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REPORT

Risk of glare due to a planned PV System in Venray, Netherlands

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Content

1 Summary

Centroplan Netherlands B.V. plans to setup a south facing Photovoltaic (PV) system equipped with anti-glaring PV modules on an open field in Venray, Netherlands. The system is surrounded by forests in the east and south. In the west of the northern corner of the PV system there are buildings.

Due to the PV system glare can occur for the buildings in the west. Other infrastructure, e.g. the road in the south east of the PV system is not affected due to the surrounding forest.

Result:

For the buildings in the west of the system, glare effects may occur at a height of more than 2 m above ground and for only some hours in a year. This calculation is based on astronomical calculations assuming clear sky conditions. Under real sky conditions these numbers will be lower.

Assessment:

For one out of three reference points glaring occurs for maximum 8 hours a year at a height of 6 m above ground.

As a result we assume a very low risk of glare due to the planned PV system.

The results of the assessment are shown in Chapter 3 of this report.

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Description of the PV system

Name	Zonnewelde
Location	Venray, Netherlands
Coordinates	51.51°N, 6.02°E
Peak Power	3945.92 kWp
PV Modules	Crystalline silicon modules equipped with anti-glaring glass (manufacturer: Suntech)
Module tilt angle	15
Module azimuth angle	180 ° (South)
Mounting	Ground mounted using "Renusol Console" with a construction height of 0.30 m

Table 1: PV System

Figure 1:
Example picture of the mounting system

3
Detailed Results

To analyze the occurrence of glare effects, various reference points were chosen. The locations of the points on the map are shown in Figure 2. For these three reference locations p1, p2 and p3 the possible occurrence of glare was calculated for a 1 m raster of heights between 1 m and 6 m above ground. In this way the glare risk for 18 reference points was analyzed.

Figure 2
Reference points

At all reference location p1 glare occurs at 2 m and above. For p2 glare occurs only at a height of 6 m. At location p3 no glare occurs up to 6 m height.
The distribution of monthly glare hours is shown in Table 2 – 7. Annual glare does not exceed 8 hours when looking at clear sky calculations and does not exceed 4 hours when looking at real sky conditions.

Month	Day time hours	Clear sky glare hours	Real sky glare hours
1	266	0	0
2	285	0	0
3	368	0	0
4	412	0	0
5	477	**1**	0
6	486	0	0
7	490	0	0
8	446	0	0
9	377	0	0
10	332	0	0
11	270	0	0
12	251	0	0

Table 2: Results for p1 at 2 m height

Month	Day time hours	Clear sky glare hours	Real sky glare hours
1	266	0	0
2	285	0	0
3	368	0	0
4	412	0	0
5	477	**1**	**1**
6	486	0	0
7	490	**1**	0
8	446	**2**	**1**
9	377	0	0
10	332	0	0
11	270	0	0
12	251	0	0

Table 3: Results for p1 at 3 m height

Month	Day time hours	Clear sky glare hours	Real sky glare hours
1	266	0	0
2	285	0	0
3	368	0	0
4	412	**1**	**1**
5	477	**2**	**1**
6	486	**2**	**1**
7	490	0	0
8	446	**2**	**1**
9	377	0	0
10	332	0	0
11	270	0	0
12	251	0	0

Table 4: Results for p1 at 4 m height

Month	Day time hours	Clear sky glare hours	Real sky glare hours
1	266	0	0
2	285	0	0
3	368	0	0
4	412	**2**	**1**
5	477	0	0
6	486	0	0
7	490	**2**	**1**
8	446	0	0
9	377	0	1
10	332	0	0
11	270	0	0
12	251	0	0

Table 5: Results for p1 at 5 m height

Month	Day time hours	Clear sky glare hours	Real sky glare hours
1	266	0	0
2	285	0	0
3	368	0	0
4	412	**2**	**1**
5	477	**1**	**1**
6	486	0	0
7	490	**2**	**1**
8	446	0	0
9	377	**3**	**1**
10	332	0	0
11	270	0	0
12	251	0	0

Table 6: Results for p1 at 6 m height

Month	Day time hours	Clear sky glare hours	Real sky glare hours
1	266	0	0
2	285	0	0
3	368	0	0
4	412	**1**	0
5	477	0	0
6	486	0	0
7	490	0	0
8	446	0	0
9	377	0	0
10	332	0	0
11	270	0	0
12	251	0	0

Table 7: Results for p2 at 6 m height

4
Calculation method

Monthly and annual frequency of occurrence of possible glare was calculated as follows:

18 reference points were defined. For each of these reference points the following steps were performed:

- Determination of the field of view (azimuth and elevation) under which the PV system is visible for the defined position
- Calculation of the sun position (= viewing direction to the sun) for every day within a 10 year time period in 15 minute steps
- Calculation of the mirrored sun position , that means the viewing direction to the sun that results from a mirroring surface of the chosen azimuth and elevation of the PV system for every time step
- Counting of the 15 minute time steps for which the mirror image of the sun is in the field of view defined above
- Summation of the counted time steps from the 10 year period to values of maximum (clear sky) glazing hours per year
- Summation of the counted time steps without clouds from the 10 year period to values of realistic glazing hours per year

5
Appendix

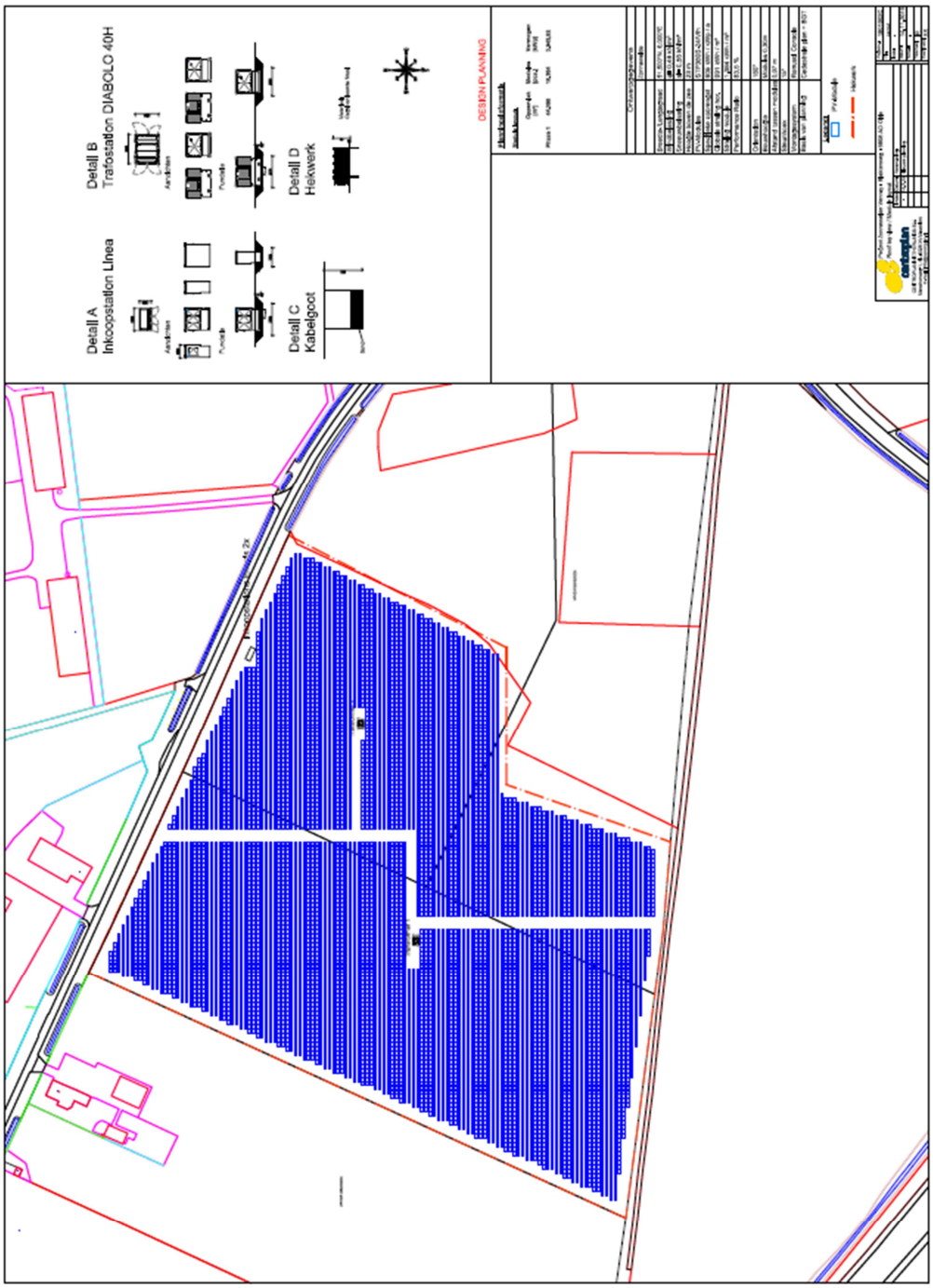

Figure 3
Layout plan for the PV system