Technology Collaboration Programme
by iea

International Energy Agency
Photovoltaic Power Systems Programme

Task 1 Strategic PV Analysis and Outreach

PVPS

National Survey Report of PV Power Applications in SWITZERLAND 2021

PLANAIR
Ingénieurs conseils en énergies et environnement

What is IEA PVPS TCP?

The International Energy Agency (IEA), founded in 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD). The Technology Collaboration Programme (TCP) was created with a belief that the future of energy security and sustainability starts with global collaboration. The programme is made up of 6.000 experts across government, academia, and industry dedicated to advancing common research and the application of specific energy technologies.

The IEA Photovoltaic Power Systems Programme (IEA PVPS) is one of the TCP's within the IEA and was established in 1993. The mission of the programme is to "enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems." In order to achieve this, the Programme's participants have undertaken a variety of joint research projects in PV power systems applications. The overall programme is headed by an Executive Committee, comprised of one delegate from each country or organisation member, which designates distinct 'Tasks,' that may be research projects or activity areas.

The IEA PVPS participating countries are Australia, Austria, Canada, Chile, China, Denmark, Finland, France, Germany, Israel, Italy, Japan, Korea, Malaysia, Morocco, the Netherlands, Norway, Portugal, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, and the United States of America. The European Commission, Solar Power Europe, the Smart Electric Power Alliance, the Solar Energy Industries Association, the Solar Energy Research Institute of Singapore and Enercity SA are also members.

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What is IEA PVPS Task 1?

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of PV power systems. Task 1 activities support the broader PVPS objectives: to contribute to cost reduction of PV power applications, to increase awareness of the potential and value of PV power systems, to foster the removal of both technical and non-technical barriers and to enhance technology co-operation. An important deliverable of Task 1 is the annual "Trends in photovoltaic applications" report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the country National Survey Report for the year 2021. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

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COVER PICTURE

Lac des Toules – Philippe Maly

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1 INSTALLATION DATA

The PV power systems market is defined as the market of all nationally installed (terrestrial) PV applications with a PV capacity of 40 W or more. A PV system consists of modules, inverters, batteries and all installation and control components for modules, inverters and batteries. Other applications such as small mobile devices are not considered in this report.

For the purposes of this report, PV installations are included in the 2021 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2021, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

The first photovoltaic installation in Switzerland dates back to 1992, but the country had to wait 2011 to observe a significant growth of the size of the yearly installed capacities, it has been developing at a rapid pace ever since (section 1.2).

The installations are mainly set on industries and residential areas. Nearly 80% of new installations are on residential areas but the industrial area systems make up for 40 % of the capacity installed (Figure 1 and Figure 2).

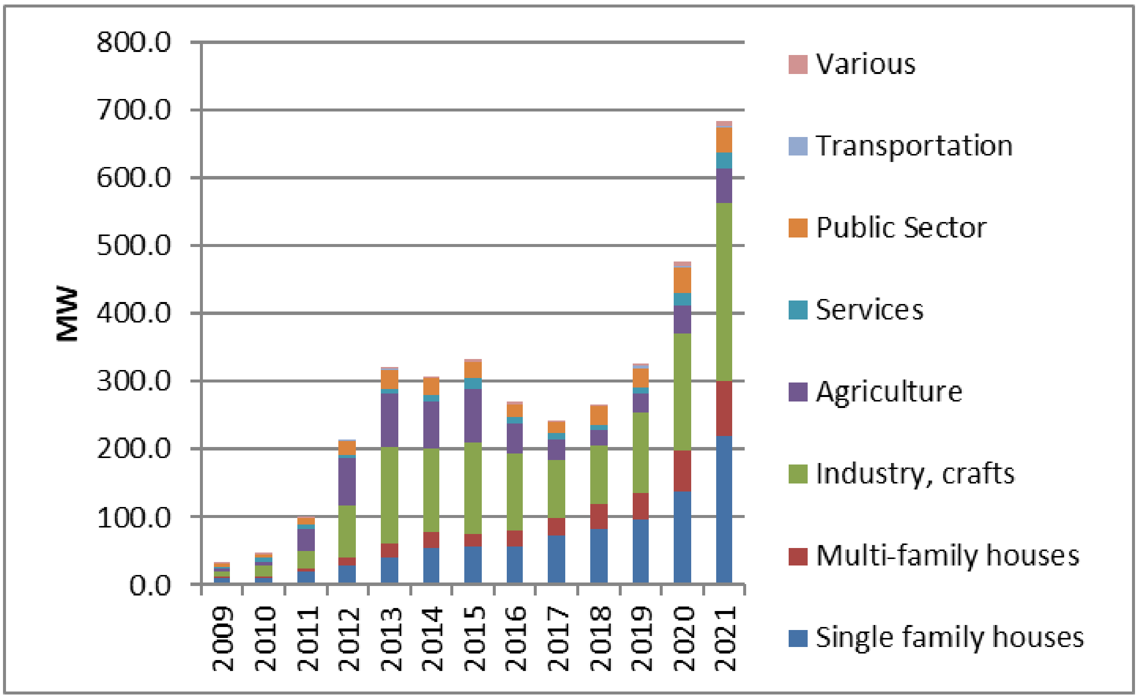


Figure 1: Photovoltaic installed capacity per sector

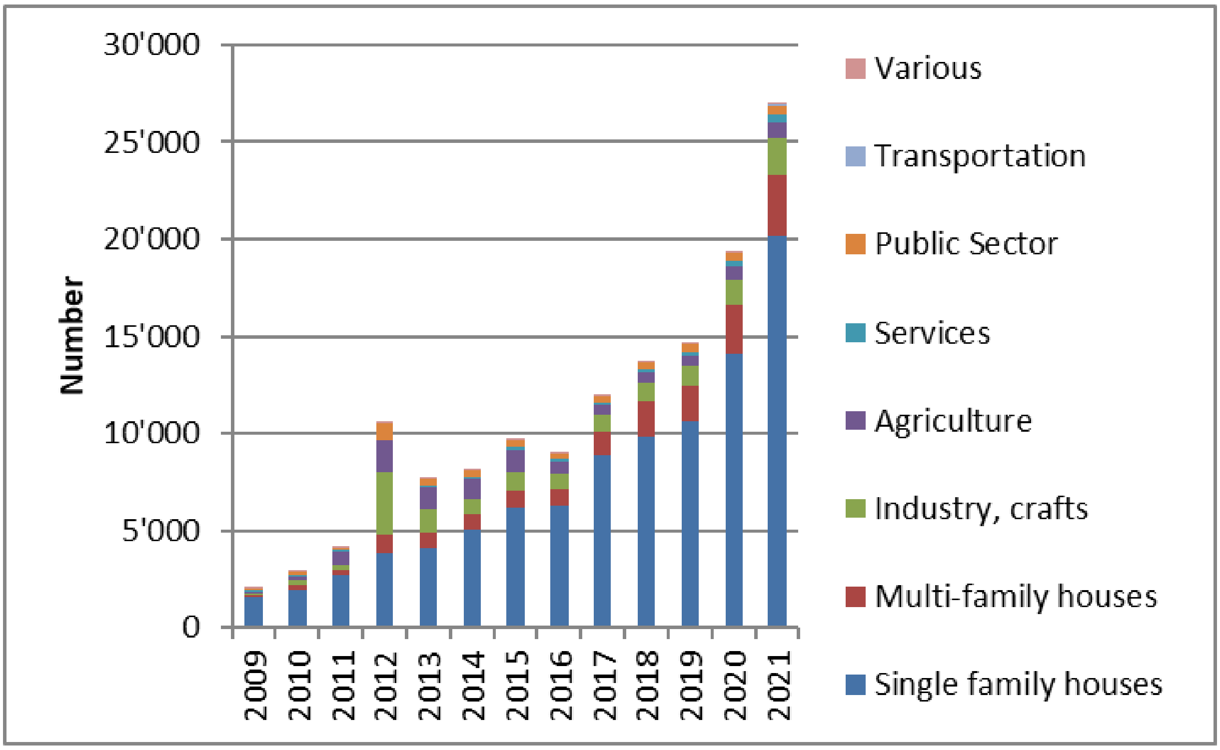


Figure 2 Number of photovoltaic systems installed per sector

Applications of PV in Switzerland are primarily roof-top grid-connected PV systems. Off-grid installations are very slowly appearing, 2021 saw for the second year in a row a decrease in newly installed off grid systems with 0.2 MW installed 2021 compared to 0.3 MW in 2020.

Façade PV projects started in 2020 and continue in 2021 with 4.1 MW installed (0.6% of installed capacity).

Ground-mounted projects are slowly announced and planned. Agricultural PV is still at the demonstrator stage but it is gaining traction, keeping in mind that the law underlines that PV installations must not prevent a terrain from being cultivated.

Switzerland has very strict heritage protection laws requiring the use of BIPV in numerous cases. It represents 12% of 2021 installed capacity.

This development is still slow, even if we notice technological advancements (colour & shape of modules) and increasing awareness of architects to use PV as a building element (thanks to policies making PV compulsory in new buildings).

The country is currently finding new ways to take advantage of its topography to install PV. High altitude PV systems in the Alps, either with floating installations like on the Lac des Toules (see illustration frontpage) or on dams. In 2020, the first dam was equipped with PV on top of it, 2021 has seen another breakthrough in the technology as AXPO and IWB started the installation of 2.2 MW on the Muttsee dam faces.

1.2 Total photovoltaic power installed

On behalf of the Swiss Federal Office of Energy, Swissolar is mandated to survey the Swiss solar market and publish the annual installed capacity in the report: "Statistiques de l'énergie solaire: Année de reference 2021". The data is based on a survey amongst 336 companies active in the PV and solar thermal market. About 95% of installers, importers/distributers and manufacturers are estimated to be covered in this annual market survey

In 2021, 685 MWp of PV capacity were installed compared to 475 MWp in 2020. It is the second year in a row where the installed capacity undergoes a close to 50% increase compared to the previous year .

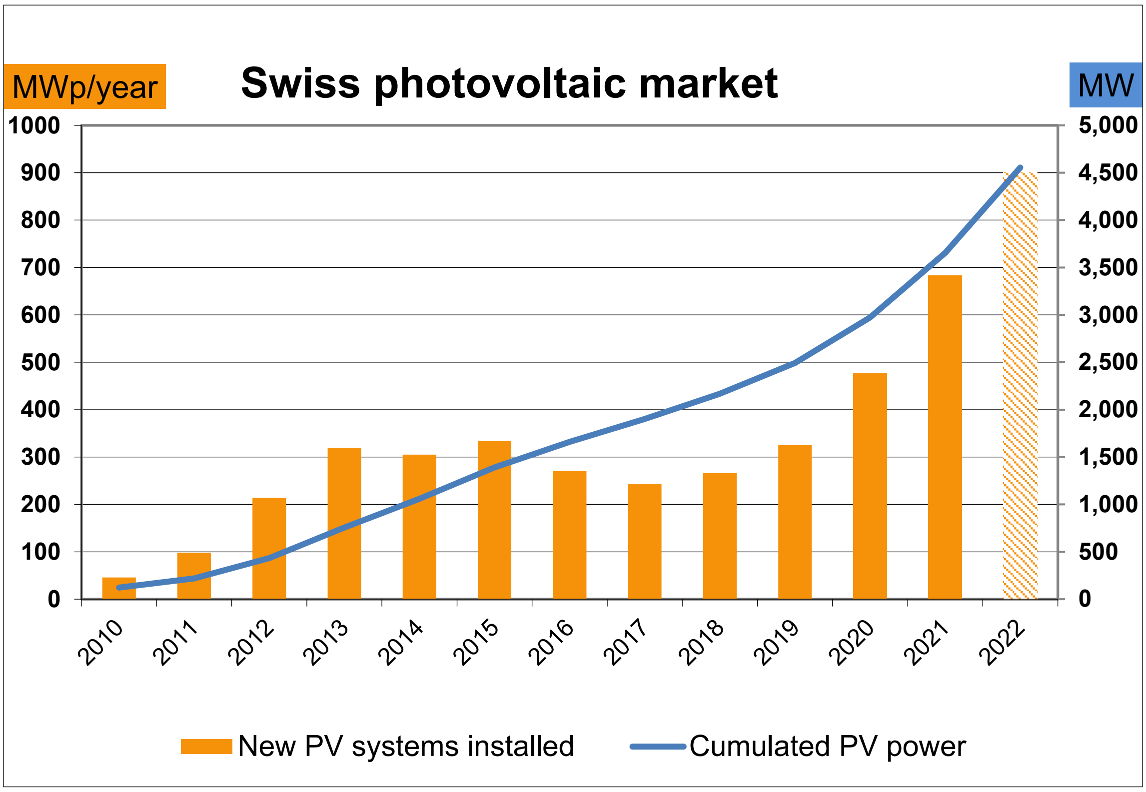


Figure 3 Installed PV capacity per year

Table 1: Annual PV power installed during calendar year 2021

		Installed PV capacity in 2021 [MW]	AC or DC
	Decentralized	681.7	DC
	Centralized	0	DC
	Off-grid	0.2	DC
	Total	681.9	DC

Table 2: PV power installed during calendar year 2021

			Installed PV capacity [MW]	Installed PV capacity [MW]	AC or DC
Grid-connected	BAPV	Residential	601.6	232.8	DC
		Commercial		97.2	DC
		Industrial		271.7	DC
	BIPV	Residential	80.1	31.0	DC
		Commercial		12.9	DC
		Industrial		36.2	DC
	Utility-scale	Ground-mounted			
		Floating			
		Agricultural			
Off-grid		Residential	0.2	0	DC
		Other		0.2	DC
		Hybrid systems		0	DC
Total			681.9		DC

Table 3: Data collection process

If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	Data are collected in DC
Is the collection process done by an official body or a private company/Association?	The data collection process is done by Swissolar (Swiss Solar Professional Association) on behalf of the Swiss government. It is based on a questionnaire sent to all importers, installers and manufacturers. It is estimated, that about 90% of the market is covered with this survey. To validate the data, there is a compulsory registration for systems above 30 kVA since the beginning of 2013 (Guarantees of origin and electricity labelling). The Swiss Federal Office of Energy has been surveying the solar market in Switzerland for more than 20 years. Due to this long experience the quality of the data has been maintained, thanks as well to all the installers and distributers who are willing to complete the annual questionnaire. The report was published by the Swiss Federal Office of Energy in July 2022 and also serves as a basis for the annual renewable energy statistics.
Link to official statistics (if this exists)	Solar Energy market survey (DE/FR): https://www.swissolar.ch/en/about-solar/facts-and-figures/solar-energy-statistics/ Electricity Statistics (DE/FR): https://www.bfe.admin.ch/bfe/fr/home/approvisionnement/statistiques-et-geodonnees/statistiques-de-lenergie/statistique-de-l-electricite.html Overall Energy Statistics (DE/FR): https://www.bfe.admin.ch/bfe/fr/home/approvisionnement/statistiques-et-geodonnees/statistiques-de-lenergie.html
	The quality and accuracy of the data are expected to be better than +/-10%.

Table 4: The cumulative installed PV power in 4 sub-markets

Year	Off-grid [MW] (including large hybrids)	Grid-connected distributed [MW] (BAPV, BIPV)	Grid-connected centralized [MW] (Ground, floating, agricultural…)	Total [MW]
1992	0.72	4.1		4.82
1993	0.88	5.1		5.98
1994	1.04	6.1		7.14
1995	1.2	7.1		8.3
1996	1.4	8.42		9.82
1997	1.6	9.74		11.34
1998	1.8	11.06		12.86
1999	2	12.38		14.38
2000	2.2	13.7		15.9
2001	2.2	16.1		18.3
2002	2.3	17.9		20.2
2003	2.4	19.5		21.9
2004	2.5	21.8		24.3
2005	2.6	25.7		28.3
2006	2.7	27.4		30.1
2007	2.9	34.5		37.4
2008	3	46.4		49.4
2009	3	76.5		79.5
2010	3	122.4		125.4
2011	3	219.9		222.9
2012	3	433.5		436.5
2013	3.2	752.4		755.6
2014	3.7	1056.9		1060.6
2015	3.9	1390.1		1394
2016	4	1660.2		1664.2
2017	4.1	1902.3		1906.4
2018	5.6	2167.6		2173.2
2019	6.1	2492		2498.1
2020	6.35	2967.05		2973.4
2021	6.6	3648.7		3655.3

Table 5: Other PV market information

<table>
<tr><th></th><th>2021</th></tr>
<tr><td>Number of PV systems in operation in your country</td><td>Around 144'550
Split per market Segment of PV systems
<table>
<tr><th>Market Segment</th><th>Share (of the number of installations)</th></tr>
<tr><td>Residential</td><td>78%</td></tr>
<tr><td>Industry</td><td>10%</td></tr>
<tr><td>Agriculture</td><td>7%</td></tr>
<tr><td>Services</td><td>1%</td></tr>
<tr><td>Utilities</td><td>3%</td></tr>
<tr><td>Transport</td><td><1%</td></tr>
<tr><td>Others</td><td>1%</td></tr>
</table></td></tr>
<tr><td>Decommissioned PV systems during the year [MW]</td><td>< 0.5 (estimation)</td></tr>
<tr><td>Repowered PV systems during the year [MW]</td><td>2.7</td></tr>
</table>

Table 6: PV power and the broader national energy market

	2020	2021
Total power generation capacities [GW]	**22.42 GW total** (15.57 GW Hydro ; 3.33 GW nuclear ; 3.5 GW Thermal & RE)	**22.57 GW total** (15.59 GW Hydro ; 2.96 GW nuclear ; 4.01 GW Thermal & RE)
Total renewable power generation capacities (including hydropower) [GW]	**19.08 GW total** (15.57 GW hydro, 3.0 GW PV, 87 MW Wind. 422 MW waste)	**19.08 GW total** (15.59 GW hydro, 3.7 GW PV, 87 MW Wind. 406 MW waste)
Total electricity demand [TWh]	55.7 (-2.6%)	58.113 (+4.33%)
New power generation capacities installed [MW]	+ 475 MW PV + 30 MW Hydro + 17 MW Wind	+ 685 W PV + 20 MW Hydro
New renewable power generation capacities (including hydropower) [GW]	+ 475 MW PV + 30 MW Hydro	+ 685 W PV + 20 MW Hydro
Estimated total PV electricity production (including self-consumed PV electricity) in [GWh]	2'599 GWh	2'842 GWh
Total PV electricity production as a % of total electricity consumption	4.67%	4.89%
Average yield of PV installations (in kWh/kWp)	985	895

1.3 Key enablers of PV development

	Description	Annual Volume	Total Volume	Source
Decentralized storage systems In [MW,MWh or #]	+ 175% of added capacity and +98.8% of total capacity compared to 2020	**Added capacity**: 78'110 kWh (including 240 kWh lead battery) **Added number:** 6'290 (including 30 lead battery)	157'165 kWh (including 1'495 kWh lead battery)	https://www.swissolar.ch/fr/lenergie-solaire/faits-et-chiffres/enquetes-de-marche/
Residential Heat Pumps [#]	Among the added systems, 18'768 (56%) in the range 5-13kW, 9'987 (30%) for 13-20 kW and 3'837 (11%) for 20-50 kW)	+33'318 added systems (it was +28'064 in 2020 so +19% increase in added volume))	428'425 (+8.4%)	https://www.fws.ch/fr/nos-services/statistiques/
Electric cars [#]	In 2021 31'486 (13.32 %) are BEV and 21'052 (8.9%) are PHEV have been registered	+52'538 new BEV or PHEV (+58% compared to 2020)	-	https://www.bfe.admin.ch/bfe/fr/home/approvisionnement/statistiques-et-geodonnees/statistiques-des-vehicules/statistiques-des-motorisations-alternatives-des-voitures-neuves.html
Electric buses and trucks [#]	A Support program has been put in place until at least 2030 to encourage the use of hybrid or electric buses with national CO2 certificates Electric buses in 2021 are still at the stage of planification or pilot projects but the timeline has already been established for some companies like "Postauto" which plans to replace all their 2400 buses with fossil fuel free ones for 2040.			https://www.myclimate.org/fr/ Propulsions alternatives | CarPostal (postauto.ch)

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 7: Typical module prices

Year	Lowest price of a standard module crystalline silicon [CHF/W]	Highest price of a standard module crystalline silicon [CHF/W]	Typical price of a standard module crystalline silicon [CHF/W]
2005	4.6	4.8	4.75
2006			
2007			
2008			
2009			
2010	2.2	3.6	3.25
2011	1.3	2.5	2.20
2012	0.85	1.3	1.19
2013	0.8	1	0.95
2014	0.57	0.95	0.86
2015	0.55	0.93	0.84
2016	0.5	0.9	0.80
2017	0.45	0.86	0.76
2018	0.4	0.75	0.66
2019	0.36	0.73	0.64
2020	0.35	0.73	0.41
2021	0.36	0.73	0.42

The lowest price for 2021 is the average price for installation above 100 kWp, whereas the highest price is given by the highest module price on the market. The typical module price in 2020 is 0.41 CHF/W. There wasn't any substantial reduction in the module price between 2020 and 2021. The chosen methodology explains this difference. Until 2019 the price was based on field experience. The value for 2021 is computed as the weighted average of average module price for each PV capacity range and market size of each PV capacity range.

2.2 System prices

Table 8: Turnkey PV system prices of different typical PV systems

Category/Size	Typical applications and brief details	Current prices [CHF/W]
Off-grid 1-5 kW	A stand-alone PV system is a system that is installed to generate electricity to a device or a household that is not connected to the public grid.	6
Residential BAPV 5-10 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected households. Typically roof-mounted systems on villas and single-family homes	2.4 to 3.2
Residential BIPV 5-10 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected households. Typically, on villas and single-family homes.	2.6 to 4.8
Small commercial BAPV 10-100 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1.4 to 2.5
Small commercial BIPV 10-100 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1.5 to 3.8
Large commercial BAPV 100-250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected large commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1.0 to 1.5
Large commercial BIPV 100-250 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1.1 to 2.3
Industrial BAPV >250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected industrial buildings, warehouses, etc.	0.9 to 1.1 (lowest 0.7)
Small centralized PV 1-20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale	N/A
Large centralized PV >20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	N/A

Table 9: National trends in system prices for different applications

Year	Residential BAPV Grid-connected, roof-mounted, distributed PV system 5-10 kW **[CHF/W]**	Small commercial BAPV Grid-connected, roof-mounted, distributed PV systems 10-100 kW **[CHF /W]**	Large commercial BAPV Grid-connected, roof-mounted, distributed PV systems 100-250 kW **[CHF /W]**	Centralized PV Grid-connected, ground-mounted, centralized PV systems 10-50 MW **[CHF /W]**
2010	6.6 - 7.1	5.5 - 6.6	5 - 5.5	-
2011	-	-	-	-
2012	4.6 - 5.0	3.4 - 4.6	3 - 3.4	-
2013	-	-	-	-
2014	-	-	-	-
2015	4.8 - 3.5	-	-	-
2016	4.8 - 3.5	-	-	-
2017	4.2 - 3.3	-	-	-
2018	2.6 - 3.6	1.4 - 2.6	1.2 - 1.4	-
2019	2.5 - 3.5	1.3 - 2.5	1.2 - 1.3	-
2020	2.4 - 3.1	1.3 - 2.4	1.0 - 1.3	-
2021	2.4 - 3.2	1.4 - 2.5	1.0 - 1.5	

The dependence of PV system costs on its size is shown in Figure 4.

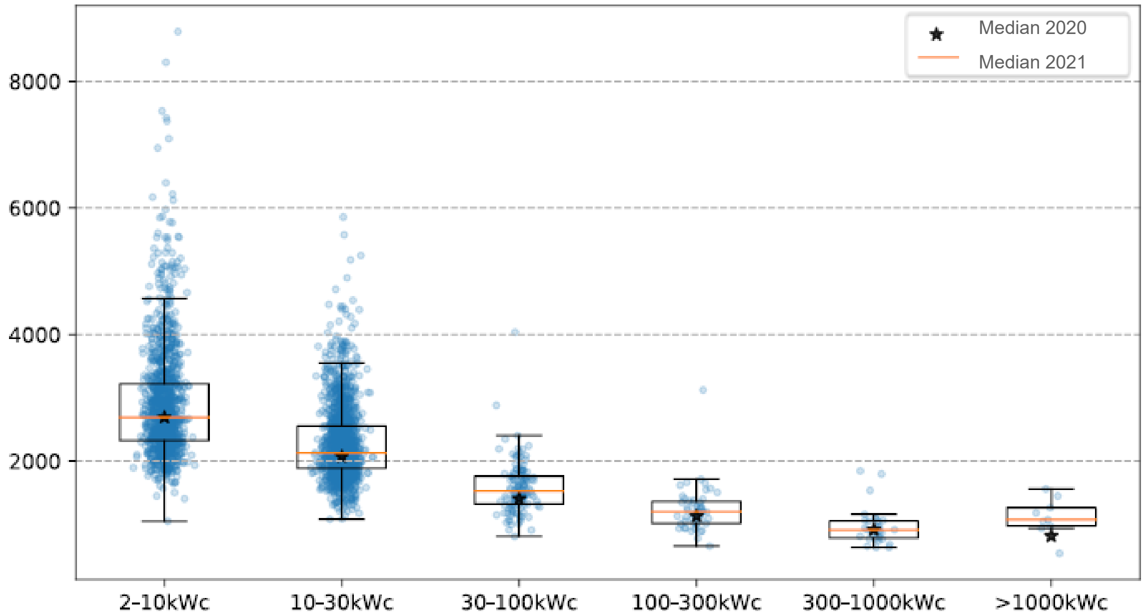


Figure 4 : Grid-connected PV system specific costs (source: Observation des prix du marché photovoltaïque 2021)

2.3 **Cost breakdown of PV installations**

The cost breakdown of a typical 5-10 kW roof-mounted, grid-connect, distributed PV system on a residential single-family house at the end of 2021 is presented in Table 10.

The cost structure presented is from the customer's point of view. I.e., it does not reflect the installer companies' overall costs and revenues. The "average" category in Table 10 represents the average cost for each cost category and is the average of the typical cost structure. The average cost takes the whole system into account and summarizes the average end price to the customer. The "low" and "high" categories are the lowest and highest cost that has been reported within each segment. These costs are individual posts, i.e. summarizing these costs does not give an accurate system price.

A comprehensive cost survey has been published for 2021. The results are presented in the pie charts below for the BAPV:

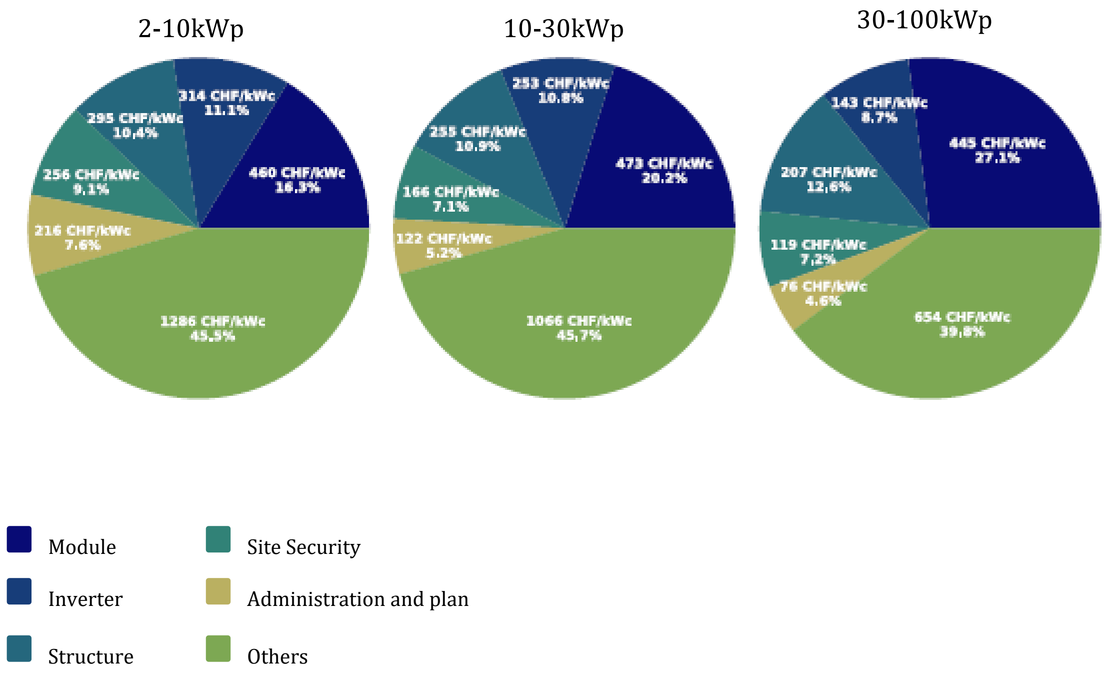


Figure 5 : Breakdown of the costs of added photovoltaic installations, divided into six main categories

The chosen installation to calculate those costs all have known and non-zero values for the first 5 categories (excluding "Others"). There were too few data for installations above 100 kWp to calculate a reliable cost breakdown.

Table 10: Cost breakdown for a grid-connected roof-mounted, distributed residential PV system of 5-10 kW

Cost category	Average [CHF/W]	Low [CHF/W]	High [CHF/W]
Hardware			
Module	0.459		
Inverter	0.312		
Mounting material	0.295		
Other electronics (cables, etc.)	0.296		
Subtotal Hardware	1.362		
Soft costs			
Planning	0.211		
Installation work	0.864		
Shipping and travel expenses to customer	0.076		
Permits and commissioning (i.e. cost for electrician, etc.)	0		
Project margin	0.21		
Subtotal Soft costs	1.361		
Total (excluding VAT)	2.723		
Average VAT	7.7%		
Total (including VAT)	2.933		

2.4 Financial Parameters and specific financing programs

Table 11: PV financing information in 2021

Different market segments	Loan rate [%]
Average rate of loans – residential installations	1.25 - 1.40 (2020) *
Average rate of loans – commercial installations	2.75 – 3.5 (2021) * 2.30-3.20 (2020) *
Average cost of capital – industrial and ground-mounted installations	2.25 - 3.15 (2020) *

* Depending upon secured/unsecured, the specifics of the project and the duration

2.5 Specific investments programs

Table 12: Summary of existing investment schemes

Investment Schemes	Introduced in Switzerland
Third party ownership (no investment)	Yes. More and more companies and utilities offer contracting solutions for PV, either with a fixed contractual percentage of self-consumption (risk bared by the user) or without (risk bared by the investor)
Renting	No
Leasing	Yes. Various business models are explored, including leasing options, even for households.
Financing through utilities	Yes. Utilities are getting more active in the PV business. They finance PV installations either for their own portfolio or as contracting solutions for end-consumers. They are actively integrating PV in their business, including buying PV installation companies. Most utilities have now their own PV installations department
Investment in PV plants against free electricity	While this investment scheme has been employed by some utilities (investment per m2 of modules, production corresponding to the investment is deducted from the electricity bill), it is not compatible with the regulation. If still employed, it is mainly against PV green certificates.
Crowd funding (investment in PV plants)	Yes. Similar to above but usually mainly for green certificates, niche market. For investment, mainly cooperative society and crowdlending.
Community solar	Yes, it is growing thanks to the new possibilities of collective self-consumption introduced in

	2018. Community solar is increasing significantly for new residential buildings. Another possibility is cooperatives that invest in PV plants and repay the invested capital with a small dividend based on the annual performance.
International organization financing	Not applicable

2.6 Additional Country information

Table 13: Country information

Retail electricity prices for a household [CHF/kWh]	0.2048
Retail electricity prices for a commercial company [CHF/kWh]	0.1857
Retail electricity prices for an industrial company [CHF/kWh]	0.1414
Liberalization of the electricity sector	Currently, only large consumers (>100MWh/year) have access to a liberalized electricity market. However, an amendment of the law (LApEI) is currently under consultation to allow all consumers to freely choose their electricity supplier.

3 POLICY FRAMEWORK

This chapter describes the support policies aiming directly or indirectly to drive the development of PV. Direct support policies have a direct influence on PV development by incentivizing or simplifying or defining adequate policies. Indirect support policies change the regulatory environment in a way that can push PV development.

Table 14: Summary of PV support measures

Category	Residential		Commercial + Industrial		Centralized	
Measures in 2021	**On-going**	**New**	**On-going**	**New**	**On-going**	**New**
Feed-in tariffs	Yes	-	Yes	-	-	-
Feed-in premium (above market price)	Yes	-	Yes	-	-	-
Capital subsidies	Yes	-	Yes	-	-	-
Green certificates	Yes	-	Yes	-	-	-
Renewable portfolio standards with/without PV requirements	-	-	-	-	-	-
Income tax credits	Yes	-	Yes	-	-	-
Self-consumption	Yes	-	Yes	-	-	-
Net-metering	-	-	-	-	-	-
Net-billing	Yes	-	Yes	-	-	-
Collective self-consumption and delocalized net-metering	Yes	-	Yes	-	-	-
Activities of electricity utility businesses	yes	-	yes			
Sustainable building requirements	Yes	-	Yes	-	-	-
BIPV incentives	Yes	-	Yes	-	-	-

3.1 National targets for PV

The transformation of the Swiss energy system aimed with the "Energy Strategy 2050" is a long-term project. The Swiss electorate accepted a revised Federal Energy Act in 2017 in a popular referendum. This new legislation entered into force on 1 January 2018. The aims are to reduce energy consumption, increase energy efficiency and promote the use of renewable energy (www.energystrategy2050.ch).

Electricity production from photovoltaics is one of the key pillars in the strategy for the future Swiss electricity supply.

A forecast of renewable generation per year is shown in Figure 6.

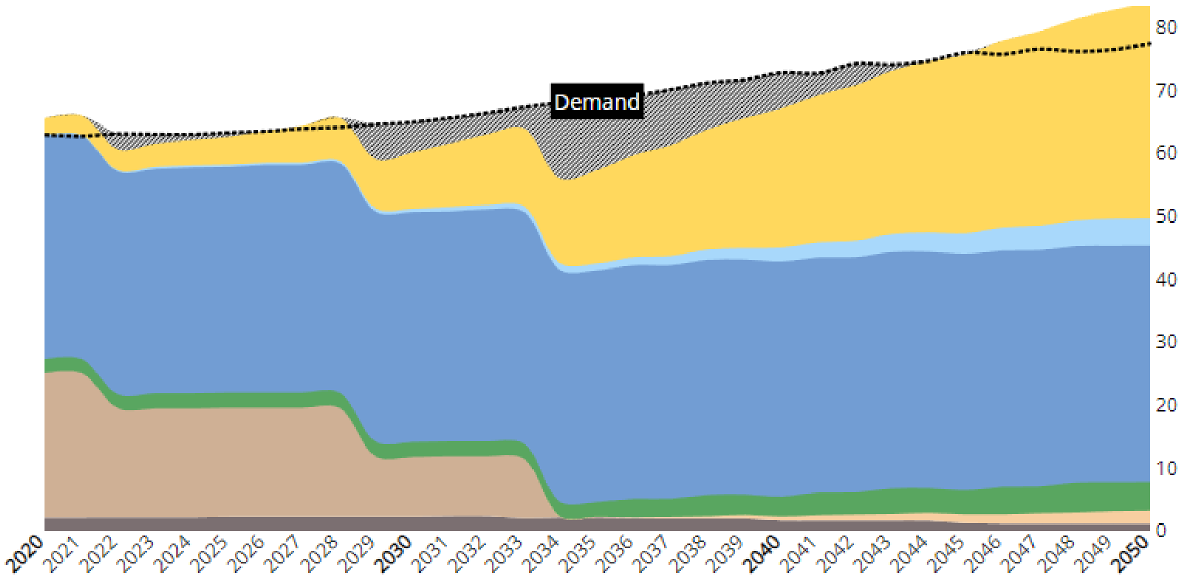
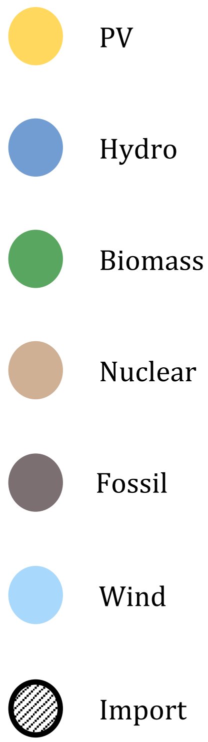


Figure 6 Annual Energy Mix as planned by the Energy Strategy 2050



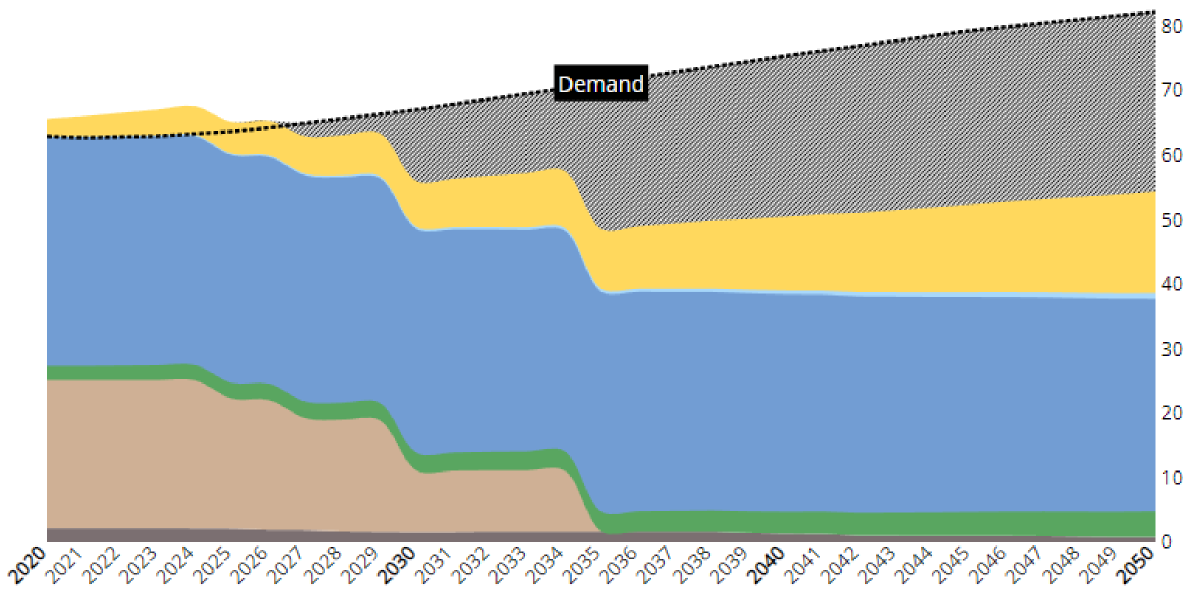


Figure 7 Annual Energy Mix evolving at the current pace if the rates are stable from 2020 on

The latest study called 2050+ aims to generate 34 TWh from photovoltaics in 2050. The 2021 record installation rate of 683.5 MWp/year is not sufficient to reach this objective by 2050 and should be raised to approximately 1000 MWp/year without taking into account the replacement of the installed capacity. Considering the replacement, the installation rate should reach 1100 MWp/year. The Figure 7 underlines the necessity to increase the installation rate showing how nuclear energy would be replaced by imports if each year a steady 475 MWp (based on 2020 new PV) is installed.

Despite having not reached yet the steady-state rate, Switzerland is on the right track. The newly installed capacity increases of more than 40% each year. With a forecast of the PV installed in 2022 of 850-900 MWp (Figure 3), the trend should continue.

Moreover, the Swiss Federal Office of Energy announced in September 2018 that the PV potential on the Swiss roof was about 50 TWh. The evaluation is based on the national maps for PV roofs (www.toitsolaire.ch) and selecting the most suitable roofs. The tool is online for all of Switzerland and is translated into English. It is possible to have an evaluation of the approximate PV potential of every single roof in Switzerland. Since April 2019, it also includes the potential of façades. This potential was confirmed by a study executed by ZHAW in 2022 (Photovoltaik Potenzial auf Dachflächen in der Schweiz | ZHAW digitalcollection). Another analysis estimates the Swiss roof-top PV potential to be 24 ± 9 TWh. Therefore, the potential of façades and others surfaces (parking, floating PV, …) will probably need to be exploited.

3.2 Direct support policies for PV installations

With the entry in force of the new Federal Energy Act since the 1st of January 2018, the support scheme for PV systems has changed:

- the one-time investment subsidy is extended to all sizes of PV systems (from 2 kW to 50 MW)
- the one-time investment was updated in 2022 from 380 * p(kW) + 700 CHF to 380 * p(kW) + 350 for plants < 30 kWp to incentive investments in larger PV capacities and avoid waste of potential with half roof usage.

3.2.1 One-time remuneration

At the national level, the primary support measure is a one-time remuneration. This direct subsidy depends on the installed capacity, as detailed in the Table below. It allows reducing the investment cost by 20%-30%. This support measure is financed through a levy on electricity consumption. In 2018, this network surcharge was increased from 1.5 cts/kWh to 2.3 cts/kWh

One-time remuneration as a function of commissioning date:

BAPV	01.04.2019-31.03.2020	01.04.2020-01.04.2021	01.04.2021-31.03.2022	Since 01.04.2022
Base contribution (CHF)	1400	1000	700	350
Additional contribution (CHF / kW)				
< 30 kW	340	340	380	380
< 100 kW	300	300	290	300
> 100 kW	300	300	290	270

3.2.2 BIPV development measures

The one-time remuneration scheme is approximately 10% higher for BIPV than BAPV for PV installations smaller than 100 kW. This difference is being reduced, especially from 2021 onwards.

One-time remuneration as a function of commissioning date:

BIPV	1.4.2019-31.3.2020	01.04.2020-01.04.2021	01.04.2021-31.03.2022	Since 01.04.2022
Base contribution (CHF)	1550	1100	770	385
Additional contribution (CHF / kW)				
< 30 kW	380	380	420	420
< 100 kW	330	330	320	330
> 100 kW	For systems larger than 100 kWp, the one-time remuneration is the same as the one for BAPV			

In addition to the federal subsidies for BIPV, some communities also give incentives for PV facades (e.g. bonus of 50% compared to roof-top).

Also, several innovative BIPV projects (such as using specifically designed modules for protected buildings or resulting in energy self-sufficient buildings) have been supported by a special fund for pilot and demonstrator projects from the government. BIPV projects are also incentivized by constraints set by the building permit process for buildings having a cultural value.

3.3 Self-consumption measures

Table 15: Summary of self-consumption regulations for small private PV systems in 2021

PV self-consumption	1	Right to self-consume	Yes, since 2014
	2	Revenues from self-consumed PV	Savings on electricity bill which is 2-3 times higher than feed-in tariffs. The electricity for an average household cost 20.5 cts/kWh in average in 2021 whereas the feed-in tariffs range from 5 to15 cts/kWh. Almost 90% of the bill is directly or indirectly related to energy (kWh), making self-consumption very profitable
	3	Charges to finance Transmission, Distribution grids & Renewable Levies	No, some DSO charge for installing a bi-directional energy meter. It is currently being debated to attribute a larger part of the grid fee to power and not to energy in order to increase the contribution of self-consumers to grid cost. An increase of the CO2 tax to in part fund renewables has been rejected by popular consultation in 2021.
Excess PV electricity	4	Revenues from excess PV electricity injected into the grid	Depending on DSO (range of 5-20 cts/kWh), often including the revenue for green certificates. (Figure 8)
	5	Maximum timeframe for compensation of fluxes	Real-time (standard metering timeframe of 15 minutes)
	6	Geographical compensation (virtual self-consumption or metering)	Local with the same user of collective self-consumption.
Other characteristics	7	Regulatory scheme duration	The compensation scheme for excess electricity is adjusted every year (with the exception of the national feed-in tariff, which is fixed over 15 to 25 years)
	8	Third-party ownership accepted	Yes, most utilities are now active to propose PV contracting and self-consumption to their large customers
	9	Grid codes and/or additional taxes/fees impacting the revenues of the prosumer	Until 2018, some utilities applied a different tariff structure for prosumers (power metering). From 2018 onward, only one tariff structure is allowed for prosumers with an annual consumption smaller than 50 MWh and with a connection to the grid below 1 kV
	10	Regulations on enablers of self-	In some cases, heat pumps or resistive heating systems are remotely controlled by the DSO, but not necessarily

		consumption (storage, DSM…)	in a way that optimizes self-consumption. DSM is common for industries to avoid power peaks but can be used to optimize self-consumption as well. Thanks to more solutions available for DSM, more and more single household owners with PV systems are interested in increasing self-consumption. Specific recommendations exist for connection and metering of storage systems
	11	PV system size limitations	No PV size limitations
	12	Electricity system limitations	No
	13	Collective self-consumption, solar communities and similar measures	Collective self-consumption has been allowed by most DSOs, of which there are more than 500, since 2014. Previously, self-consumption was restricted to consumers in the same building or within the same perimeter of land. In this context, the DSO was also responsible for billing every customer. With the new legislation that came into force in January 2018, collective self-consumption opportunities are improved significantly. End-consumers can form a community as long as their land is contiguous and the public grid is not used i.e. it is a single grid-connection, acting as a unique connection point towards the DSO. The internal metering is then under the responsibility of the consortium. This also allows the consumers to access the free electricity market, an additional strong incentive as long as the new self-consumption consortium has an electricity consumption above 100 MWh/year. Collective self-consumption has also been improved to create investment security for third-party ownership in case of a building occupied by tenants. Under specific conditions, the tenant should purchase the collectively produced PV electricity

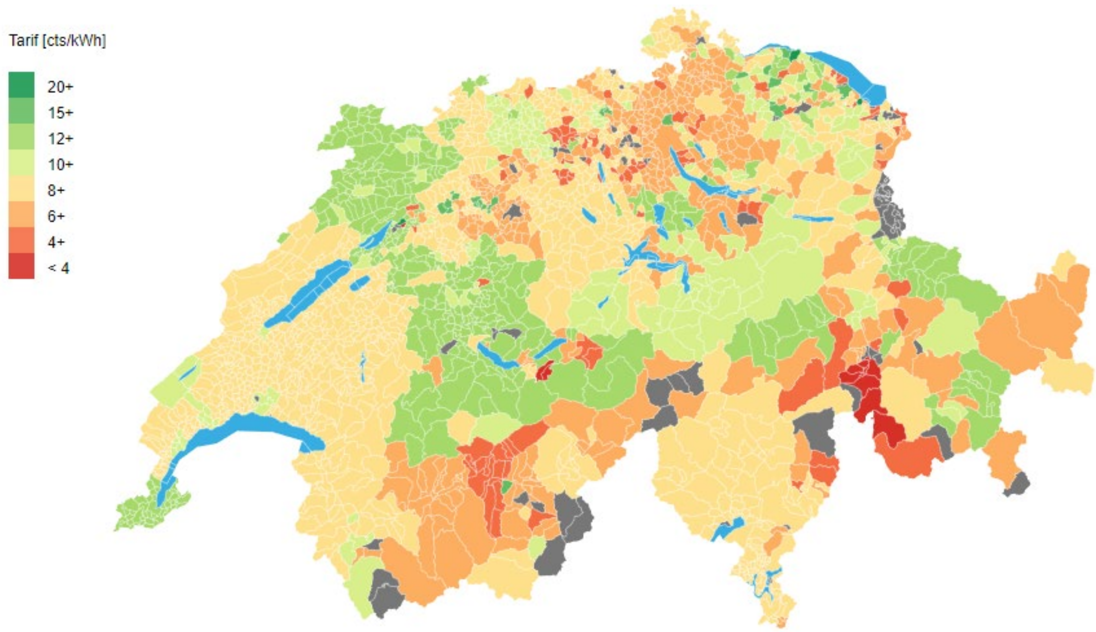
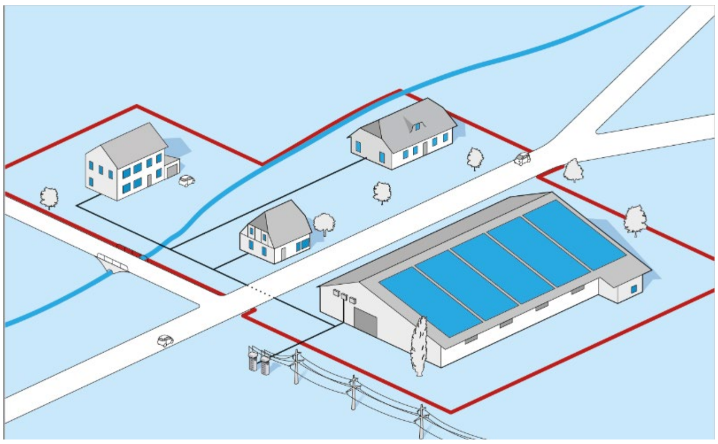


Figure 8 Revenues from excess electricity across Switzerland

3.4 Collective self-consumption, community solar and similar measures

Collective self-consumption has been allowed by most DSOs (Switzerland has around 630 DSOs in 2021) since 2014, but it used to be restricted to consumers of the same building or within the same perimeter of land. In this context, the DSO was also responsible for billing every customer.



With the new legislation that came into force in January 2018, collective self-consumption opportunities are improved significantly. End-consumers can form a community as long as their land is contiguous and the public grid is not used i.e. it is a single grid-connection, acting as a unique connection point towards the DSO.

The internal metering is then under the responsibility of the community. An additional incentive for collective self-consumption communities is the possibility to access the free electricity market if its consumption is above 100 MWh/year. Collective self-consumption becomes an enabler of a new step of market liberalization for small customers. It has also been improved to create investment security for third-party ownership in case of a building occupied by tenants (under a set of conditions, the tenant has to purchase the collective PV electricity).

Two types of collective self-consumption communities are available in Switzerland. The RCP (Regroupement de consommation propre) and the CA (Communauté d'autoconsommation). The Table below details the difference between these two options:

	RCP	CA
Number of consumers (seen by the DSO)	One	Many
Internal pricing for PV self-consumption	Strict rules	No rule
Minimum PV capacity	10% of the grid connection power	-
Consumers can leave the community whenever they want	No	Yes
Solidarity debtors	Owner	Consumers
Interests for the DSO		Data for each consumer
Interests for the consumer	Better prices Access to the free electricity market (if the RCP reaches a consumption of > 100'000 kWh/year	

This new measure allows for more flexibility for self-consumption and fosters the integration of PV in the local electricity grid.

The number of RCP registered a 100% increase from 2019 to 2020 underlining the interest it draws.

This measure is also an incentive for batteries, and several new buildings or collections of new buildings are built as a self-consumption community.

The figure above illustrates a collective self-consumption community with 198kWp of PV and a self-consumption above 95% thanks to local battery storage.

More general information and examples can be found on the Suisse Energie platform: https://pubdb.bfe.admin.ch/fr/publication/download/7964

3.5 Tenders, auctions & similar schemes

There are no tendering schemes for PV systems in Switzerland. There are, however, several auction platforms for selling/buying green certificates (guarantee of origin). The price for those certificates has constantly dropped over the past years.

3.6 Other utility-scale measures including floating and agricultural PV

There are no specific utility-scale measures in place in Switzerland.

3.7 Social Policies

Public buildings are often considered for PV installations. It is mainly because law or recommendation mentions that public authorities have to put themselves in the spotlight and show the example.

There isn't any specific subsidy for low-income electricity consumers.

3.8 Retroactive measures applied to PV

No retroactive measure was applied in 2021

3.9 Indirect policy issues

3.9.1 Rural electrification measures

No specific rural electrification measures are in place in Switzerland as already 100% of the population has access to electricity.

3.9.2 Support for electricity storage and demand response measures

There is no support scheme for electricity storage on a national level, however, some cantons (Thurgau, Appenzell Ausserrhoden, and Vaud) have introduced, for some times, direct subsidies for local storage solutions. Support sheme in Vaud and Appenzell ended in 2020.In Schaffhouse there is a subsidy of 1500 CHF per installation, an additional 150CHF per kWh of battery capacity without exceeding 10’000 CHF or 25% of the installation price.

There are ongoing discussions of some DSO for introducing new tariff designs that would allow for partial recovery of the investment costs if the storage system owner is willing to let the DSO party manage the storage unit. More and more utilities are also offering solutions for virtual storage. For a fee (fixed or per kWh), the owner of a PV system can use the DSOs grid as virtual storage for his PV production and use it later (basically a net-metering solution).

3.9.3 Minimum renewable energy for new buildings

In the framework of the MoPEC "modèle de prescriptions énergétiques des cantons" some cantons have chosen to impose a minimum renewable energy production for new buildings. For instance, in the canton de Vaud, 20% of the normalized electricity needs of new buildings should be directly covered by local renewable energy production such as photovoltaics.

3.9.4 Support for electric vehicles (and VIPV)

There is no direct national support scheme for electric vehicles in Switzerland.

Fully electric vehicles do not pay the automobile duty of 4%, and of course, since they do not run on fossil fuels, there is no petroleum tax to pay (as such, EVs do currently not contribute to road infrastructure). Electric vehicles also often pay reduced vehicle taxes, but there are significant differences from one canton to another.

On the 11th of September 2018 the Swiss Government launched a tender for the installation of fast-charging stations on 100 service stations along motorways. Grid connection will be pre-financed by the government and repaid by the operator through concession fees. The first fast charging station was unveiled mid-2020 and since then 21 more charging points have been installed. 40 more service stations are to be equipped in 2022, all the 100 installations are programmed to have their charging stations in 2030.

Since 2017, Swiss eMobility (Swiss Association for Electric Mobility) awards each year a prize (golden plug) to communities and cities with exceptional effort to push electromobility. The Schaffhouse canton is the winner in 2021 thanks to a new regulation making compulsory the presence of a charging point in every new building.

There are various ways of fostering EVs applied by some cantons and cities. Some will subsidize charging stations such as the Geneva canton which funds the installation of charging points for up to 2'000 CHF for collective parking places. Others focus on the vehicles as the industrial services city of Delémont in Jura who pays up to 15% of the price of the electric car when buying a new one. There are more general measures, as in the region of Tessin decided to allocate 3 million CHF for eMobility in 2019 and continued the program in 2021 providing 11 million CHF more.

A more exhaustive list of financial aids can be found on the Swiss eMobility website : https://www.swiss-emobility.ch/fr/electromobilite/Mesures-d-aide-/#tab_c62f256bf810322d7510f5d6908f7671_1, available in French and German.

3.9.5 Curtailment policies

For PV installations over 3MWp or production over 5000 MWh per year, the DSO is not bound to buy the injected energy, which restricts the number of such installations.

It is often difficult to obtain a permit to install PV systems elsewhere than on buildings because of the territory management laws currently in place, thus limiting the size and number of the installations.

Grid reinforcement and curtailment policies are so far rarely necessary because most development is made to have enough self-consumption. Therefore, some PV installations are not even exploiting the full roof potential of building to have a better LCOE.

In a long-term perspective, it is discussed that the incentive (mainly the one-time remuneration) should focus on promoting the reduction of the AC-DC ratio of PV installations to reduce the need for complicated curtailment policies.

3.9.6 Other support measures

Minergie, a leading building standard organization supported by the cantons and the Swiss Federal Office of Energy and the building industry, revised its building standards in 2016. PV has become quasi-mandatory to fulfill the requirements for the nearly zero-energy standards. Since for a Minergy labeled building, only 40% of the grid-injected electricity can be counted for the overall energy requirements, there is an additional incentive to optimize self-consumption (DSM, battery).

These voluntary building standards helped pave the way for the new building standards defined by the cantons (10 Watt PV per square meter of heated area in new buildings).

Since 2015, the Swiss government has published a recommendation for the energy policies in cantons. These regulations should include a requirement for PV in every new building. In some cantons (e.g. Vaud), a requirement of including about 10 W PV per square meter of heated area for new buildings is already implemented, others are expected to adapt their cantonal energy acts accordingly in the coming years. It is also recommended to include 10% renewable energy when the heating system has to be retrofitted. PV can be an option, among others.

A negative measure hindering PV development are the restrictions on installing PV systems in some cities (for example for places listed as UNESCO World Heritage), enforce restrictions on installing PV systems on roofs (color of modules/frames, module layout) and sometimes purely reject ridge, orientation, or even pure rejection), which also hinders PV development.

2021 is marked by several measure aimed at lightening the administrative burden process to install PV. Smaller installations are free of some of the previously needed authorization, systems in industrial and agricultural zones do not require a building permit anymore under some conditions.

Furthermore, the territory spatial ordinance has been modified in 2021 for an execution starting on the 1st of January 2022: the heritage protection regulation is loosened and, floating PV even out of the building zones is now authorized.

In early 2021 the The Swiss Federal Office of Energy (SFOE) launched Swiss Energy research for the Energy Transition (SWEET) program to fund innovation in sustainable solutions. For example, in 2021 a call for projects to ensure a better integration of renewables in the energy grid was made, 77 projects were presented and 4 awarded.

National researches (Extract from the PVPS Annual report 2020)

The Swiss Federal Office of Energy (SFOE) runs a photovoltaic RTD program that involves a broad range of stakeholders. The programme is part of the long-standing coordinative activities by the SFOE to support research and development of energy technologies in Switzerland, where funds deployed in a subsidiary manner aim to fill gaps in Switzerland's funding landscape. Grants are given to private entities, the domain of the Swiss Federal Institutes of Technology (ETH), universities of applied sciences and universities.

The focus of the photovoltaics programme lies on RD&D from basic research, over applied research, product development, pilot and demonstration projects. On average, the volume of the SFOE programme support (including pilot and demonstration) is in the order of 10% of the total public support for photovoltaics research in Switzerland, which is in the order of 36 MCHF per year (including roughly 30% from European projects) (https://pv.energyresearch.ch/projects).

The SFOE photovoltaics programme supports research and pilot & demonstration in different areas of photovoltaic cell technologies (namely c-Si, CIGS and perovskites), in the field of photovoltaic modules and building integration of photovoltaics, as well as in the topics of system aspects of photovoltaics such as grid integration, quality assurance of modules and inverters or battery storage technology. Other topics are life cycle analysis, solar forecasting and performance monitoring. International co-operation on all levels, related to activities in the Horizon 2020 programme of the European Union, the European PV Technology and Innovation Platform, the European SOLAR-ERA.NET Network, the IEA PVPS Technology Collaboration Programme and in technology co-operation projects is another key element of the programme.

3.10 Financing and cost of support measures

National PV incentives (one-time remuneration and feed-in tariff) are financed by a network surcharge paid on a kWh-basis by all electricity consumers. Under certain conditions, companies for which electricity cost exceeds 10% of their gross value can be reimbursed.

In January 2018, the network surcharge was increased from 1.5 ct/kWh to 2.3 ct/kWh. This corresponds to a burden of 103.5 Swiss francs per year (67.5 in 2017) for an average household consuming 4'500 kWh.

In 2021, the following amount was paid for the two incentive measures:

- One-time remuneration: 231 Millions CHF (to 29'120 small installations and 720 large ones – 201 more large installations were promised to receive the remuneration later in 2021). This subsidy registered a decrease of 31 millions CHF despite the number of installations skyrocketing because the new installations are deemed cheaper, the average installation cost sunk indeed (see Table 19).

4 INDUSTRY

4.1 Production of feedstocks, ingots and wafers (crystalline silicon industry)

There is no feedstock, ingots, and wafers production in Switzerland

4.2 Production of photovoltaic cells and modules (including TF and CPV)

Module manufacturing is defined as the industry where the process of the production of PV modules (the encapsulation) is done. A company may also be involved in the production of ingots, wafers or the processing of cells, in addition to fabricating the modules with frames, junction boxes etc. The manufacturing of modules may only be counted to a country if the encapsulation takes place in that country.

Total PV cell and module manufacture together with production capacity information is summarised in Table below.

Table 16: PV cell and module production and production capacity information for 2021

Cell/Module manufacturer (or total national production)	Technology (sc-Si, mc-Si, a-Si, CdTe, CIGS)	Total Production [MW]		Maximum production capacity [MW/yr]	
		Cell	Module	Cell	Module
Wafer-based PV manufactures					
Megasol Switzerland *	Mono Perc	-	37 MWp	-	400 MWp
3S Solar Plus**	Mono Perc	-	no data provided	-	60 MWp (300’000 m2)-
Thin film manufacturers					
Flisom	Flexible CIGS	-	No data provided	-	15 MWp pilot line
Totals		0	37 MWp	0	475 MWp

* Megasol also has a production facility of 130 MW capacity in Ningbo, China, for standard high-performance modules, they produced 120 MW in 2019. In Switzerland, they installed a production line (40 megawatts expanded to 400 megawatts in 2021) in Deitingen SO since 2013, which specializes in glass-glass modules and small series / custom-made products (size, shape, and color).

There is no cell production in Switzerland, except for pilot lines for new technologies such as SmartWire connection Technology SWCT (Meyer Burger) or CIGS (Flisom)

**Swiss manufactures are specialized in BIPV products. 3S Solar Plus (previously Meyer Burger) produces its Megaslate module (a roofing material consisting of roof tiles, PV tiles, and thermal tiles.) as well as hybrid (PV and solar thermal) collectors. Due to a growing number of complaints related to the glare of PV installations, 3S Solar Plus has developed a special glare free module (MegaSlate Satinato).,

4.3 Manufacturers and suppliers of other components

Switzerland has a strong industry for BOS-components. Among them are the following companies:

Inverter

Studer Innotec manufactures inverters and chargers for stand-alone and storage solutions, mostly for remote sites without grid access all over the world.

Belenos Clean Power Holding produces MPP trackers and module integrated mico-inverters

Junction Boxes/Connectors:

Stäubli Electrical Connectors (former Multi Contact AG) is the leading manufacturer of cables and connectors for PV Systems. They claim that over 200 GW of PV is connected using their connectors and to have market share of 50% with module connectors.

Cables

Huber & Suhner and Heiniger AG have been offering a variety of dedicated PV cables for several decades.

Supporting Structures

Montavent offers mounting systems for profiled metal and corrugated roofs.

ALUSTAND has mounting structures for tilted and flat roofs.

dhp technology AG offer flexible solar folding roof

Ernst Schweizer produces in-roof mounting systems (Solrif) as well as structures for flat and pitched roofs. They also produce solar thermal collectors for roof-top and façade applications.

Storage Batteries

Leclanché develops and produces energy storage systems with large format lithium-ion cells and has specialized in storage systems based on Lithium titanate technology.

Components for customized PV modules

Solaxess develops a nanotechnology-based film for producing white and colored solar panels without visible cells or connections.

SwissInso produces colored solar glass (Kromatix^{TM}) by plasma processes for building integrated PV.

Most actors in the PV research & Technology in Switzerland are shown in Figure **9**7. A list of the actors can be found on page indicated in the caption.

Figure 9 : https://pv.energyresearch.ch/index.php?ID=2000

5 PV IN THE ECONOMY

This chapter aims to provide information on the benefits of PV for the economy.

5.1 Labour places

Table 17: Estimated PV-related full-time labour places in 2021

Market category	Number of full-time labour places
Research and development (not including companies)	200
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	9000
Distributors of PV products and installations	
Other	500
Total	**9700**

5.2 Business value

Table 18: Rough estimation of the value of the PV business in 2021 (VAT is excluded)

Sub-market	Capacity installed [MW]	Average price [CHF/W]	Value	Sub-market
Off-grid	0.2	6	1’200’000	1’200’000
Grid-connected distributed	681.7	1.65 (Figure 10)	1’124’805’000	1’124’805’000
Grid-connected centralized	0	0	0	0
Value of PV business in 2021				1’126’005’000

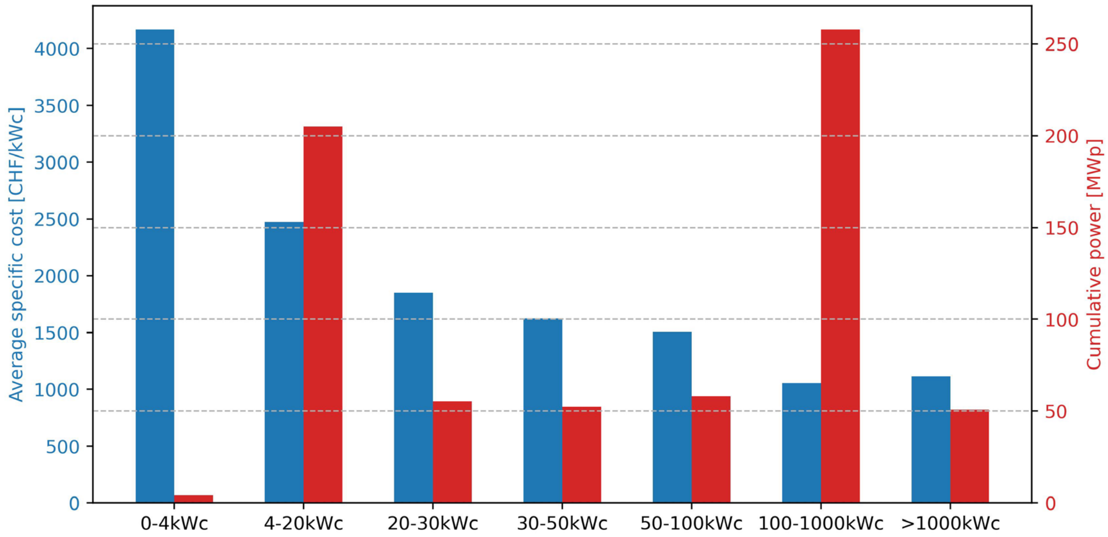


Figure 10 : Average specific cost and cumulative power for each power category

(data compilation from "Statistiques de l'énergie solaire: Année de reference 2021 and "Observation des prix du marché photovoltaïque 2021")

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

The electricity system in Switzerland is divided into seven network levels, from the high-voltage transmission network (level 1) down to the low-voltage distribution to the end-consumer (level 7).

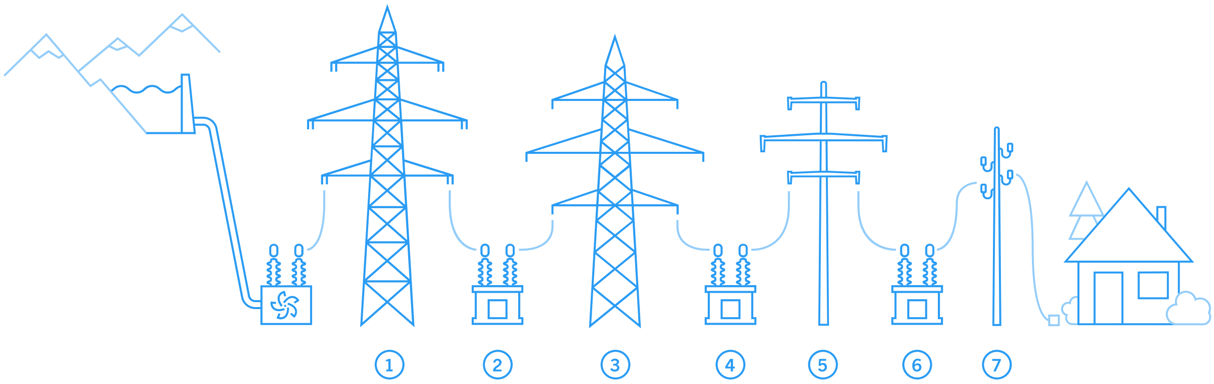


Figure 11 : Network level (source: https://www.swissgrid.ch/en/home/operation/power-grid/grid-levels.html)

Swissgrid is the national transmission grid operator at level 1 (380 kV and 220 kV transmission lines) and is responsible for grid stability and frequency control.

Switzerland's supply of electricity to end-users is made by around 630 DSO companies. Many of them are also responsible for supplying water and gas. In some cantons and municipalities, a single vertically integrated company is responsible for these supply tasks, while in other cantons, a variety of companies share this responsibility. Some of the utilities may have only a few hundred customers, while others have more than 100’000 customers.

In terms of grid-interconnection of PV, there are national regulations and recommendations, but each DSO may have its specific technical interconnection conditions. There is, however, a tendency for harmonization and simplification, both in administrative and technical terms.

DSOs are required to accept electricity from a PV power plant up to 3’000 MWh per year and 50 MW, and there is a minimal tariff that has to be paid, calculated based on the DSOs procurement and generation cost.

6.2 Interest from electricity utility businesses

Please outline key PV business models that have been implemented or are being considered **by electricity utility businesses** in your country (e.g. PV plant development / ownership, PV power purchase arrangements, customer PV support initiatives and so on, self-consumption polices, storage policies, electric vehicles…).

An increasing number of electricity utilities are entering the PV business. Especially larger utilities that have their own (non-solar) electricity production facilities have been under increasing financial pressure due to falling electricity prices on the European market and are therefore expanding their business activities. Due to the private-public status of most of the utilities (they are typically owned by the communities and the cantons), this development is not always well seen by the traditional PV installing companies

The following PV business models are implemented by electricity utilities

- Investment in their own PV plants for their production portfolio
- Establishment of subsidiary units for engineering and installation services (sometimes including the acquisition of PV installations companies)
- Offering contracting solutions for PV power plants, selling the PV electricity to the end-consumer
- Providing services for metering and billing within the newly possible (from 2018 onwards) self-consumption communities
- Virtual battery solutions, batteries on district level and EV charging stations

To intensify the exchange between the traditional solar sector (represented by Swissolar, the professional association) and the traditional grid stakeholders (represented by VSE/AES, the Swiss utility association), experts from both sectors meet regularly in working groups to revise recommendations for grid connections, metering requirements, battery exploitation schemes, etc.

6.3 Interest from municipalities and local governments

Municipalities and cities are key stakeholders in pushing the development of PV in their jurisdiction. On the one hand, they are becoming increasingly aware of their huge potential (on infrastructure owned by the local government such as schools, public buildings, etc.) and therefore invest themselves in PV power plants. On the other hand, they can create favourable conditions (simplified administrative procedures, for example) and grant additional local subsidies for solar, storage, or EV to push the development. Swiss energy also pushes for a better energy management of cities through its program “2000 Watts Society”

Municipalities are often pushing also collective self-consumption and promoting it for new urban developments

There is a label called “Energy City” and “Energy Municipality” which is awarded to cities and municipalities that live and implement a sustainable municipal energy policy. Energy cities promote renewable energies, environmentally-friendly mobility, and rely on the efficient use of resources. There are 450 Energy Cities in Schweiz.

Most of the cantons have energy policies favourable to photovoltaics. An example is the canton of Geneva that has set the target to produce 100 GWh of PV electricity by 2025. Another one is the Glarus canton which published its energetic goals in 2021 who wants to reach 100% renewable energy in 2035 and recognizes the photovoltaic as the greatest unused potential to reach that goal.

7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

A trend for large systems with high self-consumption started in 2021 with 2 installations one of around 500kWp on a shrimp-farm and one of 300 kWp on a recycling facility both with 80% self-consumption. This trend is bound to continue as batteries develop and the price of energy rises in 2022 and as large systems are explicitly fostered by Switzerland's policies.

Another trend meant to continue are the regulation in favor of a lighter administrative burden. The search for new surfaces on farmlands, lakes, dams, building facade able to welcome PV is also on the rise.
For example, high altitude installations are still efficient in winter and therefore be a solution for a winter source of clean energy as illustrated Figure 11 .

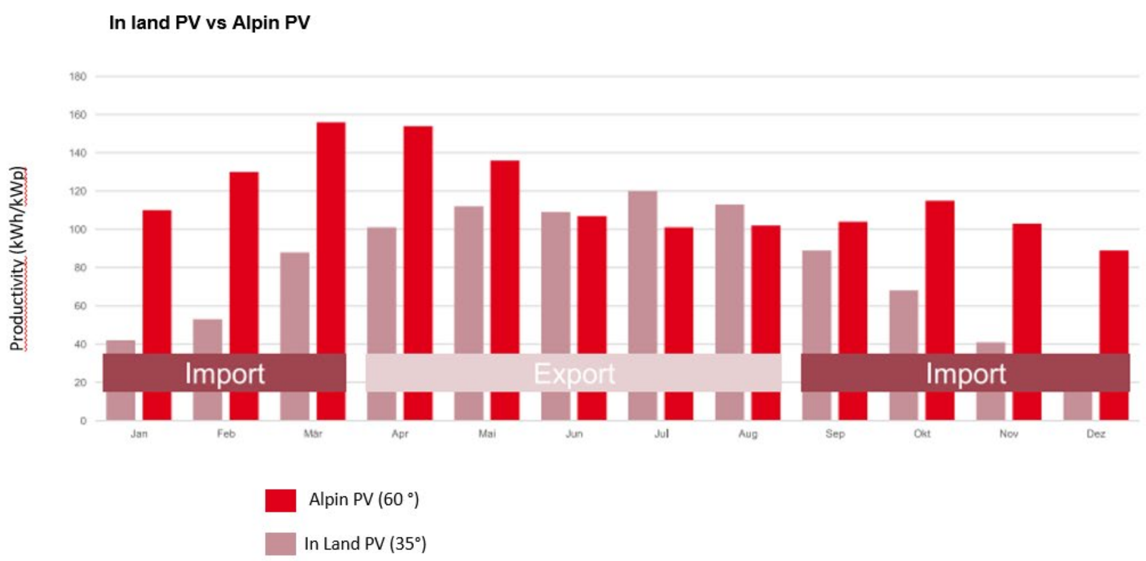


Figure 12 : Inland PV vs Alpin PV

Another example, in 2021, Agroscope and Insolight launched each a pilot project for PV above farmlands that don't impede the crops production.

Research also focuses on integrating renewables on a smart grid which manages storage to make up for the intermittent characteristic of these energy sources. Swiss grid and ewz have launched a pilot project of a "crowd balancing" grid which uses the consumers storage to cover the needs of the distribution grids. The project is meant to be continued and finished in 2022.

7.2 **Prospects**

Even though 2021 was marked by a setback because the law on the CO2 was rejected by popular consultation (this law aimed at raising taxations on CO2 to fund renewables), the near future of PV in Switzerland seems bright.

Policies will be changing in 2022, to support large PV installations and to tap in the unused potential. For the latter, the one-time investment subsidy will reach 60% of the investment cost (compared to 30% in 2021) for installations with no self-consumption in order to not waste the potential of roofs on top of barns and storage facilities. For installations larger than 150 kW, the subsidy will be decided through auctions. To foster large PV systems, the base grant will be replaced by an increase of the grant per kWh. Furthermore, new building bigger than 300 m^2 will have to install a renewable energy production system.

The energy production goal set for 2020 in the Energy Strategy 2050+ were fulfilled and even outdone by 300 GWh (4712 GWh instead of the 4400 GWh planned) and the trend is bound to continue as innovation, policies and local governments mostly align in favor of PV.

Finally, the solar potential of Switzerland is still mainly untapped as the bulk of the installation are roof-mounted but still doesn't come near to cover all the roof potential as seen Figure 12

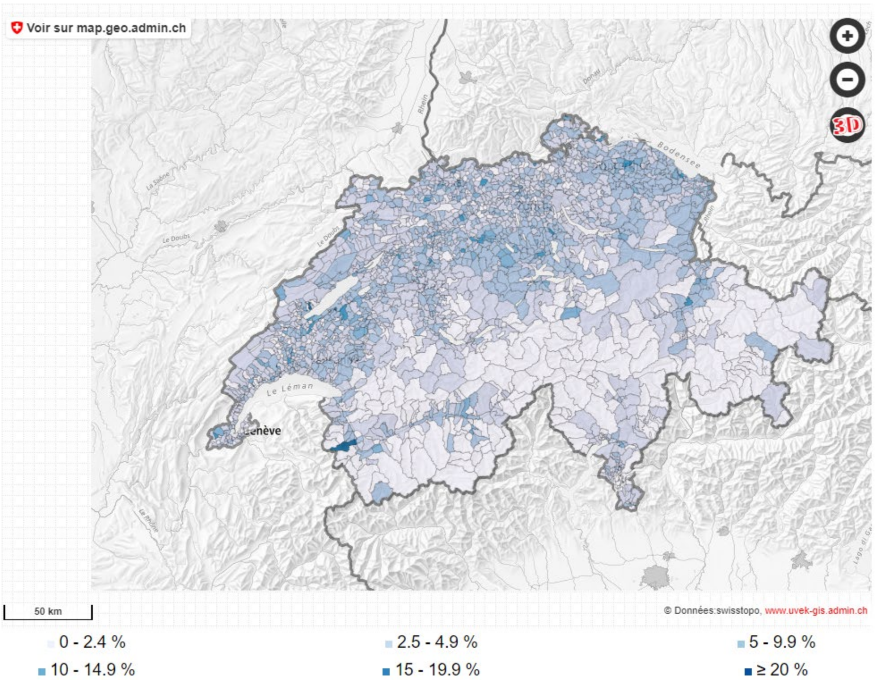


Figure 13 Map of the share of exploited potential of solar energy on roofs