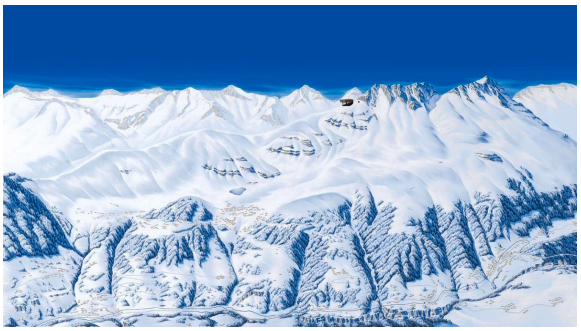
ETH Zurich Department of Architecture
ARCHITECTURE OF TERRITORY
Chair of Architecture
and Territorial Planning
Professor Milica Topalović

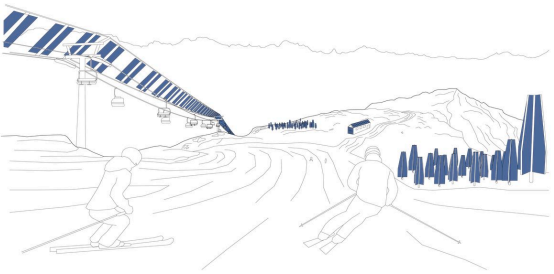
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Spring 2024

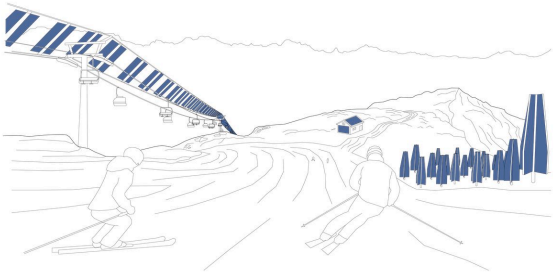
Solar

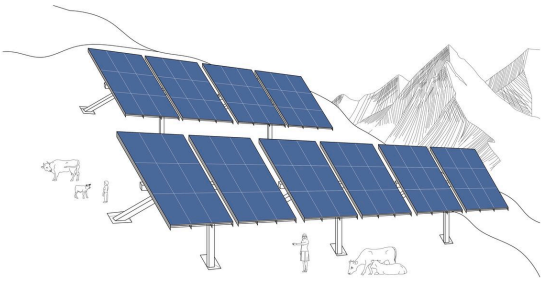
Peak Power: Managing Solar Energy Production in the Alps

David Bodor, Arno Amez-Droz, and Silas Zeller



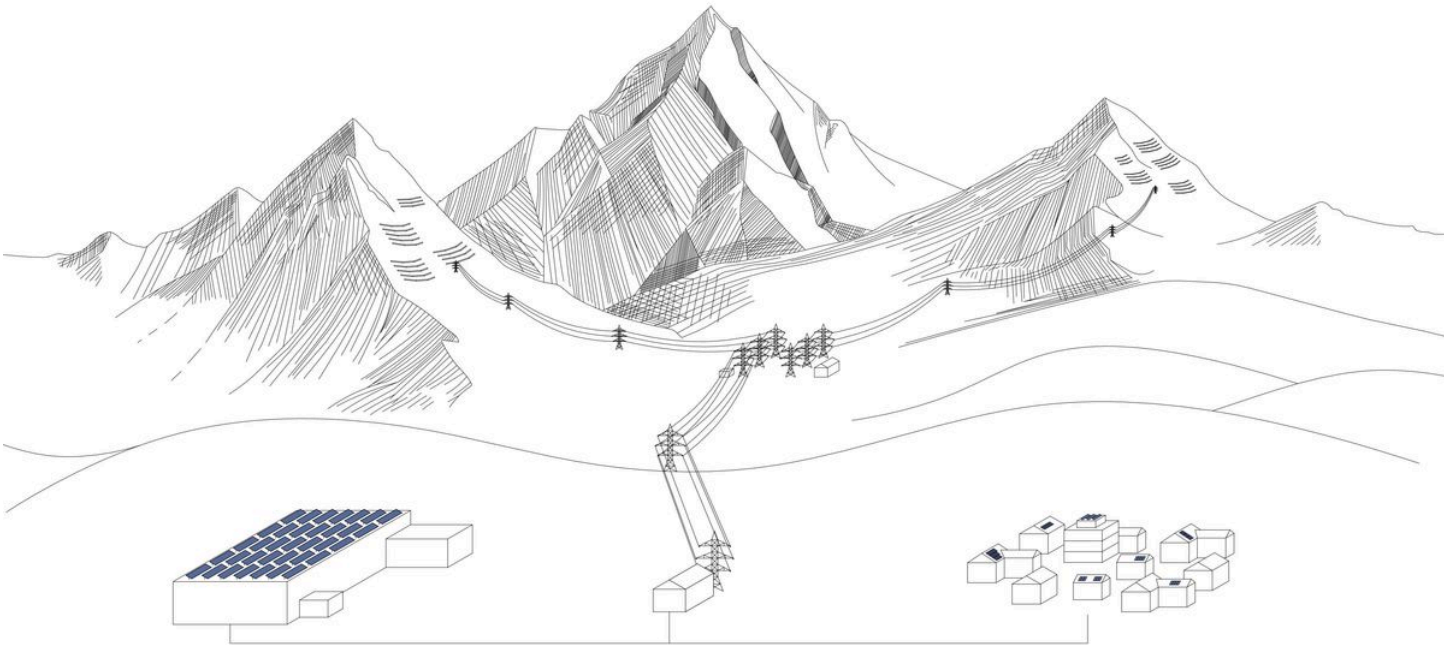




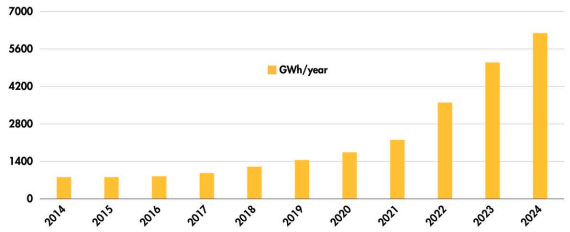


In recent years, solar energy production in Switzerland has surged, largely driven by private rooftop installations. However, Switzerland's broader strategy to decarbonize its energy production also includes pushing the development of large-scale solar parks in the alpine regions. This has led to a number of hastily implemented projects, often sparking controversy due to their impact on local areas. A more harmonious approach could involve integrating solar energy with existing alpine infrastructure, like ski resorts.

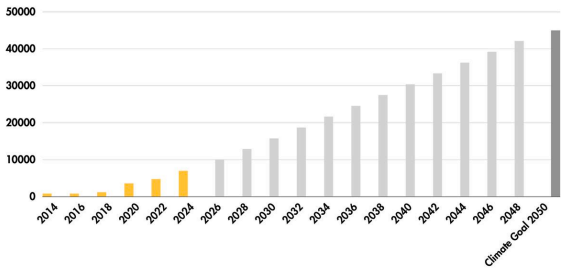
Illuminating Switzerlands Status Quo



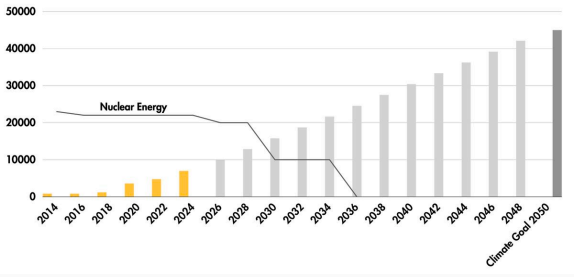
Solar energy infrastructure has seen the most significant growth among all sustainable energy sources in Switzerland over the past decade. By 2050, Switzerland aims to generate 40% of its energy from solar power. To achieve this goal, numerous new large scale alpine solar projects are underway, with a notable spatial impact.



SWITZERLANDS SOLAR GROWTH. Source: UVEK, 2023

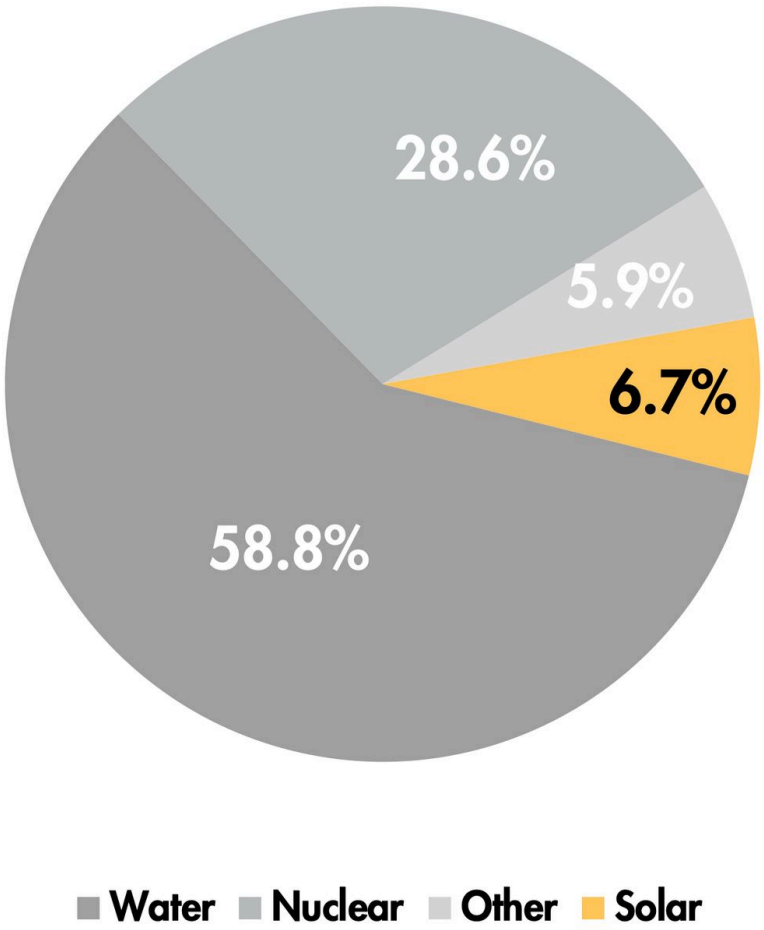


PRESSURE ON SOLAR TO ACHIEVE CLIMATE GOALS. Source: UVEK, 2023



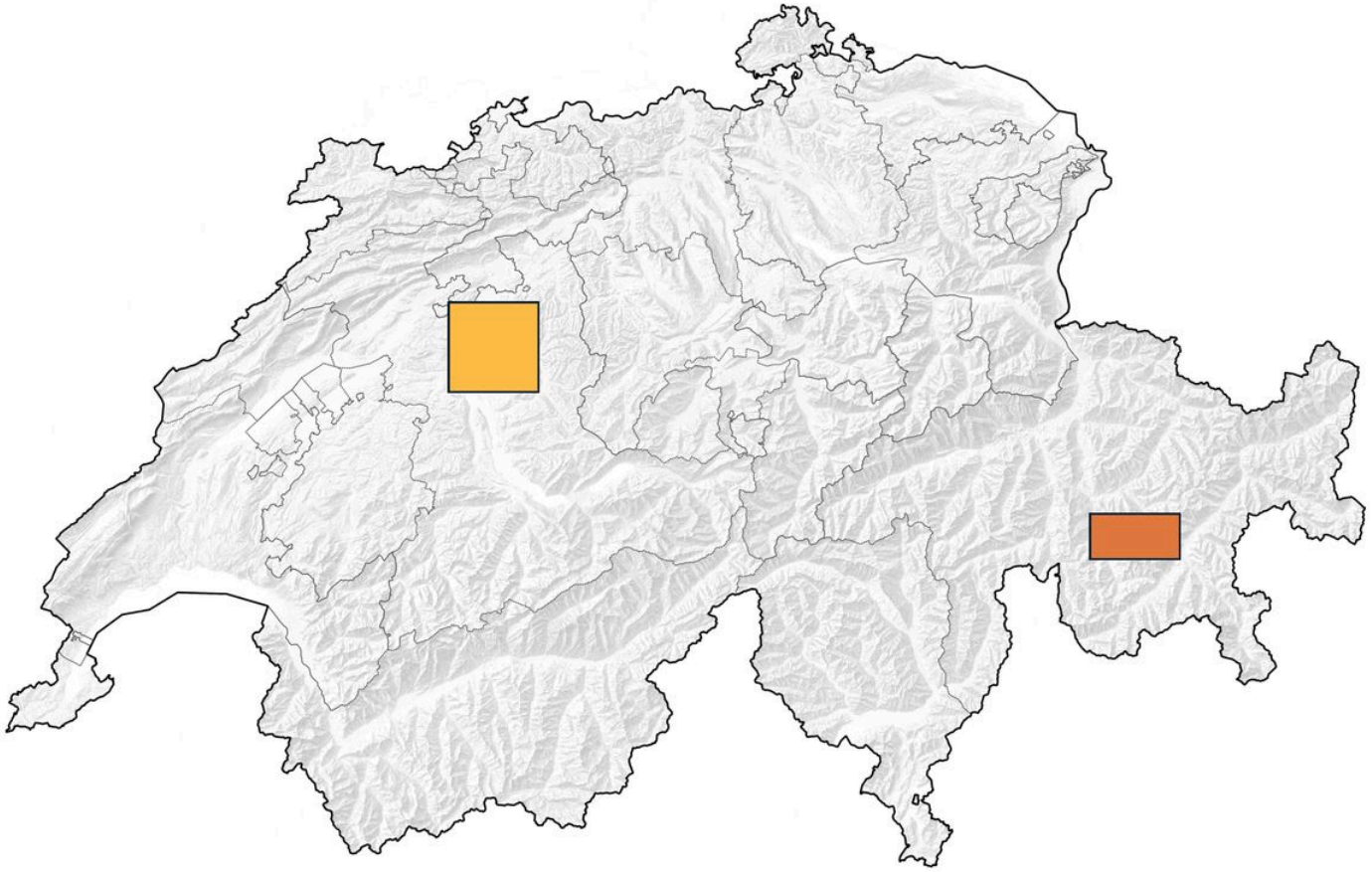
PRESSURE ON SOLAR TO ACHIEVE CLIMATE GOALS. Source: UVEK, 2023.

To meet Switzerland’s climate goals, the country needs to install approximately seven times the current amount of photovoltaic capacity in 25 years. Additionally, there is increased pressure to develop solar energy as it is set to replace nuclear power, which is scheduled to be phased out by 2036.



CONTRIBUTION IN THE SWISS ENERGY MIX. Source: UVEK, 2023.

Currently, solar energy accounts for about 7 % of total energy production in Switzerland. A closer look reveals that the vast majority of this 7 % comes from urban photovoltaic installations, with less than 1 % produced by alpine photovoltaics. However, this is set to change soon: numerous new alpine solar projects are underway. Once completed, these projects will contribute approximately 14 % of Switzerland's solar energy production.



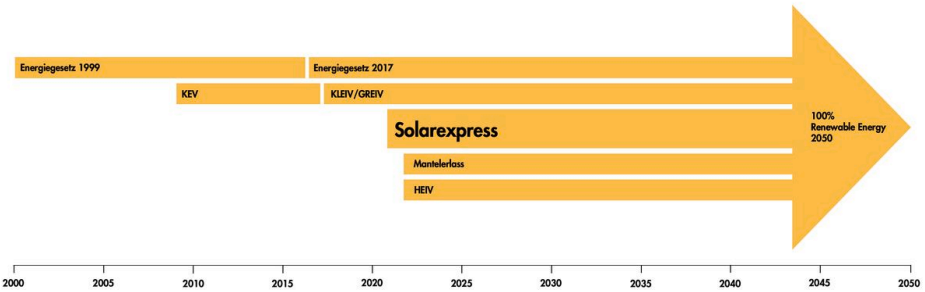
SPATIAL IMPACT OF SOLAR DEVELOPMENT

Urban Photovoltaik

Alpine Photovoltaik

Alpine photovoltaic systems are significantly more efficient, with an optimally placed alpine park generating nearly twice as much electricity annually as a similar installation in the Mittelland. This difference also impacts spatial requirements. Here, you can see the area needed to meet Switzerland's development goals. Due to the higher efficiency of alpine installations, especially during winter, the government is pushing their development.

Changing the Solar Landscape: Solarexpress



SWITZERLANDS PLAN TO ITS CLIMATE GOALS

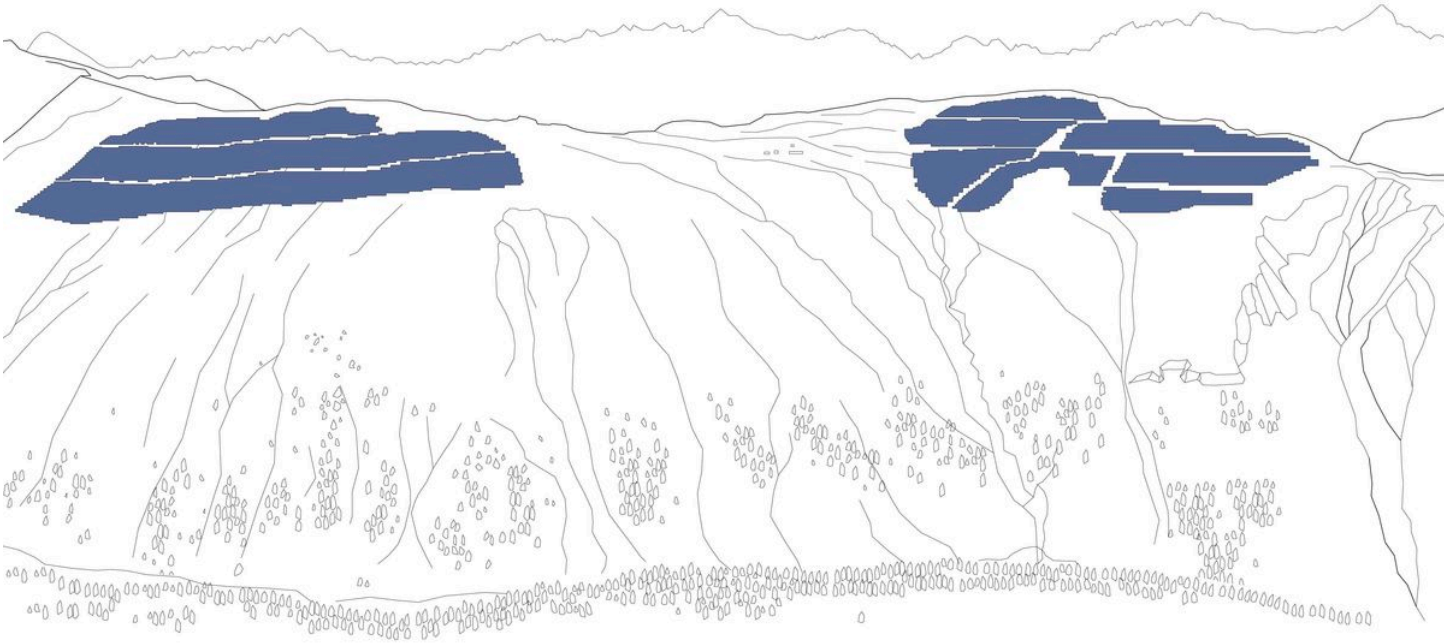
The Solar Express is an amendment to the Swiss Energy Act introduced in 2022. This change aimed to implement urgent measures for securing a reliable power supply during winter in response to the 2022 energy crisis. The main feature of the Solar Express is subsidies covering up to 60 % of investment costs.



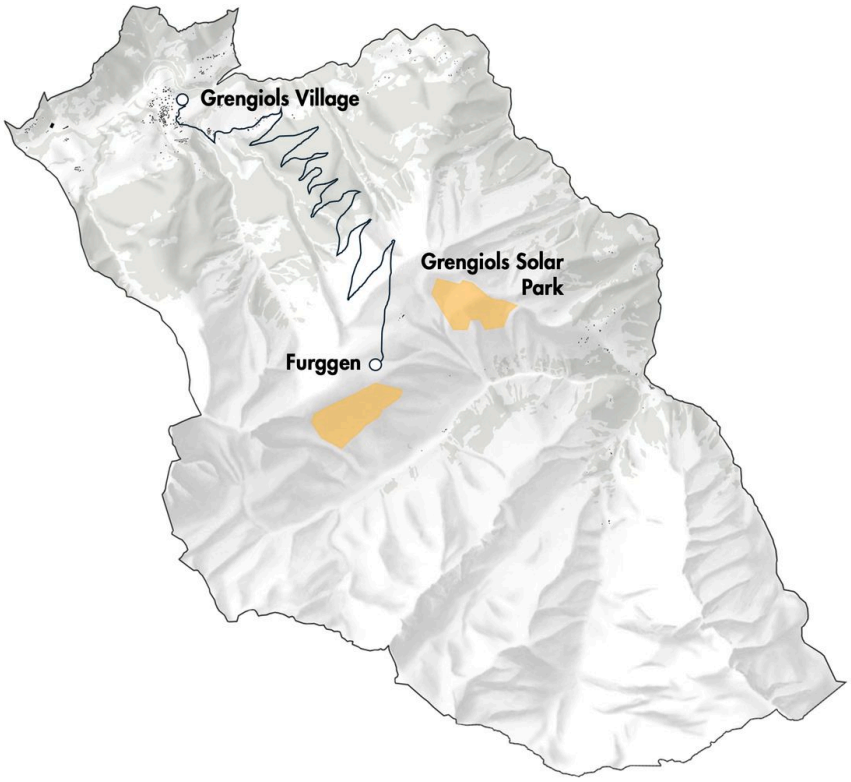
PROPOSED ALPINE SOLAR PARK IN VAL NANDRO. Source: https://www.ewz.ch/de/ueber-ewz/newsroom/aus-aktuellem-anlass/hochalpine-photovoltaikanlagen/hochalpine-pv-anlage-im-val-nandro.html [https://www.ewz.ch/de/ueber-ewz/newsroom/aus-aktuellem-anlass/hochalpine-photovoltaikanlagen/hochalpine-pv-anlage-im-val-nandro.html], 2023.

Though efficient in energy production, alpine solar parks have sparked controversy. The primary concerns stem from environmental and aesthetic impacts. Many Swiss citizens value the pristine landscapes of the Alps, seeing them as a national treasure, and fear that large-scale solar installations could destroy these natural ecosystems.

Where Light Meets Shadow: Grengiols Solar



In the small municipality of Grengiols, with fewer than 500 residents, plans are underway for the largest alpine solar park in Switzerland. Although the project received a favorable vote, there are strong opposing voices, primarily concerned about the environmental and spatial impact on an otherwise pristine natural area.



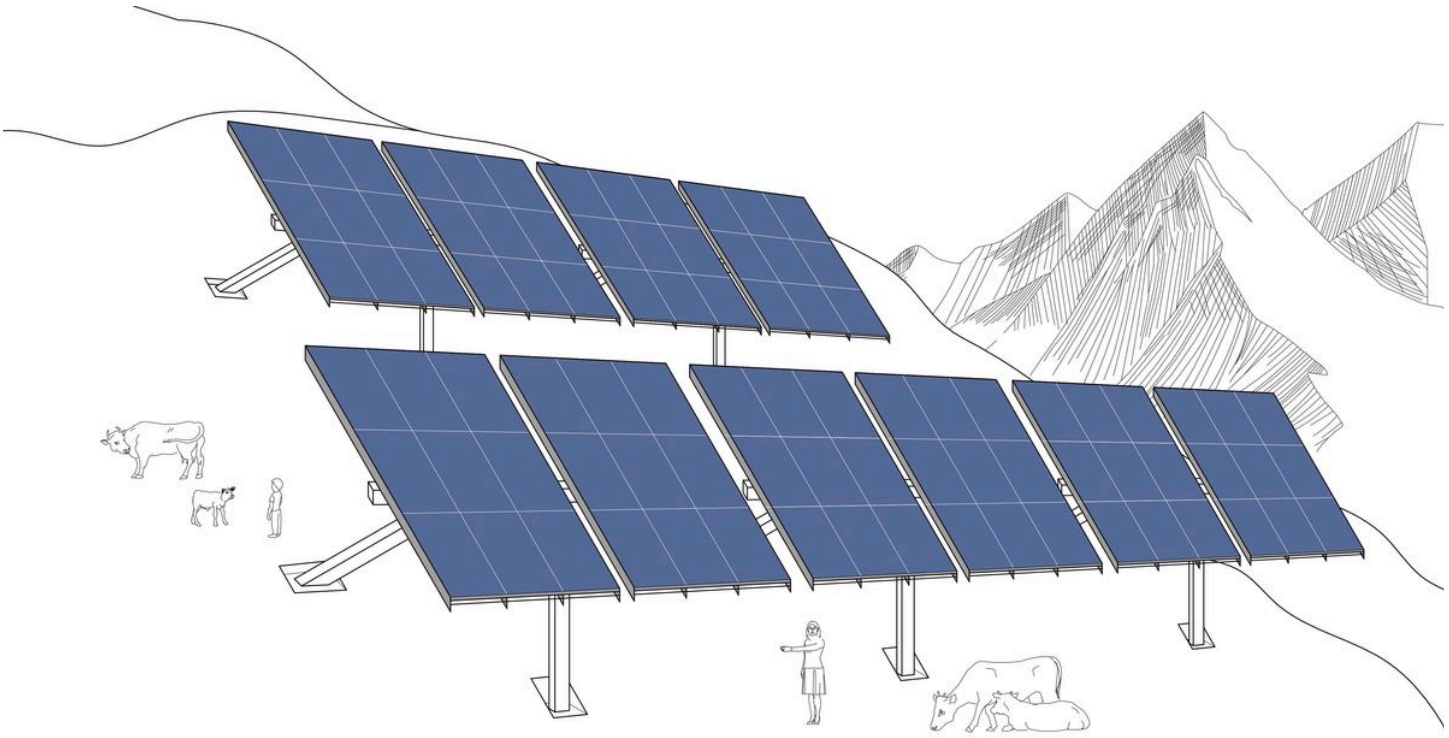
PROJECT AREA IN GRENGIOLS

The majority of the municipality consists of untouched natural landscapes. Furggen is an alpine area situated at an elevation of 2,400 meters above sea level. It is not visible from the village and can only be accessed via an unpaved road. During the summer, a few farmers use the area for grazing. This location is where the new solar park is being constructed. Spanning 800,000 m^2, it is projected to produce 150 GWh annually, making it the largest solar park in Switzerland. While almost 70 % have voted in favor of the projects, the farmers in Furggen are concerned.



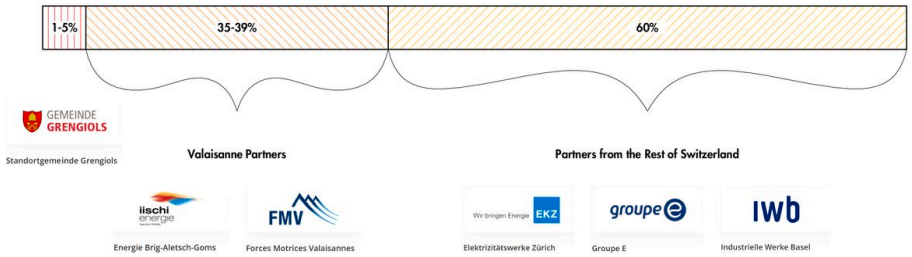
https://youtu.be/7TqhndkpxM8

Enlightening Revelations: Learning from Grengiols



A close examination of the Grengiols case study revealed three primary discussion points. The first aspect concerns organisation, including ownership percentages. The second aspect pertains to the chosen technology type and its specifications. The third aspect relates to the park's location and its integration into the surrounding area.

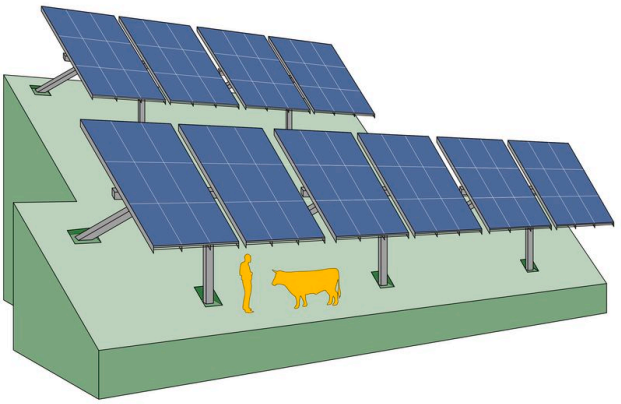
Organisation



CONTRIBUTORS OF THE SOLAR PARK IN GRENGIOLS. Source: https://www.grengiols-solar.ch/de [https://www.grengiols-solar.ch/de], 2024

The problem with the ownership is that it mostly lies in the hands of large national energy corporations such as EKZ and IWB, followed by some other big players from the canton of Wallis. Grengiols only contributed a measly 1-5% to the project's total cost. As a result, they will not receive any of the produced electricity but rather an annual sum of around CHF 1'000'000. It is however unclear if or how this money will trickle down to the residents, which highlights the lacking communication with them during the planning stage.

Technology

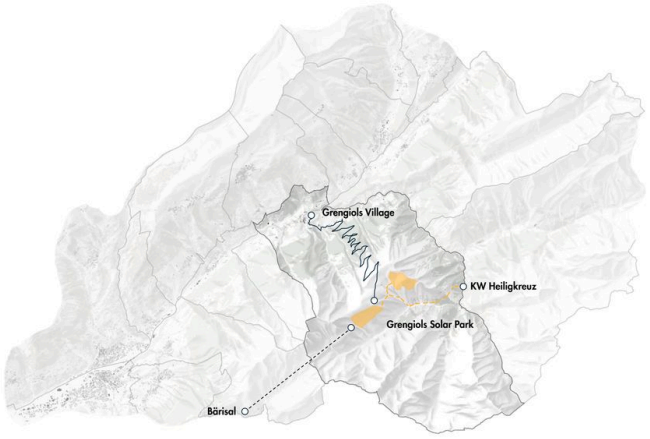


This homogenous typology is a clear product of the profit-oriented nature of the solar park. By placing 13'000 of these so-called solar tables, a grand total of 230'000 individual modules are expected to be installed on the mountain. Neither the dimensions nor the distribution of these modules are designed to be a human-scale development. Not to mention that aesthetically they will not interact with the landscape at all, but rather lead to an uninterrupted coverage of it. The implications of this installation method on wildlife and the cows that graze in this area are up for debate, with the council saying they will not be impacted and farmers such as Ulrike saying these areas will become completely uninhabitable.



POV VISUALIZATION OF THE SOLAR MODULES. Source: www.grengiols-solar.ch/de/medien [http://www.grengiols-solar.ch/de/medien], 2023

Location



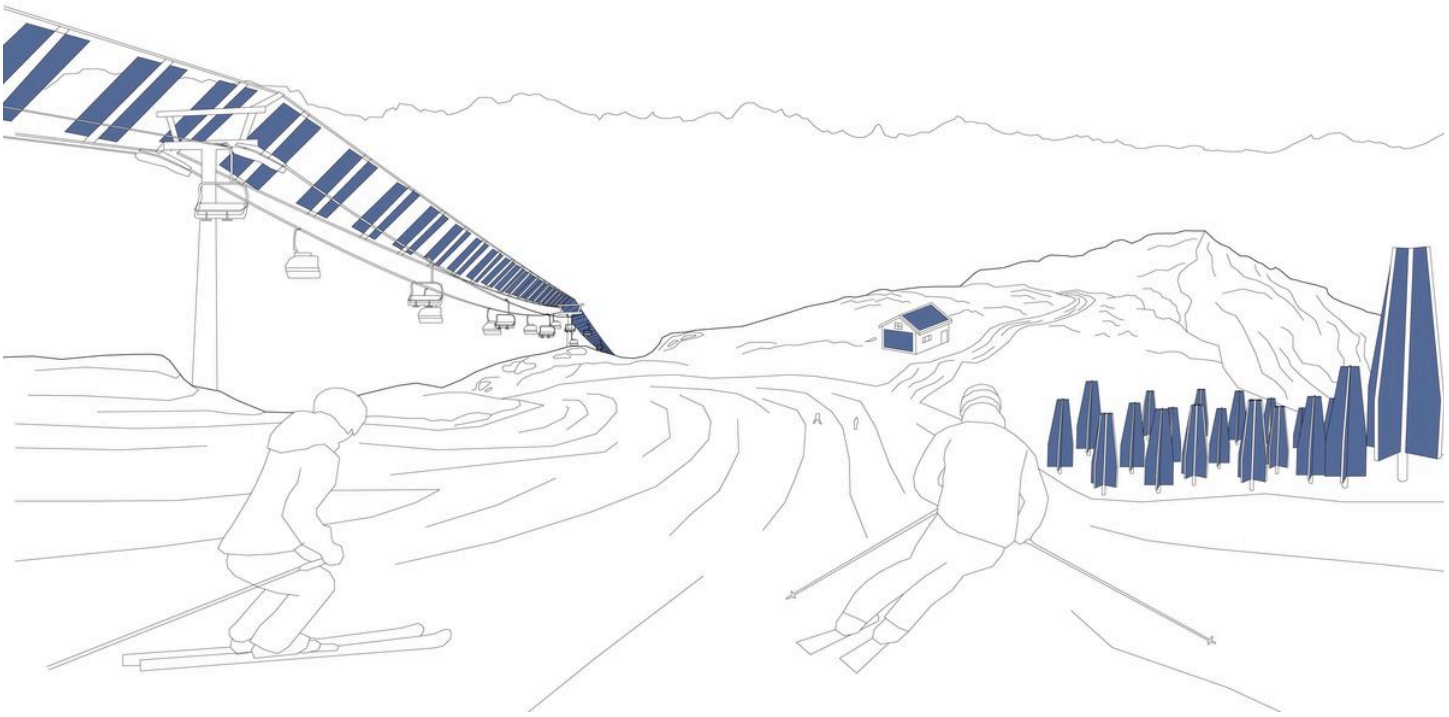
LOCATION OF THE SOLAR PARK IN GRENGIOLS AND
THE INFRASTRUCTURE NEEDED TO SUPPORT IT

Lastly we need to contextualize the location of the solar park and its consequences on the existing landscape. As part of the construction they are planning on building a transport cable car from the nearby Bärisal up to the solar park, because the existing road from Grengiols itself is inadequate for this purpose and covered by snow during most of the year. The electricity will be routed to a third location, where it can be fed into the energy grid at the power plant of Heiligkreuz.
So by choosing this location as the place for the solar park, there is no getting around the fact that the infrastructure will have to be expanded up to the mountain from multiple directions, further conquering remote regions and permanently leaving our mark on the alpine landscapes.



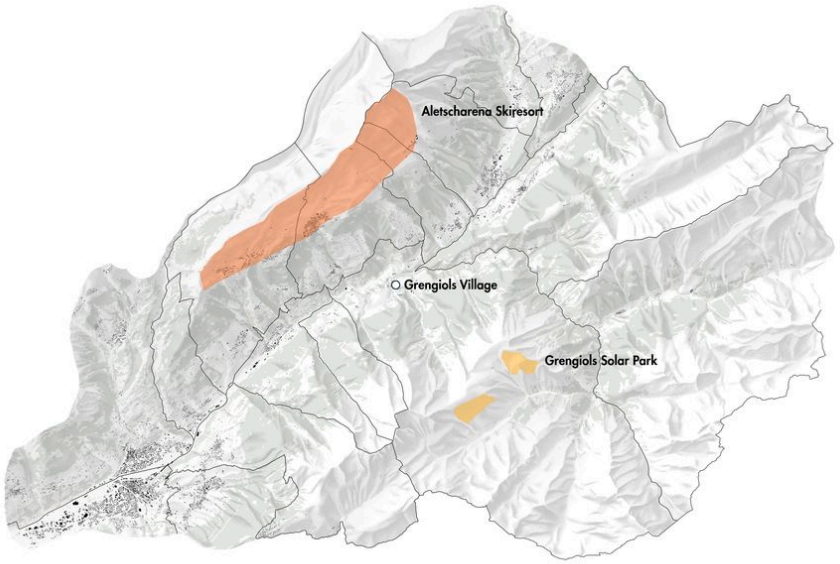
VISUALIZATION OF THE PROPOSED SOLAR PARK. Source: www.grengiols-solar.ch/de/grengiols-solar/anlage [http://www.grengiols-solar.ch/de/grengiols-solar/anlage], 2023

Brighter Days Ahead: Envisioning Alternatives



To address the three discussion points of the Grengiols case study, these three distinct scenarios each target a specific issue. Alternative approaches in location, organisation and technology reveal further potential to support the local economy and minimize resistance amongst the people.

Location

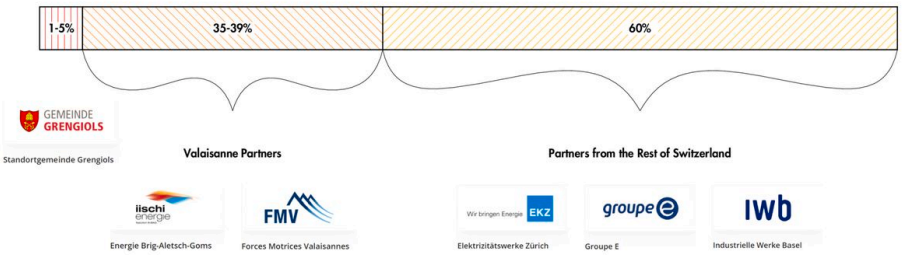


MAP OF GRENGIOLS AND THE NEARBY ALETSCH ARENA

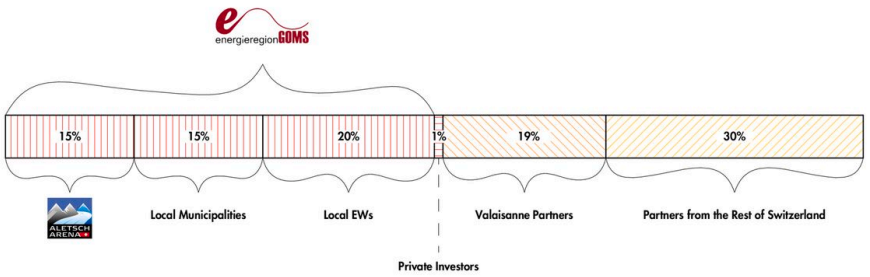
Across the valley from Grengiols lies the Aletsch Arena. A big ski resort with a massive infrastructure spread along the mountain ridge. The parallel flow of the mountains provide similar conditions for solar energy production to the designated area in Grengiols. With a total cable car and ski lift length of 33.9km, the infrastructure provides a lot of potential to implement a solar energy system.

Organisation

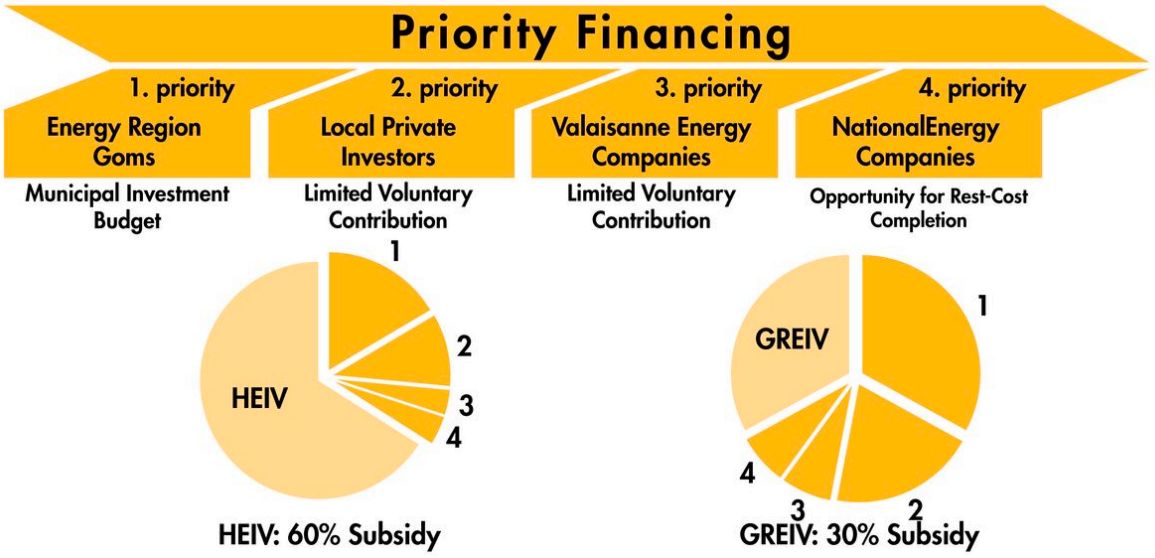
Ownership Model of Grengiols Solar



Ownership Model of Aletsch Solar



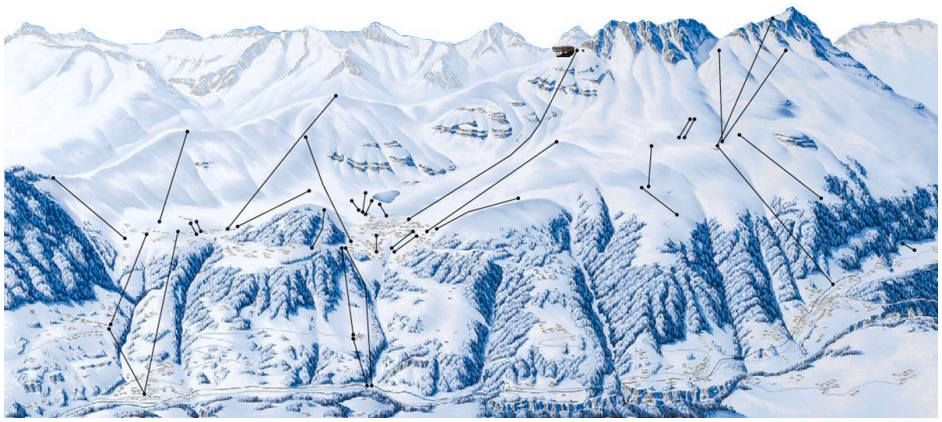
As visualized in the diagrams, we strive to involve the local actors in order to support them financially. The consequences of climate change is a danger to ski tourism, which is the main source of income for the region. With our organisational proposal, leading the main financial profit to the local economy, we could take this chance to let the sun be the savior instead of the curse.
The Energy Region Goms together with the local private investors have 51% ownership, giving them the significant control over company decisions.



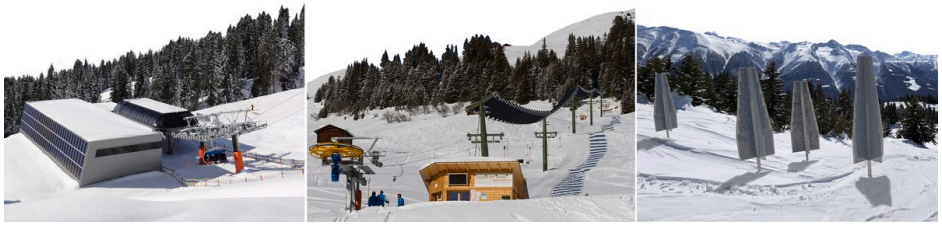
OUR PROPOSED BLUEPRINT FOR NEW SOLAR PARKS

Through an investment hierarchy, the involvment of local actors can be assured. The priority financing will create an order in which the investors have the opportunity to participate regardless of the project scale. This strategy allows to shift control from the big energy corporations to the locals, in order to support the people, which are directly affected by the project.

Typology



The Aletsch Arena provides a big alpine area with south orientation. It lies across the valley from proposed solar park in Grengiols. However, there is already a big network of infrastructure applied onto this mountain, which allows to install solar pannels without urbanizing untouched nature.



We chose 3 typologies of solar pannel installations. We use the stations and restaurants to cover the suitable roof area with pannels. In a second step we span lines of solarwings over the existing skilift network structure. For that technology we used the solar skilift Tenna as a reference. With both stations and cable lines used, we analyse the topography to determine which area between the slopes would be suitable for the third typology. We took the Helioplants as a reference and adapted its shape to blend in with the pine trees. Planting them in groups creates an aesthetic that reminds of a forest.



All three typologies combined compensate for the entire energy performance of the solar park proposed in Grengiols. However, the purpose of this alpine scenario laboratory is not to bring a perfect solution to every counter argument, but to allow ourselves to think beyond mere profit and efficiency. By using existing infrastructure, we do not have to conquer nature and urbanize what is left of it.

ACKNOWLEDGEMENTS

We would like to thank everyone who took the time to talk to us, especially Waldemar Schön, Ulrike Steingräber and Armin Zeiter.

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