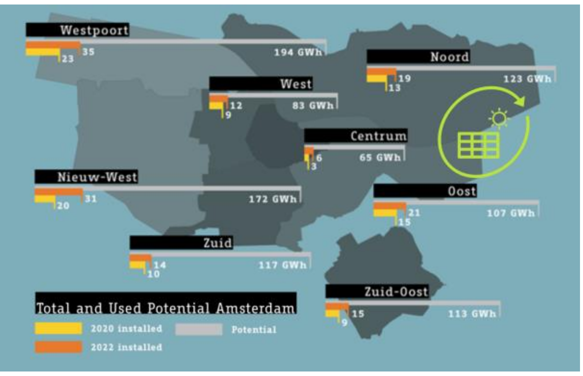
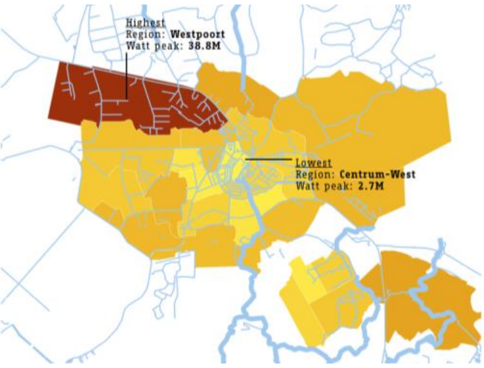
simply positive

D6.2. Semi-annually visualization of PV installations progress per neighbourhood based on the Focus District in Amsterdam including a PV development strategy showing unused potential

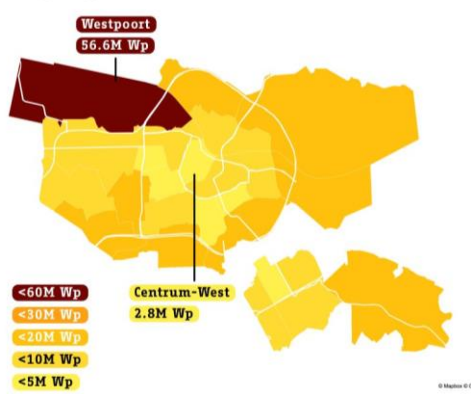
2023-2024



Visualization Summer ’23 ↑



Visualization Winter ’23 ↑



Visualization Summer ’24 ↑

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Leader: PV Works

Dissemination Level

PU	Public	X
CO	Confidential	

History

Version	Description	Lead author	Date
V1	First Template	PVW	May 2023
V2	Draft Semi-Annual Report	PVW	June 2023
V3	Review	PVW, SON	July 2023
V4	Final 1st Semi-Annual Report	PVW	July 2023
V5	Draft Semi-Annual Report V.2	PVW	December 2023
V6	Updated Draft Semi-Annual Report V.2	PVW	January 2024
V7	Updated Draft Semi-Annual Report V.3	PVW	July 2024

Disclaimer

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Executive Summary

A prioritization strategy for cities will be developed to facilitate the installation of PV systems across their urban fabric and to raise awareness of the PV energy yield potential. Several factors will be taken into consideration in developing the strategy:

a) economical (feed-in tariffs, LCOE and RoIe of urban PV systems),

b) energetical (known or computed bottlenecks in mid-low voltage distribution grid), prioritization of PVT over PV regarding the heat transition,

c) architectural (status of building permits, planned constructions, etc.), and

d) governance (ownerships, collective projects).

The strategy will be based on the data from the city of Amsterdam with focus on replicability and usability for all other SIMPLY POSITIVE focus districts.

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List of Abbreviations and Acronyms

AC	Alternating Current
AHN	Algemeen Hoogtebestand Nederland (in Dutch)
BAG	Basisregistratie Adressen en Gebouwen (in Dutch)
DC	Direct Current
DNI	Direct Normal Irradiance
DHI	Diffuse Horizontal Irradiance
DSO	Distribution system operator
DSM	Digital Surface Model
GHI	Global Horizontal Irradiance
LCOE	Levelized Costs of Electricity
LiDAR	Light Detection and Ranging
PDOK	Publieke Documentatie Op de Kaart (in Dutch)
PV	Photovoltaic
PVT	Photovoltaic Thermal
RoI	Return on Investment
SCF	Sun Coverage Factor
SVF	Sky View Factor
WP	Work Package

Table of Contents

1. Introduction

1.1. Purpose of the document

In this document the available annual data on the installed capacity of photovoltaic (PV) systems is retrieved for city of Amsterdam per district to present the progress in PV installations. Also, the rooftop PV energy yield potential is calculated and compared with future targets of the city.

1.2. Relation to other project activities

A study to estimate the rooftop PV energy yield potential in Amsterdam was carried out by the TU Delft and the AMS institute. The project resulted in a realistic quantification of solar PV potential on Amsterdam rooftops and a comparison with the actual PV installations. In such a modelling framework, further developed at PV Works, height data of the terrain are used to digitally construct the urban fabric; recognize rooftops with respect to cadastre data; automatically place PV modules on rooftops; and accurately compute the PV systems' energy yield up to the AC-side for every considered building. All this is accomplished with a pace of 2.4 buildings/second. These data are already used by the city of Amsterdam to engage citizens and plan in time PV installations with accelerated permit certifications. The city of Amsterdam supports the Simply Positive project.

1.3. Structure of the document

In Chapter 2 of the document the methodology for retrieving the amount of existing PV systems and the model used for calculating the rooftop PV potential is presented. Chapter 3 obtains the results and discussion on semi-annual progress of PV installations in Amsterdam. Chapter 4 contains the results and discussion on the calculated PV energy yield potential taking limiting factors into account. Finally, the conclusions are given in Chapter 5.

2. Methodology

2.1. Inventory of existing PV systems in Amsterdam

2.1.1. Annual detection of PV systems from aerial imagery

The municipality detects the installed solar panels from aerial photos of the buildings and makes this information available. The detection is carried out by a collaboration between Amsterdam and *Reader,* a company specialized in automatic detection. The high-resolution aerial photos are made publicly available [1] every year up to a resolution of 8 cm. An example of an aerial image with installed PV modules is presented in Figure 1. In addition to the most recent 2022 aerial images, they also share the aerial photos from 2016 till 2021. This enables us to determine when and where the installations have been placed. From matching the PV energy yield per year and making the comparison between the two following years we have found out that the peak power of modules installed each following year increases as shown in Table 1.

Table 1 - PV Module peak power

Installation year	Module Peak power
Year	**Peak power (Wp)**
2021 -2024	330
2020	315
2019	305
2018	295
2017	256
2016	252

Figure 1 - Existing PV on aerial imagery

2.1.2. Quarterly increase in PV systems connected to electricity network.

The data of PV systems connected to the electricity network is collected by the distribution system operator (DSO) Liander [2] which is active in all districts of Amsterdam. This dataset consists only of PV systems that are connected to the low-voltage grid. The data of individual PV systems are aggregated per Amsterdam neighbourhoods to meet privacy regulations. Neighbourhoods with less than 5 connections are not included in districts but are added to a separate section (in Table 3 called *Others*). In total there are 342 neighbourhoods in Amsterdam with PV systems connected to the low-voltage grid, which are brought under 8 districts.

2.2. Potential PV systems

2.2.1. Input Data

LiDAR Height data

In 2020 and 2021 new height data was retrieved by Algemeen Hoogtebestand Nederland (AHN4) and made available on their website *AHN viewer* [3]. The point cloud has an average resolution of 25 cm, but for the sake of quick analysis this data is converted into a digital surface model with a grid size of 50 cm. This raster data comes in tiles of 2.5 by 1.25 km which means the data must be processed per districts in Amsterdam.

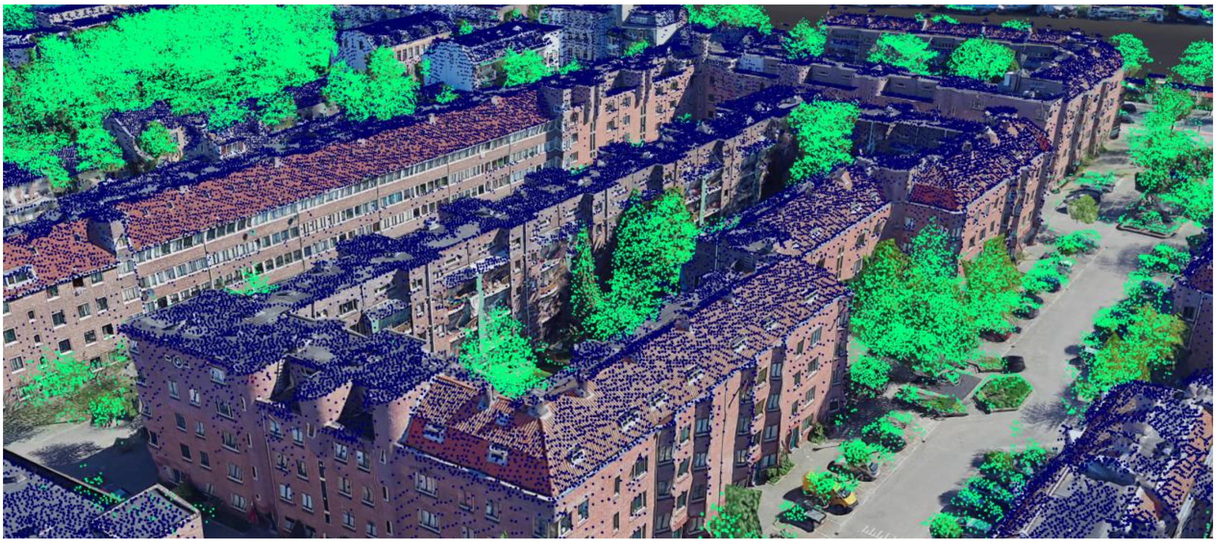


Figure 2 - LiDAR Point cloud visualized on a 3D building block in Amsterdam

BAG cadastre building data

The so-called BAG data (Basisregistratie Adressen en Gebouwen) was collected on the 6th of June 2023 from the Cadastre [4], including 545,288 addresses for 194,380 buildings across the city of Amsterdam. For each building, the projected footprint of the building is a 2D polygon described in X and Y coordinates as shown in Figure 3.

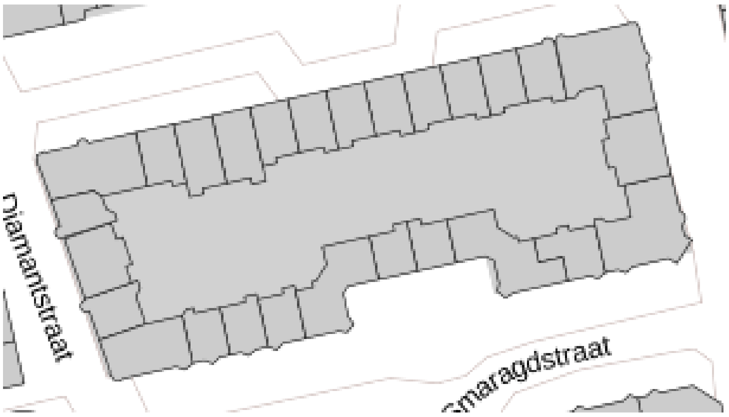


Figure 3 - BAG cadastre building footprints for a building block in Amsterdam

Climate Data

Hourly meteorological data is collected from weather stations in and around the city of Amsterdam and they are used to determine a weather pattern for an average year. Several years of historical weather data are used by software programs like METEONORM to create an array of 8760 hours with a typical weather pattern for each day. The required parameters for calculating the time-dependent solar irradiance on a module are solar position polar coordinates azimuth and elevation in degrees, Global horizontal irradiance (GHI), Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DHI), ambient temperature and windspeed.

PV Module Data

Standard rectangular PV modules are fitted on the available roof area. The dimensions of the module as well as the mounting height are input parameters. Furthermore, the characteristics of the module such as the efficiency under standard test conditions (STC), open circuit voltage, short circuit current, number of cells in series, ideality factor and temperature coefficient are required for calculating the energy yield. These characteristics are commonly found in the datasheet of the PV module. Also, the overall reflective index, back and front emissivity and ground albedo are taken into account. A summary of the parameters of the PV module panel used in our study is given in Table 2.

Table 2 - BAG cadastre building footprints for a building block in Amsterdam

	PV Module parameters
Parameter	**Value**
Module length (m)	1.669
Module width (m)	0.996
Efficiency at STC (%)	19.6
Open circuit voltage (V)	41.08
Number of cells in series	120
Ideality factor (-)	1.2
Temperature coefficient (%/*C)	-0.027
Ground albedo (-)	0.2
Reflective index (-)	0.1
Top emissivity (-)	0.2
Back emissivity (-)	0.89

2.2.2. Skyline-based model

Figure 4 details our modelling framework to evaluate the PV deployment for a particular site. We start with LiDAR data which are readily available in the Netherlands. In this step, we consider only points that are classified as buildings. Using these points, we detect planar surfaces that are large enough to fit a PV array. Non-curved surfaces larger than 10 m^2 are selected for PV module installations.

A heuristic layout algorithm is used to fit as many modules as possible in different orientations on the selected surfaces. For flat rooftops, modules are placed facing south with a tilt angle of 13 degrees and a row spacing of 0.7 meter, or east-west with 10 degrees tilt. On sloped rooftops, both the portrait and landscape orientation of modules are assessed.

The surrounding horizon is scanned for each module of the array. In this case we use every Lidar point, including, for example, trees. The horizon scan is used as an input for our skyline-based approach to calculate the energy yield. In this approach we apply the sky-view factor (SVF), sun-coverage factor (SCF), ground albedo, and module tilt and azimuth to make a quick estimation of the annual PV energy yield.

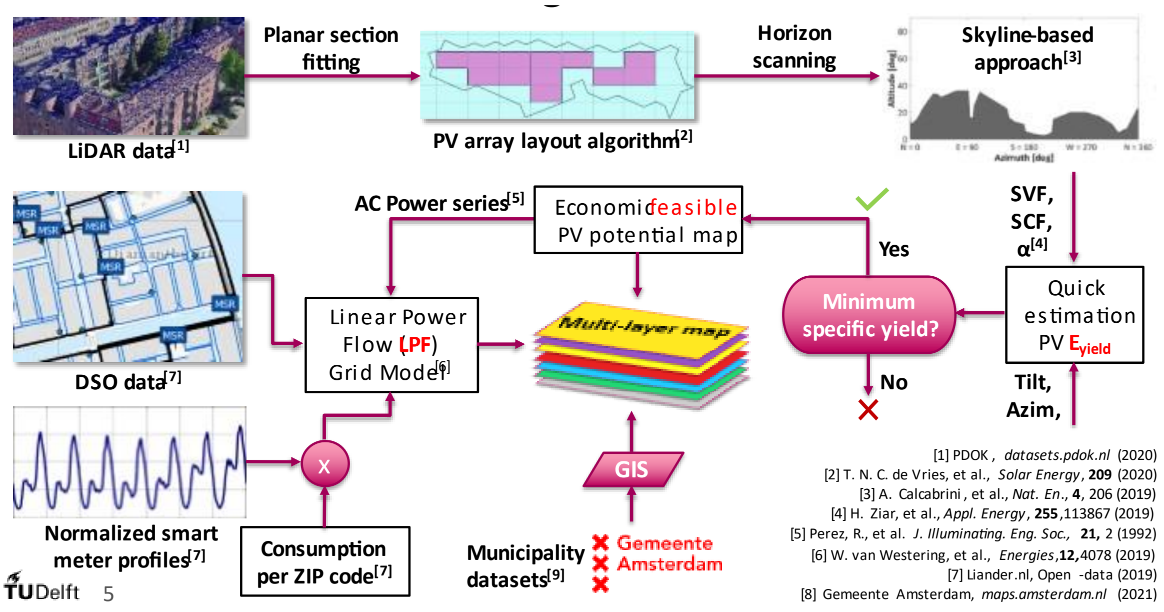


Figure 4 - Modelling framework for the assessment of PV energy yield

After obtaining the annual PV energy yield per module we check whether the performance of the module is cost-effective. A performance threshold of 650 kWh/kW$_p$ is used to filter out poor performing modules. When the module performance is lower 650 kWh/kW$_p$ the spot is not considered as suitable for PV module installation. Conversely, we consider the spot cost-effective for which we continue to calculate a yearly AC power output. The AC power output is an input for a linear power flow model, designed to calculate bus-line voltages for grid networks. The result of this model indicates parts of the grid that could lead to voltage problems.

Figure 5 shows how flat surfaces are successfully detected and geometry sticking out-of-plane is ignored. This means that there are gaps in the detected surface where, for example, a dormer was placed at the roof.

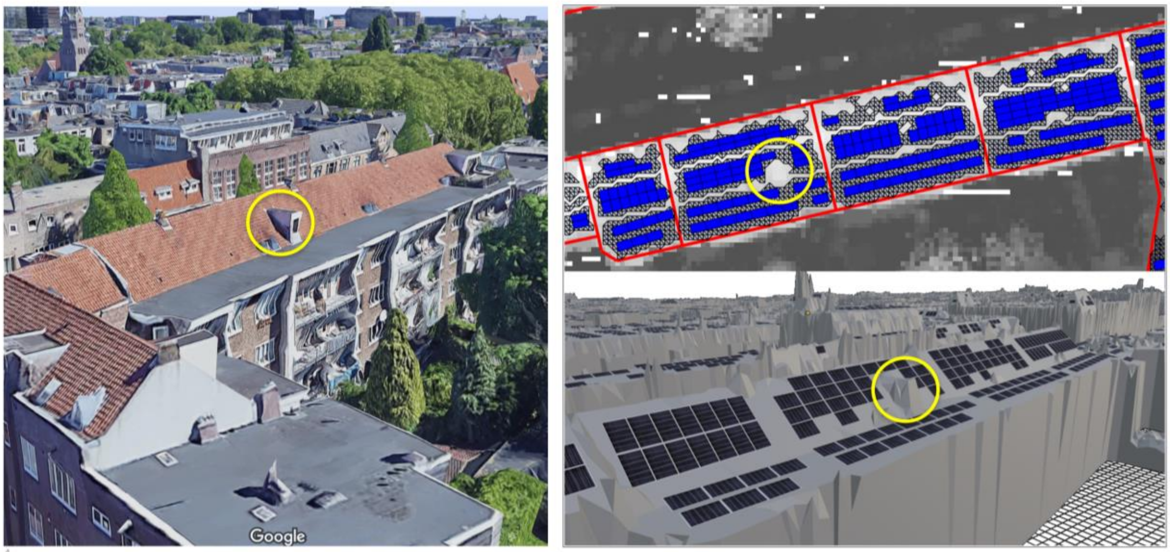
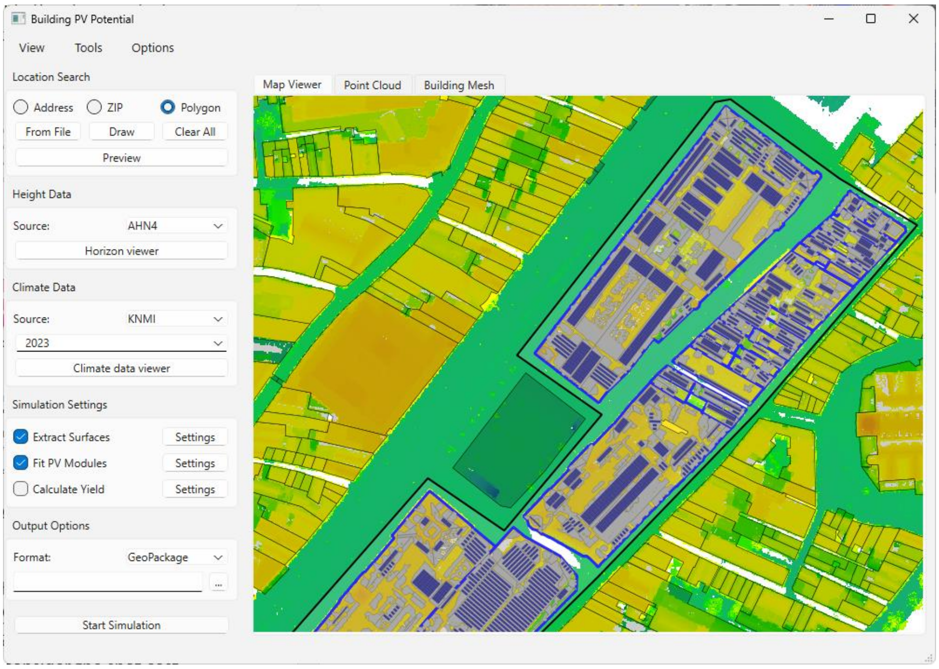


Figure 5 - Detection of available roof space and fitting of PV modules in multiple orientations

2.2.3. Improved methodology

A new app has been developed in python to improve upon the lessons learned from the previous Matlab code and extend the framework with python's broad capabilities.


Building PV Potential

Location Search

○ Address ○ ZIP ● Polygon

Height Data

Source: AHN4

Climate Data

Source: KNMI

2023

Simulation Settings

☑ Extract Surfaces

☑ Fit PV Modules

☐ Calculate Yield

Output Options

Format: GeoPackage

Figure 6 – New tool developed in Python using the PyQt6 package

The skyline-based approach had to be adapted for the more complex PV-T calculations, which require a hourly incident irradiation profile for a full year. This means meteorological data is now used for each PV module to calculate the DC output power for each hour and the annual yield is obtained by integration, instead of creating climate coefficients.

Roof polygons

The methodology for the detection of roof points and conversion to polygons has been improved to create a more complete roof shape. The edges are snapped to the adjacency lines of neighbouring polygons to create a seamless roof mesh, as can be seen in the images below.

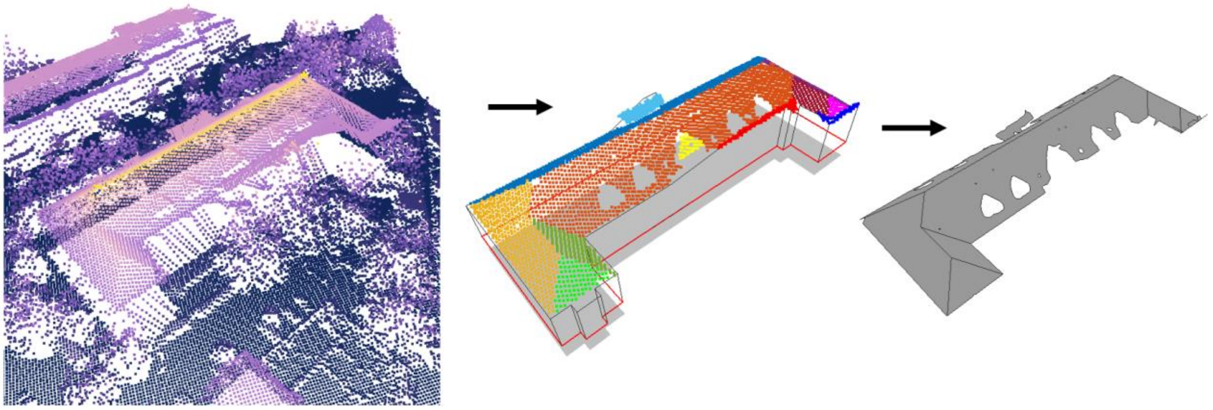


Figure 7 – Process from point cloud to detected planar clusters of points to simplified polygons

Module fitting

To take into account the choice of more aesthetically pleasing module layouts, new algorithms have been developed to remove panels from the maximum. In a iterative process an erosion function is used to erase sticking-out panels from the edges of a group. Alternatively, the choice can be made to have strictly rectangular groups of panels within a roof section. Depending on the shape of the roof and size of the panels, this process can remove many panels from being further processed.

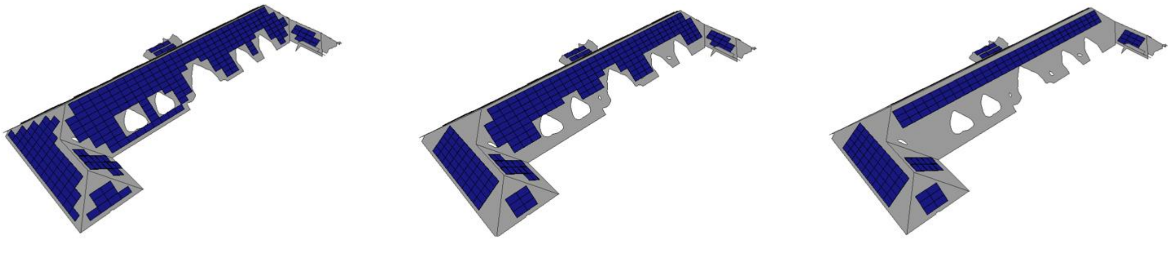


Figure 8 – Different choices of module layout methods. First the maximum possible on the left, then eroded in the middle and strictly rectangular on the right

Horizon profile

The horizon scanning approach has been sped up by resampling the height data based on distance. This means nearby points are unchanged, but points far away from the module have been removed at random before doing any further processing. This means a much larger search radius can be used.

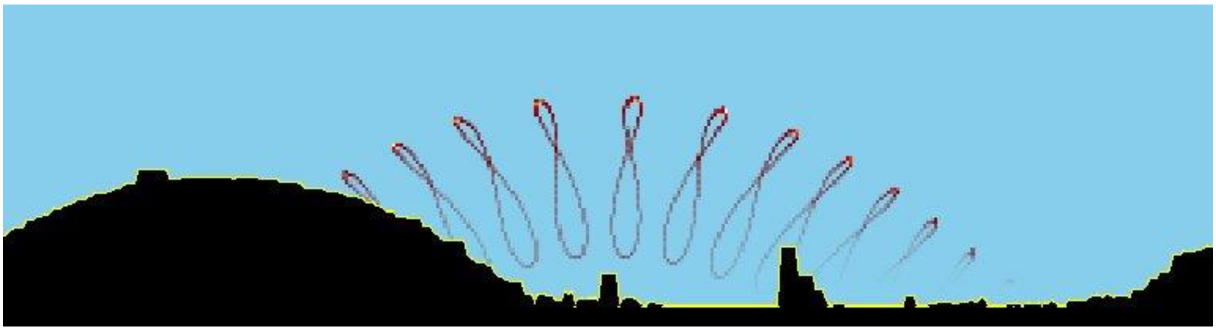


Figure 9 – Skyline profile generated by horizon scanning algorithm in yellow, with the solar position shown for a full year in the background

3. Semi-annual development of the installed PV capacity

3.1. PV systems connected to DSO in the past period.

The PV related data provided by the DSO was not available for every three months of the past period. Instead, a datasheet made available in August 2022 was used for the analysis in this project. In total there are 25892 PV systems connected to the low-voltage grid in the city of Amsterdam, with a total installed capacity of 80177 kW. The overview of installations per district is presented in Table 3. Note, these are only small (household) PV systems connected to the low-voltage grid. Some PV systems installed on large buildings can be connected directly to the medium-voltage network and are not considered in our analysis. It means that the data presented in this report could underestimate the real situation in the city of Amsterdam.

Table 3 - PV systems connected to the DSO

	PV systems connected to low-voltage grid	
District	**Number of connections**	**Grid installed capacity (kW)**
Centrum	604	2179
Nieuw-West	6982	20067
Noord	4200	14374
Oost	5631	16759
West	2206	6186
Westpoort	214	776
Zuid	2536	7238
Zuidoost	2997	9864
Others	522	2734

3.2. Latest results of aerial detection of PV systems

The DSO report on the detection of all existing PV system using aerial images was made at the beginning of 2023 and made available at the end of June 2023. The data from the report reveal that a total of 100000 new PV modules were installed in Amsterdam in 2022 as shown in Table 4. The Centrum district of Amsterdam has the smallest number of new PV modules, which can be expected from the densely populated city centre with many historical buildings. The most modules in 2022 were installed in Westpoort district that are clustered in 135 separate PV systems.

Table 4 - Latest information on detected existing PV systems (update January 2024)

	Detected in 2023				
District	**Buildings**	**PV Systems**	**Total number of Panels**	**New Panels 2023**	**Cumulative Installed Capacity (kW)**
Centrum	16207	692	27929	5823	8854

Nieuw-West	36230	6025	155818	38890	49158
Noord	34673	4064	104257	32564	32973
Oost	21162	1301	55315	11401	17161
West	2697	164	176353	47937	56574
Westpoort	27923	1736	68852	15519	21501
Zuid	20975	3598	81024	25275	25944
Zuidoost	22547	3514	101726	23478	31871
Overig	11179	2254	45501	9431	14174

3.3. Progress of installed PV per district

Table 5 presents 7 years of PV installation history in the districts of Amsterdam. The year columns show the cumulative installed capacity in kW and the column next to it shows the annual growth rate percentage in that year with respect to the previous year (numbers are shown in blue colour). Westpoort district has experienced the fastest growth in PV installations, going from the smallest amount of installed PV capacity in 2016 to the largest one in 2022.

Westpoort is the industrial district in Amsterdam, meaning that the growth mainly comes from very large installations. The “Others (Overig)” row are the panels that are not in any of the 8 main districts.

Table 5 - Progress of installed PV capacity per district in Amsterdam (update January 2024)

	Cumulative installed capacity (kW) & annual growth rate (%)														
District	**2016**	**2017**	**+%**	**2018**	**+%**	**2019**	**+%**	**2020**	**+%**	**2021**	**+%**	**2022**	**+%**	**2023**	**+%**
Centrum	818	1206	47,43%	1870	55,06%	2616	39,89%	3798	45,18%	5848	53,98%	6809	16,43%	8854	30,03%
Nieuw-West	3630	5057	39,31%	7890	56,02%	13680	73,38%	23080	68,71%	29978	29,89%	36248	20,92%	49158	35,62%
Noord	3497	5187	48,33%	6935	33,70%	9668	39,41%	14702	52,07%	18319	24,60%	21898	19,54%	32973	50,58%
Oost	3287	5377	63,58%	7184	33,61%	11615	61,68%	16838	44,97%	20521	21,87%	23779	15,88%	31871	34,03%
West	2440	2886	18,28%	4115	42,58%	6566	59,56%	10177	55,00%	11899	16,92%	13228	11,17%	17161	29,73%
Westpoort	323	541	67,49%	3550	556,19%	9020	154,08%	26939	198,66%	31502	16,94%	40679	29,13%	56574	39,07%
Zuid	2752	4131	50,11%	5348	29,46%	7486	39,98%	11417	52,51%	13036	14,18%	16194	24,23%	21501	32,77%
Zuidoost	3332	4589	37,73%	5792	26,21%	8784	51,66%	10391	18,29%	13238	27,40%	16795	26,87%	25944	54,47%
Overig	1365	2101	53,92%	2496	18,80%	3933	57,57%	6790	72,64%	9425	38,81%	10970	16,39%	14174	29,21%

3.4. Visualisations of PV systems installed

Some visualizations are provided in this document to help understanding the general situation in Amsterdam and in each district. These visualizations relate to available data in Spring 2024 by aerial photos, coming from 2023. New uptake data from aerial photos is available in fall 2024.

In Figure 10 it is possible to see the total installed power in watt peak in 2023, divided in the different districts of Amsterdam. As explained in the previous section (3.3), Westpoort has the largest amount of installed PV capacity with a value of 56.6 MW_p, while the lowest value is attributed to the Centrum-West district (2.8 MW_p). Overall, Amsterdam rooftops hold upwards of 250MW worth of solar panels. While the industrial area of Westpoort accounts for the 22% of the total, it is noticeable that closer to the city center the installations are less. Moreover, outer areas like Weesp, Noord-Oost and Buitenveldert contribute roughly twice the whole amount of the city center.

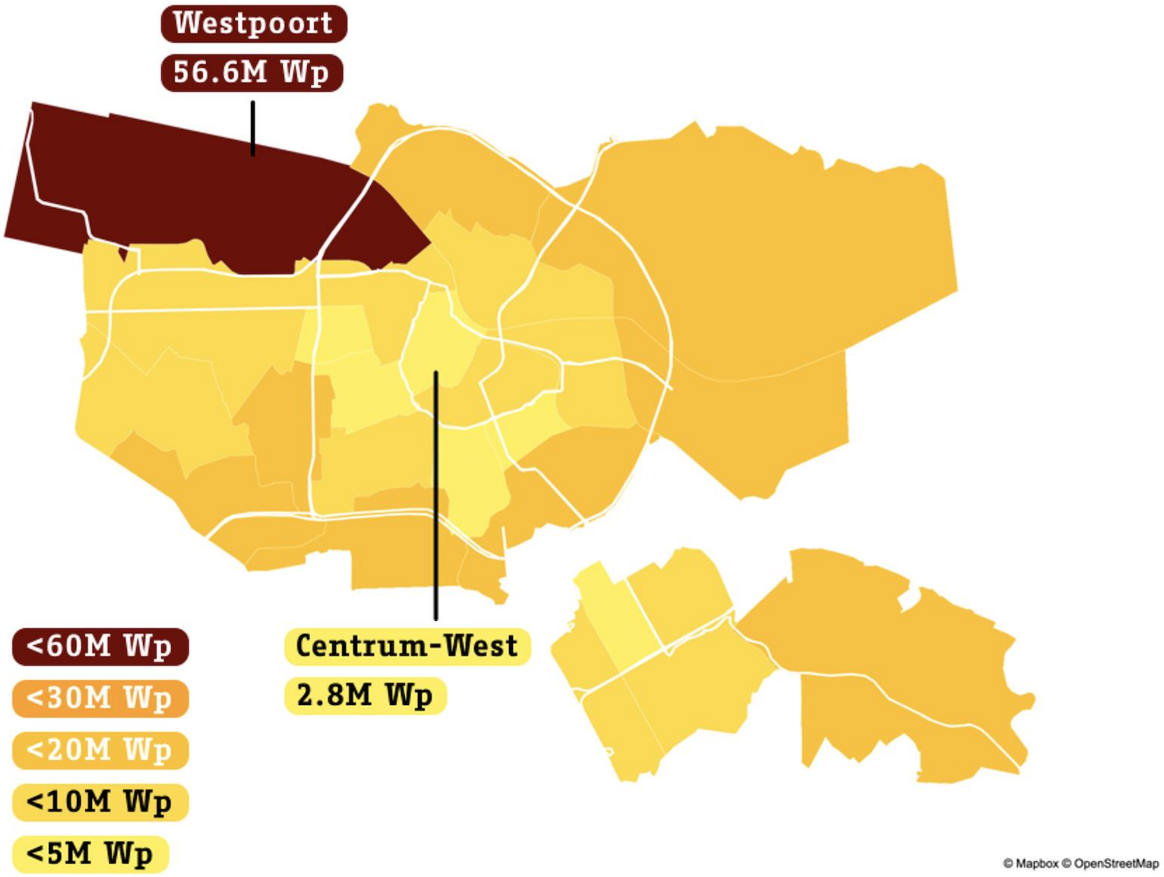


Figure 10 – Total watt peaks installed per different areas in Amsterdam

Building on this, in Figure 11 it is possible to see the timeline of watt peak from rooftop solar panels installed between 2016 and 2023, with a projection towards the municipality's objective of 550 MW_p installed in 2030. Rooftop solar panels in the city increased 12-fold between 2016 and 2023. In 2023 alone, 72MW were added (a 38% increase). If the uptake rate of 2023 can be the same for upcoming years, it should be possible to reach the goal around 2027.

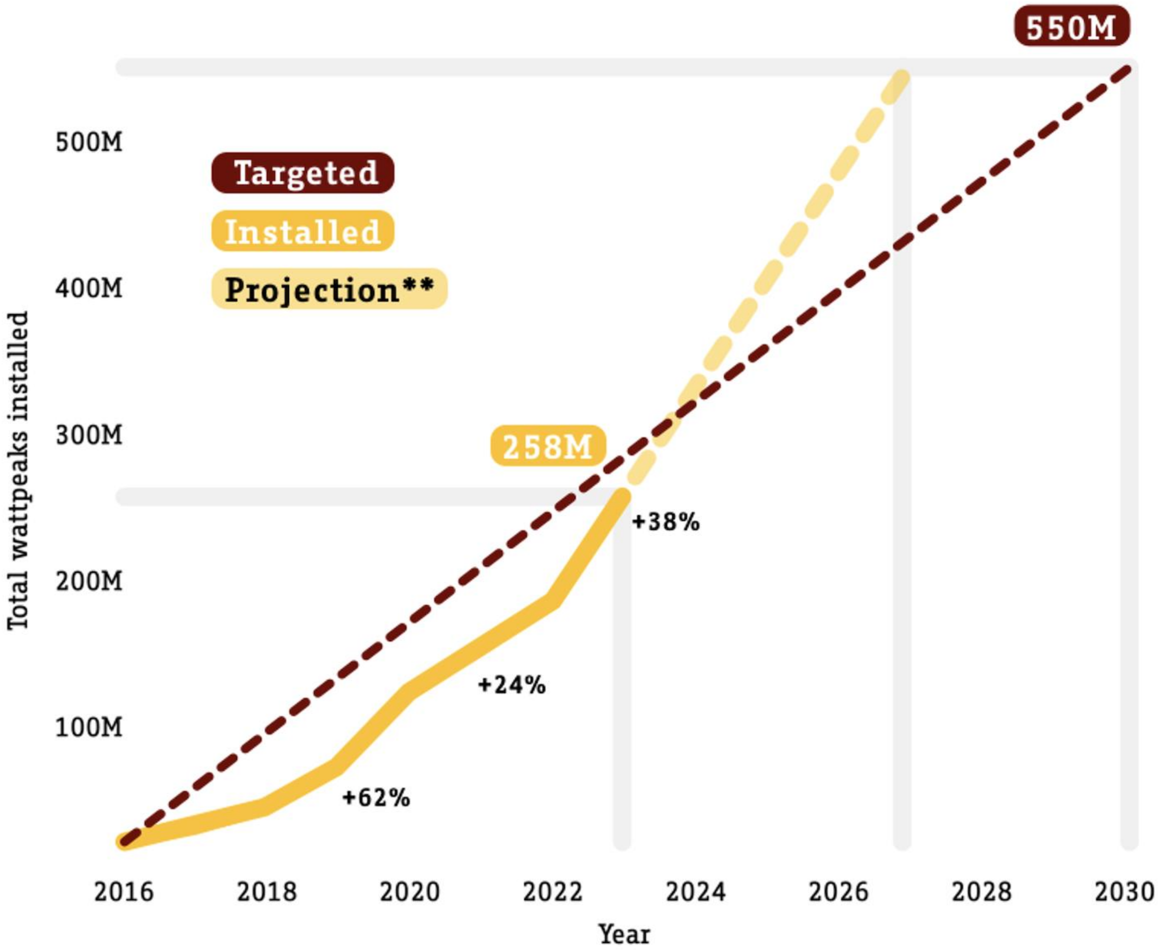


Figure 11 – Timeline of watt peak from rooftop solar panels from 2016 with projection to 2030

4. Calculated Rooftop PV Potential

4.1. Maximum possible installed capacity

As explained in Chapter 2, we used the skyline-based model approach to calculate the annual energy yield of modules placed on the suitable roofs of Amsterdam buildings. The results of the roof assessment, number of installed modules and the annual energy yield are displayed in Table 6. The simulated annual energy yield results are visualized in the front cover image while being compared with installed capacity in 2020 and 2022. This deliverable will be then updated in upcoming semi-annual versions to visualize how actual PV installations compare with simulated potential.

Table 6 - PV Potential of the districts in Amsterdam

	Building Info		Potential			
Text	Buildings	Roof area (km^2)	PV systems*	Modules	Capacity (MW)	Annual Yield** (GWh)
Centrum	15,422	1.65	10,393	247,719	66.9	60.0
Nieuw-West	24,970	2.62	21,611	608,194	164.2	154.7
Noord	22,649	1.85	18,355	446,734	120.6	111.9
Oost	16,814	1.79	14,256	380,753	102.8	96.2
West	16,996	1.54	14,475	294,852	79.6	74.9
Westpoort	2,371	2.23	1,877	645,270	174.2	171.4
Zuid	21,701	2.20	18,798	426,569	115.2	106.4
Zuidoost	13,230	1.67	11,364	397,103	107.2	101.8
Total	**134,153**	**15.54**	**111,129**	**3,447,194**	**930.7**	**877.2**

*PV system consists at least of 4 PV modules
**The annual energy yield is calculated for a typical meteorological year

4.2. Limiting factors for PV implementation

The results presented in Table 6 were calculated taking several limiting factors into account that do not currently allow placing PV modules. The limiting factors are related to the existence of green roofs or terraces, monumental buildings, water management works and grid congestion.

During Winter 2023-2024 we were studying various possible correlation analysis to better understand the PV adoption through the city with supporting reflections. This will possibly lead to better, data-driven policy recommendations.

Identification of correlation of building functions, properties, value, ownership can indicate a pattern in adoption of PV panels. Together with an overview of contemporary policy (result 6.4), this can lead to new insights for more effective support mechanisms or to identify troubling regulations.

To start, it is interesting to focus on building functions. In figure 13, a timeline from 2016 till 2023 grouped by building function, is presented. It is evident that residential buildings are predominant in the provision of electricity through rooftop solar panels, leading with $127MW_p$ in 2023, roughly half of the total provision, while functions like Sports, Commercial and Education provide together only 17 MW_p in 2023. This data is expected as residential buildings are the 80% of all the buildings in Amsterdam. Moreover, it is relevant to notice that in 2019 residential and industrial received a clear bump. Might be interesting understand the policies adopted in that period and the successful strategies. Comparing the total with the average it is possible to highlight important factors, indeed the residential watt peak installed is the lowest, contributing with less than $1KW_p$. This suggests further analysis and exploration of the reasons behind. Education and industrial buildings contribute on average the most watt peak, partly explained by their relatively large rooftop areas. Comparatively, commercial rooftops offer a lot of room for more solar panels. Even though the residential sector provides most of the space for PV installation, still it can be exploited even more, due to the enormous number of residential buildings in the city of Amsterdam.

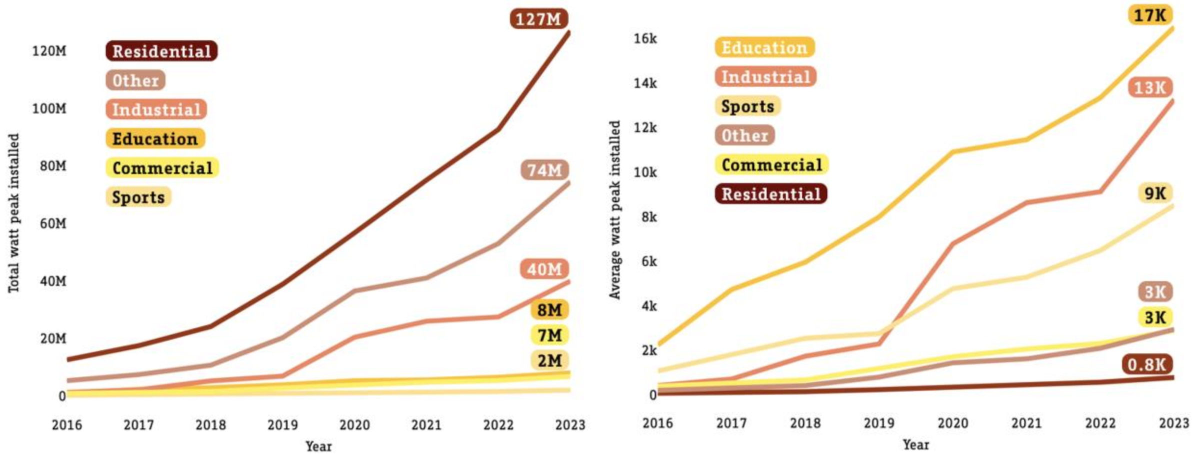


Figure 12 – Timeline of total (left) and average (right) watt peak from rooftop solar panels from 2016 till 2023, grouped by building function

In figure 13, a specific analysis of the total watt peak installed on residential buildings is provided. This map highlights that closer to the city center there is less watt peak installed, questioning whether it is because of older buildings and their policies, or for other reasons. The best-performing areas are along the city outer ring, where also newer buildings are present, having a notable exception closer to the city center with Houthavens-West counting

3.9 MW_p. This visualisation opens conversations to understand the causes behind a scarcity of watt peak on residential rooftops in the inner parts of Amsterdam.

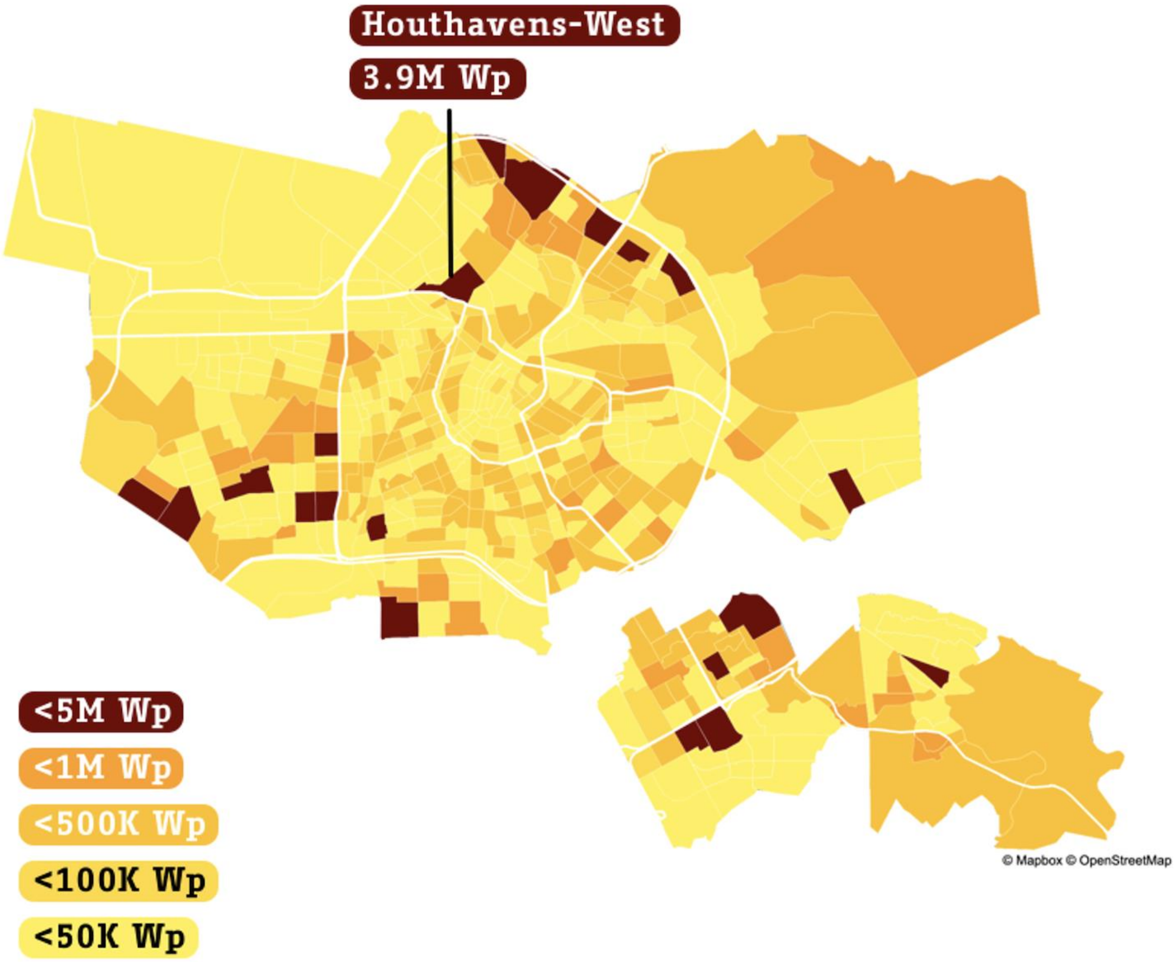


Figure 13 – Total watt peak from residential rooftop solar panels in 2023, grouped by neighbourhood

To support the analysis of the situation, we decided to consider further different features related to housing and PV installation. Understanding the distribution of average watt peak based on the building construction year (figure 14) outlines the trend of new buildings to have more PV installations. Buildings from 2019 and 2020 alone account for 38MW_p. Moreover, buildings constructed in 1900 also jump out, contributing with 5.4MW_p, a unique amount for pre-war buildings. The bottom right corner of the graph shows there are still many modern buildings without solar panels, requiring for more attention.

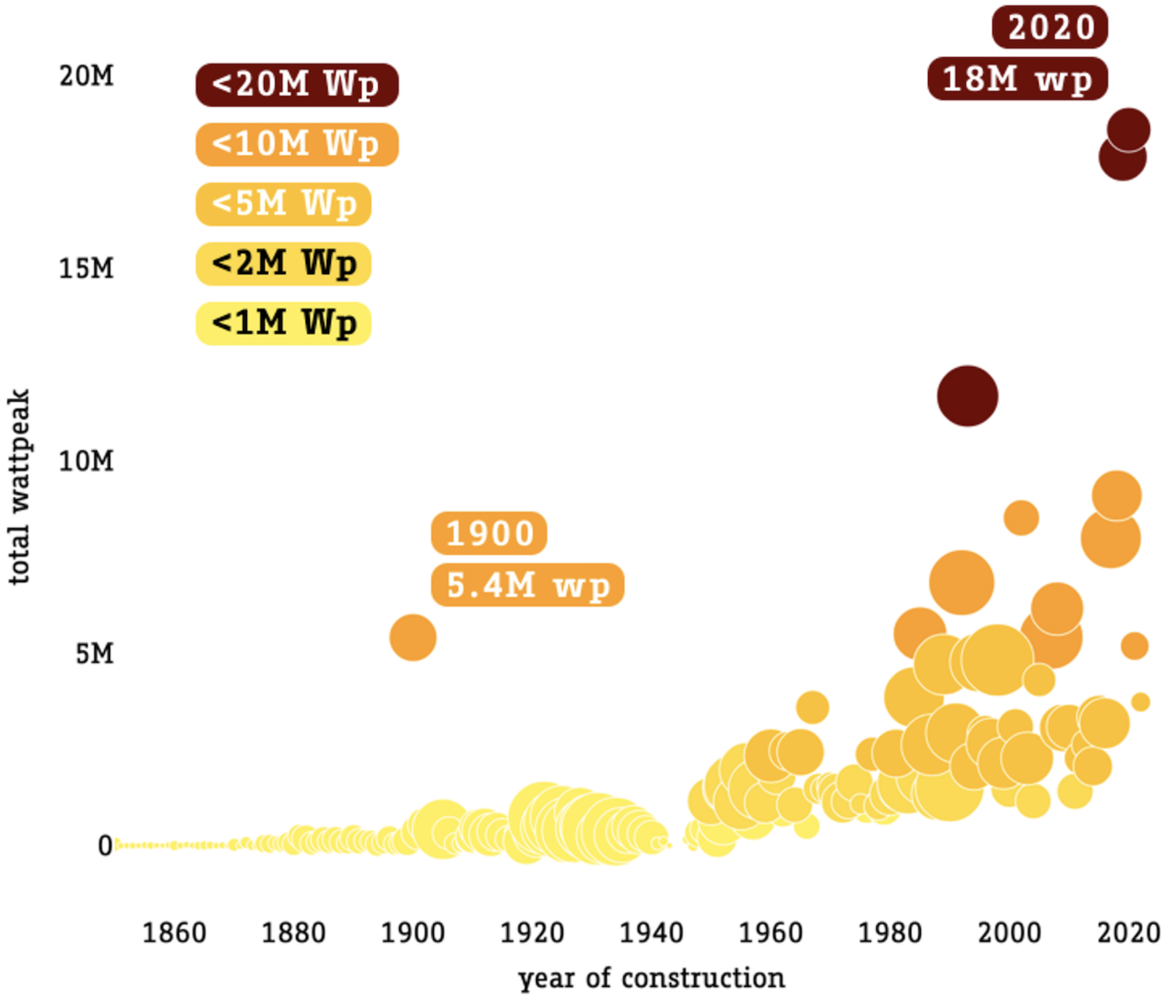


Figure 14 – Total watt peak from rooftop solar panels in 2023, grouped by building construction year

Adding on this, the timeline for protected and non-protected buildings (figure 15) highlights the importance of finding solutions dealing with restriction policies on monumental buildings. Buildings with monumental status have not taken part in the recent sprawl of solar panels. While protected buildings make up 16% of the city's potential, they only account for 8% of its current total solar watt peak. On the other hand, as per June 2024, the city of Amsterdam announced a lesser strict regulation of monuments for energy solutions. This will become effective in a new plan for sustainable heritage in Fall 2024 (*Meer Erfgoed Duurzaam Maken Door Minder Regels*, 2024).

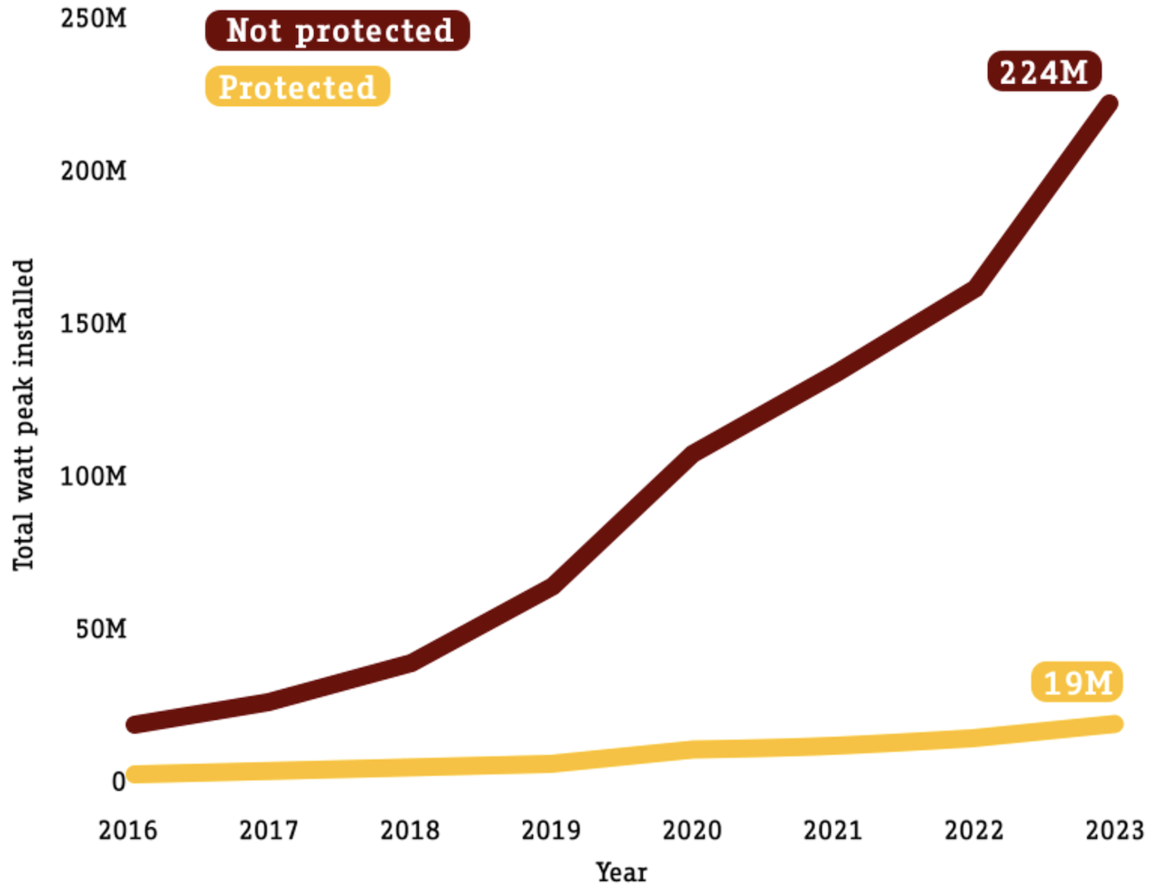
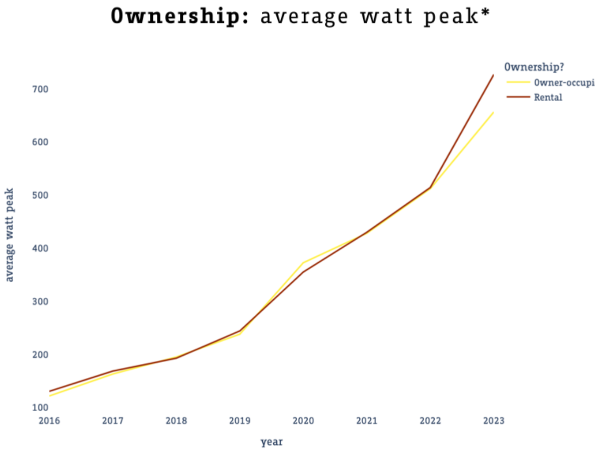


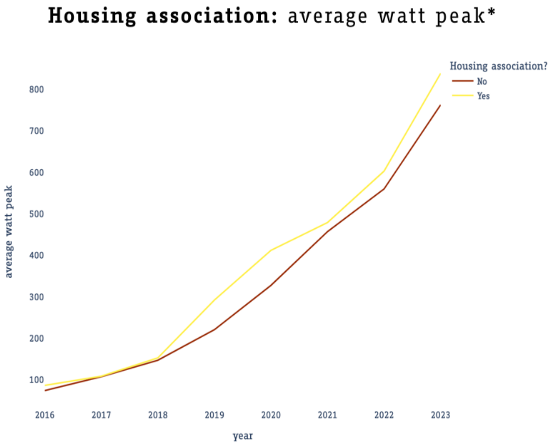
Figure 15 – Timeline of watt peak from rooftop solar panels, grouped by monumental status

To conclude, analysing the ownership of the property gave interesting output, seeing how the difference between owner occupation and rental is not relevant, giving some useful insights for the research (figure 16). Moreover, the difference between the presence or not of housing association does not show significant variations, displaying only a little advantage for buildings with house associations that installed slightly more PV systems on their rooftops (figure 17).



* Average watt peak for all buildings with a residential function

Figure 16 – Average watt peak related to the ownership of the building



* Average watt peak for all buildings with a residential function

Figure 17 – Average watt peak related to the ownership of a housing association

In figure 18, 19 and 20 we want to consider limiting factors in residential buildings, starting from the relation between their energy label and the average watt peak installed, showing that a good energy label is not strictly related to a high average watt peak installation, even though the trend line has a positive slope. On the other hand, it is interesting to notice the impact of PV installation on property values, which even if a high average watt peak installation might rise the value of a property, it is not a determinant factor on its price. To conclude with figure 20, a logical positive slope trend line shows how the bigger the building, the bigger the power installed on it.

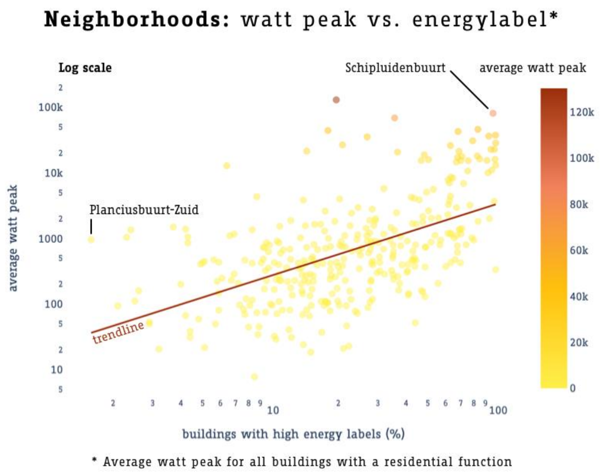


Figure 18 – Average watt peak compared to the building energy label

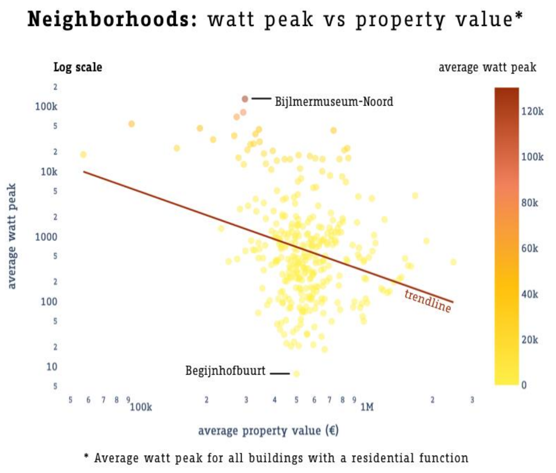


Figure 19 – Watt peak compared with property value

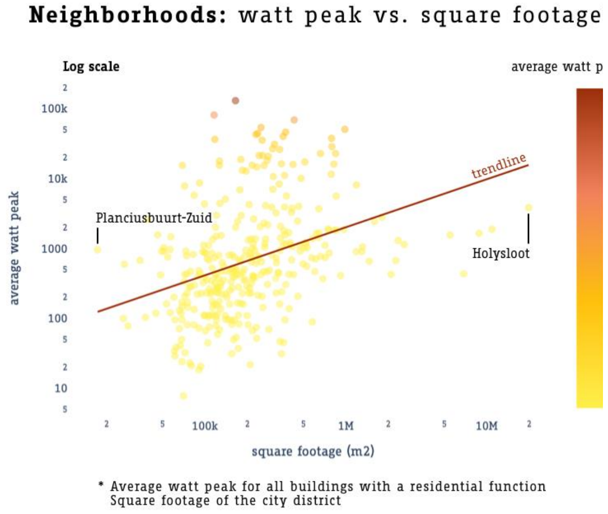


Figure 20 – Building size (presented in square meters) versus PV uptake (in average watt peak)

! NB: In fall 2024, new, additional research from social sciences is expected to provide clear indicators for barriers for adoption of PV. These results, coming from another research project at AMS Institute, will inform the best approach for new visuals of Simply Positive to provide better insights for policy makers.

4.3. Comparison with new methodology

The new methodology shows a significant increase in the calculated potential for this district. We can see a 30% increase in detected roof surface. Also, the orientation of the surfaces is more accurate, meaning more panels can be fitted in the available surfaces. This leads to a capacity increase of 40%. The calculated yield is more than 60% higher than the previously calculated potential. The yield is calculated with meteorological data of the past 5 years. It could be seen that the solar irradiation has been increasing over the last years, adding to the disproportional increase of the yield.

Table 7 - New and Old PV Potential of the south districts in Amsterdam

	Building Info		Potential			
Text	**Buildings**	**Roof area (km^2)**	**PV systems**	**Modules**	**Capacity (MW)**	**Annual Yield (GWh)**
Zuid Old	21,701	2.20	18,798	426,569	115.2	106.4
Zuid New	-	2.85	17,707	501,053	165.3	174.3

4.4. Visualisations of potential PV systems installed

One more visualization is presented in Figure 21, followed by Figure 22, to show the potential power installable in each district of Amsterdam. The city is only at 23% of its solar potential, which is well over 1000MW$_p$. It shows how actually the district of Westpoort despite its high values in the previous figures, still has a good amount of installable watt peak. The Weesp and Ijburg regions are two outliers, at or near 50% of their solar potential, while the lowest percentage of 9% refers to the district of Centrum-West, the same that has the lowest total amount of watt peak installed.

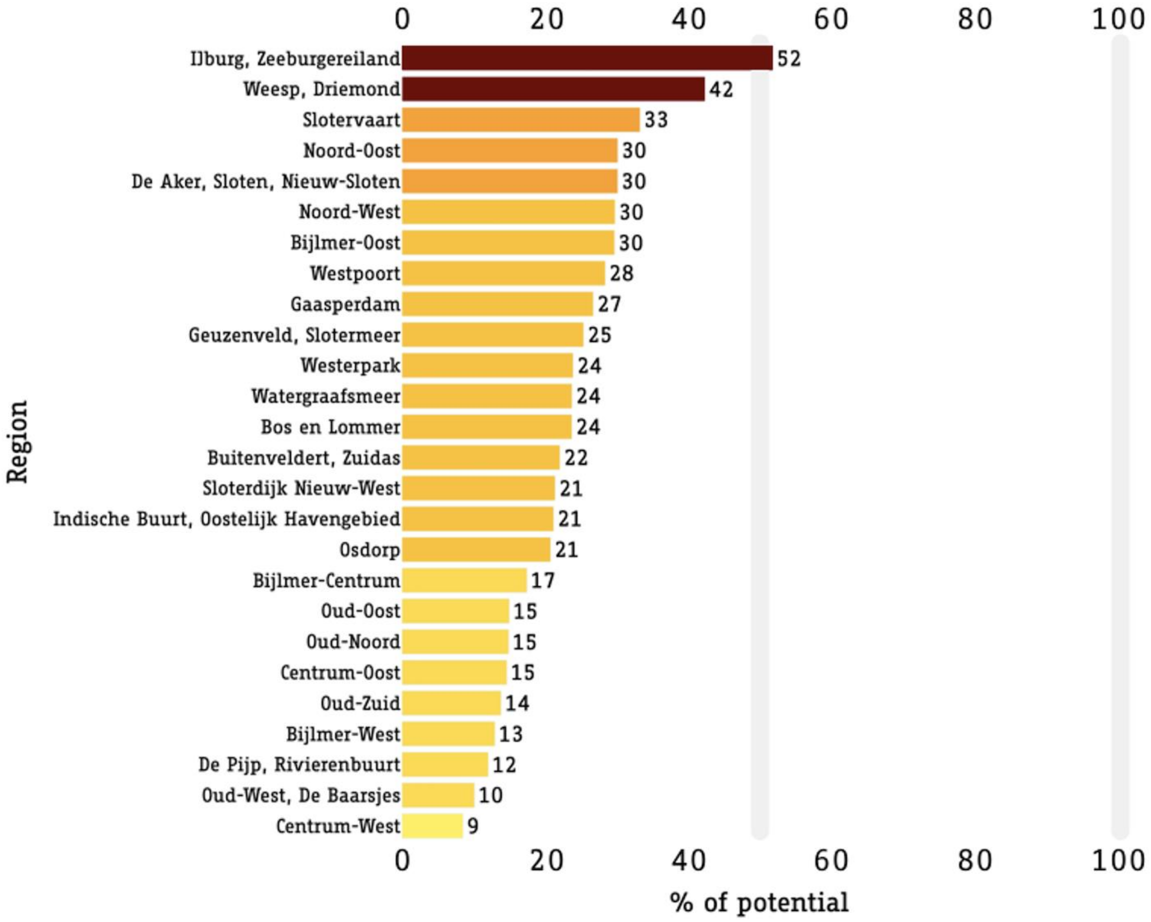


Figure 21 – Potential of watt peak from rooftop solar panels in 2023, grouped by city region

In Figure 22, the potential is grouped by building function, showing that there is big room for improvement in the commercial sector. Even though residential is second only to education, still, great potential is there in the city. Considering the differences in rooftop sizes and the number of buildings, it is important to address every typology with different approaches and solutions based on the specific limitations.

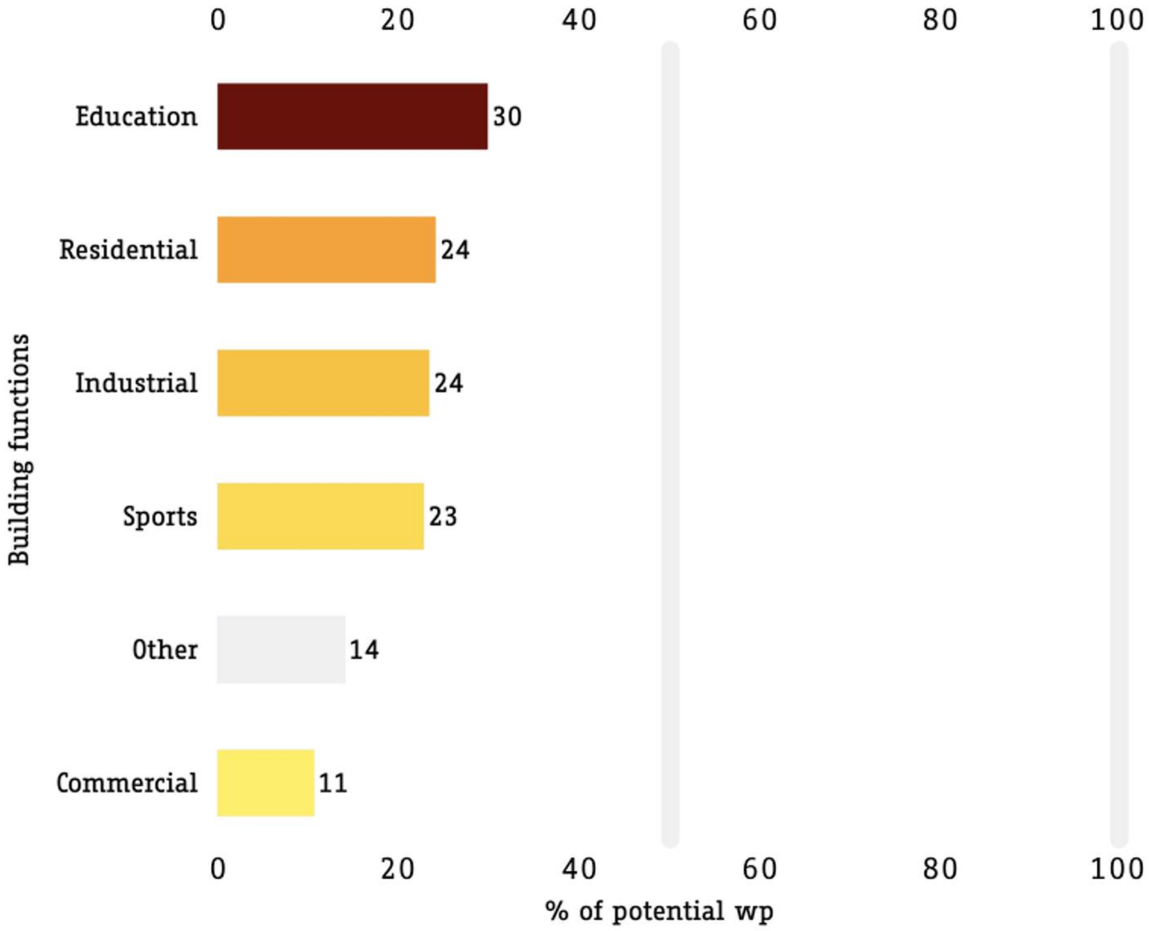


Figure 22 – Potential of watt peak from rooftop solar panels in 2023, grouped by building function

5. Conclusions

This document contains an overview of installed capacity of photovoltaic (PV) systems in the city of Amsterdam per district. It also reports on the rooftop PV energy yield potential and the actual electricity generation of installed PV systems.

The approach of calculating the PV energy yield potential of building rooftops in Amsterdam is described in the document. Through the cooperation of the AMS institute, TU Delft and PV Works, the city of Amsterdam has an accurate information about the PV energy yield potential of the city.

With new data, there is a big opportunity to include more analysis in the visualisations due to a deeper understanding of the barriers for adoption of PV for Amsterdam. New, further social science research is projected to provide distinct indicators of PV adoption challenges by autumn 2024. Merging the knowledge and data regarding policy, with technological and social barriers, it is possible to identify the gaps to optimise the implementation of PV systems on rooftops.

In this instance of the report, we used new data of the aerial imagery analysis from Spring 2023. Initially, there were doubts about the correctness, due to a mismatch with other communicated numbers from the municipality. After verification, the new numbers are now included in Tables 4 and 5.

New visualisations show the comparison between total and average watt peak installed per building functions, together with a timeline of PV installation in the city and the monumental status of buildings related with solar panels installation. New updates about the potential are added, with a focus on the potential divided by building function.

This document will be updated every 6 months throughout the Simply Positive research project.

Sources

[1] High resolution arial imagery can be accessed via https://www.pdok.nl/-/nu-hoge-resolutie-luchtfoto-2022-bij-pdok

[2] Open Data of Liander for new PV connections. https://www.liander.nl/partners/datadiensten/open-data/data

[3] Height data retrieved from algemeen hoogtebestand Nederland, https://www.ahn.nl/open-data

[4] Bag Cadaster data from bag viewer, https://bagviewer.kadaster.nl/lvbag/bag-viewer/

[5] Meer erfgoed duurzaam maken door minder regels. (2024, June 13). Gemeente Amsterdam. Retrieved July 20, 2024, from https://www.amsterdam.nl/nieuws/nieuwsoverzicht/erfgoed-duurzaam-maken/

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