

The background of the slide is a grayscale aerial photograph of a city, showing a dense network of streets and buildings. The perspective is from a high angle, looking down on the urban layout.

Urban PV tool

-a tool for decision makers, designers and builders

Task 10/PV-UP-Scale, Madrid seminar 24.10.07

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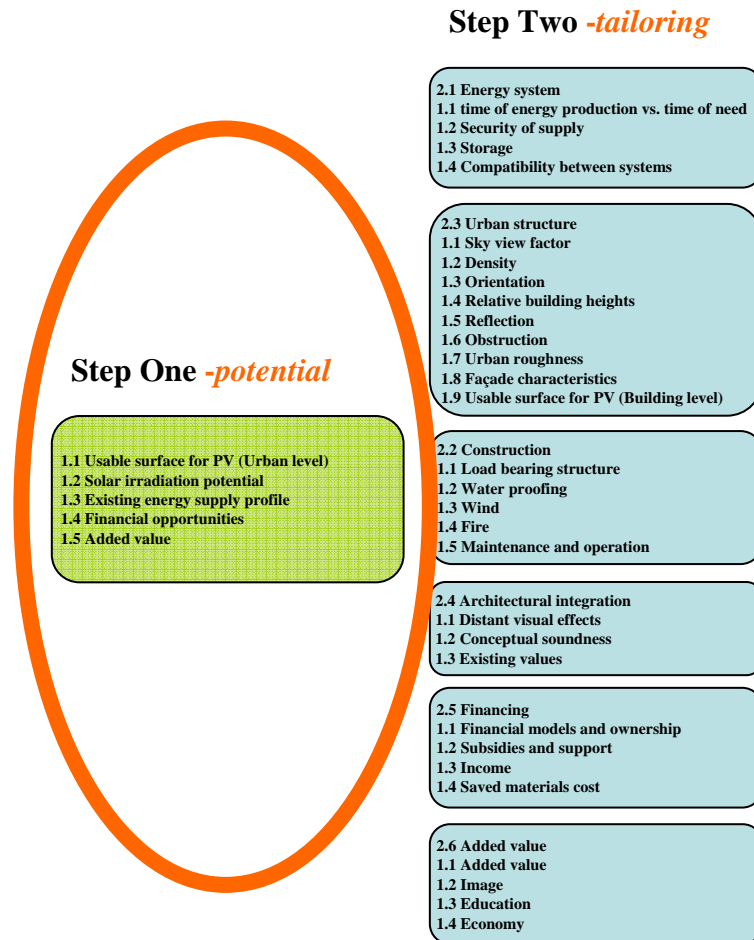
Content

- Purpose of the tool
- The structure of the tool
- Criteria, indicators and scale
- The content of the two steps of the tool
(extract)

The purpose of the tool

The urban PV tool should help decision makers, designers and builders to clarify the suitability for PV in an urban scale for an area and to provide a checklist for design and integration of PV.

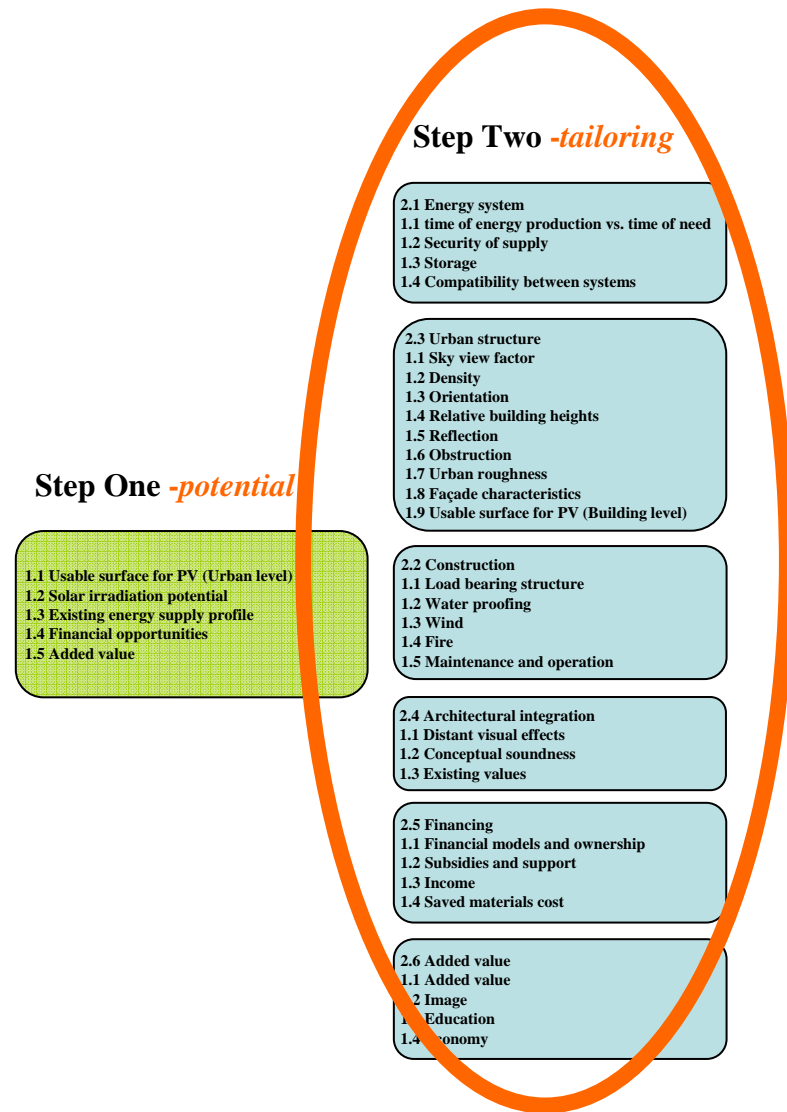
Urban PV *tool* step one -potential



The purpose of the first step is to clarify if PV is a worthwhile measure for an area or not.

Issues related to the amount of solar irradiation and usable space for fitting solar cells, the energy profile for the area (renewable/non renewable), financial opportunities (subsidises and support) and added value are mapped.

Urban PVtool step two -tailoring



If the conclusion of the investigations in step one is positive one proceeds to step two for tailoring of the PV system for the specific area.

A number of issues are dealt with, from energy and urban structure, financing and construction to architecture and added value.

Criteria – Indicator – Score

Criteria:

One aspect that the main topic is made up of, defined by, characterised by or dependent on, i.e. *solar irradiation*.

Indicator:

Qualitative or quantitative unit of the criteria, i.e. *kWh/m²* or an *expert evaluation*

Score:

Performance of the particular criteria related to a “performance scale” from A- G, i.e. *score C*

Step one –*mapping of potential*

Step Two –*tailoring*

Step One –*potential*

- 1.1 Usable surface for PV (Urban level)
- 1.2 Solar irradiation potential
- 1.3 Existing energy supply profile
- 1.4 Financial opportunities
- 1.5 Added value

- 2.1 Energy system
 - 1.1 time of energy production vs. time of need
 - 1.2 Security of supply
 - 1.3 Storage
 - 1.4 Compatibility between systems

- 2.3 Urban structure
 - 1.1 Sky view factor
 - 1.2 Density
 - 1.3 Orientation
 - 1.4 Relative building heights
 - 1.5 Reflection
 - 1.6 Obstruction
 - 1.7 Urban roughness
 - 1.8 Façade characteristics
 - 1.9 Usable surface for PV (Building level)

- 2.2 Construction
 - 1.1 Load bearing structure
 - 1.2 Water proofing
 - 1.3 Wind
 - 1.4 Fire
 - 1.5 Maintenance and operation

- 2.4 Architectural integration
 - 1.1 Distant visual effects
 - 1.2 Conceptual soundness
 - 1.3 Existing values

- 2.5 Financing
 - 1.1 Financial models and ownership
 - 1.2 Subsidies and support
 - 1.3 Income
 - 1.4 Saved materials cost

Step one –*mapping of potential*

Step One -*potential*

- 1.1 Usable surface for PV (Urban level)
- 1.2 Solar irradiation potential
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Consisting of five criteria

- Surface [m^2 PV/ m^2 land *]
- Solar irradiation [kWh/m^2 yr]
- Existing energy profile [% renewable]
- Financial opportunities [*subsidy* €/*Cost PV* €]
- Added value** [qualitative evaluation]

**Estimations for different area types, i.e. city blocks, high-rise city centre etc.*

***Image, education, economy...*

Area types *ref. “1.1 Usable surface for PV”*

1. Open structure, small scale
2. Open structure, large scale
3. City block, continuous
4. Skyline, high-rise
5. Heterogeneous, complex

Open structure, small scale



- Relatively homogeneous areas with small buildings and small to large in-between spaces
- The area type consists primarily of villas and row-houses with up to two floors
- Average roof angle of 31°
- Built area 9-25% (20% average)
- Site utilisation 17-50% (30% average)

Open structure, large scale



- Relatively homogeneous areas with large buildings and large in-between spaces
- The area type consists primarily of blocks of flats/satellite towns along with homogeneous commercial and institutional areas. Some satellite towns contain high rise buildings, but the area type mainly has a horizontal built character
- Average roof angle of 26°
- Built area 20-45% (35% average)
- Site utilisation 40-85% (50% average)

City block, continuous



- Relatively homogeneous areas with closed built structures and recreational spaces of “urban scale”
- The are type consists primarily of villas and row-houses with up to two floors
- Average roof angle of 31°
- Built area 30-65% (45% average)
- Site utilisation 160-300% (230% average)

Criteria 1.1 *Usable surface for PV*

Step One

- 1.1 Usable surface for PV (Urban level)
- 1.2 Solar irradiation potential
- 1.3 Existing energy supply profile
- 1.4 Financial opportunities
- 1.5 Added value

Step Two

- 2.1 Energy system
 - 1.1 time of energy production vs. time of need
 - 1.2 Security of supply
 - 1.3 Storage
 - 1.4 Compatibility between systems

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City Block, continuous. Built area 30-65 %

Indicator [m ² PV/ m ² land]	Score [A - G]
0,75 m ² PV/ m ² land	A
0,5 m ² PV/ m ² land	B
0,4 m ² PV/ m ² land	C
0,25 m ² PV/ m ² land	D
0,15 m ² PV/ m ² land	E
0,05 m ² PV/ m ² land	F
0 m ² PV/ m ² land	G

Criteria 1.2 *Solar irradiation potential*

Step One

- 1.1 Usable surface for PV (Urban level)
- 1.2 **Solar irradiation potential**
- 1.3 Existing energy supply profile
- 1.4 Financial opportunities
- 1.5 Added value

Step Two

- 2.1 Energy system
 - 1.1 time of energy production vs. time of need
 - 1.2 Security of supply
 - 1.3 Storage
 - 1.4 Compatibility between systems

- 2.2 Urban structure
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Solar irradiation on a horizontal plane

Indicator [kWh/m ² yr.]	Score [A - G]
1300 kWh/m ² yr.	A
1100 kWh/m ² yr.	B
900 kWh/m ² yr.	C
700 kWh/m ² yr.	D
500 kWh/m ² yr.	E
300 kWh/m ² yr.	F
100 kWh/m ² yr.	G

Criteria 1.3 *Existing energy supply*

Step One

- 1.1 Usable surface for PV (Urban level)
- 1.2 Solar irradiation potential
- 1.3 Existing energy supply profile
- 1.4 Financial opportunities
- 1.5 Added value

Step Two

- 2.1 Energy system
 - 1.1 time of energy production vs. time of need
 - 1.2 Security of supply
 - 1.3 Storage
 - 1.4 Compatibility between systems

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 - 1.4 Economy



Existing energy supply profile

Indicator [% renewable]	Score [A - G]
0 %	A
10 %	B
20 %	C
40 %	D
60 %	E
80 %	F
100 %	G

Criteria 1.4 *Financial opportunities*

Step One

- 1.1 Usable surface for PV (Urban level)
- 1.2 Solar irradiation potential
- 1.3 Existing energy supply profile
- 1.4 **Financial opportunities**
- 1.5 Added value

Step Two

- 2.1 Energy system
- 1.1 time of energy production vs. time of need
 - 1.2 Security of supply
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 - 1.4 Compatibility between systems

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 - 1.4 Economy



Subsidies, feed-in tariffs, tax credits, etc.

Indicator [subsidy €/Cost PV€]	Score [A - G]
100 %	A
80 %	B
60 %	C
40 %	D
20 %	E
10 %	F
0 %	G

Criteria 1.5 *Added value*

Step One

- 1.1 Usable surface for PV (Urban level)
- 1.2 Solar irradiation potential
- 1.3 Existing energy supply profile
- 1.4 Financial opportunities
- 1.5 Added value

Step Two

- 2.1 Energy system
 - 1.1 time of energy production vs. time of need
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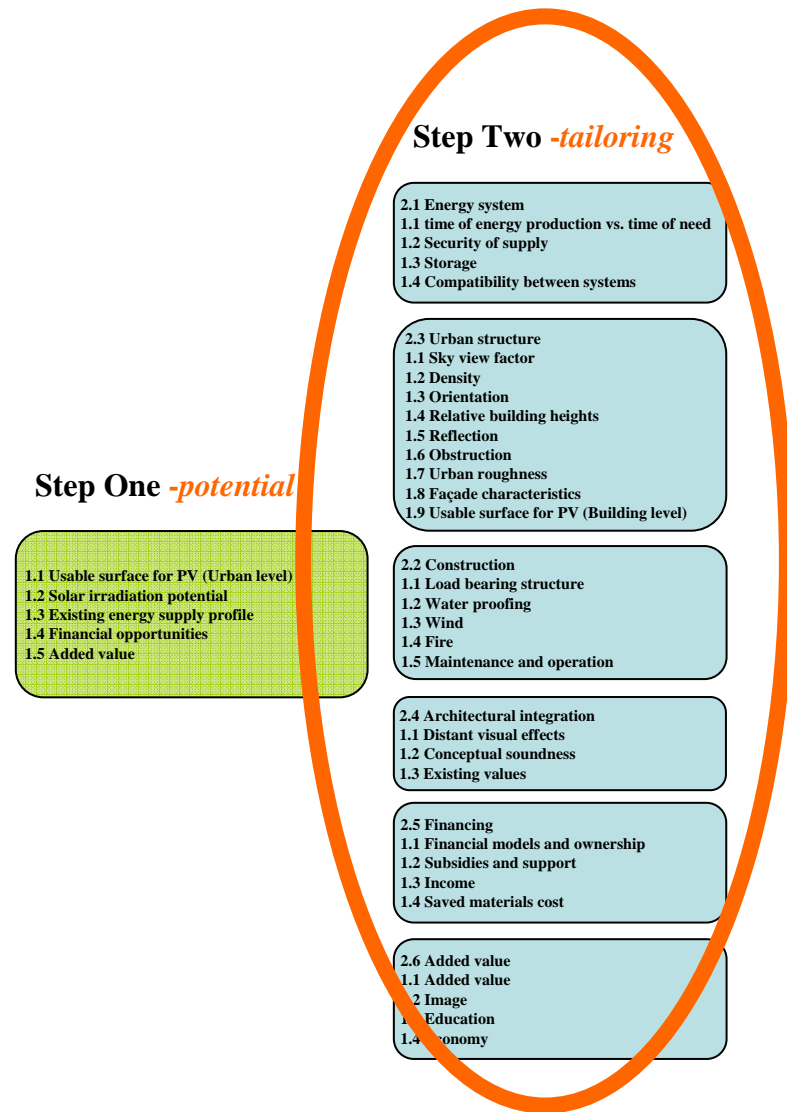
- 2.6 Added value
 - 1.1 Added value
 - 1.2 Image
 - 1.3 Education
 - 1.4 Economy



Added value (Image, education, economy)

Indicator [Qualitative]	Score [A - G]
	A
	B
	C
	D
	E
	F
	G

Step two – *system tailoring*



Step two – *system tailoring*

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2.1 Energy system
1.1 time of energy production vs. time of need
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1.1 Added value
1.2 Image
1.3 Education
1.4 Economy

Consisting of six main topics

- Energy system
- Urban structure
- Construction
- Architectural integration
- Financing
- Added value

Step two – *energy system*

2.1 Energy system

- 1.1 time of energy production vs. time of need
- 1.2 Security of supply
- 1.3 Storage
- 1.4 Compatibility between systems

2.3 Urban structure

- 1.1 Sky view factor
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2.1 ENERGY SYSTEM

Criteria 1.1	<i>Time of energy production vs. time of need</i>
Indicator	<i>Correlation in time [%?]</i>
Scale	<i>A - G</i>
Criteria 1.2	<i>Security of supply</i>
Indicator	<i>Downtime [hr./year]</i>
Scale	<i>A – G</i>
Criteria 1.3	<i>Storage</i>
Indicator	<i>Losses [%]?</i>
Scale	<i>A – G</i>
Criteria 1.4	<i>Compatibility between systems</i>
Indicator	<i>Qualitative evaluation ++</i>
Scale	<i>A - G</i>

Step two – *urban structure*

2.1 Energy system

- 1.1 time of energy production vs. time of need
- 1.2 Security of supply
- 1.3 Storage
- 1.4 Compatibility between systems

2.2 Urban structure

- 1.1 Sky view factor
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2.3 Construction

- 1.1 Load bearing structure
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2.4 Architectural integration

- 1.1 Distant visual effects
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Block of flats, 4-6 stories, gable roof

Indicator [m ² PV/ m ² g.floor area]	Score [A - G]
2,0 m ² PV/ m ² g. floor area	A
1,5 m ² PV/ m ² g. floor area	B
1,1 m ² PV/ m ² g. floor area	C
0,8 m ² PV/ m ² g. floor area	D
0,4 m ² PV/ m ² g. floor area	E
0,2 m ² PV/ m ² g. floor area	F
0 m ² PV/ m ² g. floor area	G

Step two – *construction*

2.1 Energy system

- 1.1 time of energy production vs. time of need
- 1.2 Security of supply
- 1.3 Storage
- 1.4 Compatibility between systems

2.2 Urban structure

- 1.1 Sky view factor
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2.6 Added value

- 1.1 Added value
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2.3 CONSTRUCTION

Under development...

Step two – *architectural integration*

2.1 Energy system

- 1.1 time of energy production vs. time of need
- 1.2 Security of supply
- 1.3 Storage
- 1.4 Compatibility between systems

2.2 Urban structure

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2.4 Architectural integration

- 1.1 Distant visual effects
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2.6 Added value

- 1.1 Added value
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2.4 ARCHITECTURAL INTEGRATION

Under development...

Step two –*financing*

2.1 Energy system

- 1.1 time of energy production vs. time of need
- 1.2 Security of supply
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2.6 Added value

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2.5 FINANCING

Under development...

Step two – *added value*

2.1 Energy system

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2.6 ADDED VALUE

Under development...

Urban PVtool -two step model

Step One *-potential*

- 1.1 Usable surface for PV (Urban level)
- 1.2 Solar irradiation potential
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- 1.4 Financial opportunities
- 1.5 Added value

Step Two *-tailoring*

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Further development

- Simplification
- Testing out
- Modification based on experience (iterations)