

**Solar-Reports:**

- . [The Price of Policy Risk – Empirical Study Looks at the Willingness of European Photovoltaic Project Developers to Invest](#)
- . [Photovoltaics: Thin-film technology about to make its breakthrough; crystalline silicon cells to continue their dominant role](#)
- . [Pvresources annual review: all-time records in capacity and growth in 2008](#)
- . [PV Innovation in North America: the gateway to solar gigawatts](#)
- . [Concentrated photovoltaics: the path to high efficiency](#)
- . [Large-scale solar systems: the sun supplies warm water and supports room heating](#)

- . [Solar Report](#)
- . [Solar News](#)
- . [Solar Links](#)
- . [Solar Energy System of the Month](#)
- . [Solar point of view](#)
- . [Solar Interviews](#)
- . [Solar Archive:](#)
  - . [Photovoltaics](#)
  - . [Solar heating](#)
  - . [Solar Building](#)
  - . [Fuel Cell](#)
  - . [Solar News Archive](#)

. [Your Suggestion](#)

## THE SOURCE OF POWER »

### The Price of Policy Risk – Empirical Study Looks at the Willingness of European Photovoltaic Project Developers to Invest

by Sonja Lüthi and Rolf Wüstenhagen  
2009-09-17

Policy risks need to be compensated by a higher feed-in tariff when designing policies effective in attracting PV investments. This is one of the key findings of a study by the Swiss University of St. Gallen's Institute for Economy and the Environment, conducted by Sonja Lüthi and Prof. Dr. Rolf Wüstenhagen. In particular, policy makers should be aware that long administrative processes and, to a somewhat lesser extent, policy risks related to the existence of a cap and a substantial number of unexpected policy changes, have a cost attached to it that will need to be reflected in a higher level of the feed-in tariff (FIT) to attract solar project developers. Solarserver as a contribution to the discussion on FITs and policy framework publishes an abridgment of the study including research examples for Spain and Greece as the "Solar-Report" in September 2009.

Solar-Report as [PDF-Document](#)



Policy Risk resp. Security influence the willingness of PV project developers to invest. Photos: left: 20 MWp-Solar PV plant in Spanish Beneixama (Source: City Solar AG), right: Solar power plant "Waldpolenz" (Germany) (Source: juwi-Gruppe).

search



#### [Alles für Solartechnik](#)

Fachhandel für Solartechnik  
Trennschalter - Solarkabel  
[www.europartner-solar.de](http://www.europartner-solar.de)

#### [Solar Cell Processing](#)

Monitor, Manage Laser Beams For High Quality Solar Cells  
[www.Ophir-Spiricon.com](http://www.Ophir-Spiricon.com)

#### [Silicon Wafers reclaiming](#)

Silicon, Wafers, thin film, Reclaim Polished silicon wafers  
[www.pcasilicon.com](http://www.pcasilicon.com)

#### [Breakout Solar Companies](#)

A Few Select Companies Will Corner the New Solar Market. Free Report.  
[www.GreenChipStocks.com/S](http://www.GreenChipStocks.com/S)

#### [Solar Energy](#)

Find Electronics Solutions For Your Business. Get It Done Now!  
[www.business.com](http://www.business.com)

The achievement of energy policy objectives, and thus the transition to a sustainable energy system depends on whether policy instruments effectively influence investors' behaviour. Applying a sophisticated research method from another field (marketing), the study is one of the first empirical contributions that investigate the influence of renewable energy policies on investors' decisions. By means of different estimations and simulations, the relevance of different policy factors and the costs of different policy risks have been quantified. Based on this solid empirical basis, it is possible to develop specific scenarios that enable policy makers to assess the costs and benefits of reducing various elements of policy risk.

## Policy support required to enhance PV power production

Successfully making the transition to renewable energy is high on the policy agenda in many countries around the world, and one technology that has particular potential for contributing to a future low-carbon energy supply is solar photovoltaic (PV) technology. However, the contribution of solar power to the total power production is still negligible. The barriers slowing this transition process are manifold, but are to a large extent related to the current high prices. PV is still an early-stage technology and the transition from central to distributed power generation brings along transition costs. The cost disadvantage of PV technology is also influenced by subsidies for conventional, non-renewable energy sources and a lack of internalization of external costs (e.g. climate damages). Furthermore, the investment profile is different compared to competing technologies: PV plants have a higher initial cost, but lower operating cost and no fuel price risk. Other barriers to diffusion of solar energy are related to path dependencies (e.g. market power of incumbent energy firms) and cognitive factors (e.g. valuation methods that favor large-scale power plants).



Greenfield PV plant in Thiva (approx. 50 km north of Athens) with 12.400 solar panels and a capacity of 2 MW, one of the biggest Greek solar power plants.

Photo: aleo Solar AG

## An attractive feed-in tariff by itself does not guarantee an increase in PV capacity

Because of the barriers mentioned above, the PV market is not yet self-sustaining but dependent on policy incentives to reach a self-sustaining market. Policy can help to reach grid parity and thus transform the market into a self-sustaining market. Currently, policy incentives such as feed-in tariffs (FITs) have been implemented in a number of countries. FITs have been praised for their effectiveness but have also received mixed reviews when it comes to assessing their efficiency. A key empirical puzzle is why similar FITs lead to differing outcomes (in terms of newly installed PV capacity) in different countries. Thanks to effective incentives for PV systems by national and local governments, countries like Germany have become front runners in the adoption of PV panels. In other countries like Greece, the same financial incentive scheme has however so far not led to a significant increase in installed PV capacities, even though FIT and solar irradiation are higher. There is a vivid debate about what constitutes efficient and effective renewable energy policies, and recently it has been highlighted that both sides of the risk-return equation are important. Policy risk is thus very



[pv-tech.org](http://pv-tech.org)

important in the design of an effective policy, but which risk factors are relevant, and how should policy makers prioritize them?

In Italy, solar plants are supported in the framework of the tariff regulation "Conto Energia". The PV-plant "Solevivo" with a capacity of 1 MWp is located in Acquaviva Delle Fonti (Bari) in the region of Puglia.



Photo: Isofoton S.A

Motivated by this fact, a study at the IWÖ addressed the question of policy effectiveness by analyzing the PV project developers' point of view. Specifically, it aimed at identifying the most relevant PV policy-related factors in the location decision for PV project developers, and it calculates their willingness-to-accept certain policy risks.

### **Less bureaucracy, wavering support-cap, and reliable policy framework allow a lower FIT**

The key finding is that risk matters in PV policy design. More specifically, the attributes "Duration of the administrative process" and "FIT level" were perceived as the most important attributes in the location decision. Further, willingness-to-accept simulations allow attaching a price tag to specific policy risks. A reduction of the administrative process of 6 months enables a 4 ct/kWh lower FIT without a loss of attractiveness for PV project developers to investing in the given country. The waiver of a cap also allows having a lower FIT: removing a cap which is expected to be reached in one (four) year(s) will allow governments to reduce the FIT by about 11(5) ct/kWh.

The third policy risk analyzed in this study is political instability. Compared to one significant unexpected policy change in the last 5 years, respondents accept a 4 ct/kWh lower FIT if the political conditions are stable. These estimations confirm prior research that points to the importance of policy risk and "non-economic" barriers – such as duration of the administrative process and political instability – to the deployment of renewable energy.

### **Policy Attributes about which PV Project Developers really care**

The analysis of the relative importance of the attributes reveals the highest importance for the duration of the administrative process with 26%. Almost as important is the level of the FIT (24%). The existence of a cap and PV policy changes are of medium importance with 19% and 18% respectively. The lowest importance (14%) is attributed to the duration of the FIT.

PV project developers are thus particularly sensitive to the duration of the administrative procedures, followed by other policy risks (policy changes, existence of cap). Duration of support is relatively less important. This indicates that a more effective administrative procedure enables a lower FIT, without a loss of attractiveness for PV project developers.

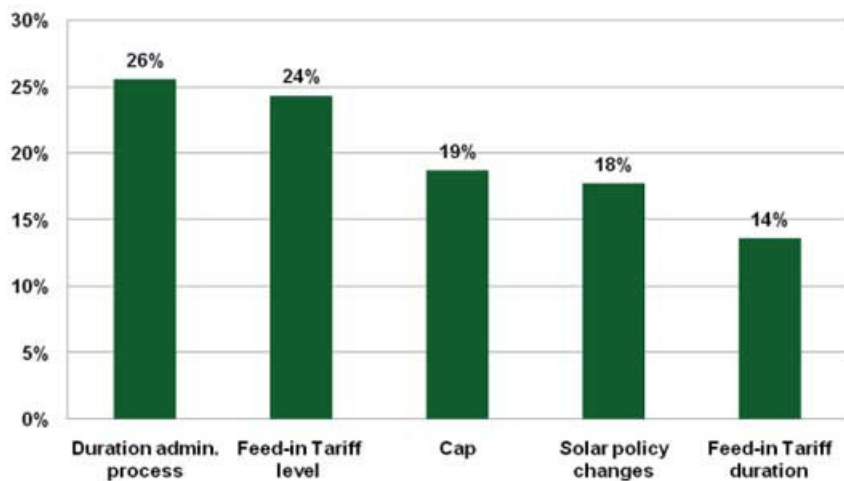


Fig. 1: Relative Importance of Policy Attributes

### Price Tags of Policy Risk Attributes

Fig. 2 shows that for every half-year increase in the duration of the administrative process, a government has to pay project developers a FIT premium of about 4 ct/kWh (all else being equal).

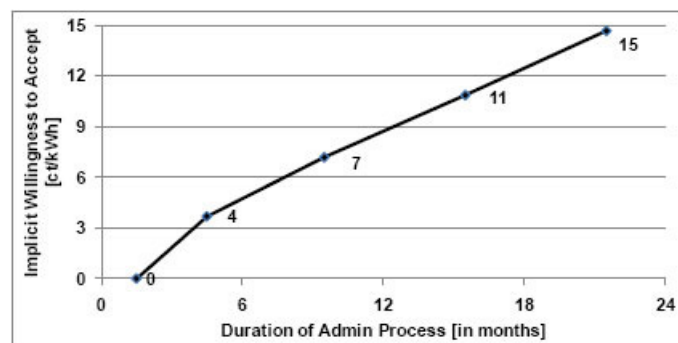


Fig. 2: Willingness to accept (=FIT premium [ct/kWh]) a certain duration of the administrative process

The choice experiments included three attribute levels regarding the existence of a cap, being no cap, a cap that is going to be reached in 4 years (loose cap), and a cap that is going to be reached in 1 year (tight cap). The analysis shows that removing a loose (tight) cap will allow governments to attract the same level of investment at a FIT that is about 5 (11) ct/kWh lower (Fig 3).

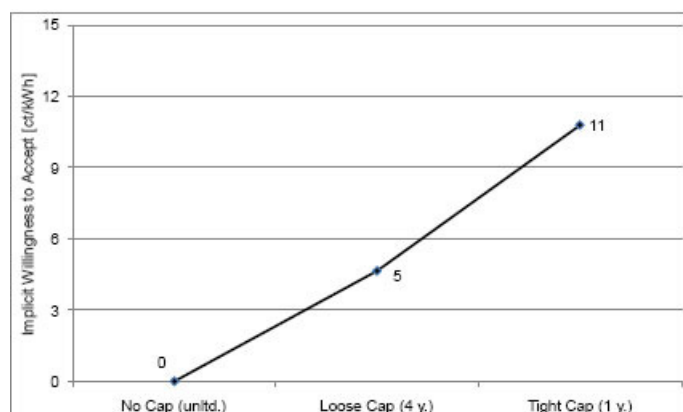


Fig. 3: Willingness to accept (=FIT premium [ct/kWh]) a loose/tight cap

With regard to the policy stability, the study estimates that compared to no policy risk conditions, in low risk conditions (one significant unexpected policy change in the last 5 years) the FIT needs to be 4 ct/kWh, in high risk conditions (three significant unexpected policy changes in the last 5 years) 10 ct/kWh higher to keep its attractiveness (Fig. 4).

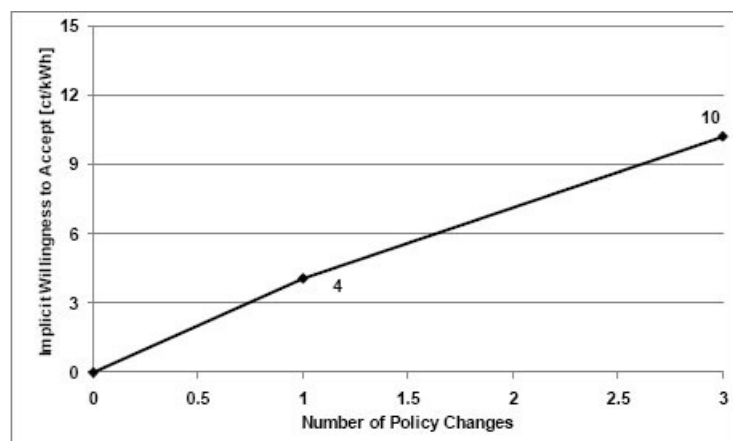


Fig. 4: Willingness to accept (=FIT premium [ct/kWh]) a certain number of policy changes

## How would a Change in Policy Attributes influence Project Developers' Preferences?

A couple of simulations to estimate the influence of a hypothetical change in the policy design (e.g. increase in remuneration level, decrease of administrative process duration) on the project developers' likelihood for investing (on a scale of 0-100) in a certain country have been conducted to analyze the investment likelihood in Spanish situation (Tab. 1) and in Greece (Tab. 2). The attribute levels which were changed from the initial scenario are in bold.

One of the risks policy makers can influence to some degree is the duration of the administrative process. Scenario A: Admin. process reveals that an administrative process that is 6 or 12 months shorter (7-12 or 3-6 instead of 13-18 months) would bring a significantly higher investment likelihood of 66 or 84, respectively, compared to the initial situation (39).

Besides the administrative process, the tight cap is another important issue in Spain. Scenario B: Cap shows that loosening the cap (reached in 4 yr.) or removing the cap (no cap) makes sense to attract project investments since the likelihood of investing increases to 81 or 95, respectively.

Finally, the importance of a continuous PV policy is illustrated in Scenario C: Policy stability. Having no changes in policy instead of one in the last 5 years increases the likelihood of investment on a scale from 0-100 from 39 to 68.

Scenario D: FIT illustrates the influence of a rise of the FIT on the investment likelihood. A 4 (9) ct/kWh higher FIT would bring an investment likelihood of 64 (86), i.e. similar appeal for investors as in the case of a 6 (12) months shorter administrative process.

	Spain (2007)	A Admin. Process	B Cap	C Policy stability	D FIT
<b>Policy Framework</b>					
Admin. process (months)	13 - 18	<b>7-12/ 3-6</b>	13 - 18	13 - 18	13 - 18
FIT level (ct/kWh)	41	41	41	41	<b>45/50</b>
Cap	in 1 yr.	in 1 yr.	<b>in 4 yr./ no cap</b>	in 1 yr.	in 1 yr.
PV policy changes	1	1	1	<b>0</b>	1
FIT duration (years)	25	25	25	25	25
<b>Investing Likelihood</b> (given on a 0-100 scale)					
SMRT Simulation	39	66/84	81/95	68	64/86

Tab. 1: Investment likelihood simulations for changes in the PV policy framework of Spain in 2007

Similar simulations have been conducted for Greece. The current likelihood of investment of 85 can be significantly improved by shortening the duration of the administrative process to 6 months (Scenario A: Admin. process). On the other hand, Scenario B: Cap shows that the introduction of a loose cap (reached in 4 yr.) would lead to an important decrease of the investment likelihood (57). In the case of a tight cap (reached in 1 yr.) there would hardly be any investment appeal (18).

Scenario C: Policy stability illustrates the importance of a continuous PV policy. Having no negative changes in policy instead of one in the last 5 years increases the likelihood of investment from 85 to 95. Three past changes would let drop the investment likelihood to just 46.

Finally, to reach a higher investing likelihood, other than reducing the policy risks, an increase of the FIT is also possible. To reach an investing likelihood of 95, the FIT needs to be as high as 50 ct/kWh.

	Greece (2007)	A Admin.process	B Cap	C Policy stability	D FIT
<b>Policy Framework</b>					
Admin. process (months)	19 - 24	13-18/ 7-12/ 3-6	19 - 24	19 - 24	19 - 24
FIT level (ct/kWh)	45	45	45	45	50
Cap	No cap	No cap	in 4.yr./ in 1 yr. cap	No cap	No cap
PV policy changes	1	1	1	0/3	1
FIT duration	20	20	20	20	20
<b>Investing Likelihood</b> (given on a 0-100 scale)					
SMRT Simulation	85	95/98/99	57/18	95/46	95

Tab.2: Investment likelihood simulations for changes in the PV policy framework of Greece in 2007

The Full Paper is available to download at:

[http://www.solarserver.de/solarmagazin/download/full\\_paper\\_the-price-of-policy-risk.pdf](http://www.solarserver.de/solarmagazin/download/full_paper_the-price-of-policy-risk.pdf)

### Methodology

In a first step, qualitative expert interviews have been conducted to explore the PV project developers' policy preferences, and thus to identify the most relevant factors influencing the location decisions. In the second step and upon the background of the expert interviews, an Adaptive Conjoint Analysis (ACA) has been conducted to quantify the importance of the different policy framework characteristics and calculate the willingness-to-accept a certain policy risks. ACA belongs to the family of conjoint experiments. These are widely used in marketing research and have recently become increasingly popular in environmental and resource economics because they allow for modeling of realistic trade-off situations while avoiding some of the pitfalls of social desirability bias. This well established PC-based market research technique allows determining the optimal features of projected as yet undeveloped products and services. The population of interest of the on-line survey is European PV project developers which are engaged in or are thinking about undertaking PV projects abroad in other European countries. The online survey has been conducted in October-November 2008. The PV project developers were solicited to participate in the survey by phone and/or e-mail, at a solar industry fair, by an article on the Solarserver website ([www.solarserver.de](http://www.solarserver.de); [www.solarserver.com](http://www.solarserver.com)), and a leaflet in a solar industry journal.

135 respondents logged on to the survey website and 63 questionnaires were completed. Each project developer made 25 choice tasks (cf. Fig. 5+6), resulting in a final data set of 1575 choice decisions. The ACA interview was time-efficient; the duration had a median of 20 minutes.

Fig. 5: Screenshot of a "Paired-Comparison" question, Fig. 6: Screenshot of a "Calibrating Concept" question

### The Authors



**Sonja Lüthi** is a PhD candidate and research associate at University of St. Gallen's Institute for Economy and the Environment (IWÖE-HSG) since 2007. She holds a Masters degree in Geography with a minor in Environmental Economics from University of Fribourg. For her cumulative PhD thesis in the area of solar energy policy, investor decisions, and marketing, she joined the marketing specialization of the PhD program in management at the University of St. Gallen. Apart from her academic track record, Mrs. Lüthi also has taken on key responsibilities in two current research projects funded by the European Commission under the 6th and 7th framework programmes for research.

Within the project on renewable distributed generation technologies in the Mediterranean region (DISTRES), she has coordinated a survey among 15 consortium partners from nine countries, and lead-authored the final report on work package 2 (Financing and business models for solar energy). In the project "Barriers for energy changes among end consumers and households (BARENERGY)", she has coordinated qualitative stakeholder interviews in six European countries. Currently she co-leads an empirical analysis based on choice experiments with international wind and solar energy investors, a project commissioned by the International Energy Agency (IEA). From June 2009 until June 2010 she is a visiting scholar at UC Davis and UC Berkeley, California.



**Prof. Dr. Rolf Wüstenhagen** is Director of the Institute for Economy and the Environment (IWÖ-HSG) and holds the Good Energies Chair for Management of Renewable Energies at the University of St. Gallen. He graduated in management science and engineering from Berlin University of Technology in 1996 and holds a PhD (2000) and *venia legendi* (2007) from University of St. Gallen. In 2005 and 2008, he was Visiting Professor at University of British Columbia (Vancouver, Canada) and Copenhagen Business School (Denmark).

Before embarking on an academic career, Rolf worked in the venture capital industry, where he was involved in investments in energy technology firms such as US solar cell manufacturer Evergreen Solar, as well as marine energy pioneer Pelamis Wave Power Ltd. from Scotland. Since 2004, Rolf Wüstenhagen is a member of the Swiss Federal Energy Research Commission. He is one of the lead authors of the upcoming special report of the Intergovernmental Panel on Climate Change (IPCC) on the role of renewable energy in mitigating climate change.

Solarserver editor: Rolf Hug

### Additional Solar-Reports:

- . [The photovoltaics industry: against all odds, strong growth continues](#)
- . [PV production: The dawn of the "gigawatt" fab](#)
- . [Review Intersolar 2008: the largest solar fair of the world](#)
- . [2008 Photovoltaic trends: Innovative thin film technology and large-scale power plants](#)
- . [Large photovoltaic power plants: average growth by almost 100 % since 2005](#)

- . [Research Agenda provides a Vision for European Photovoltaic Solar Energy Technology](#)
- . [Organic photovoltaics: solar power from extremely thin tinted films and polymer films](#)
- . [Intersolar on its way to becoming the Solar World Fair](#)
- . [Building integrated Photovoltaics \(BIPV\): Solar electric power systems conquer large roofs and façades](#)
- . [Solar thermal in Europe: expanding markets, state-of-the-art technical solutions](#)
- . [Photovoltaic investments outside Germany? Looking into the southern EU states](#)
- . [Solar power from the desert rather than desert in Germany](#)
  
- . [New Study: Renewable Energy can replace abandoned Nuclear Energy in Germany](#)
- . [BBC Interview with Dr. Knies \(TREC\): The energy source of the future is solar](#)
- . [Photovoltaic industry achieves record profits, discussion over high module prices continues](#)
- . [Chinese solar modules penetrating the German market](#)
- . [Solar Roof Tile Exhibition shows developments in photovoltaic roofing](#)
- . [Intersolar 2006: Solar technology and demand at an all-time high](#)
  
- . [New Photovoltaic Factories and Capacities in Germany](#)
- . [Renewable Energy in Australia](#)
- . [Cooling with Solar Heat: Growing Interest in Solar Air Conditioning](#)
  
- . [Building Solar: The Prospects and Costs of Living with the Sun](#)
- . [Fuel Cell Research and Development in Southern Germany](#)
- . [The Photovoltaic Market in Japan: Unquestioned Leadership of World Market](#)
- . [The National Energy Plan](#)
- . [Trade Fair Intersolar 2001 Presents World Wide Solar Technology for the First Time](#)
- . [Solar Thermal Technologies in the United States](#)
- . [An Overview of Photovoltaics in the USA](#)
- . [The Year 2000: Breakthrough for Solar Technology in Germany](#)
  
- . [Fuel Cells and Solar Hydrogen-A Power Package for the Future?](#)

**amazon.com**  
and you're done.™

 <p><a href="#">Got Sun? Go Solar</a> Rex A. Ewing; Doug...</p>	 <p><a href="#">Photovoltaic Systems</a> James P. Dunlop, I... <b>New \$85.00</b></p>	 <p><a href="#">Photovoltaics Solar Energy Inter...</a> <b>New \$37.77</b></p>	 <p><a href="#">Renewable Energy</a> Martin Kaltschmitt... <b>New \$79.20</b></p>	 <p><a href="#">Solar Power Your Home For Dummies</a> Rik DeGunther <b>New \$12.99</b></p>	 <p><a href="#">Got Sun? Go Solar, Expanded 2nd Edit...</a> Rex A. Ewing, Doug... <b>New \$13.60</b></p>
<a href="#">Privacy Information</a>					

[Banner Advertising](#) | [Bulletin Board](#) | [Events](#) | [Solar Magazine](#) | [Funding for Solar Energy](#) | [Companies](#)  
[Solarstore \(G\)](#) | [Non-Profit Organizations](#) | [Lexicon](#) | [Basic Knowledge](#) | [Educational Institutions](#) |  
[Imprint](#) | [Contact Us](#) | [Home](#)

up

Last modified: 09/17/2009 10:36:42  
[Webdesign Heindl Internet AG](#)