



**FIG Working Week 2012**  
Rome, Italy 6–10 May

Knowing to: Manage the territory  
Protect the environment  
Evaluate the cultural heritage



TS06L – Implementation of Plans and Infrastructure  
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**Visual impact, landscape and renewable energy plants: the case of PV**

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**Introduction: The authorization procedure for PV plants**

A number of different studies and documentation are required. These are:

- Documents that demonstrate the compatibility with the planning instruments;
- Documents regarding the type of crop and the land use capability (agronomy report);
- Documents regarding the geological, geomorphological, hydrogeological and seismic surveying;
- Documents regarding the impact on the landscape (landscape report).

The [landscape report](#) contains the description of the actual landscape conditions, the proximity to protected areas, a photographic survey, a representation of the natural and anthropic barriers (orthoimages, cross sections).

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## Scope

An [objective visual impact assessment](#) to be used during the authorization of project developments of PV plants.

This is particularly important in case of proximity to historic sites, protected areas, hill territory or mountains, where the site of the [PV installation can be seen](#) from various different locations and may affect the landscape perception from some of the typical views.

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## Methods

Two different types of [landscape impact assessment](#) methodologies can be applied to renewable energy plants and to the PV plants in particular:

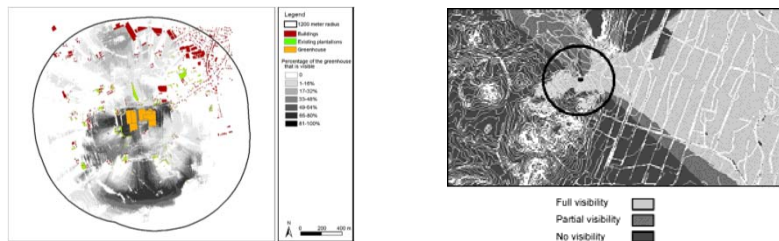
- 1) methodologies based on the calculation of [visibility indexes](#) of the plant over a large portion of land
- 2) methodologies based on the analyses of real [photographic images](#) or visual simulations;

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### Method 1) Calculation of visibility indexes

- Based on a discretization on land units (LU) of the territory potentially impacted and the calculation of index of impact based on visibility (3 D models)
- The impact on each LU can be weighted as a functions of different parameters

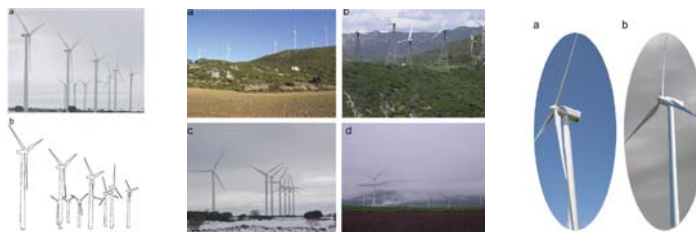


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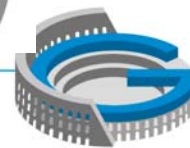


### Method 2) Real photographic images or visual simulations

- Takes into account not only the visibility but also other aspects of the plant such as shape and colour, from a "static" point of view
- Visual simulation may be affected by the conditions of the picture (weather, focus, etc.)



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## Method 2) Real photographic images or visual simulations

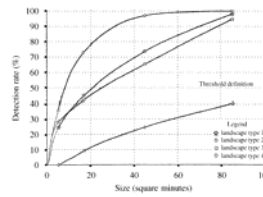
Widely used for the assessment of the visual quality of the rural landscape (Arriaza et al., 2004) or of the wind turbine installations (Bishop, 2000)



Picture J03, average scoring: 2.81



Picture A06, average scoring: 2.64



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## Method 2) Real photographic images or visual simulations

Visual simulations of ground mounted PV plants are always requested by the Local Landscape Authorities but there is no uniformity on the way they should be done and analyzed.



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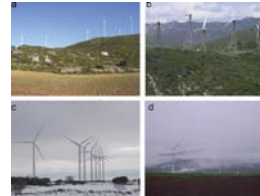
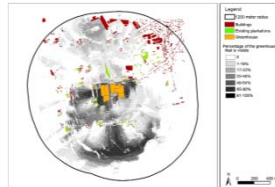
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## Visibility indexes VS Visual simulations



- Complexity, information databases, time
- 3D models of terrain and buildings

- Landscape is still perceived from specific viewpoints or towards certain locations (a hill, etc.)
- Uses the same visual simulations that already are to be presented when authorizing a PV plant

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## Evaluation of visual simulations of ground mounted PV plants 1/2

Stage	Regulatory framework	Actor	Time
1	<i>Step</i>		
1.1	Definition of the landscape outstanding elements	Local Community	Once
1.2	Definition of the viewpoints	Local Community	Once
1.3	Definition of the representation rules	Local Community	Once
1.4	Adoption of a procedure for the objective visual impact assessment	Local Community	Once
1.5	Definition of threshold of visual acceptance	Local Community	Once

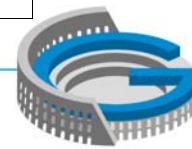
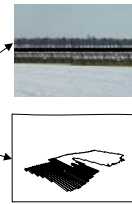


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### Evaluation of visual simulations of ground mounted PV plants 2/2

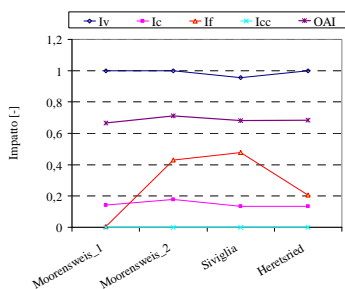
Stage 2	Analysis of the visual simulations		
	Step	Actor	Time
2.1	Creation of the visual simulation in accordance to steps 1.2 and 1.3	Project developer	At each project development
2.2	Analysis of the visual simulation of step 2.1 following the rules established in step 1.4	Project developer	At each project development, for each visual simulation
2.3	Final evaluation of the results according to the thresholds of step 1.5	Local Community	At each project development, for each visual simulation



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### Step 2.2 Analysis of the visual simulation



$$OAI_{SPP} = 0,64 I_v + 0,19 I_c + 0,09 I_f + 0,08 I_{cc}$$

- Visibility of the plant (sub-parameter  $I_v$ );
- Contrast colour with the surrounding (sub-parameter  $I_c$ );
- Form (sub-parameter  $I_f$ );
- Form concurrency (sub-parameter  $I_{cc}$ );



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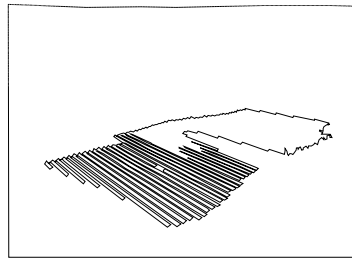
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## Step 2.2 Analysis of the visual simulation

Sub-parameter: **form**



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## Step 2.2 Analysis of the visual simulation

Sub-parameter: **colour**

Determination of the colorimetric coordinates



Colour differen.  $\Delta E^*$  calculation

Mean colour difference  $\Delta E^*_m$

Sub-parameter  $I_c$

$$\Delta E^* = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$$

$$\Delta E_{m,min} = 0 \rightarrow I_c = 0$$

$$\Delta E_{m,max} = 374 \rightarrow I_c = 1$$

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## References

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