list of standalone refrigerators for an additional fee. Similarly, a refrigerator that is already certified as a standalone appliance may also be included in a certified SHS kit, though additional testing may be required. As the company branding the kit and the company branding the refrigerator are commonly two different entities, the listing with the kit and the standalone listing may be presented under two different brand names, subject to the two companies' preferences. Both companies would need to submit documentation for review and sign an agreement as described in the VeraSol [Co-branding Policy](#).²

¹ Throughout this document, the term "refrigerators" is used to generally refer to refrigerators, refrigerator-freezer combination units, multi-temperature refrigerators, and freezers.
² The scope of the current co-branding policy is limited to co-branding of solar energy kits, but the text will be updated to more clearly cover refrigerators as well.

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Access the draft VeraSol policy:

- Via [VeraSol.org/publications](https://Verasol.org/publications)
- Scan this QR code with your phone



Submit your comments and feedback

- Via [feedback form](#)
- Submit by **10 PM ET on April 13, 2022**

Connect Initiative



VeraSol

DRAFT

for consultation

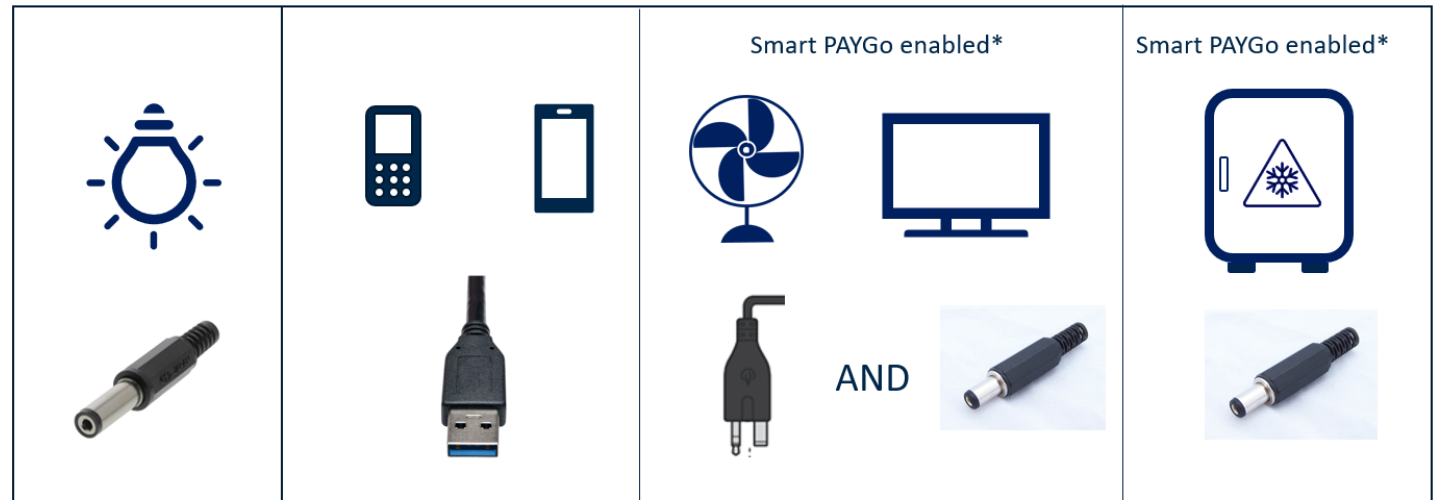
Connector & Electrical Technical Guidelines - Summary

to enhance
12V Solar Home System and Appliance interoperability

Revision 1.3
29 March 2022

- Draft Connector Technical Guidelines are also ready for review!
- If you are interested to review and provide feedback, please visit: gogla.org/resources/the-connect-initiative

The Universal Family of Connectors for 12V SHS Kits will support power delivery and communications for lights, phone charging and appliances.



Contact Us



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[Monthly newsletter and
database updates](#)



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Appendix

Proposed MEPS

Annual Energy Consumption (**AEC**) \leq Maximum Annual Energy Consumption (**AECmax**), where:

AEC = $EC_{32} \times (365/1000)$ kWh/year, where EC_{32} is the daily energy consumption at 32°C ambient

AECmax =

Reference Temperature	Product Category	AECmax (kWh/year)
32°C	Refrigerators	$0.134 \times AV + 84 + A_R$
	Refrigerator-Freezers	$0.188 \times AV + 137 + A_{RF}$
	Freezers	$0.175 \times AV + 161 + A_F$

where:

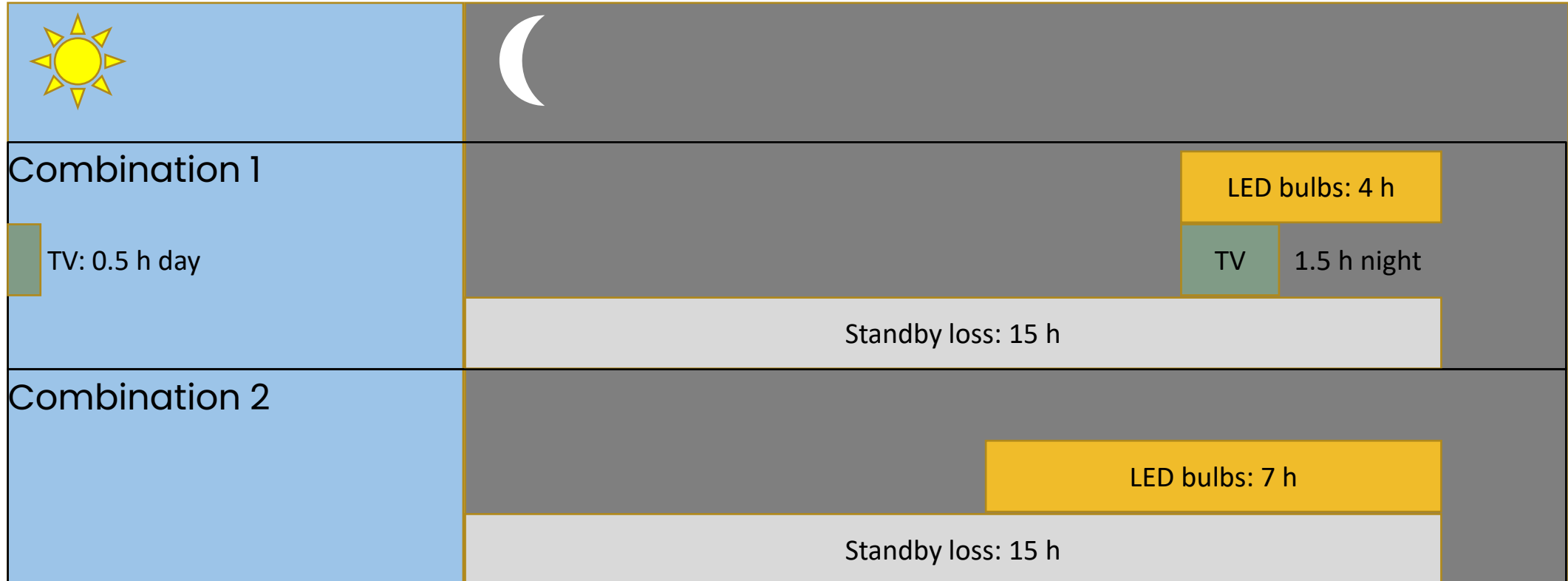
- A_R is an allowance for refrigerators with a value of 66 kWh/year
- A_{RF} is an allowance for refrigerator-freezers with a value of 225 kWh/year
- A_F is an allowance for freezers with a value of 133 kWh/year, and

AV is Adjusted Volume, which accounts for the actual compartment temperature

MEPS from [Model Regulation Guidelines for Energy-Efficient and Climate-friendly Commercial Refrigeration Equipment](#) published by United for Efficiency (U4E), though an additional allowance has been added to increase the suggested minimum energy

Standby loss

without refrigerators



Standby loss

with refrigerators

