Berner Fachhochschule
Haute école spécialisée bernoise
Bern University of Applied Sciences

SCCER – FURIES
Shaping the FUtuRe SwIss Electrical InfraStructure

Photovoltaic in Switzerland 40 years of progress and some challenges ahead

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Solar entrepreneuer since 1985-Ingenieurbüro Muntwyler/ Bern

Content

1. PV application in the last 40 years - use and whats happens since

2. Case Study «Decarbonization» with PV of a City
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5. Ramp up to 1,5 – 2 GWp/ year – resistance ahead

1. PV as a disruptive technology

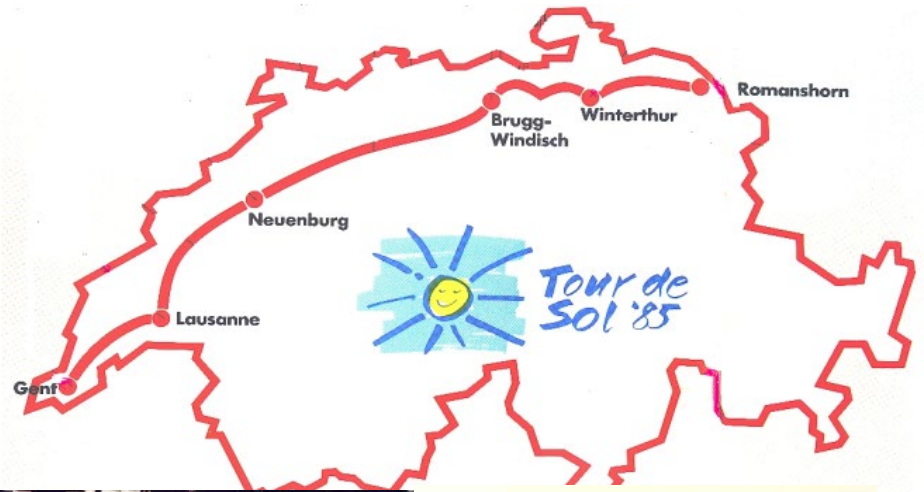
First Pilot- and Demonstration-Program for PV in Switzerland b Hasler AG Bern late 70-ties up to 1987.

One of the 7 installations: PTT Tower Chasseral with 4 Solarex HE 51 m-Si with 2 front coverages of the PV modules (photo 1983/Mu).

Inprovements since 1981: Energy paypack Si-c PV modules >30! Material can be recycled up to 90-95%! **Price reduction >200**/ efficiency more than doubled/ modules more than 10-times bigger➔**PV modules are >4'000-tomes better as 40 years ago (Factor 15'000 since 1975)!**

Tour de Sol 85 – PR Tour for solar energy

First solarcar race in the world with 58 participants in 2 categories
< 6m² (max. 480 Wp)



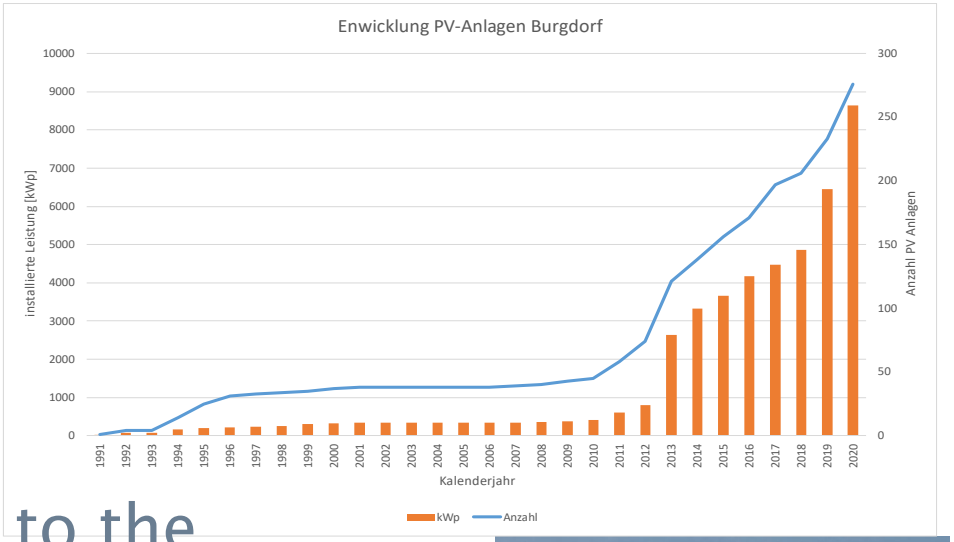
Tour de Sol car charge with solarcells on the vehicles (1985), 1986 with mobile solar «gasoline stations» (left). Still in 1987 the charge with grid connected PV installations was possible.

2. SimZukunft: Four Energy Scenarios 2050

- ES-2050 POM-E and ES-2050 NEP-E are based on the official Swiss Energy Strategy 2050
- **Utopia** reflects the official energy policy of Switzerland (Energie-perspektiven 2050+) -> **full decarbonisation**
- A «smart» version was calculated for all scenarios (-> systematic and maximum peak shaving to reduce the grid load)

Scenario	Description
ES-2050 POM-E	«Political measures», scenario «renewable energies»
~~**ES-2050 POM-E SMART**~~	~~Similar to POM-E but more smartgrid-technologies~~
ES-2050 NEP-E	«New energy policy», scenario «renewable energies»
UTOPIA	Maximum PV-Installation, maximum sector coupling, high energy retrofit standard, maximum SmartGrid-depletion, 100% e-mobility, strong improvement in energy efficiency
DYSTOPIA	Few renewables, expensive PV, economic war, climate change, refugees

Case Study «SimZukunft» (Burgdorf-CH)

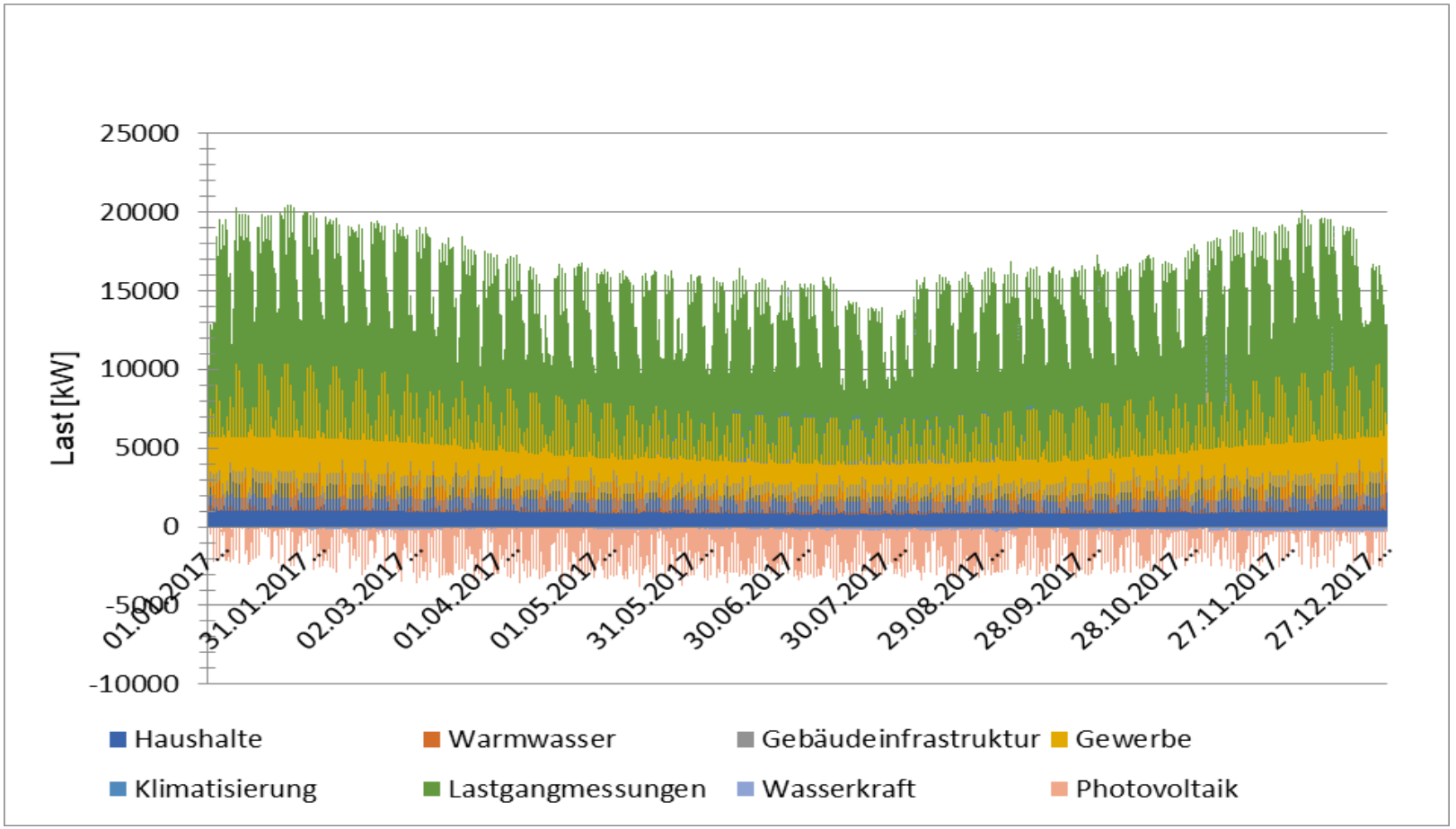


- Historical town -> entrance to the «Emmental» (Emmental Cheese)
- Near the capital of Switzerland (Bern)
- 16’000 inhabitants (in 2017)
- 1st feed-in-tariff for PV (1989) / PV LAB-BFH installed 60 kWp (1993)
- Burgdorf 2020: PV share / inhabitant: 600Wp
- Burgdorf 2020: 440 cars per 1’000 habitants; about 5% EVs

2.1 Energy Scenario «Utopia» (with 100% PV in 2050)

UTOPIA	2020	2030	2040	2050
Target population with migration	16888	18644	20450	22257
Reduction energy cons. business %	90%	90%	90%	90%
Reduct. energy cons. consumers %	90%	90%	90%	90%
Cons. new climatization kWh/m²	30.0	30.0	30.0	30.0
Surface with climatization %	0.0	20%	40%	50%
Percentage car user/household [%]	44.0%	44.0%	44.0%	44.0%
Percentage EVs [%]	5.0%	20.0%	70.0%	100.0%
Additional PV in GWh	3.0	26.0	50	75
House retrofit factor (0.2 = 20% from old status)	30.0%	30.0%	30.0%	30.0%
Electric boilers to heat pumps (HP)	400	400	400	400
Gas heatings to HP % of 2017 use	17%	28%	35%	100.0%
Oil heatings to HP in % of 2017 use	17%	28%	35%	100.0%
Other heatings to HP in % of 2017	17%	28%	35%	100.0%
Reduction electr. cons. over 5 years	95.1%	95.1%	95.1%	95.1%
Percentage building renovations	3.0%	23.0%	43.0%	63.0%

2.2 Data and Methods

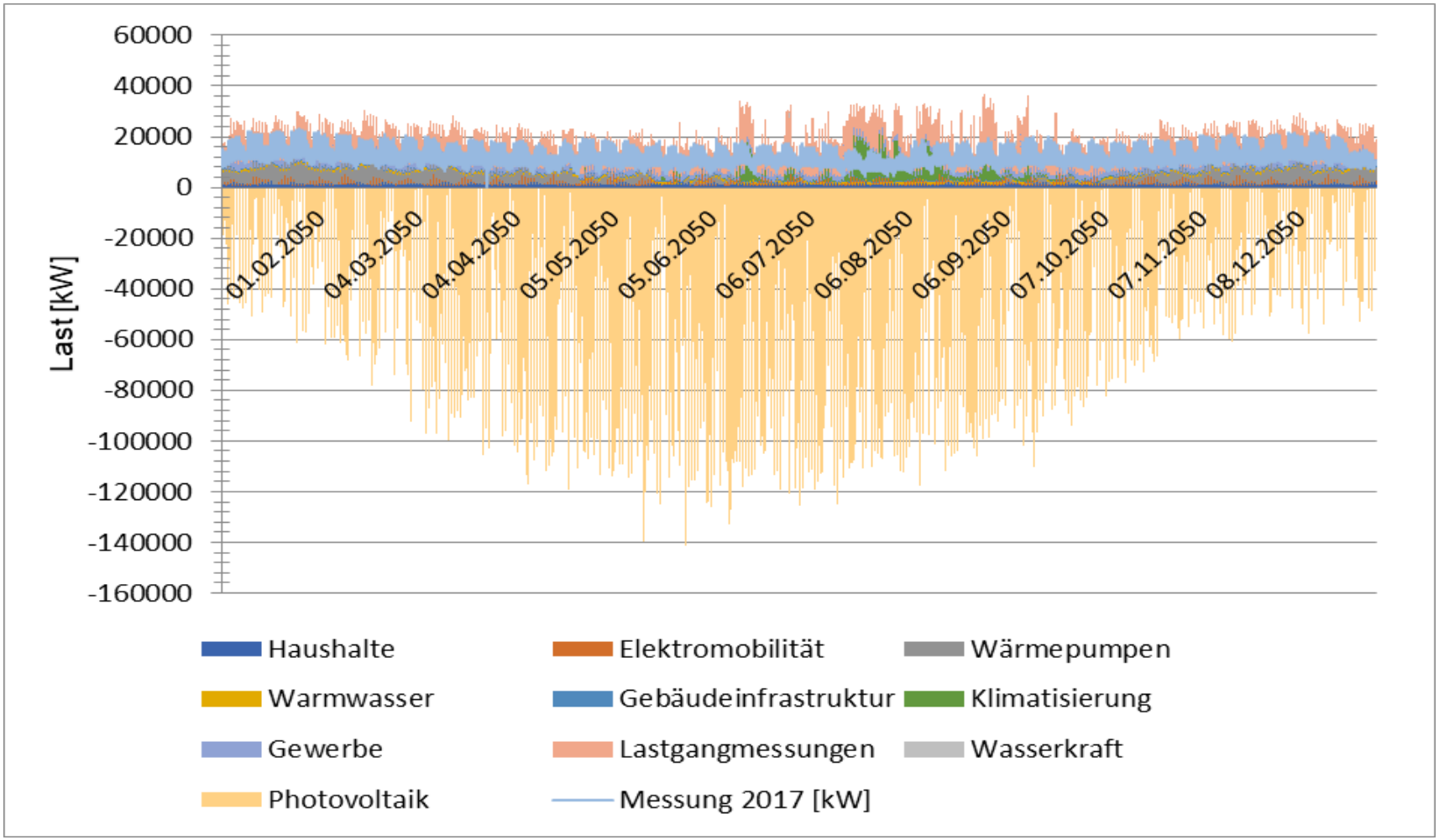


Load Profile in Burgdorf in 2017

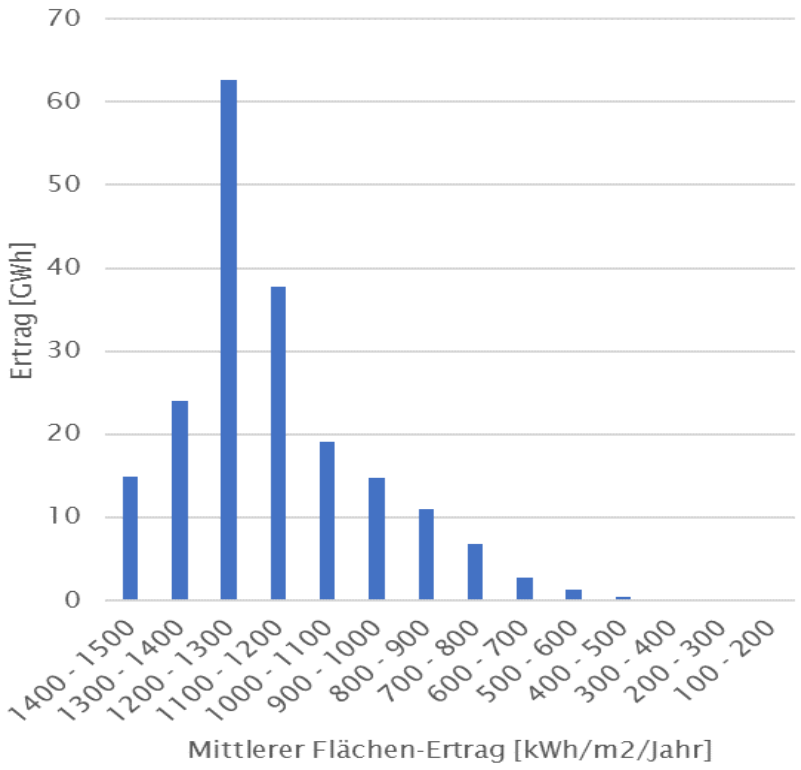
2.3 Results: Load Profile in Burgdorf 2050

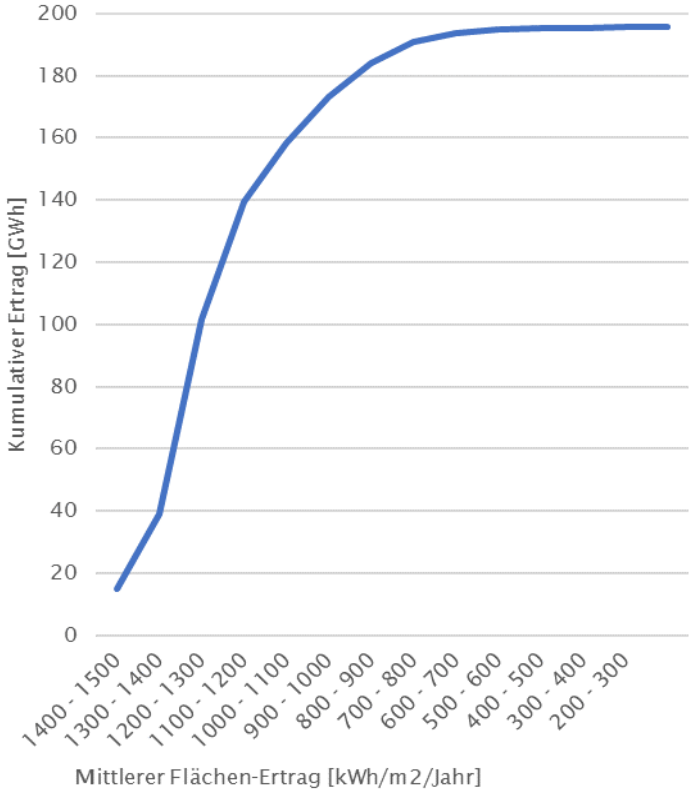
Scenario «Utopia»: 100% PV

Summer peak due to climatisation (climate change)



2.4. Results: Potential for PV Expansion in Burgdorf



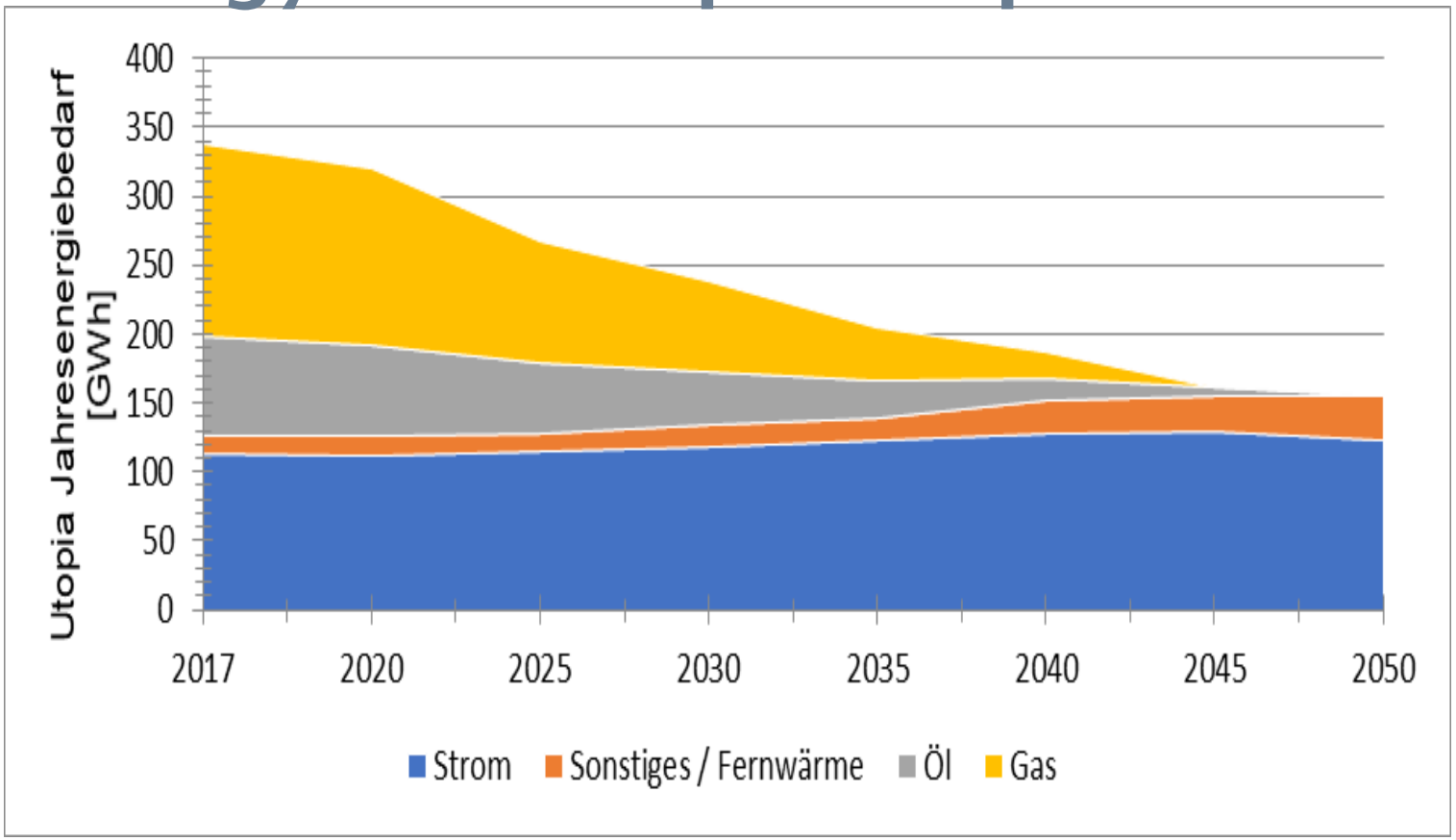


Roof-top potential until 2050 is >180 GWh/year; high yield per m^2

-> good price ratio!

-> enough for decarbonisation!

2.6. Energy Consumption up to 2050



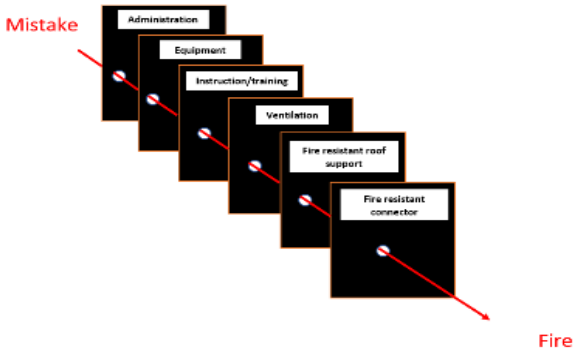
Annual energy consumption decreases in «Utopia» scenario -> **huge decrease in fossil energy use -> citizens of Burgdorf save money!**

3. PV Challenges - Quality

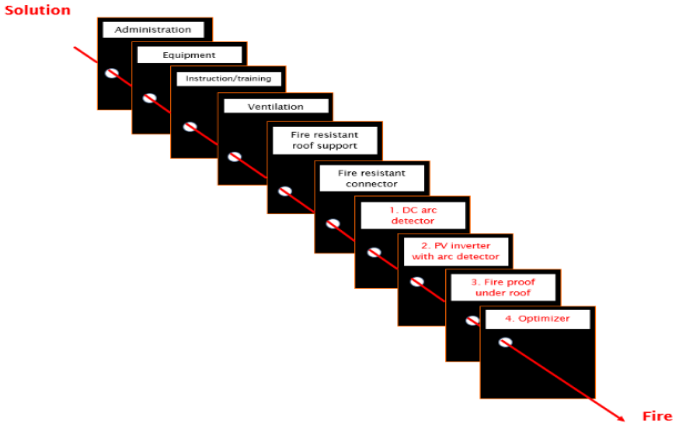
PV in-roof installations have a 20-times higher propability for a fire (Technical Report IEC).

I found in the last years 5 different constructions with fires – quality problem and wrong safety philosophy.

Fire in July 2020

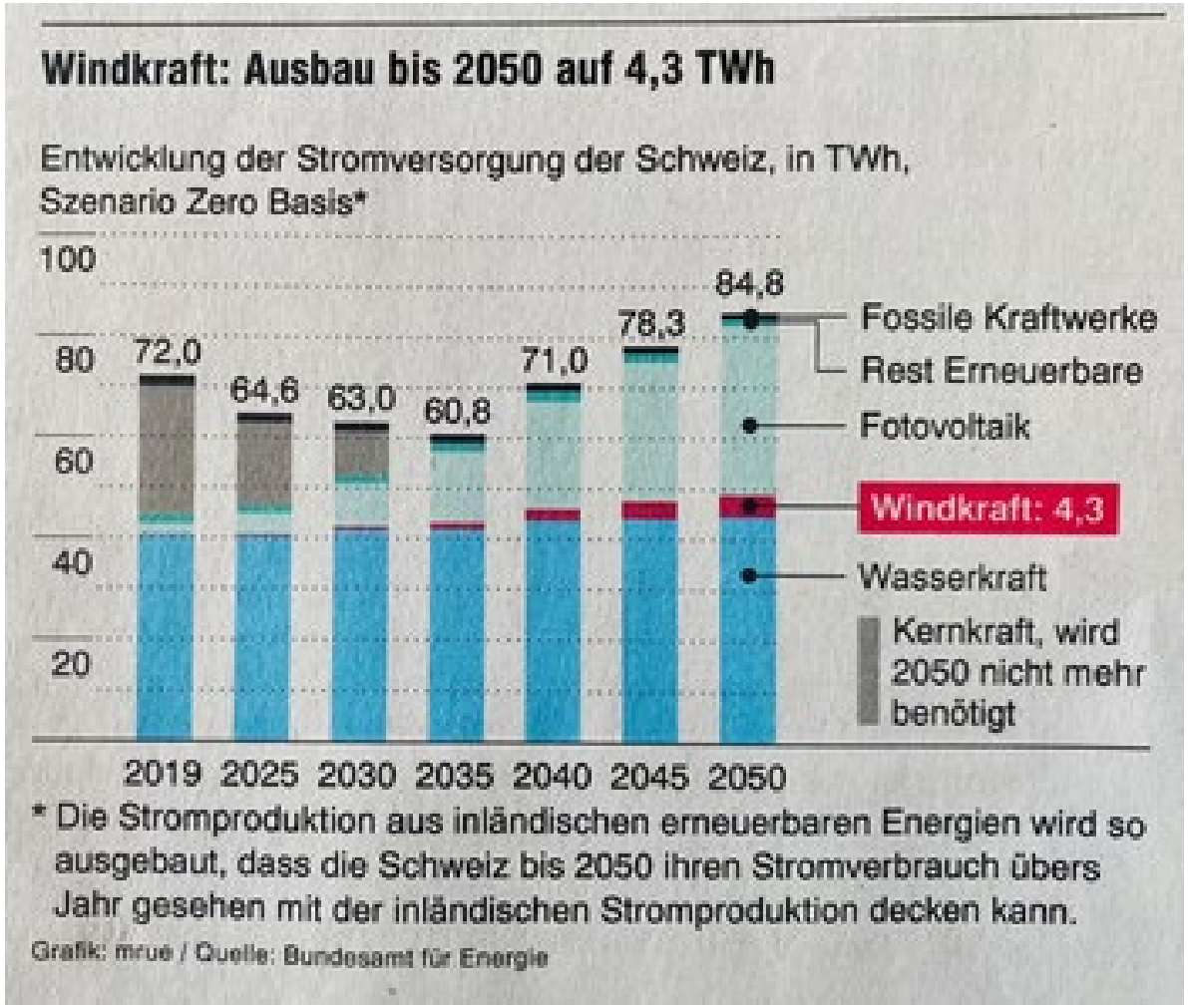


Not enough safety layers



More safety layers needed

4. PV capacity for decarbonization



We need about 35 TWh of PV in 2050: **➔1,5 GWp/ year!**

Enough PV surface potentials (BFE)

Roofs: 49/**24** TWh

Facades: 17/**6** TWh

Infrastructure: 35/**5** TWh

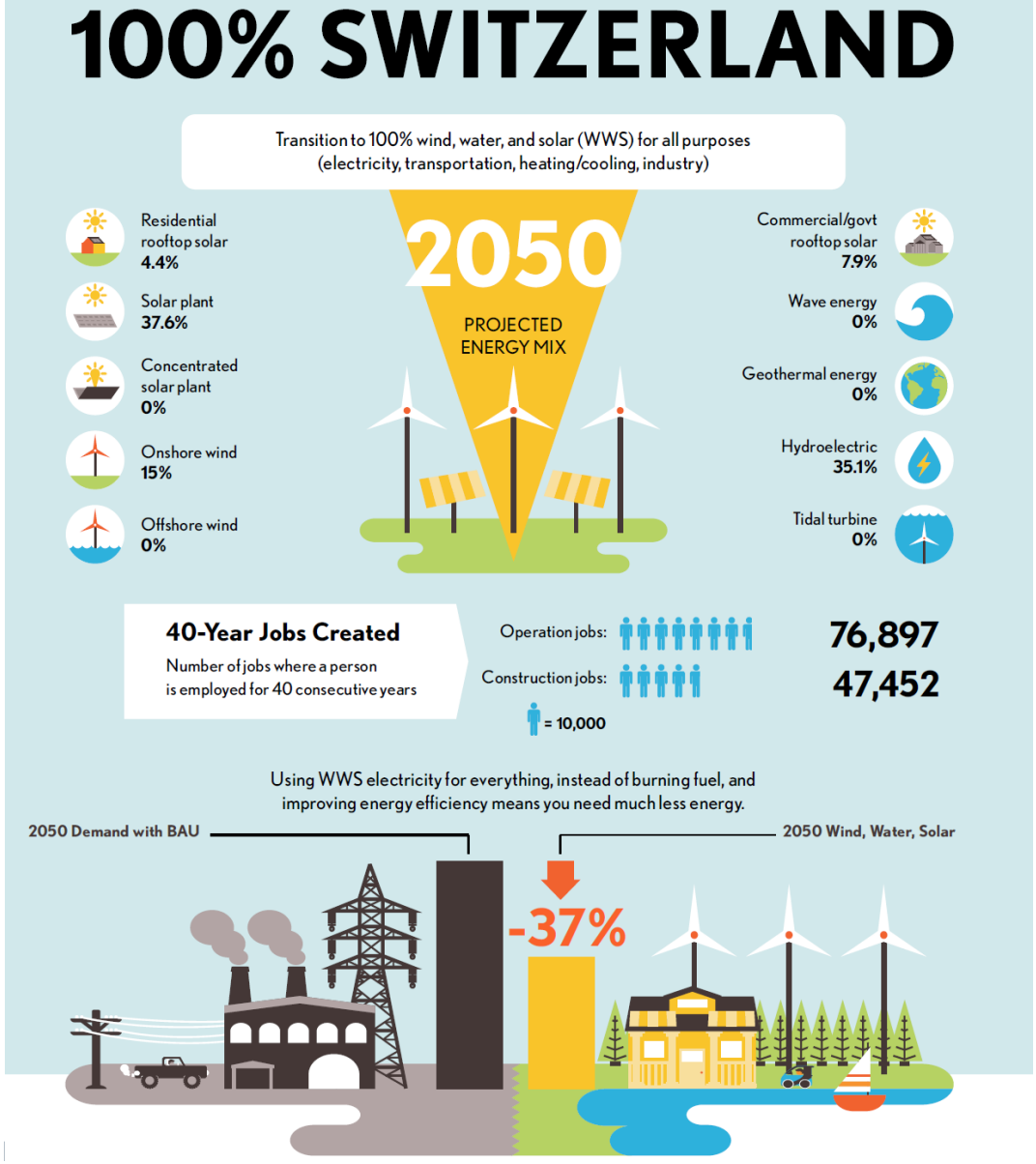
Free field: 16/**3** TWh

Totale: 117/ **38 TWh**

5. Workers needed:

Switzerland with 100% renewable energies (only SWW) – a project from Prof. Jacobsen – Stanford University CA/ USA.

We need about 120’000 workers inly in Switzerland!



6. The technology is ready – but not the Swiss policy – book for more pressure:

What the Swiss Energy policy slows down and what it needs to get quick and cheap to 100% renewable energies.
Goal of the book – influencing the politic discussion in the parliament in summer 2050!

Main autor: Dr. Ruedi Rechsteiner, retired member of parliaments/ ADEV Liestal
Co-autors:

- Dr. Ruedi Meier, Minergie etc.
- Thomas Nordmann, PV entrepreneur
- Urs Muntwyler, Prof. PV/retired politician
- Felix Nipkow, SES

7. Conclusions

Full decarbonisation in the small Swiss city of Burgdorf (e.g., no need for gas network any more) **is feasible by 2050 & avenues to be taken are realistic.**

Bottlenecks:

1) Retrofit of existing buildings -> rate has to speed up from 1% / year to 3% / year -> **skilled workers needed!**

2) 100% EVs by 2050 should work (costs are lower as for combustion engine vehicles)
   -> resistance from fossil energy lobby anticipated!

3) Lack of professionals in the PV industry – no own apprenticeship for PV planers and installers.

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Thank you for your attention!

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