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# **Solar Power Optimization Tool for Onsite Needs (SPOT-ON) User's Guide for Apple Mobile Devices**

**by David Sauter**

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# **Solar Power Optimization Tool for Onsite Needs (SPOT-ON) User's Guide for Apple Mobile Devices**

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*Computational and Information Science Directorate, ARL*

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## 1. Introduction

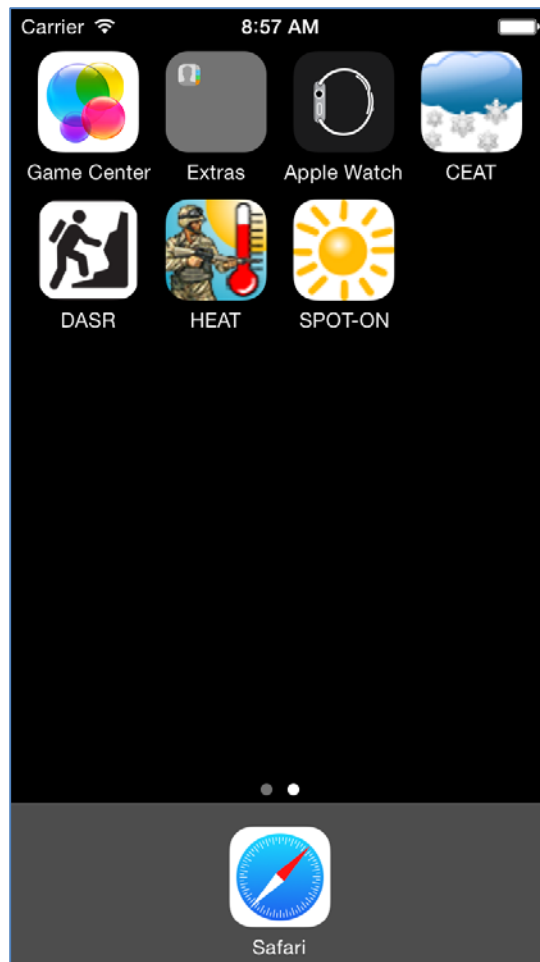
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The Solar Power Optimization Tool for Onsite Needs (SPOT-ON) application (from here on also referred to as the “app”) provides information on the peak electrical power and daily energy that can be generated by a solar collector as a function of the geographic location, date, surface type, cloud amount and type, and collector efficiency. SPOT-ON is intended to support tactical power generation and augmentation via the use of primarily flexible solar collectors that would typically be laid flat on the ground. SPOT-ON is hosted on Apple iOS (mobile device operating system) and Android-based smartphones and tablets (referred to from here on as the “device”).

## 2. SPOT-ON Inputs

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To launch SPOT-ON, tap the SPOT-ON icon on the device start screen (Fig. 1). The initial input tab is then displayed for the user to enter the site information (Fig. 2). The latitude and date are used to compute the solar altitude via the “solarposition” computer algorithm<sup>1</sup> and is based on formulations in the Astronomical Almanac.<sup>2</sup> The solar altitude, in turn, is required to calculate the clear sky irradiance value beginning at midnight local time and then every 30 min thereafter for 24 h (used to compute the total energy available in a day). The surface input is used by the app to assign a surface albedo,<sup>3</sup> which affects the resultant irradiance value. See the Table or Fig. 2 for the choices of available surface types. The table also lists the fractional albedo value associated with each surface.



**Fig. 1 Launch SPOT-ON**

**Table Surface type and fractional albedo**

Desert	0.30
Forest	0.15
Dark soil	0.10
Snow	0.55
Crops	0.20



Carrier 4:56 PM

Latitude: 32.2 N S

Surface:

Desert Forest Dark Soil Snow Crops

February 5 2013

March 6 2014

April 7 2015

May 8 2016

June 9 2017

Navigation icons: Location pin, Photo, Checkmark, Information

**Fig. 2 Site view**

Figure 3 displays a screen capture of the view to allow user entry of the cloud amount (10ths) and type. This screen is displayed by tapping the tab with the weather icon at the bottom of the app display. Photos of each of the cloud types are displayed to assist the user in determining the appropriate choice. The cloud inputs are used to determine the attenuated irradiance value,<sup>4</sup> which will provide a more realistic estimate of the electrical generation capability of the collector(s). The user can also enter a value for the solar collector efficiency in converting solar irradiance into electrical energy. Collectors available for tactical use are typically on the order of only 10%–15% efficient. As this app was designed to support tactical military operations in which logistics (transport, setup and tear-down, etc.) will likely be a primary concern, it is assumed that the collectors will generally be of a flexible design that can be folded and/or rolled. This design, coupled with use in a tactical environment, assumes that the collectors will be deployed on the ground such that they are in a generally horizontal orientation. This assumption also simplifies the determination of the overall electrical energy generation as it is not necessary to

make more involved irradiance calculations as a function of the collector/solar azimuth offset.

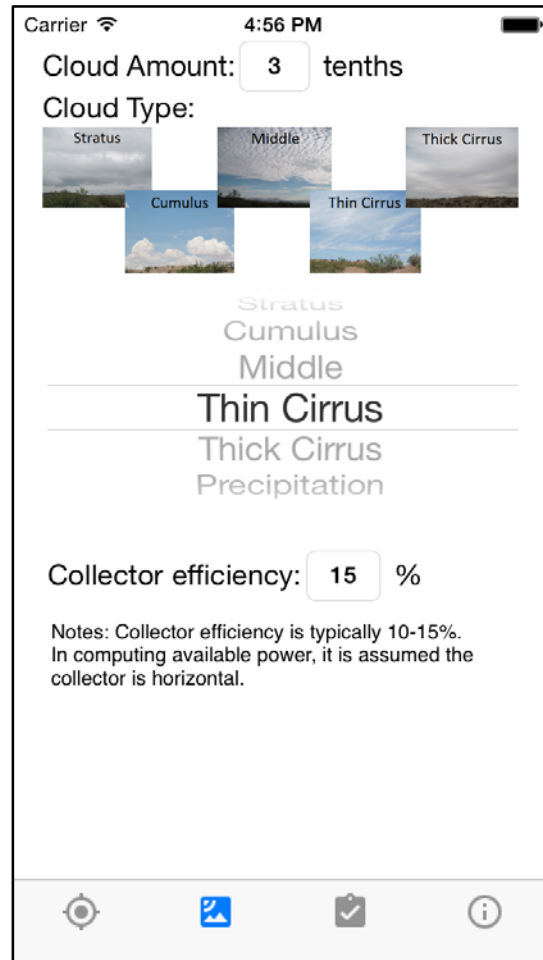
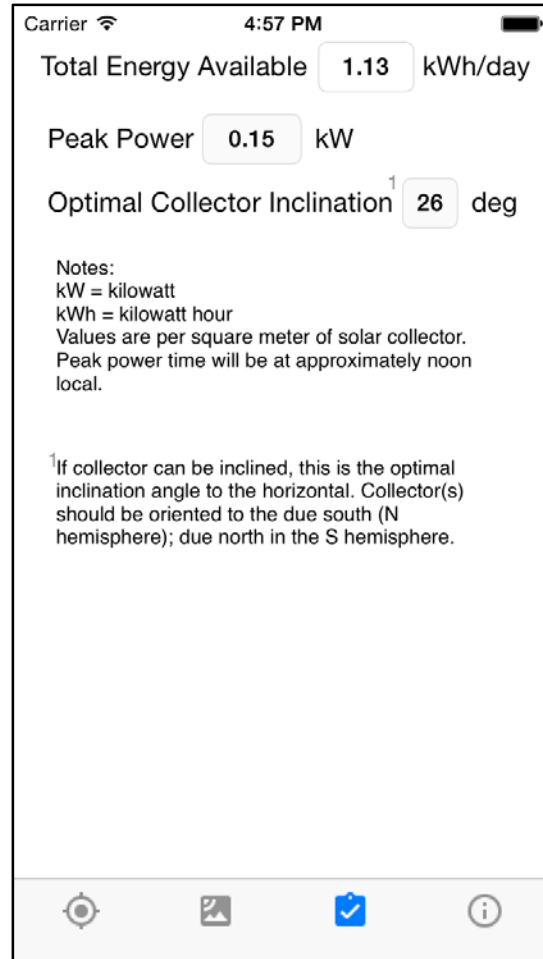


Fig. 3 Cloud/efficiency view

### 3. SPOT-ON Results

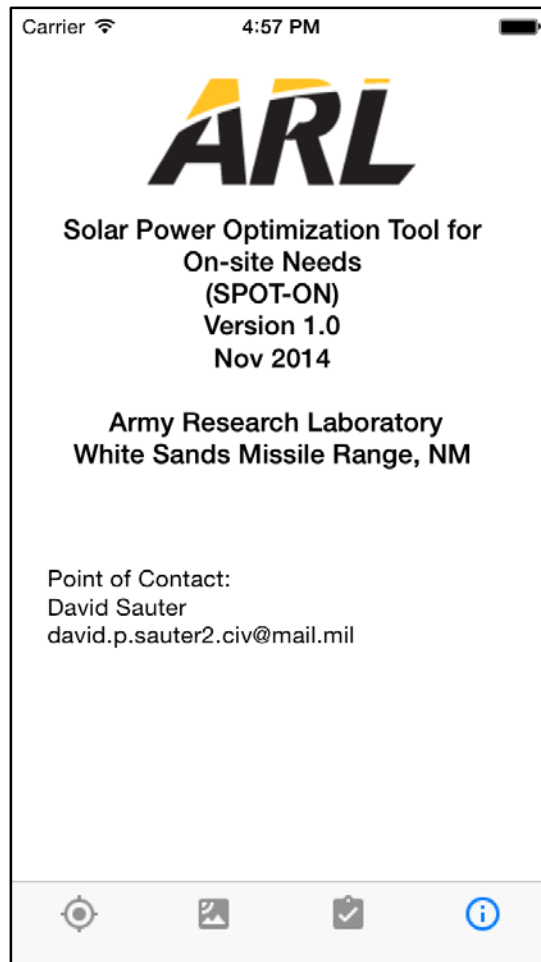
Tapping the tab bar icon of a checkbox in a folder will calculate and then display (Fig. 4) the total electrical energy available during the day, the peak power output and the optimal tilt angle for the collector(s) in the event it can be oriented other than horizontal. The energy value result is for a 1 m<sup>2</sup> solar collector. Thus, multiplying the total area (m<sup>2</sup>) of all the deployed solar collectors by the displayed energy value will provide an estimate of the daily electrical energy production.



**Fig. 4 SPOT-ON results**

The last view (Fig. 5), displayed by tapping the icon of an “i” in a circle, provides the Point of Contact (POC) information for the app as well as the version and date of the app.

Upon app exit, current values for all of the user inputs will be stored such that they will be the default values displayed when the app is next run.



**Fig. 5 Information view**

## **4. Summary and Conclusions**

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SPOT-ON provides an easy to use mobile app to estimate available electrical energy and power generation values given simple readily available inputs. Hosting on a mobile device makes it accessible virtually anywhere in a tactical environment.

After internal testing and evaluation (2015) the app will be submitted to the Defense Information Systems Agency (DISA) Mobile Application Store (MAS) for validation and with plans for eventual availability to Department of Defense users.

## 5. References and Notes

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