BIPVCOM

PRESENTS

Building Integrated Photovoltaics Company

TIPV

Transport Integrated Photovoltaics

Solutions for transportation and logistics companies

MiaSolé
A Hanergy Company

Current Transport Situation

High Cost of Fuel

Fuel is required to power vehicle electronics—.6 gal/hr of gas is typical to idle the engine. Air conditioning, refrigeration, etc. require even more

Noise Restrictions

Municipalities also have noise ordinances that ban idling during certain hours

Anti-idling Laws

Many municipalities have laws that ban truck engine idling

Solar to Power No-idle HVAC, Liftgate, Safety Lighting and Refrigeration

1

Reduce Fuel Consumption

Use solar energy instead of gas to power auxiliary systems such as HVAC*, safety lighting and liftgate operations

2

Reduce Maintenance Costs

Running the truck engine less results in decreased intervals for scheduled maintenance.

3

Reduce Emissions

Using clean solar power instead of fuel reduces emissions to help truckers comply with environmental regulations

4

Provide Stand-by Power

Use solar energy for stand-by power, without running the engine.

5

Provide Power to Truck De-icing System

De-ice the truck with solar energy instead of fuel

6

Off-load Alternator Loads

Use solar power to provide off-load electrical power

*HVAC – heating, ventilation, air-conditioning

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TIPV Solution Benefits

1. Optimized module **sizes** and **layouts** at low weight for truck trailers
2. Ruggedized **components** to achieve superior reliability
3. Optimized **charge controller** maximizes solar power contribution
4. **Multi-voltage** configurations to meet the needs of different solar-charging applications
5. Integrated **safety features** to meet the unique demands of the transportation industry
6. Reduced **carbon emissions** to help achieve corporate carbon reduction goals

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Solar Power for the Future

Move the needle towards a clean future

- ✓ Use less fuel
- ✓ Reduce emissions
- ✓ Comply with noise regulations
- ✓ Reduce engine maintenance
- ✓ Easy installation
- ✓ Easy-to-maintain system
- ✓ Payback in less than two years
- ✓ “Free” energy for 10 years or longer

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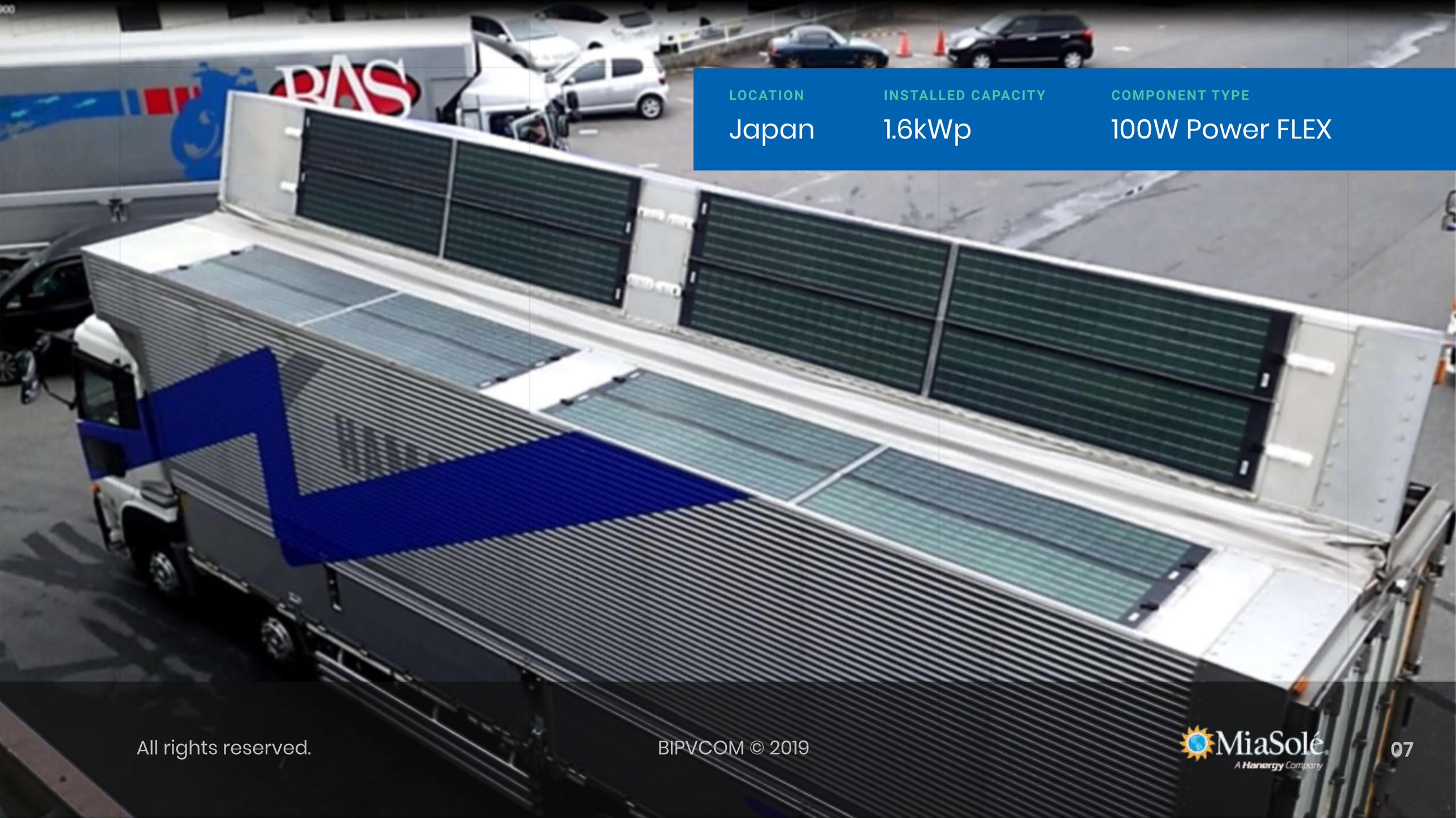

LOCATION	INSTALLED CAPACITY	COMPONENT TYPE
Japan	1.6kWp	100W Power FLEX

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TECHNOLOGY BENEFITS

FLEX Benefits

Improved Shade Performance

By-pass diodes every two solar cells provide maximum output in shade conditions

Powerful

With aperture efficiencies as high as 17%, you get the most power possible in a flexible, lightweight module

Resistant to Wind

FLEX modules have been tested on winds up to 200mph and provide the same wind resistance as the vehicle structure itself

Shatter-proof

FLEX modules will not break when struck by debris, making them resistant to road conditions and vandalism

Lightweight

MiaSolé FLEX modules weight less than 2.4 kg/m2

Flexible

Size can be modified to fit application

TIPV Product Offering

Transportation Kit Options

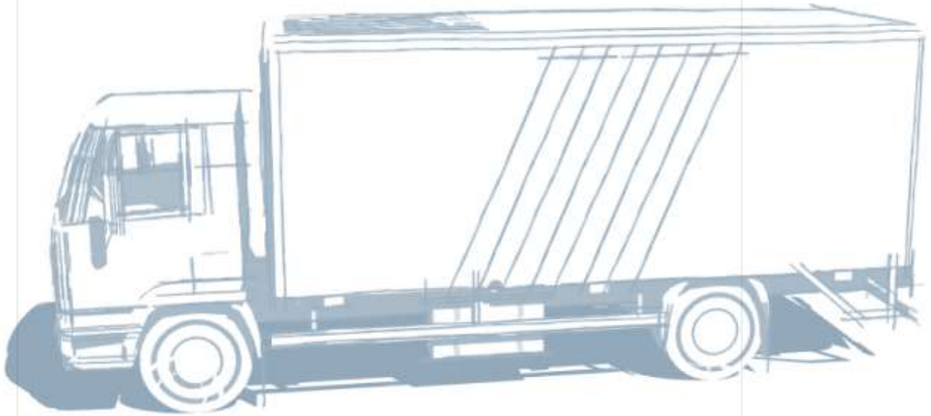
Intercity Delivery Truck	125W — 1,000W
Electric Truck	250W — 500W
Tractor/Trailer	125W — 5,000W

Solar powered:

- HVAC
- Refrigirator
- Lift Gate
- Battery Charging
- Safety Lighting

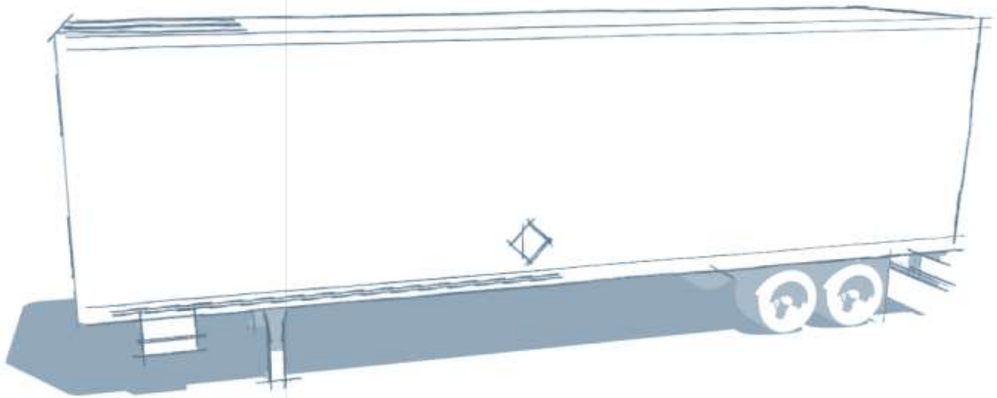
Sample Configurations

BIPVCOM Transportation Solution is **highly customizable**



Rigid Truck

PV SYSTEM	CHARGE CONTROLLER	BATTERY VOLTAGE
125W — 400W	MHT-DS15	12/24V

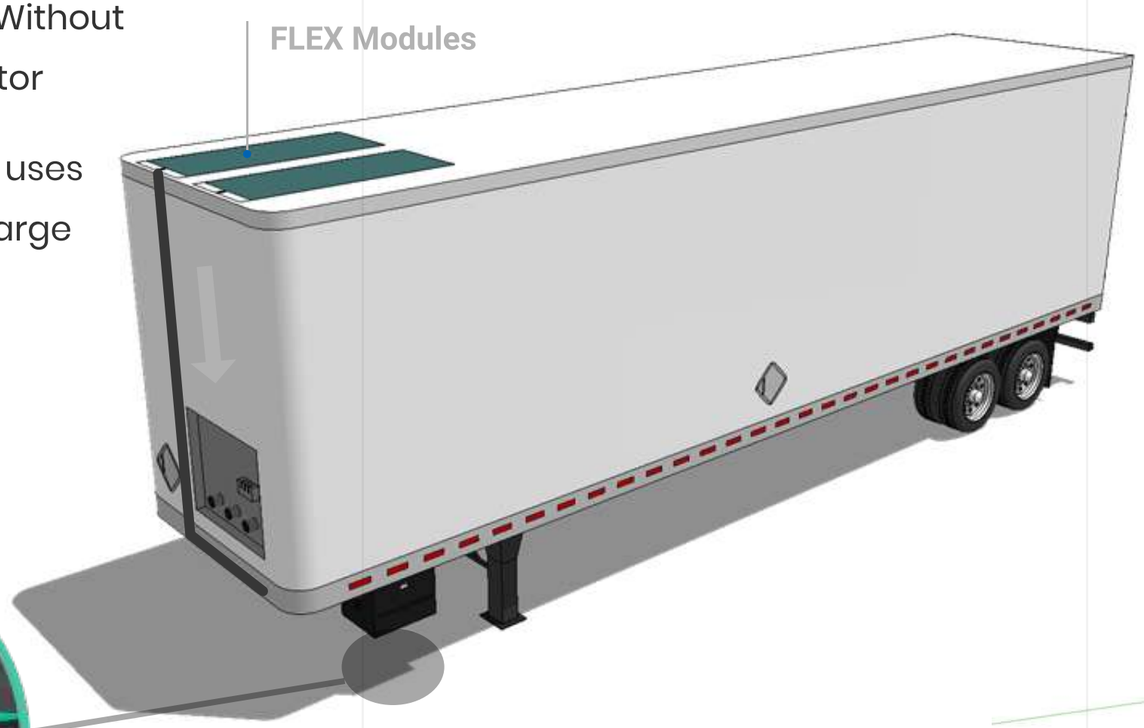


Trailer: Self Sufficient

PV SYSTEM	CHARGE CONTROLLER	BATTERY VOLTAGE
125W — 5,000W	MHT-DS15	12/24V

Trailer: Self Sufficient Battery Charging

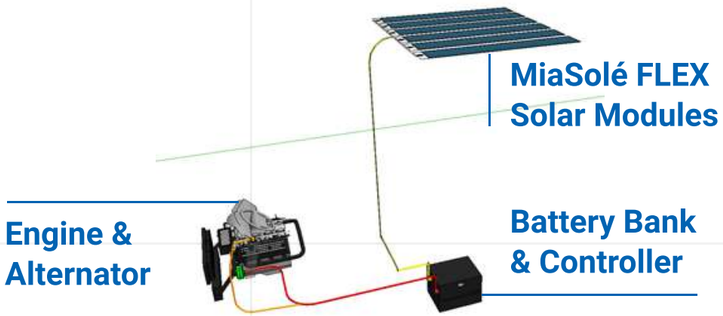
* Integrated Auxillary Charge
* Charge Batteries Without Use of the Alternator
* Charge controller uses solar power to charge batteries



Current

MHT Charge Controller Functionality

1. **Engine ON** — Prioritizes solar power over alternator
2. **Engine OFF** — Solar power charges the vehicle battery(s)
3. Reliably manages power delivery of multiple sources



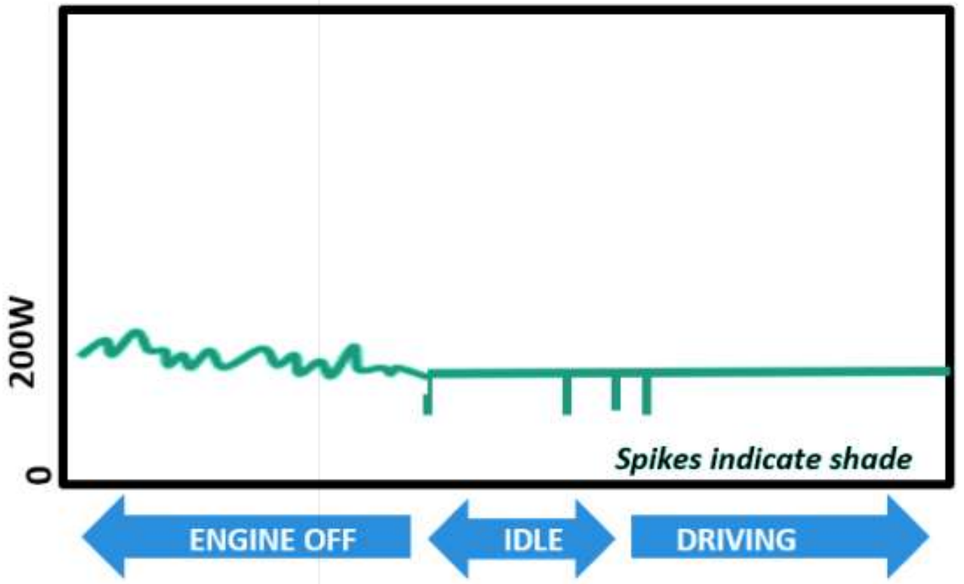
Charger Controller Optimization

Solar Contribution
Before Solar Power Optimization

Truck uses solar power only when the engine is off.

Most of the solar solutions in the market operate this way.

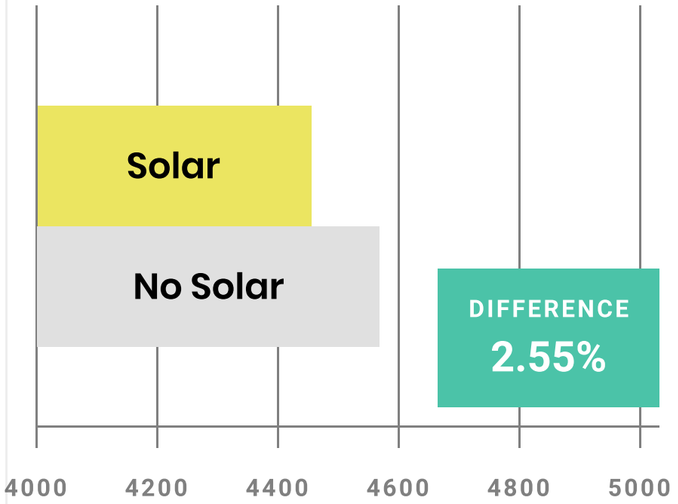
Solar Contribution
After Solar Power Optimization



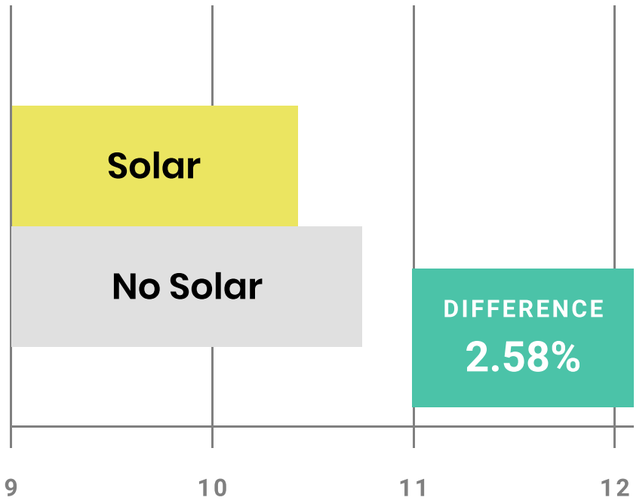
Solar power is contributing to truck operations even when the engine is on. *Unlike other solutions, you get the full benefit of your solar modules.*

Fuel Economy Test Analysis

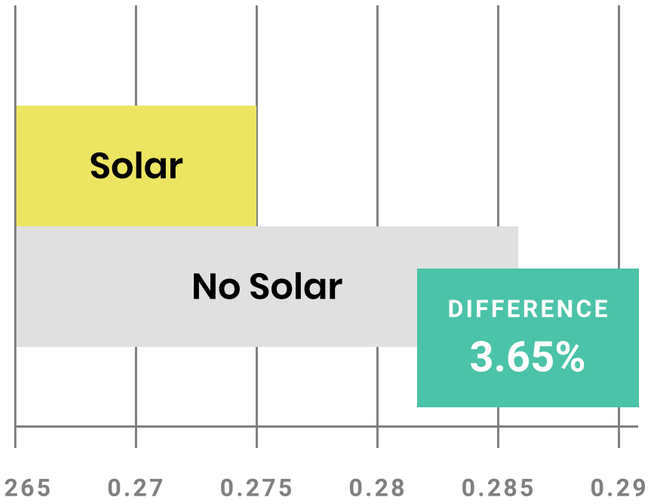
Total Fuel Used at 40mph (ml)



Average Fuel Rate at 40mph (l/hr)



Average Fuel Per Mile (ml)



NOTES

* 250W PV system
* 3rd Party Validated
* Based on 18T rigid with liftgate
* Location: UK
* “At 40mph” refers to the same 26.6 minutes period for each run when the vehicle is at a steady state speed

Flex Panels Payback Period — Example

- ✓ Payback in less than two years
- ✓ 10-year warranty on the system

— Typical PV Size	**250W**
— System Cost Hardware + Installation	**€1,600**
— Annual Fuel Savings Idle & Fuel Efficiency	**€2,600**
— Battery Replacement Savings per Year	**€250**
— Payback (years) without Tax Credit	**< 2 years**

Annual Fuel Savings for 250W System
(€4.8/3.7L)

€2,850

USE CASE BASED ON

* Truck Type: 18 tons Rigid with Lift Gate
* Location: Southern UK
* 7 lifts at each drop
* 10 Drop shipments per day (36m drop time + 24m drive time) repeated 10 times
* Operation from 6 AM — 4 PM, Monday — Friday, 1 weekend per month
* Diesel cost: 1.3 €/Liter

Trailers, Tautliners and Cars applicable to MiaSole thin-film panels

Box-Trailer (Hard sided Trailer)

Dimensions: 13,50 x 2,46 x 2,71 m

Volume: 90 m³

Max Weight 23.000 kg

Palettes: 33

Reefer (temperature control Trailer)

Dimensions: 13,41 x 2,49 x 2,70 m

Volume: 90 m³

Max Weight: 21.000 kg

Palettes: 33

Insulation (cool Trailer)

Dimensions: 13,41 x 2,49 x 2,70 m

Volume: 90 m³

Max Weight: 21.000 kg

Palettes: 33

Trailers, Tautliners and Cars applicable to MiaSole thin-film panels

Tautliner (Curtainsider)

Dimensions: 13,60 x 2,50 x 2,65 m

Volume: 90 m³

Max Weight: 24.500 kg

Palettes: 33

Van, Sprinter

Dimensions: 2,98 x 1,68 x 1,8 m

Volume 9 m³

Max Weight 1.900 kg

Palettes: 4

Avia

Dimensions: 6,49 x 2,48 x 2,60 m

Volume: 42m³

Max Weight: bis 5.500 kg

Palettes: 16

Trailers, Tautliners and Cars applicable to MiaSole thin-film panels

- Tail-lift truck is equipped with a lifting mechanism which can be used to load the goods onto the truck
- Depending on the type of the tail-lift, the maximum weight load is from 500 to 2000 kg
- The cargo space in the truck is 7-9 x 2,45 x 2-2,5 meters (there are numerous variations)
- Tail-lift truck can capacitate up to 18-20 EUR pallets or 14-16 FIN pallets
- The goods can be loaded only through the back of the truck
- Used mainly on distribution freights

Mesilla Valley Transportation is using eNow's eCharge auxiliary solar system as part of its fuel efficiency spec

Photo: Mesilla Valley Transportation

The main use of solar on tractors is to support battery HVAC systems and hotel loads without batteries.

Solar panels can extend the runtime of battery HVAC systems, not only to help the HVAC system make it through the night without draining the truck's batteries, but also to reduce the load on the alternator the next morning, resulting in fuel savings.

Solar panels can augment the energy coming from the truck batteries and maintain the batteries at a higher state of charge extending the battery life and increasing driver comfort by allowing hotel loads to operate for longer periods of time.

Facts for consideration

Since there are two to three trailers for every tractor in most fleets, many trailers experience a significant amount of time when they are not hooked up to a tractor. As a result, any batteries installed on the trailer don't always have a ready source of power for charging.

The trailer power requirements need to be carefully evaluated to assure proper function during operation. This includes items like liftgates, refrigeration units, telematics, lighting, pallet jack charging, etc. Although each of these devices requires trailer-mounted batteries to operate, they all have different electrical current and charging demands.

The main function of the solar panel is to maintain the trailer batteries at a higher average state of charge versus just charging with the tractor or refrigeration unit alternator.

Solar panel sizing should be determined by the duty cycle that the trailer electrical system is likely to encounter. This can be evaluated by temporarily putting a data logging system on a trailer for a period of time to determine the true loads that the batteries will see during typical days

Savings of implementing solar panels are primarily associated with increasing battery life and reducing emergency roadside calls to jump or fix dead batteries.

Determining a return on investment for a solar panel system is a simple calculation looking at the potential savings in battery replacement costs and the value of having charged batteries vs. the total system installation costs.

The average trade cycle in most fleets for trailers is typically longer than that for tractors. If the trailer only has a telematics system on it without additional equipment, then a solar panel to keep that battery charged is generally an excellent investment. On some newer systems, the telematics is not even hooked into the truck electrical system, so in these cases, a solar panel is required in order to keep the battery charged.

Testimonials

“The big savings for me is getting more hours on your APU,” Jones says, as the solar panels provide four to six more hours of cooling time. “It’s hard to figure the ROI, because it’s not an exact science. But if you save two jump-starts a year, that’s $600. If your driver comfort is better, how do you put a price on that? And we used to replace all eight batteries every year, but the trucks with the solar panels have had them for four years.”

Another proponent of solar panels for trucks is Montreal-based Groupe Robert, one of Canada’s largest trucking companies. Solar panels help it keep drivers comfortable without idling, keep batteries charged in cold weather, and keep batteries charged on methane detectors on trucks powered by liquefied natural gas.

In its idle reduction efforts, Robert found that electric APUs were preferable to diesel ones — except the battery life was limited to about six hours. In 2012, it tested a single solar panel mounted on the roof fairing and found it upped that to about eight hours, explains Daniel St-Germain, vice president, material resources. But he found that for a little bit more, the carrier could install six flexible solar panels on the roof fairing and the hood (600 watts total) with four deep-cycle batteries, giving drivers a full 10-hour rest period of noiseless sleep. It now has those on more than 150 units. The expected return on investment, based on fuel savings, is 3.5 years. One disadvantage, of course, is that there’s less solar energy available in overcast, rainy weather — thus the deep-cycle batteries to store reserve power.

Testimonials

K&J Trucking, Sioux Falls, South Dakota, uses diesel-powered APUs, but it has found another driver comfort application for its ThermoLite solar panels from Thermo King. It's testing a solar panel on the cab to charge the refrigerator in the sleeper when the driver's off the truck for extended periods. The normal policy if a driver is going to be gone for more than 24 hours is to empty the refrigerator and turn it off. With the solar panels, they don't have to, making it that much easier for drivers to keep healthy options handy.

"One of the things that sets Carrier Transicold's solar panels apart from many other solar-powered solutions is that they do not require direct sunlight," explains Jason Forman, sales and marketing manager. "Their amorphous silicon solar cell technology performs reliably even in low- and indirect-lighting conditions. As long as there is daylight, they will generate a charge, and that includes on cloudy days."

Purkeys has a product called Solar Bolt. Installed on the roof of a trailer, it provides a constant charge to electrical accessories such as liftgate batteries and reefers. Depending on the type of liftgate, the Solar Bolt can produce enough charge to power 10 to 100 additional lifts every day, according to the company.

Benefits – Why Solar?

- **Flexible** panels with form, fit, and function to adapt to various roof contours
- **Reduce** battery depth of discharge
- **Reduce** O&M Expenses:
  - Reduce frequency of costly DPF (Diesel Particulate Filter) cleaning, oilchanges and engine overhauls.
- **Extend** battery life by up to 200 percent
- **Increase** Fuel Savings:
  - Extend power availability without idling engine
  - Add up to 10 hours of run-time.
  - Relieve alternator load
- **Reduce** Auto-Start Events
- **Minimize** roadside assistance cost for jump starts
- **Minimize** engine idling
- **Minimize** emissions
- **Driver** Comfort, Safety, and Retention
- **Enhanced** energy output under all light conditions
- **Optimized** system to maximize solar energy (Amp-hours) delivered to battery
- **Provide** adequate auxiliary power for various electrical appliances
- **Minimize** battery changeouts
- **Up** to 50% additional runtime for smart HVAC systems
- **Up** to 50% additional cycles of Liftgate
- **Practically** eliminate dead batteries
- **Excellent** Return-on-Investment numbers

Solar panels on truck roofs to reduce fuel consumption

Journalist Trans.info
Photo: DHL
11.06.2019

DHL Freight has introduced 15 new 12 ton trucks into its fleet in Europe. These wouldn't be unusual if they weren't equipped with a solar system on their roofs.

The trucks manufactured by MAN are modern not only because of the steering assistant, which increases safety. Start-up Trailar, part of Deutsche Post DHL, has developed a special set of photovoltaic mats that are connected to the truck battery.

Thin, flexible solar panels have been installed on the roofs of trucks. They generate enough energy to power functions such as air conditioning and loading lifts. This saves up to 5% on fuel consumption. Installing solar mats on a single vehicle can reduce CO2 emissions by 4 tons per year. The vehicles will be used mainly for the transport of cargo at the last mile stage.

Volvo SuperTruck Features Solar Panels

Volvo Trucks North America has unveiled a SuperTruck demonstrator that has achieved a freight efficiency improvement of 88 percent – and solar power gets a look-in on the high-tech vehicle.

On top of the cab are solar panels, charging SuperTruck's battery and powering interior lighting.

https://www.energymatters.com.au/renewable-news/volvo-supertruck-solar-em5667/

The fuel-efficiency SuperTruck concept truck from Navistar used solar panels extensively. Volvo's SuperTruck used them as well.

Photo: eNow

Drivers Convenience

Driver Convenience

Solar can allow the refrigerator to remain on when the truck is not in use. This can be especially valuable to drivers to eliminate unloading and reloading the refrigerator during resets and weekends. Solar can also allow drivers to run some hotel loads, including battery HVAC systems, without idling during rest periods.

Driver Retention & Recruiting

The advantages of using solar power to keep refrigerators running and avoiding downtime (and therefore lost miles) waiting for jump starts can be valuable in keeping and finding new drivers. Solar and battery HVAC systems together can minimize engine idle time and therefore increase driver bonus opportunities.

Canada’s Groupe Robert is using six solar panels and four deep-cycle batteries to keep drivers comfortable and batteries charged.

Photo: Groupe Robert

Royal Jones, the president and CEO of Mesilla Valley Transportation (USA) is always trying something new to improve fuel economy. That’s what he tried about five years ago with solar power, installing panels on the truck cab to extend the amount of time electric auxiliary power units could operate. He discovered that the batteries on those trucks were lasting far longer. He found those trucks didn’t need the yearly battery replacement its other trucks do.

Today, newer, thinner, flexible solar panels have solved the aerodynamic problem, so the Texas-based truckload fleet now has several hundred of its Navistar trucks running with auxiliary solar system. This has resulted in less idling, longer battery and alternator life, and increased driver satisfaction.

In testing the solar system from eNow, MVT noted increased daily run time for auxiliary equipment, such as in-cab HVAC; increased battery life from six months to two years; saving approximately 3 gallons of fuel per day from reduced engine idling; and decreased maintenance cost due to reduction in engine idling.

Driving Innovation Shell

5,000 watt solar array on trailer roof that charges and stores power in the battery pack for the main 48 volt battery bank on the tractor, powering the normal truck loads such as lights, wipers, blower motors, gauges, air conditioning and heating, microwaves, and other electrical components.

Thermolite Photo

Solar panels are the ideal solution to meet the power needs of Class 4-6 Delivery Truck

Solar Panels for Trailers Features

Features

Ideal for long term battery maintenance and support of parasitic loads
Greatly extends battery life and prevents costly jump starts
Prevents mid-day liftgate battery failures
Flexible, adhesive backing allows for a quick, efficient installation

High-efficiency solar cells use latest technology to produce abundant power, even in low light conditions
Chemical cleaning and pressure wash compatible
Solar help reduce the cost of replacement batteries, fuel consumption, and delivery delays

Solar Panels can help meet the power needs of school buses, mass transit, shuttles, and coach buses

Thermolite Photo

Features

Produce abundant power, even in low light conditions
Eliminate jump starts
Extend battery life to reduce
Maintenance costs and costly
Emergency road service calls
Are designed for quick, easy installation
Lower fuel consumption and reduced emissions
Ensure sufficient starting power to eliminate need for costly super capacitors
Offer weatherproof panel construction for durability and long system life

Some fleets are installing solar panels on their trailers to power liftgates

Features

If you're running an electric APU*, it makes your APU run longer. It improves your battery life and gives you more alternator life because you're using the sun. There is also a minute improvement in fuel economy because it takes fuel to run that alternator. It is also greener because less idle time is less pollutant time and prevents mid-day liftgate battery failures.

*APU – Auxiliary Power Unit

Photo: GO Power

Super Lawn Technologies

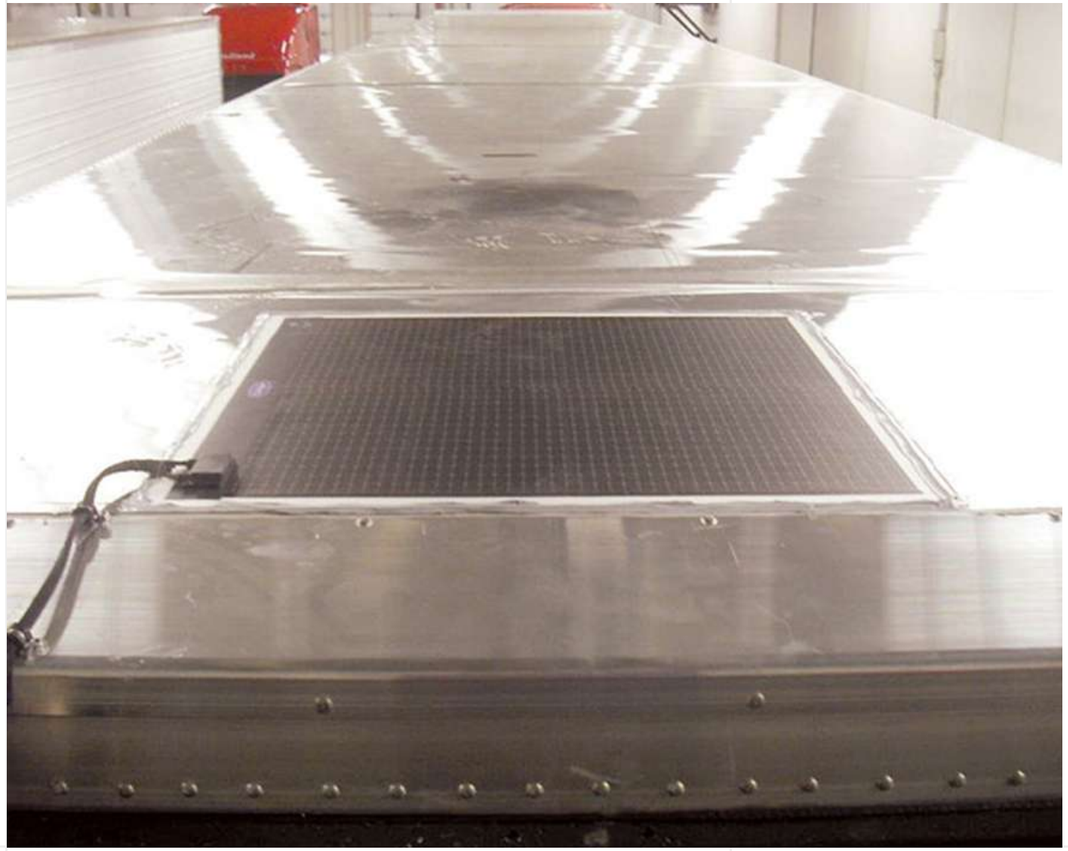
Features

Super Lawn Technologies offers landscape professionals on-the-go battery-charging capabilities for their outdoor power equipment from any location throughout the workday. The Solar Lawn Truck, a vehicle lined with solar panels to channel solar energy into power was introduced first introduced in 2017 with the Mobile Solar Powered Charging Station to provide renewable energy for the on-the-go-battery charging of commercial lawn care equipment. In 2019, the Generation 2 Mobile Solar Powered Charging Station was released to allow for charging of zero-turn or stand-on battery-powered lawn mowers inside the enclosed truck body.

Electric tow tractor in the ŠKODA plant: Solar modules charge the battery during operation; An electric tow tractor with two trailers is equipped with solar panels. The photovoltaic modules charge Li-ion batteries during operation.

Switzerland's E-Force One 300 kW electric truck with a 18m2 solar panel roof

Holland Enterprises uses solar panels on its trailers to supply power to its transport refrigeration units. Holland Enterprises Inc



Jason Forman, a sales and marketing manager for Carrier Transicold, said refrigeration system batteries are increasingly being tapped to power additional electronics, such as telematics devices, fuel-level sensors, interior trailer lighting and other accessories.

Those accessories can continue to draw power while the refrigeration unit is off, which could drain the TRU battery to the point that it doesn't have enough charge to start the engine if the TRU has not been operated for some time.

Richard Houska, director of maintenance for Holland Enterprises Inc., which is based in Fargo, N.D., said the fleet uses solar power from Carrier Transicold to support its reefer units.
The company is installing the solar products on 125 new trailers this year and plans to use the devices on every new trailer.
"We started with five, and I saw a benefit from not having service calls and having to run out a service truck," he said.

When the truck is down for service or other needs, it is not unusual for refrigerators and other hotel loads to drain a battery. The use of solar to keep the batteries charged can reduce the expense and inconvenience of jump-starts and therefore unplanned downtime.

Carrier Transicold’s Thin Film Flexible Solar Panels are specifically designed to maintain the refrigeration unit’s battery charge, even if it’s cloudy

Photo: Carrier Transicold

In addition to charging the batteries to power the in-cab HVAC and hotel loads, fleets are using technology for truck and trailer liftgate applications, for truck and trailer refrigeration, and for safety lights and HVAC for emergency vehicles,” explains eNow President and CEO Jeff Flath. “The system mounts on either the tractor or trailer, or both, so it can power any battery system.”

Solar panels on trailers can help keep batteries charged for refrigeration units, liftgates, pallet jack chargers, and trailer tracking and telematics
For instance, Thermo King’s ThermoLite solar panel solution was developed to provide an alternative power source to both refrigerated and dry van fleets and offset battery drain from parasitic loads. It allows Thermo King’s TracKing or other telematics systems to monitor assets over long periods of time, even when the refrigeration unit is off and the trailer’s untethered from the tractor.

Vprašalnik

		Sleeper Cab without a battery HVAC or a Day Cab	Predlagani razponi	Opombe
1	Izberite vrsto sončnega sistema, ki jo želite oceniti, na spustnem seznamu			
2	Navedena strojna oprema + stroški namestitve na tovornjak		€0 to €4,000	
3	Na spustnem seznamu izberite mesto, ki je najbližje območju obratovanja vozila		n/a	
4	Stevilka od 10 urnih počitnic / teden v spalnih urah		0 – 6	
5	% počitkov v spalnem obdobju, ki potekajo čez dan		0 – 100%	
6	Tedne na leto potrebnih A / C baterij		0 – 52 teden/leto	
7	% počitka, pri katerih baterija HVAC ni dovolj		0 – 100%	Premalo = baterije ne zdržijo celotnega počitka in bodisi je treba voziti v prostem teku ali pa je treba izklopiti HVAC
8	Skupno število akumulatorjev Skupine 31 na tovornjaku		3 – 10 akumulatorjev	
9	Povprečne sončne ure v času počitka čez dan		0 – 10 ura	
10	Kako dolgo trajajo baterije HVAC, preden morate zagnati motor?		4 – 10 ura	
11	Skupni vat, ki ga proizvedejo panele		20 – 600 watts	
12	Povprečna življenjska doba baterije v mesecih - tovornjak		0 – 60 mesec	
13	Povprečna življenjska doba baterije v mesecih - HVAC		0 – 60 mesec	
14	Stroški plus delo na zamenjavo baterije - 4 baterije		n/a	
15	% pričakovano izboljšanje hitrosti zamenjave baterije		0 – 100%	
16	Povprečna flota km na galon		6,5 – 16 km per galon (3.79l)	
17	Povprečna kilometraža tovornjakov na leto		65,000 – 400,000 km	
18	Skoki na leto za celotno floto		n/a	
19	Povprečni stroški na začetek skoka (notranji / zunanji)		n/a	
20	Velikost flote (# tovornjakov)		n/a	
21	Pričakovani% skoka se začne izogibati s soncem		0 – 75%	
22	Povprečni stroški goriva na galonou		n/a	
23	Prihranki na tovornjak na leto pri zadrževanju / najem		€0 – €300	Ocenjujemo, da so tipični prihranki pri zadrževanju / najemu za primer uporabe HVAC približno 100 euro na leto

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