A solar-powered car can generate its own energy, independently of fuels, using a photovoltaic panel on its roof (or using the electricity grid). It may therefore be an interesting solution to the issue of clean mobility. Currently, only non-commercial prototypes of practical solar-powered cars for everyday use exist and there is little literature on the possible performance of these cars. The question “how far can a solar-powered car drive until it has to be recharged from the grid?” does not have a simple answer as it is highly dependent on the vehicle parameters, location, the built environment, daily driving distances, time of day, day of year and more.

The main deliverables of this thesis are therefore (1) a probability model for days between charges and (2) a model and method to compute the solar irradiation while taking shading due to buildings into account. The models are applied to solar irradiation data from urban environments in the Netherlands. It has been found that less than roughly 30% of the solar irradiation is blocked by buildings and at least a 100% increase in vehicle performance can be achieved by very energy-efficient cars (energy consumption <120 Wh/km) and up to 50% for existing EVs (energy consumption ~150 Wh/km) when equipping them with solar panels.

Figure: Probability distributions of “days until next charge” for vehicles with a battery size of 30 kWh, solar panel efficiency of 20% and solar panel area of 4 m². With energy consumptions 75 (top), 100 (middle) and 125 Wh/km (bottom).

Figure: Contour plot of the “solar improvement factor” with a solar panel of 4 m² and 20% efficiency and various combinations of energy consumption and battery size. The solar improvement factor dictates roughly how much further a solar car can drive as compared to the same car without a solar panel.