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Bottom-up approach for Solar Siting and PV potential: design and results of a pilot in the Netherlands

Bhavya Kausika^{1,*}, Wiep Folkerts², Wilfried van Sark¹, Bouke Siebenga³, Paul Hermans⁴

Copernicus Institute of Sustainable Development, Utrecht University, Heidelberglaan 2, 3584 CS Utrecht, The Netherlands
Solar Energy Application Centre (SEAC), High Tech Campus 21, Eindhoven, The Netherlands
I-Real, Stationsweg 30, Terborg, the Netherlands
Aurum Europe, Zandsteen 6, Hoofddorp, The Netherlands
Email: B.B.Kausika@uu.nl
* Corresponding author

We present a bottom-up methodology to estimate PV potential at high resolution accounting for slope, orientation and shading factors. We selected the city of Apeldoorn, in the Gelderland province of the Netherlands as the pilot for our study. ArcGIS was used as a platform for all the analyses. The aim of the study is to answer the following questions:

- 1. What is the PV potential capacity of the residential buildings in Apeldoorn?
- 2. How is this related to the potential yield in the region?
- 3. Would local generation be able to accommodate the supply-demand mismatch?

RESULTS

Apeldoorn	GRID CODE	Potential Capacity (MWp)	Potential Yield (MWh)	Total Area/ Capacity/Yield
100Wp/m ²	Ο	Not Suitable	Ο	2.9 km ²
flat roofs	1	158	94804	392.9 MWp
150Wp/m ² sloping roofs	2	209.6	157215.9	274.8 GWh
	3	25.3	22801	

METHODOLOGY DESCRIPTION

The estimation of solar potential in this study was calculated in two steps. First, suitable locations for roof-top PV were singled out, and then potential estimation calculations were performed based on GIS data analysis.

Solar Radiation Analyst of Arc GIS is used to calculate



Solar Irradiation on roof tops considering Slope, orientation and shadows from nearby objects.

The criteria selected for potential estimations are given in the table below





ATTRIBUTE TABLE

pot_apdf									
GRIDCODE	Woonplaats	Huisnummer	Postcode	Sleutel	Shape_Leng	Shape_Area	Capacity	Yield	Ī
2	Apeldoorn	10	7313AJ	1e Beukenlaan 10 7313AJ Apeldoorn	7.88734	0.9213	0	0	T
3	Apeldoorn	10	7313AJ	1e Beukenlaan 10 7313AJ Apeldoorn	78.646742	47.164435	7.07467	4244.8	T
4	Apeldoorn	10	7313AJ	1e Beukenlaan 10 7313AJ Apeldoorn	83.715567	57.221659	0	0	T
2	Apeldoorn	11	7313AJ	1e Beukenlaan 11 7313AJ Apeldoorn	30.981267	11.570781	1.73562	1301.71	t
3	Apeldoorn	11	7313AJ	1e Beukenlaan 11 7313AJ Apeldoorn	62.344886	35.141869	5.27128	3162.77	T
4	Apeldoorn	11	7313AJ	1e Beukenlaan 11 7313AJ Apeldoorn	80.114084	58.381573	0	0	T
2	Apeldoorn	12	7313AJ	1e Beukenlaan 12 7313AJ Apeldoorn	47.569993	34.430939	5.16464	3873.48	T
3	Apeldoorn	12	7313AJ	1e Beukenlaan 12 7313AJ Apeldoorn	90.74446	37.451626	5.61774	3370.64	T
4	Apeldoorn	12	7313AJ	1e Beukenlaan 12 7313AJ Apeldoorn	85.998428	30.342268	0	0	t
1	Apeldoorn	13	7313AJ	1e Beukenlaan 13 7313AJ Apeldoorn	3.9998	0.74995	0	0	T
2	Apeldoorn	13	7313AJ	1e Beukenlaan 13 7313AJ Apeldoorn	40.76475	33.365789	5.00487	3753.65	t
3	Apeldoorn	13	7313AJ	1e Beukenlaan 13 7313AJ Apeldoorn	68.521565	23.758462	3.56377	2138.26	T
4	Apeldoorn	13	7313AJ	1e Beukenlaan 13 7313AJ Apeldoorn	86.009393	49.143061	0	0	t
2	Apeldoorn	14	7313AJ	1e Beukenlaan 14 7313AJ Apeldoorn	7.586853	1.083604	0	0	t
3	Apeldoorn	14	7313AJ	1e Beukenlaan 14 7313AJ Apeldoorn	50.574866	36.941042	5.54116	3324.7	t
4	Apeldoorn	14	7313AJ	1e Beukenlaan 14 7313AJ Apeldoorn	67.97326	46.370199	0	0	t
1	Apeldoorn	16	7313AJ	1e Beukenlaan 16 7313AJ Apeldoorn	14.9998	2.99995	0.449993	404.994	t
2	Apeldoorn	16	7313AJ	1e Beukenlaan 16 7313AJ Apeldoorn	50.218418	23.808081	3.57121	2678.41	t
3	Apeldoorn	16	7313AJ	1e Beukenlaan 16 7313AJ Apeldoorn	80.790678	36.862644	5.5294	3317.64	t
4	Apeldoorn	16	7313AJ	1e Beukenlaan 16 7313AJ Apeldoorn	74.69931	40.227134	0	0	t
2	Apeldoorn	17	7313AJ	1e Beukenlaan 17 7313AJ Apeldoorn	28.228229	18.737315	2.8106	2107.95	t
3	Apeldoorn	17	7313AJ	1e Beukenlaan 17 7313AJ Apeldoorn	47.677987	12.819904	1.92299	1153.79	t
4	Apeldoorn	17	7313AJ	1e Beukenlaan 17 7313AJ Apeldoorn	74.071381	72.4386	0	0	t
2	Apeldoorn	18	7313AJ	1e Beukenlaan 18 7313AJ Apeldoorn	31.146593	17.119829	2.56797	1925.98	t
3	Apeldoorn	18	7313AJ	1e Beukenlaan 18 7313AJ Apeldoorn	69.618934	27.424126	4.11362	2468.17	t
4	Apeldoorn	18	7313AJ	1e Beukenlaan 18 7313AJ Apeldoorn	82.079057	65.844269	0	0	t
2	Apeldoorn	2	7313AJ	1e Beukenlaan 2 7313AJ Apeldoorn	103.345568	18.925092	2.83876	2129.07	t
3	Apeldoorn	2	7313AJ	1e Beukenlaan 2 7313AJ Apeldoorn	165.396647	73.383819	11.0076	6604.56	t
4	Apeldoorn	2	7313AJ	1e Beukenlaan 2 7313AJ Apeldoorn	210.501136	108.904986	0	0	t
2	Apeldoorn	20	7313AJ	1e Beukenlaan 20 7313AJ Apeldoorn	23.993162	10.165496	1.52482	1143.61	t
3	Apeldoorn	20	7313AJ	1e Beukenlaan 20 7313AJ Apeldoorn	66.828967	30.555525	4.58333	2750	t
4	Apeldoorn	20	7313AJ	1e Beukenlaan 20 7313AJ Apeldoorn	76.535543	45.745839	0	0	t
1	Apeldoorn	3	7313AH	1e Beukenlaan 3 7313AH Apeldoorn	3.8748	0.410068	0	0	t
2	Apeldoorn	3	7313AH	1e Beukenlaan 3 7313AH Apeldoorn	35.741736	20.127156	3.01907	2264.3	t
3	Apeldoorn	3	7313AH	1e Beukenlaan 3 7313AH Apeldoorn	97.845264	36.813557	5.52203	3313.22	t
4	Apeldoorn	3	7313AH	1e Beukenlaan 3 7313AH Apeldoorn	97,454403	36,873529	0	0	t
2	Apeldoorn	5	7313AJ	1e Beukenlaan 5 7313AJ Apeldoorn	33.634009	11,291132	1.69367	1270.25	t
3	Aneldoorn	5	731341	1e Beukenlaan 5 7313A Apeldoorn	60 93119	35 285882	5 29288	3175 73	+



Postcode	7331MG
Sleutel	Korhoenweg 19 7331MG Apeldoorn
MAJORITY	1
SUM_Capacity	6.88165
SUM_Yield	4575.280029

Conclusions

The whole model was set up in a GIS based platform (ArcGIS) which helped in exploring and visualizing the data in an efficient way. Many layers of information have been created to analyse the data at different resolutions. The potential PV capacity for the city of Apeldoorn thus was estimated at 392.9 MWp for the residential buildings. This would mean a power production of 274.8 GWh. The present PV capacity installed in the study area is about 3.4 MWp. Considering that the annual electricity demand in the region is around 230 GWh at the rate of 3500 kWh/yr per household, PV would be able to completely cover the electricity demand in the region.

We were able to successfully implement a method for estimating the PV potential using high resolution LiDAR data for a pilot area. We are currently working on techniques to extrapolate the results to the Netherlands.

Bala Bhavya Kausika Van Unnikgebouw 913 | Heidelberglaan 2 | 3584 CS Utrecht | t. 030 253 4921 | B.B.Kausika@uu.nl |