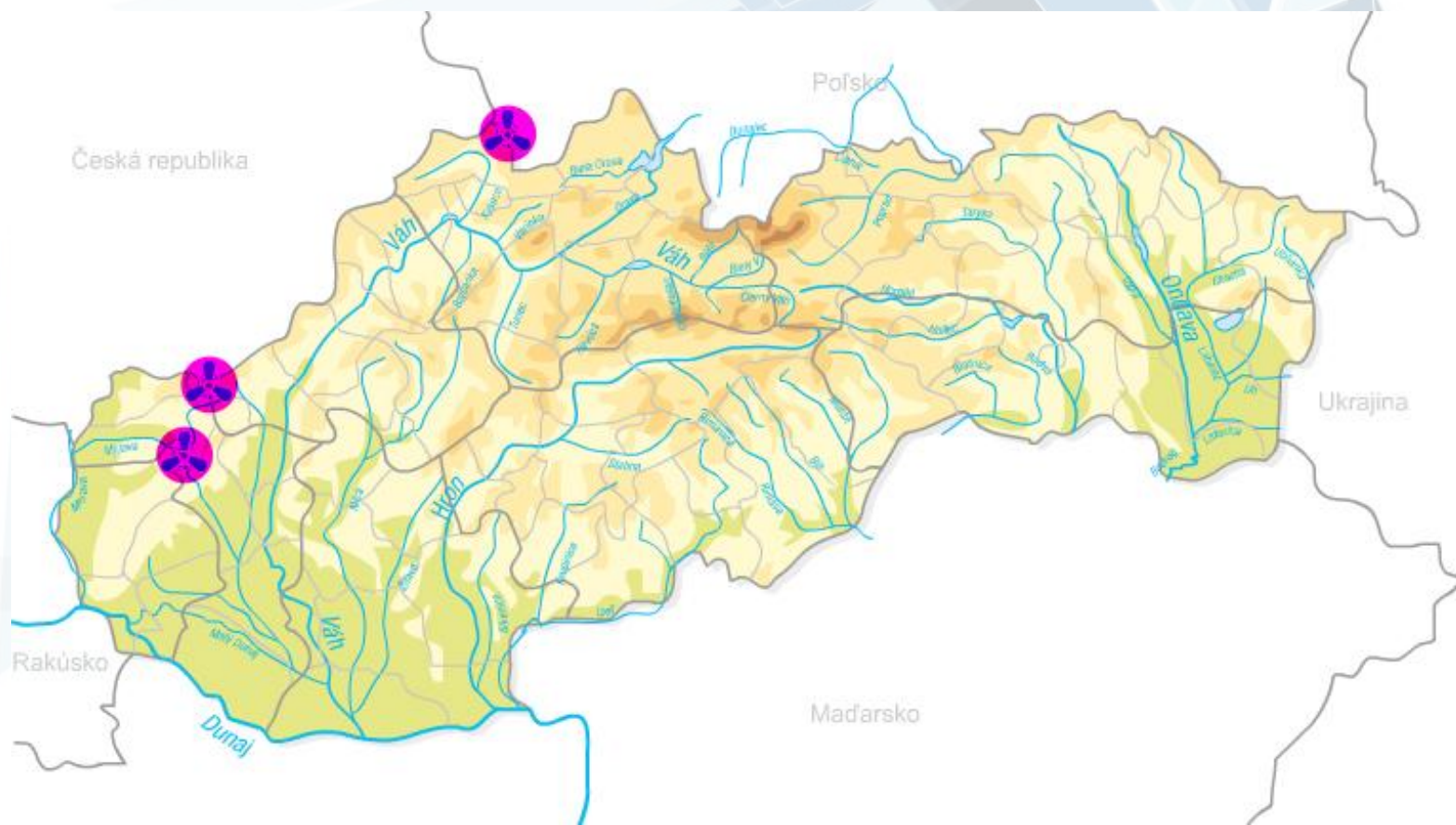


# **Public perception of Renewable Energy in Slovakia**

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## **Introduction on renewable energy in Slovakia:**

- considerable growth of renewable energy after millenium, mainly solar and wind energy
- special attention has been paid to wind energy.
- wind energy parks in 3 Slovak regions – Cerová, Ostrý Vrch and Skalité.
- initial very positive response from the side of public was later mixed with opposing attitudes.
- sustainability of the wind energy power stations have been intensively discussed and heavily challenged, taking into account not only the mere technical aspects of wind energy but also more general aspects of sustrainability, e.g. balanced spatial development.
- further expansion of the wind energy in Slovakia has been considerably slowed down and public opposition player a major role.





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## **Wind energy:**

### **Positive aspects:**

- no emission and no primary dumping sites, no or very low primary negative impact on human health
- production is not depending on the prices of inputs
- relatively low service expenditures
- step toward energetic independence
- wind energy facilities might be completely removed after their life cycle expectancy

### **Negative aspects:**

- noise (50-60 dB in 40m distance), stroboscopic effect (light rays frequency during sunset/sunrise), icing
- cumulative negative impact on biotope and animals (birds, butterflies, chiroptera)
- negative impact on visual characteristics of landscape, especially those with natural and cultural values (subjective, but playing a major role in recent disputes)



## **Public opinion development in general:**

- studies in Europe show moderate/strong support for the implementation of wind energy
- surveys have shown general support confronted by local opposition (Wolsink 2005, Kalldelis 2004)
- the key question is not tackling the national environmental policies, but rather individual renewable energy solution
- poor communication is prevalent and plays a major role (Wolsink 2005)
- public attitudes surveys are superficial, ad hoc questionnaires „lacking clear conceptual framework, such as social psychology theories on attitude formation“ (Wolsink 2005, p.1191)
- “Despite a plethora of empirical studies, there is a lack of valid and reliable methodological tools for operationalizing public perceptions of wind farms” (Devine-Wright 2005)
- underlying roots of misunderstandings lay probably deeper than obvious NIMBY theories...

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## **Public opinion based on attitudes:**

- public opinion is the collective attitude of the all stakeholder groups (population).
- attitudes are learnt predisposition to favoring or refusing reaction toward given object, person or event (Fishbein, Ajzen 1975, In Hayes, 2003, p. 95).
- generally: the attitudes are learnt, mutually consistent, stable in time and space and are concerning the positive or negative reactions.
- each attitude has cognitive (opinion based on rationalities), emotional (feelings and emotions) and behavioral (willingness to act) dimension.
- social desirability (might distort the surveys!)
- attitudes might be modified/influenced but only in long term and continually !

## **Wind energy parks in Slovakia: Public opinion development in general**

- initial moderate/strong support, mainly due to the transfer of technology and positive examples in Austria, Denmark, Germany....
- most of the mayors were pro-oriented and expected a significant income for municipality/regional development
- difficulties with selection of location (windy condition, Slovakia is predominantly mountainous landscape, natural protected areas...)
- Cerová park: the scattered settlement in Myjava region („kopanice“) – after initial positive response, the public opinion turned hugely against wind energy plants.
- Skalité park: 4 propellers park closed down in 2008
- the other planned projects failed, often due to the public opposition (e.g. public opinion in Vráble: 73 pro, 491 against, 43 indifferent, 9 no answer...)

## **Wind energy parks in Slovakia: Public opinion – Cerová park**

Reasons and background:

- the biggest single investment action covered by programme PHARE 2000 (complementary financing from state and private budget)
- operating from October 2003
- highest point of the wind energy plant is cca 100 m over terrain
- construction has been made by Agrostav, technology by Aufwind Schmack Regensburg.
- frequency of propeller 25,9/min, VG performance 660kW, minimal wind performance 4m/s, maximal wind performance 14m/s, critical wind performance 25m/s.
- production of electricity would cover the need of the municipality of 2500 population.



## **Wind energy parks in Slovakia: Public opinion – Cerová park**

### **Initial phase (2000-2004):**

- very positive and warm-hearted reaction of the public (both local residents as well as general public)
- series of explanatory articles in mainstream media, high concentration on „agenda setting“, PR campaign of the investors and companies involved into wind energy parks
- wind energy parks presented as a contribution to local, regional as well as national sustainable development
- the wind plant became tourist attraction, visiting 300-400 people daily
- positive attention of media (TVs in Slovakia, „Neue Energie“ in Germany, nov.ost.info)

## **Wind energy parks in Slovakia: Public opinion – Cerová park**

### **Initial phase (2000-2004):**

*„Energy map of Slovakia has lost next blind spot. 80km from Bratislava, new wind energy plant with the performance 4x 660kW has been built“ (Neue Energie)*

*„Wind park in Cerová became a reality and the local residents are obviously proud of it. It was an invaluable experience also for the local authority in Cerová, facing the opportunities and challenges of European funds. Of course, it was easier to say that it is too demanding project. But they did it, because they wanted. Now they know, what they have.“ (P.Ondera, journalist)*

## **Wind energy parks in Slovakia: Public opinion – Cerová park**

### **Later phase (2005-2012):**

- public support for wind park in Cerová has slowly vanished and further enlargement of Cerová park (Cerová-Kopánky) was heavily objected and questioned (EIA evaluation in 2010)
- among opposing stakeholders are Green Party, Slovak Association of Nature Protection, signators of the petition „Against enlargement of wind park“ (102 local residents...)
- Myjava region is picturesque landscape with unique visual character, being heavily injected by recreational suburbanization in recent years.
- Key stakeholders are people retreating from Bratislava, Trnava and searching for impeccable landscape without visual smog.
- These stakeholders became strong community leaders who influenced the autochtonne population significantly (see theory of personal influence – Katz, Lazarsfeld).
- Sustainability of the project has been heavily objected and questioned (e.g. only limited utilisation of brownfields etc.)

## Wind energy parks in Slovakia: Public opinion – Cerová park

### Later phase (2005-2012):

*„Wind energy park in Cerová did capitalise the absence of necessary legal framework in Slovakia in respective field. Absence of limits allowed to allocate the wind energy facilities in immediate vicinity of scattered settlements U Rehušov, Horný a Dolný Deberník, Varáková...Wind energy facilities will further compromise the tourist infrastructure in this highly attractive region. Typical scattered settlements (kopanice) are of fuzzy character and do not allow to construct neither horizontal nor vertical barriers. Visual impact evaluation must not be restricted to affected villages, because of specific character of this area – for example from Poľany you can sometimes see the Alps...”*  
*(Mr. R. Adámek, stakeholder).*







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## Wind energy parks in Slovakia: Public opinion – Cerová park

### Later phase (2005-2012):

*„Wind energy investors’ attention to Slovakia has considerably decreased. Fully functional wind energy parks are located only in Cerová and Ostrý Vrch. In most cases, the local residents and investors did not find a common language. Municipalities of Dobšiná, Telgárt and Vráble are examples of failed discussions and failed positive approach toward installation in immediate vicinity of the villages. The other priorities became more important. The unattractive visual appearance of the wind energy utilities is the main target of reproaches...”*

*(Mrs. M. Veliká, SKREA Project Manager, March 2012).*

## **Wind energy parks in Slovakia: External communication and its brief evaluation:**

### **1st task: public awareness, spread of information**

Our verdict: **rather succesful** (2000-2003), most of the relevant public knows the basic information on the wind energy

### **2nd task: communication support of the projects**

Our verdict: **moderate success** (2003-2005), initial projects (Cerová, Ostrý Vrch) were supported by public, later the public support faded away (Cerová extension, Vráble project) .

### **3rd task: construction of long-term positive attitudes**

Our verdict: **failure** (2005-2012), general attitudes toward wind energy utilities are mixed, with significant portion of negative attitudes (led by the local stakeholders!) and refusal of further extension.

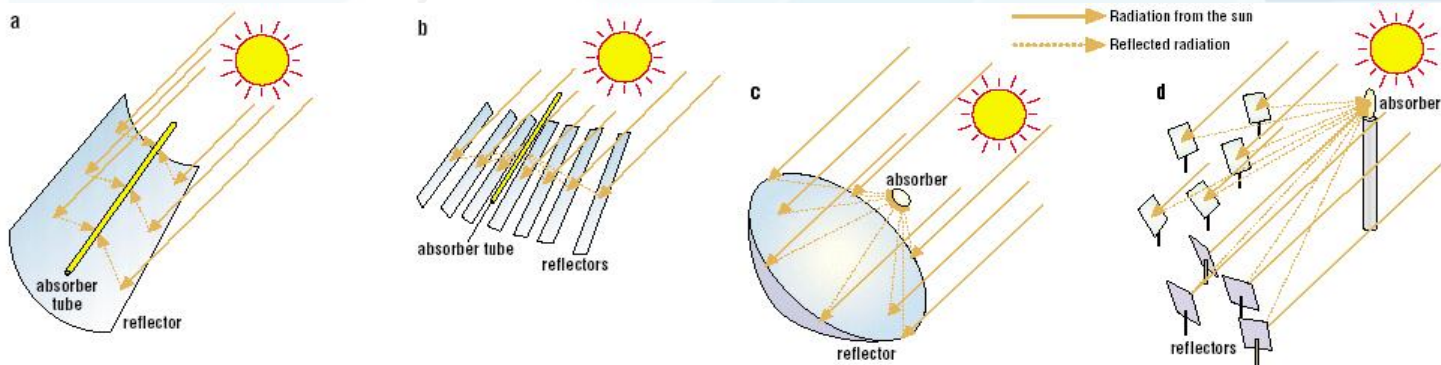
### **4th task: neutralisation of negative attitudes**

Our verdict: **rather failed** (2009-2012), the negative attitudes dont dictate the public discourse completely, but are prevailing. Agenda setting of wind energy in media has been replaced by other themes.

## Solar power in general

Solar power is the conversion of sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power (CSP).

1) Concentrating Solar Power (CSP) systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. The concentrated heat is then used as a heat source for a conventional power plant. (a) parabolic trough collector (b) linear Fresnel collector (c) central receiver system with dish collector (d) central receiver system with distributed reflectors



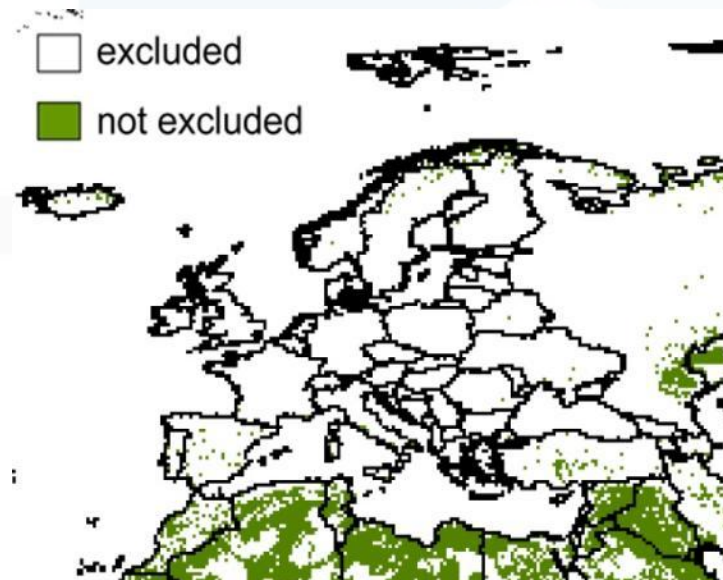
Quaschnig, V.(2003) Solar thermal power plants, Renewable Energy World

2) A solar cell, or photovoltaic cell (PV), is a device that converts light into electric current using the photoelectric effect.

## CSP system vs. PV systems in Central Europe

CSP systems are capable of storing energy by use of Thermal Energy Storage technologies and using it at times of low or no sunlight, e.g. on cloudy days or overnight, to generate electric power. CSP systems are far more attractive for large scale power generation as thermal energy storage technologies are far more efficient than electricity storage technologies (Green 2012).

### Site Exclusion for CSP Plants – Trough



Concentrating systems can only make use of direct radiation, and are therefore applicable in areas where there are few clouds. In cloudy or dusty areas, photovoltaic technologies are likely to be preferred (EASAC 2011)

## CSP system vs. PV systems

	Investment cost [\$2005/kW]	Operation & Maintenance [% of inv. cost]	Life time* [years]	Floor cost [\$2005/kW]	Learn rate [%]	Cum. installed capacity [GW]	Land use m <sup>2</sup> /kW
PV	4,900	1.5	35	600	20	5	15
CSP	9,000	2.5	35	1,500	10	0.4	50

**\*Over the life time, the production is continually decreased down to 60% of initial capacity**

Pietzcker R. et al (2009) The Role of Concentrating Solar Power and Photovoltaics for Climate Protection

It has been stated by energy market players that PV systems constitute a more proven technology which can be built easier, at lower cost and at much shorter time than CSP plants, which, to the contrary, need more space for large-scale applications and are associated with greater risks (e.g. higher investment, challenges with thermal storage) (Green 2012).

## Is photovoltaic power a genuinely cleaner technology?

Life Cycle Assessment is a concept and a methodology to evaluate the environmental effects of a product or activity holistically by analyzing the entire life cycle of a particular product, process, or activity

LCA was applied to assess renewable energy electricity generation in Poland. The electricity from a solar cell system (PV) was found to **give higher impact value than those of wind turbine and hydro**, but lower than those of fossil fuel power plants (Malgorzata, 2002)

In Japan and Thailand, the numerical environmental total standard (NETS) method and Life Cycle Assessment (LCA) technique has been applied to study the environmental impacts of the power plant systems. The results showed that the solar cell power **plants gave lower environmental impacts than those of nuclear, waste fuels and fossil-fired** power plants (Naoki, M. et al, 2002)

# Life Cycle Assessment of PV power plants

Unfavorable effects of solar power plants are usually minor and they can be minimized by appropriate mitigation measures. The potential environmental burdens of solar power plants are regularly site specific, depending on the size and nature of the project.

## Manufacturing

It was found that the highest value of environmental impact for the solar cell power plant occurs at the **solar module manufacturing phase**, wherein the major environmental impacts are natural resource depletion, fossil fuel depletion and air pollution (Chamsilpa, M. et al 2010).

The production of current generation PV's is rather energy intensive and large quantities of bulk materials are needed. Also, small quantities of scarce materials (Indium/Tellurium/Gallium) are required; also limited quantities of the toxic Cd.

## Transportation

In the transportation phase, the fabricated solar cell modules are transported from the manufacturers to the power plant by truck. Therefore, there is consumption of fossil fuel (diesel oil and motor oil) which generates emissions to the air. The **emissions associated with transport of the modules are insignificant in comparison with those associated with manufacture**. Transport emissions were still only 0.1–1% of manufacturing related emissions.

# Life Cycle Assessment of PV power plants

## Land use

The **impact** of land use on natural ecosystems is **dependent upon specific factors** such as the topography of the landscape, the area of land covered by the PV system, the type of the land, the distance from areas of natural beauty or sensitive ecosystems, and the biodiversity. The impacts and the modification on the landscape are likely to come up during construction stage by construction activities, such as earth movements and by transport movements.

In the long run, PV power plants change the quality of the surface soil because the constructions shade the ground underneath and thus they may inversely impact local biotopes. PV power plants also **consume the natural environment** and may occupy areas appropriate for agriculture or other land use.

## Visual impacts

Visual intrusion is highly dependent on the type of the scheme and the surroundings of the PV systems. It is obvious that, if we apply a PV system near an area of natural beauty, the visual impact would be significantly high.

## Operating

PV systems emit no gaseous or liquid pollutants, and no radioactive substances. In the case of CIS and CdTe modules, which include small quantities of toxic substances, there is a potential slight risk that a fire in an array might cause small amounts of these chemicals to be released into the environment (Various, 1996 ). Running cost are generally low and they are mostly linked with maintaining the land cover by mowing or grazing and with the a security system preventing thefts.

## Dismantling

PV modules do not last forever; they have a life expectancy of about 30 years before they must be decommissioned. PV modules consist of the three major components: metal, glass, and silicon wafers. The metal and glass can be recycled using the current recycling infrastructure. Intact silicon wafers can be processed into new solar cells, using standard solar cells production processes. Multiple groups have reported solar cells created from recycled wafers have efficiencies similar – if not equal – to the originals.



## Positive aspects of using solar power

- reduction of the emissions of the greenhouse gases (mainly CO<sub>2</sub>, NO<sub>x</sub>)
- prevention of toxic gas emissions (SO<sub>2</sub>, particulates)
- reclamation of degraded land;
- reduction of the required transmission lines of the electricity grids
- improvement of the quality of water resources (Karapanagiotis, 2000)

### **In regard the socio-economic viewpoint**

- increase of the regional/national energy independency
- provision of significant work opportunities
- diversification and security of energy supply
- support of the deregulation of energy markets (Tsoutsos, 2005)
- utilisation of former brownfields (see e.g. BROWNTRANS project)



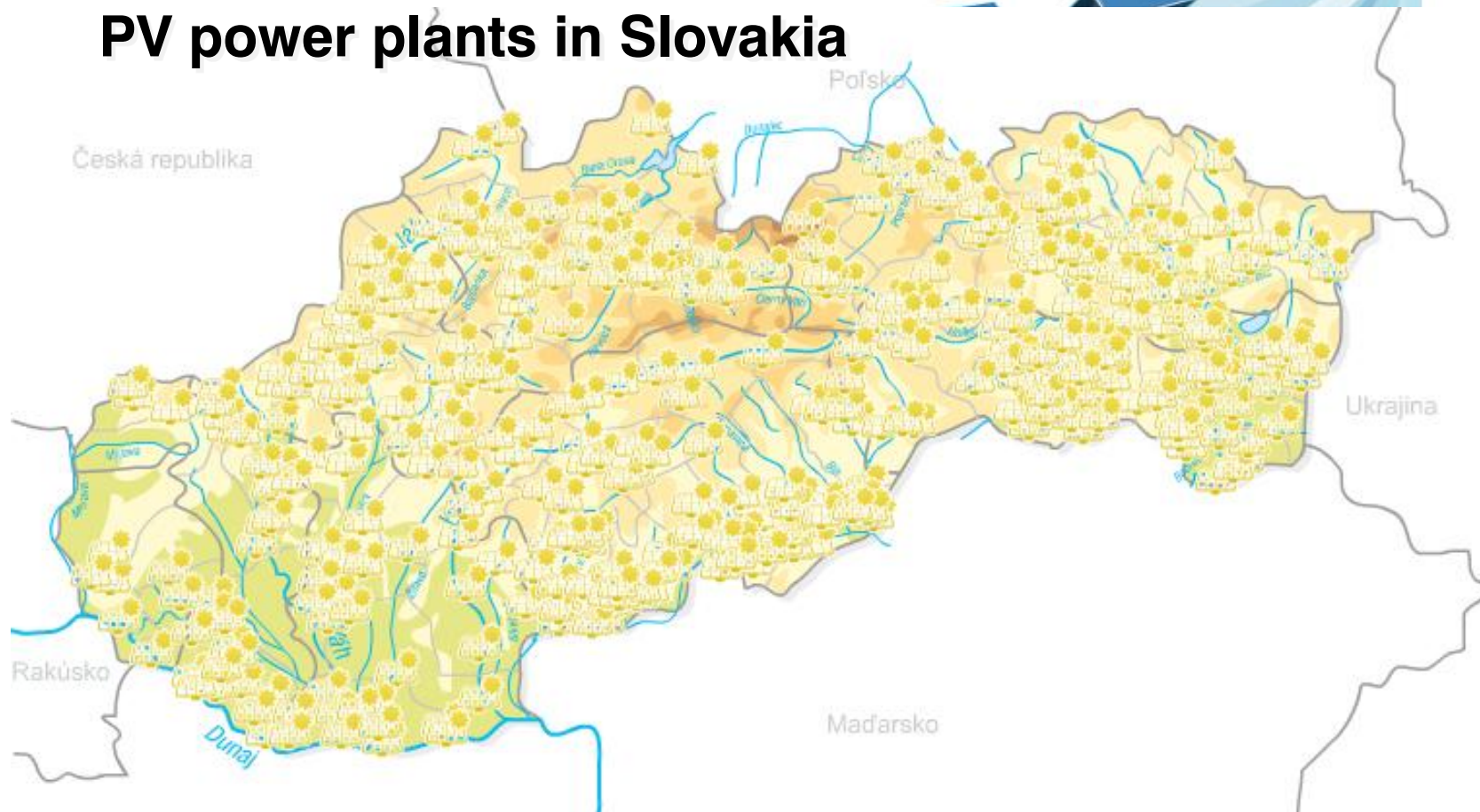
# Solar power plants in Slovakia

The amount of sunlight falling on the ground (kWhm<sup>2</sup> per year)



The maximal difference between the amount of light falling on the ground in Slovakia doesn't considerably vary from region to region. The difference between the highest amount (1525 kWhm<sup>2</sup> per year) and the lowest amount (1175 kWhm<sup>2</sup> per year) is approximately 23%.

# PV power plants in Slovakia



	2009		2010		2011		1Q 2012		Σ	
	number	energy generation	number	energy generation	number	energy generation	number	energy generation	number	energy generation
Up to 10 kW	13	70	43	258	195	1083	12	73	263	1,484
Up to 100 kW	1	100	70	2,504	391	21,439	21	1,610	483	25,653
Up to 1 MW	1	102	133	128,112	282	245,826	0	0	416	374,040
Up to 4 MW	0	0	21	54,733	19	52,326	0	0	40	107,059
Σ	15	272	267	185,607	887	320,674	33	1,683	1,202	508,236

# Contemporary state and future of solar power plants in Slovakia.

Prices of solar power supplied to the electricity supply chain in €/kWh

<b>Slovakia</b>	<b>0.259 €/kWh (2011)</b>
France	0.30 €/kWh
Portugal	0.32 €/kWh
Italy	0.36 €/kWh
France (Corsica)	0.40 €/kWh
Greece	0.40 €/kWh
Spain	0.44 €/kWh
Germany	0.45 €/kWh
Greece (islands)	0.45 €/kWh
Switzerland	0.45 €/kWh (1 € = 1,5 CHF)
Czech Republic	0.55 €/kWh (1 € = 24,7 Kč)

Regulatory Office for Network Industries of the Slovak Republic decreased the price of 1 kWh to €0,195 since January 1, 2012.