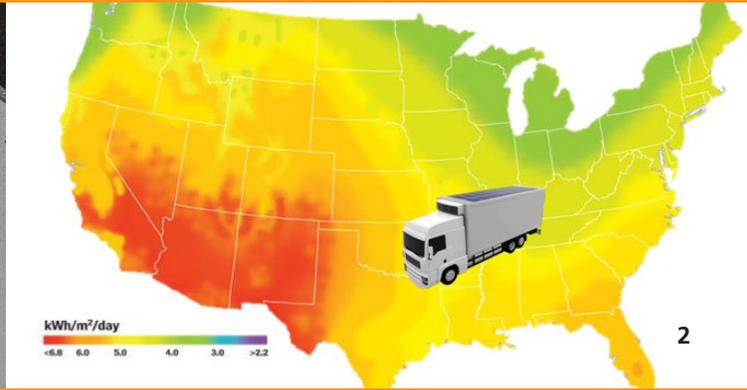


ROOFTOP SOLAR POWER FOR TRUCKS



- 1 Installed solar panels designed to calculate the potential energy generated from rooftop solar
- 2 Solar irradiation map of the US shows what parts of the country typically have higher irradiation

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A joint project with

Why Solar on Trucks?

Truck-mounted solar can save fuel by providing power for cabin services (heating/cooling, fridge, entertainment), refrigeration (reefers) and even range extension. Truck-mounted solar is not yet popular, because of the perception of high cost and the uncertainty about the payback time. Savings from truck-mounted solar is more difficult to determine than for grid-connected solar. Factors that affect the savings include: truck route, which determines the solar irradiation (Image 2), electrical load, fuel costs, and solar system efficiency/durability. To help individual truck and fleet owners, manufacturers and end users determine whether solar makes sense for their application, Fraunhofer can measure the solar potential for a specific truck or trucking fleet. The following case study provides an example.

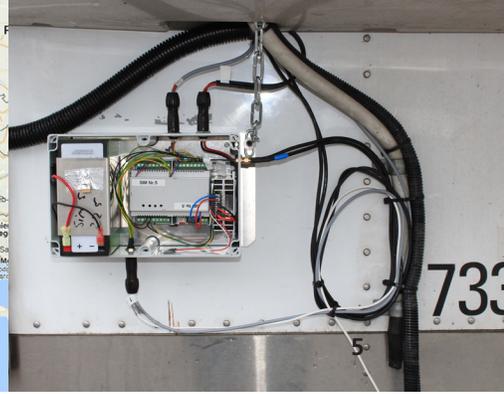
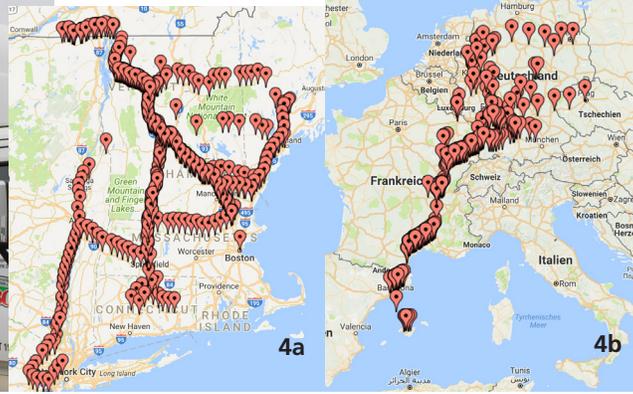
Case Study: Reefers in the Northeast US

Fraunhofer CSE (Boston, MA), partnered with Agri-Mark/Cabot Creamery (Burlington, VT) to measure the solar potential on two reefers in the Northeast during October-December 2016 (Image 4a). Self-powered instrumentation was installed to measure the amount of sunlight, rooftop temperature and truck location on the road. Table 1 describes the instrumentation package.

The instrumentation is solar-powered, with the battery, data-logger and cell modem contained in a weather-proof enclosure mounted on the trailer behind the tractor (Images 3 and 5). The Cabot Creamery trucks traveled throughout Vermont, New Hampshire, Maine, Massachusetts, Connecticut and New York (Image 4a), making regional deliveries of cheese.

Measurement	Instrument
Roof-top solar irradiation	Roof-mounted solar panel (Image 1)
Roof-top temperature	Roof-mounted solar panel (Image 1)
Trailer temperature	Thermocouple
Ambient air temperature	Thermocouple
Location	GPS tracker

Table 1



Northeast US Study Results

The dataset was filtered using several criteria: day/night, moving/parking, in home port/traveling. The solar energy generated while moving is more valuable as the truck is off-grid while on the road. While in home port, the truck could feed the solar power into the grid to generate savings at grid electricity rates.

The Cabot Creamery trucks moved 15% of the time (15% off-grid) with most of their time spent at their home port (Burlington, VT). Assuming full roof coverage of solar (36 m²; 388 ft²), a total energy savings equivalent to 290 gallons of diesel per year was calculated. The energy savings during the off-grid time is equivalent to 44 gallons of diesel.

Case Study: Reefers in Central Europe

The same instrumentation was installed on 4 reefers which traveled through Central Europe (Image 4b) from June 2016 through January 2017. The truck that traveled furthest south into the French Riviera generated the most total fuel savings (equivalent to 480 gallons of diesel). Both the sunnier location and the warmer season increased the fuel savings compared to the Cabot Creamery trucks driven in the Northeast during the fall months. The off-grid time (35%) enabled an annualized energy savings of 169 diesel gallons while on European roads (vs. 44 diesel gallons calculated for the Northeastern US). Table 2 compares the energy savings of the best Cabot Creamery truck with the best overall truck of the study.

- 3 Cabot Creamery truck showing installed solar monitoring system
- 4a/b Routes traveled by US and European Reefer Trucks for study
- 5 Installed solar monitoring system enclosure
- 6 Table showing truck's rooftop irradiance en route

How can Fraunhofer help?

Together with Fraunhofer ISE, Fraunhofer CSE can provide an analysis of the savings and payback time for your truck in your usage scenario. Fraunhofer would install instrumentation on your truck(s), record the data and perform the analysis to provide solar power output, fuel savings and payback time.

Most current solar installations on trucks are "retrofits" and thus are not fully optimized for the truck application. Fraunhofer ISE can partner with trailer/truck manufacturers to design an integrated solar system which is optimized for trucking. Design aspects such as ventilation, temperature management, cable management, weight and durability will be optimized to maximize output while minimizing cost.

Please contact us for more information:
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	Total energy savings (diesel gallons)	Off-grid energy savings (diesel gallons)	Comment
Best Cabot Creamery Truck	290	44	15% off-grid in the northeast
Best Truck Overall	480	169	35% off-grid in southern France

Table 2

