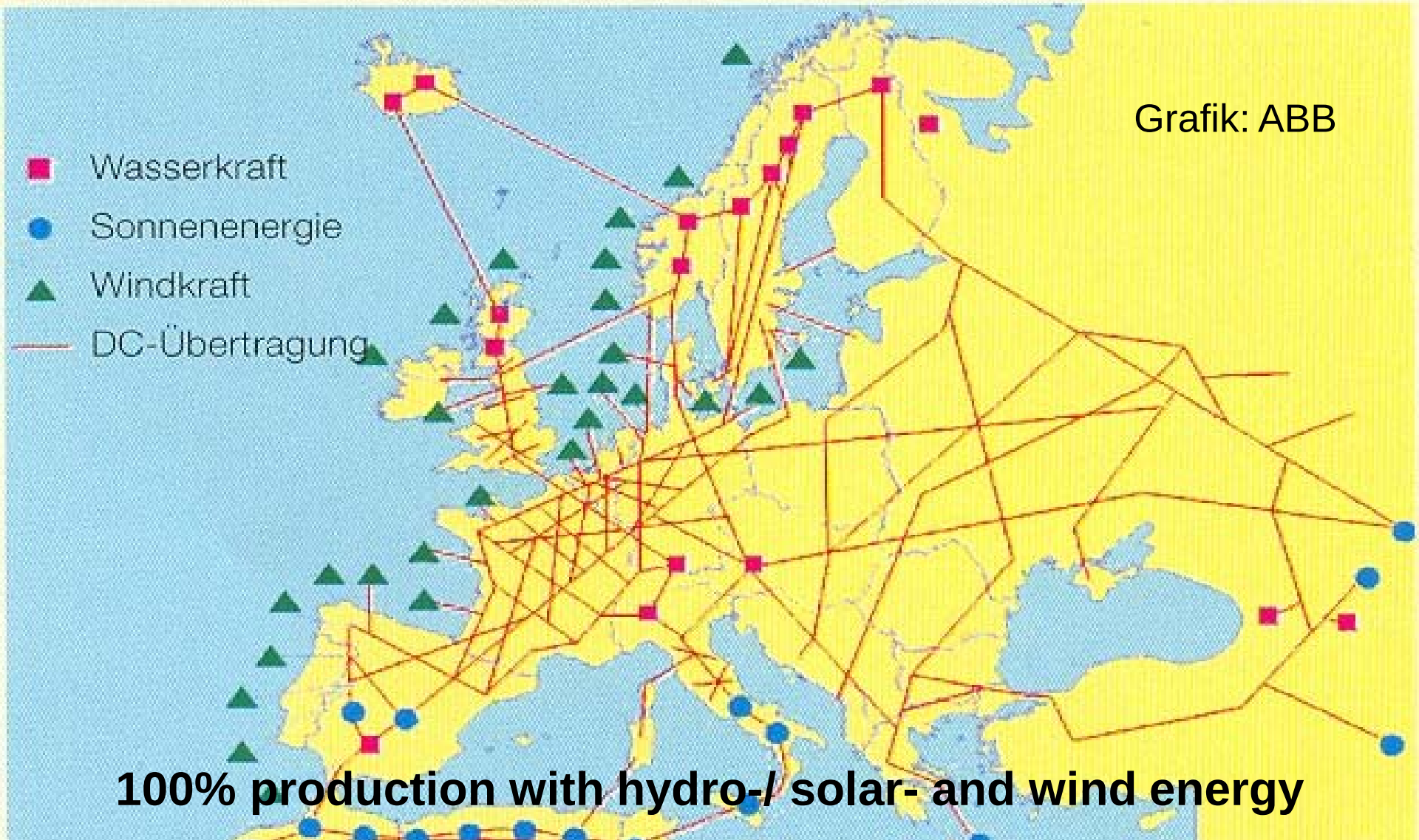
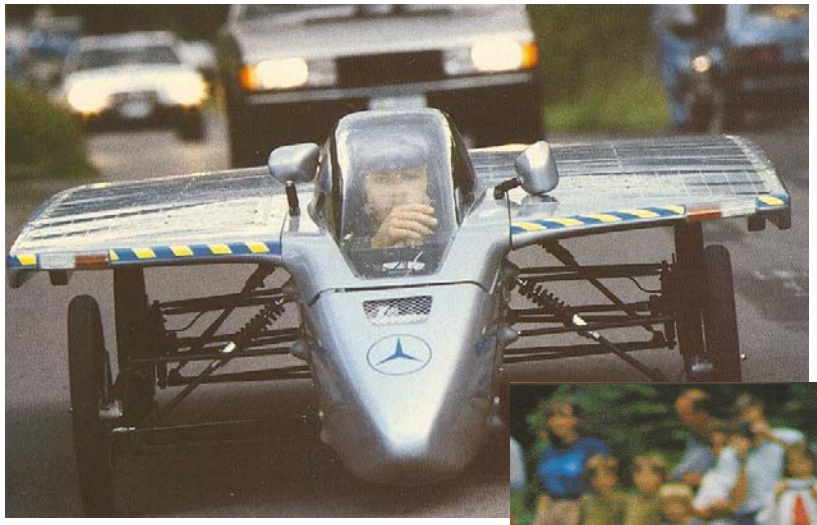
PV as a dominant energy source



100% production with hydro-/ solar- and wind energy

Tour de Sol 85: 1st solarcar race in the world

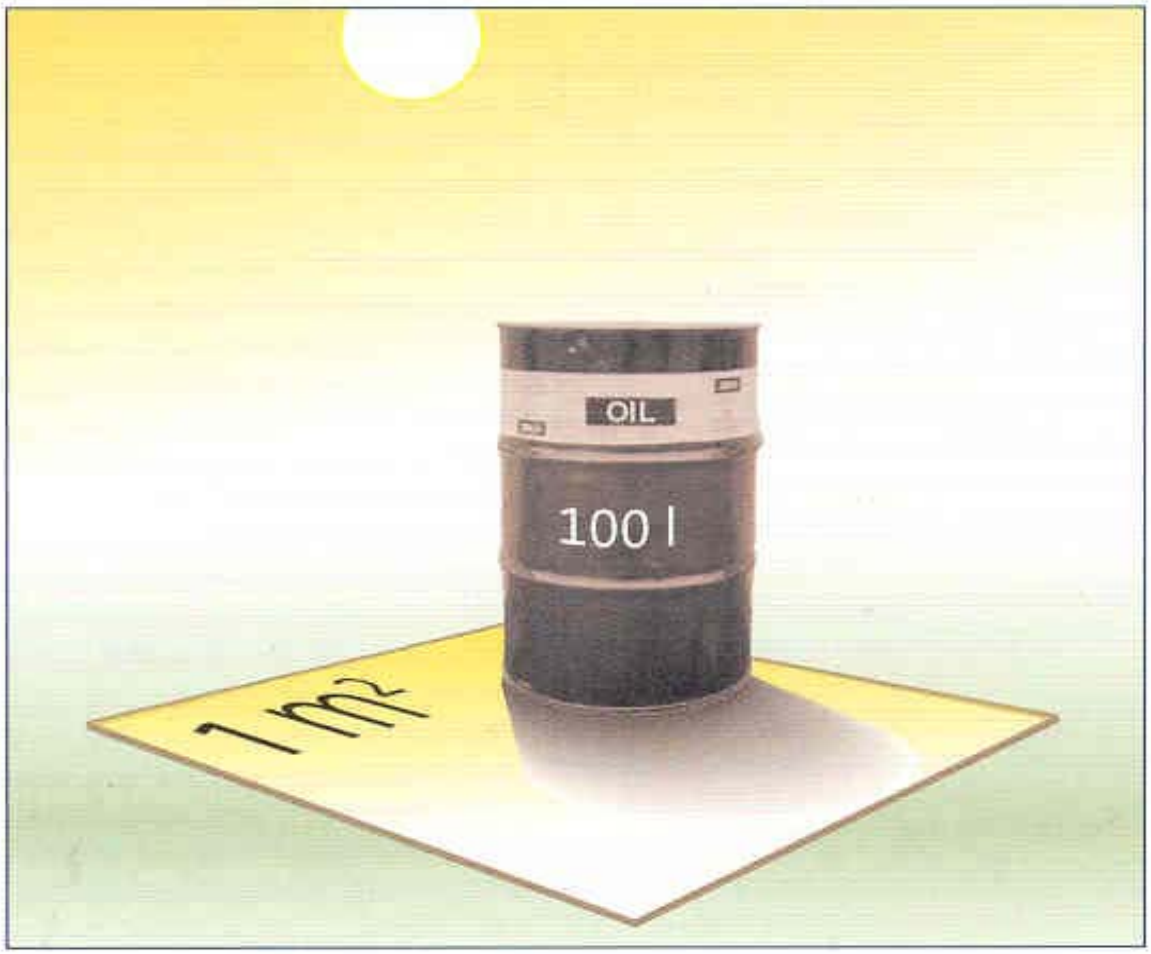


Planned as PR-campaign for solar energy

Tour de Sol: EV (electric vehicle) +PV (photovoltaic) grid-connected

Switzerland was the leading PV user in the 90-ties

„to much Energy on your roof“

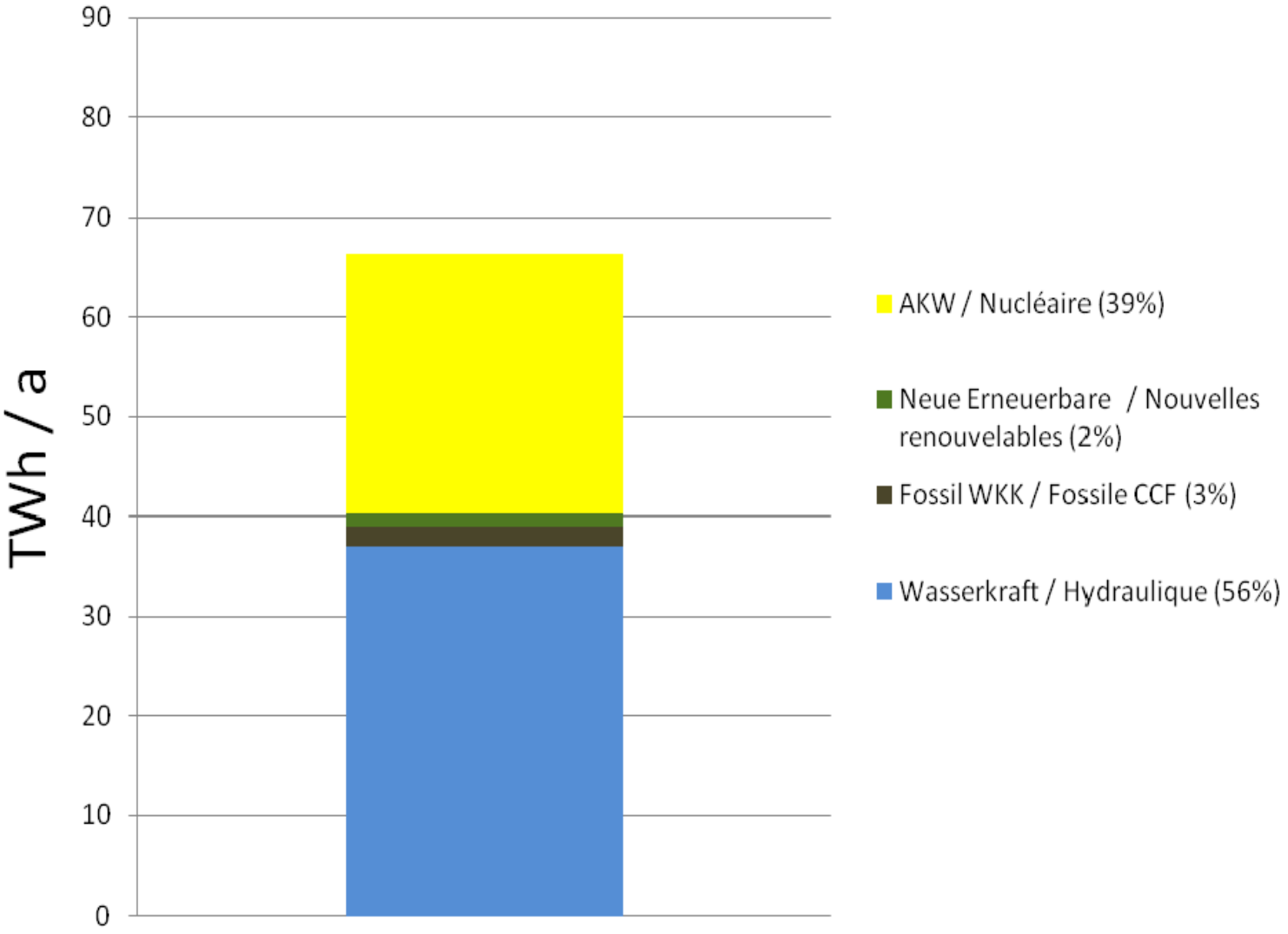


Sonneneinstrahlung in Berlin

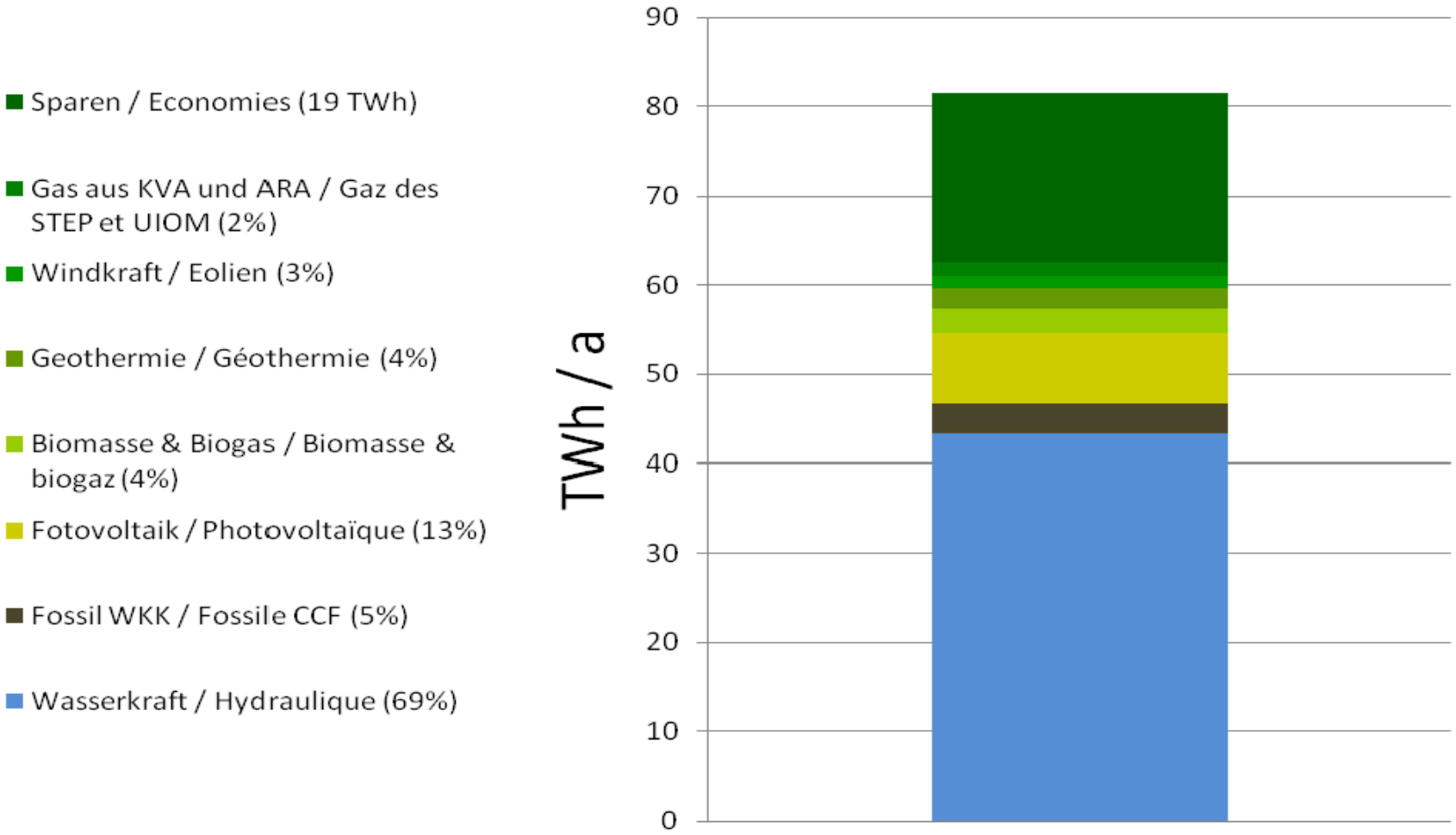
Die Sonne strahlt im Durchschnitt in Berlin auf jeden m² ca. 1050 kWh (Kilowattstunden) pro Jahr. Dies ist in etwa der Jahresverbrauch einer Person an Strom. Ein Liter Öl enthält ca. 10 kWh. Die Sonnenenergie die jährlich auf jeden m² fällt, entspricht somit einer Energiemenge von ca. 100 l Öl.

... We have enough Energy – but we are to lazy to collect them ... (Paul Dominik Hasler – philosopher from Burgdorf) …

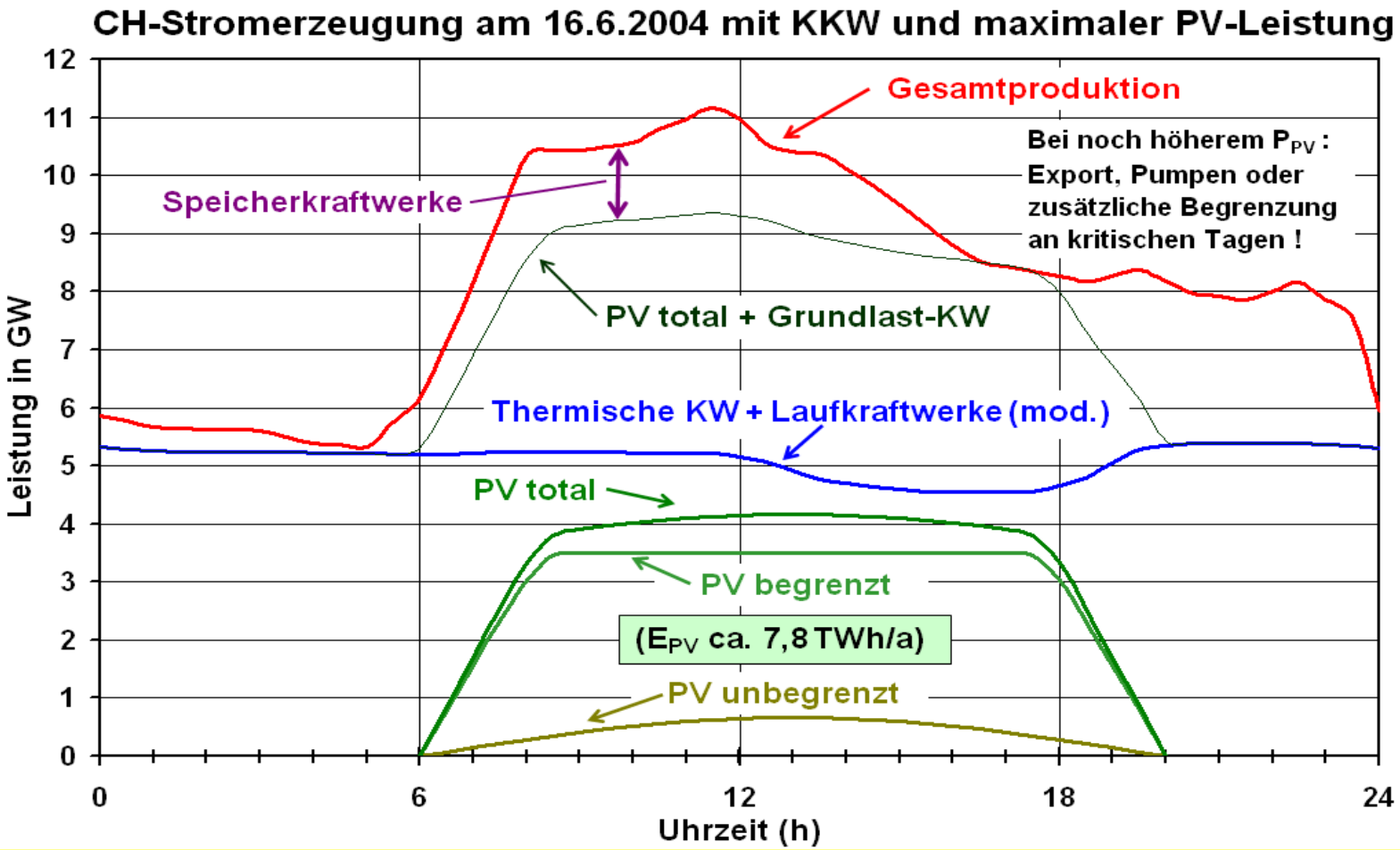
Electricity production in Switzerland 66 TWh



Concept: Annually use of electricity 2024 81 TWh



PV about 8 TWh or 8 GWp!



CH-electricity production on April 16, 2004, with the maximum tolerable production by PV installations added with and without regulation at PV optimized regime of the run-of-river power plants.

PV: strong growth over decades…

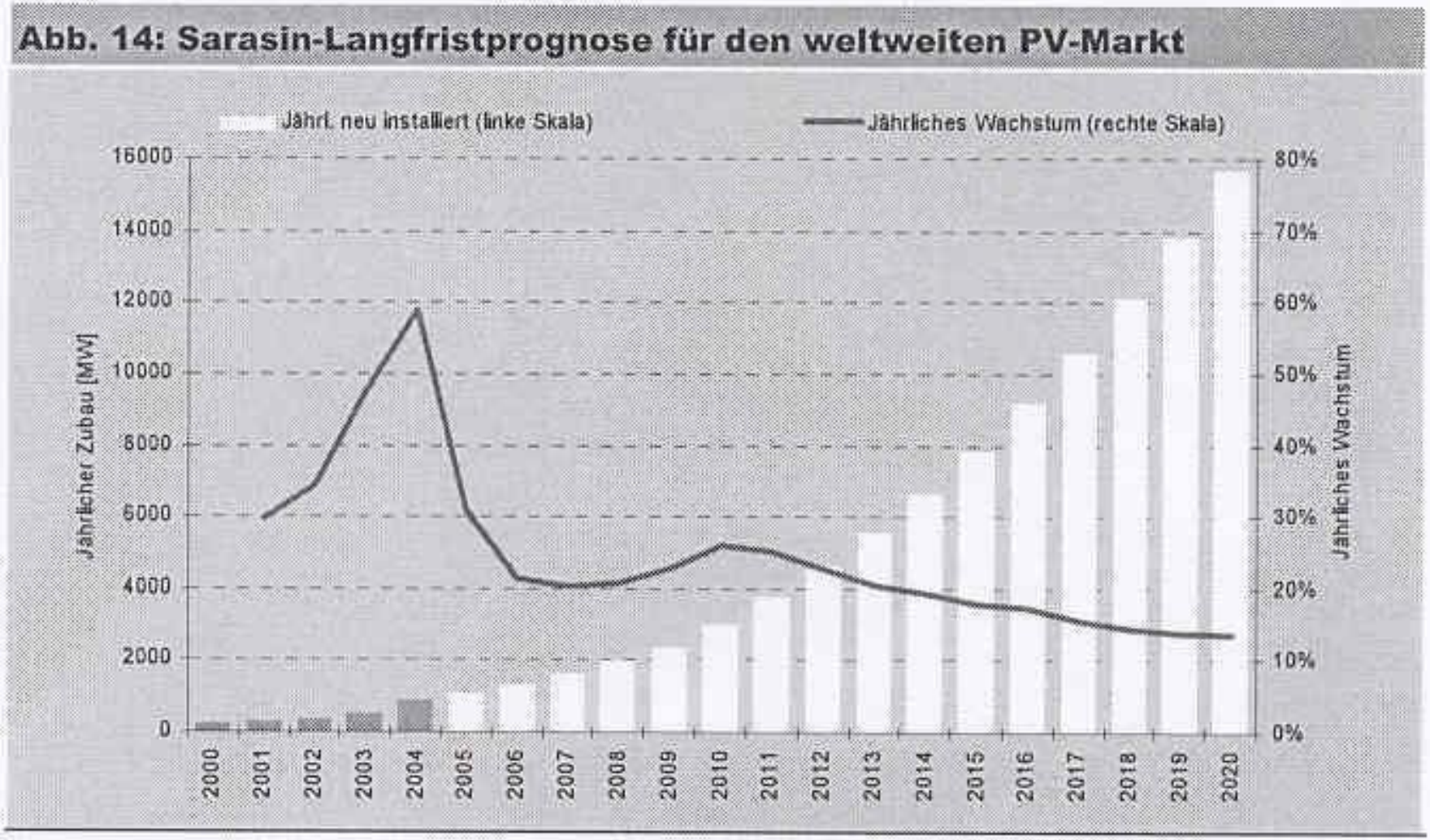
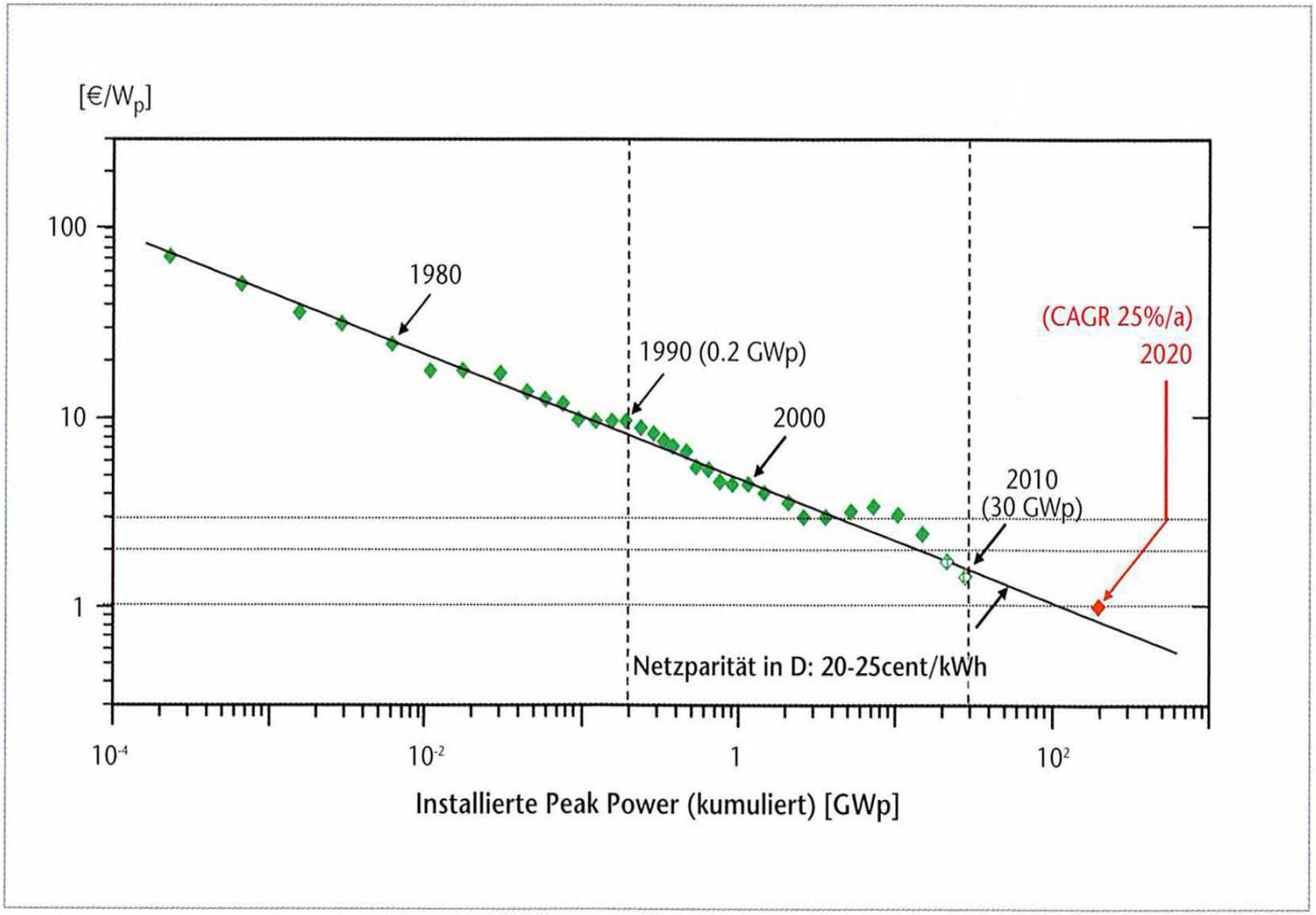


Abbildung 20
Preis-Lernkurve von c-Si PV-Modulen (Stand September 2009)

Quelle: G. Willeke, Fraunhofer ISE [37]



PV-electricity prices will decrease

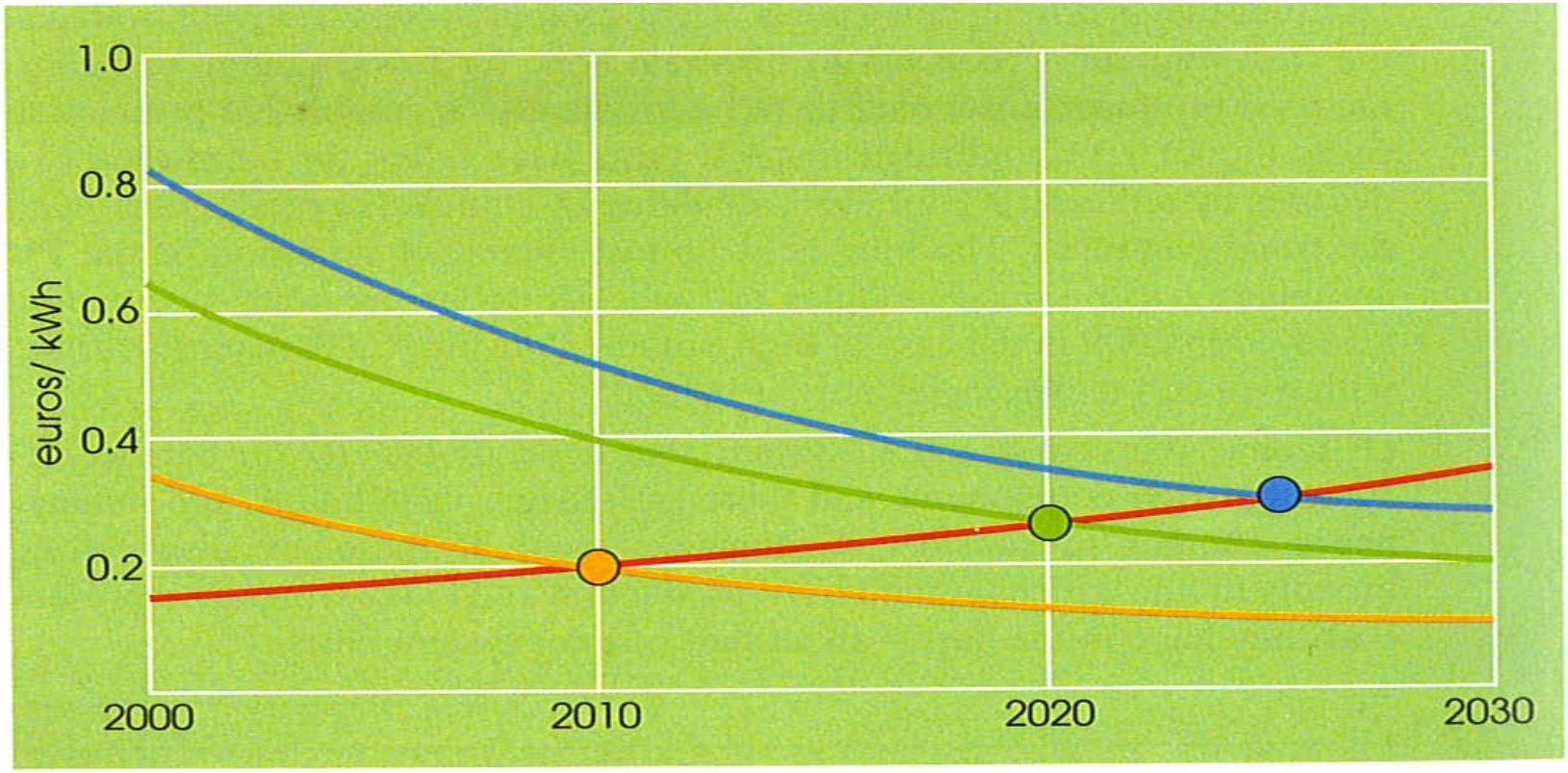


Figure 6.1 Towards grid parity in Europe.

Gelb: Südeuropa/ **Grün:** D und Mitteleuropa/ **Blau:** Skandinavien

Feed in tarif: the recept from Burgdorf...

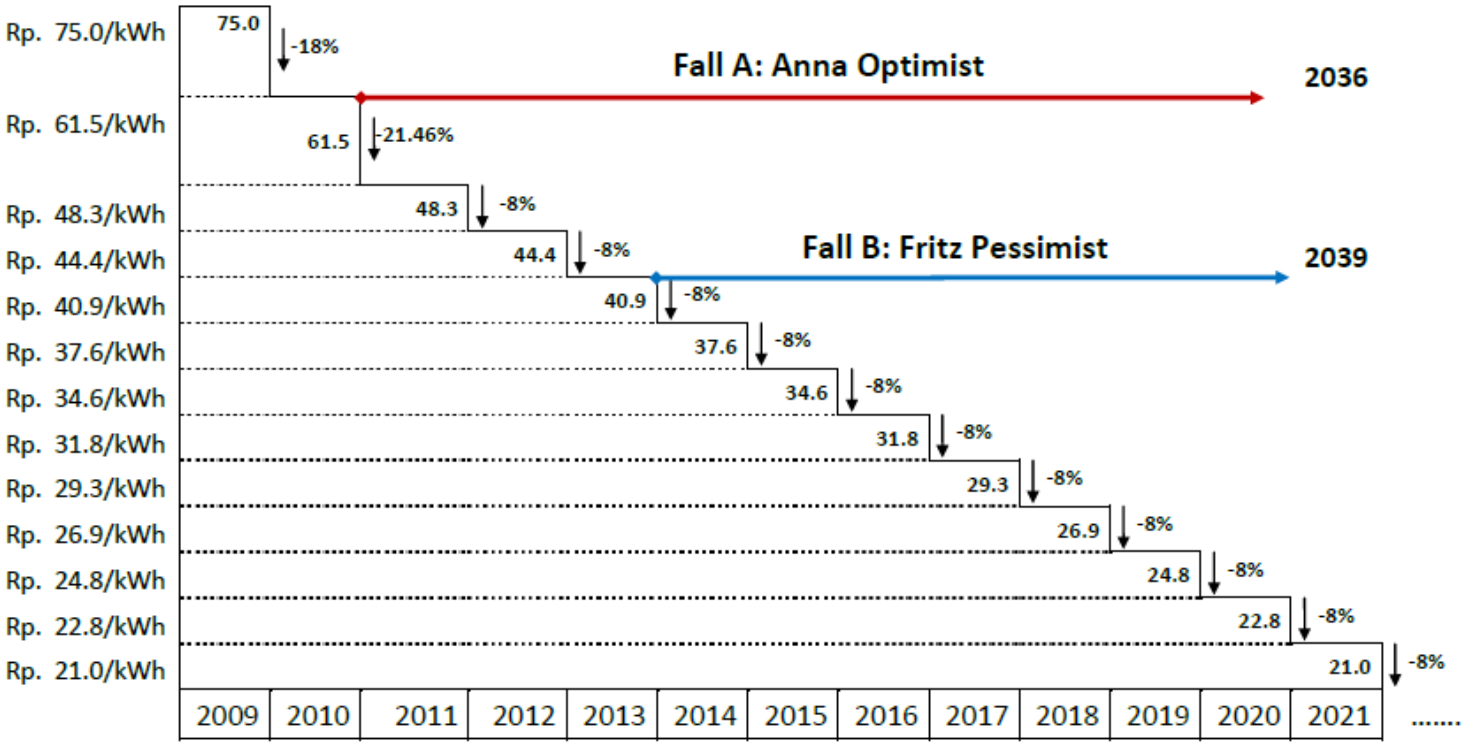


Abbildung: Diese Grafik zeigt die jährliche Absenkung des Vergütungsbeitrages um 8 Prozent anhand einer angebauten PV–Anlage (< 10 kWp).

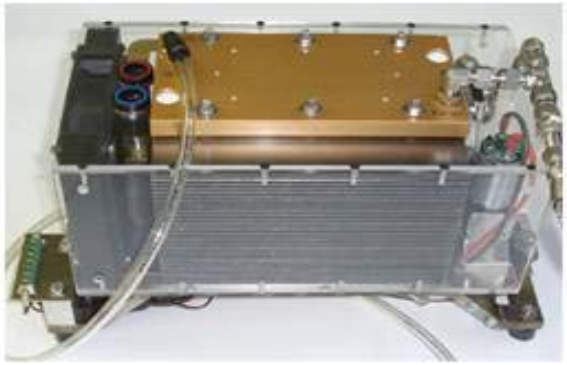
12.11.2008 MU/tb korrigiert 16.02.2010 MU/mw/modifiziert 19.11.2010 MU/mw

High potential for farm houses in the Alps

Roof integrated barne in Chateux-d‘Oeux (130 kWp)

Bern University of Applied Sciences (BUAS) PV-Laboratory in Burgdorf

Research focus: energy, traffic and mobility



Long-term measurement of PV-installations at Jungfraujoch (3,580 m asl)

- Fine tuning measuring for 20 years
- 70 installations up to 3‘500 m.asl in CH
- Higher radiation intensity-> higher production
- Analysis of the PV-production

- **Results**
- Reliability of PV-installations
- Influence of dirt on PV-installations

- **Economic implementation**
- EU-project für cleaning robots
- Fire prevention in PV-installations
- Books and publications

H. Häberlin, 2011, „Photovoltaics“, Wiley, 700 p.

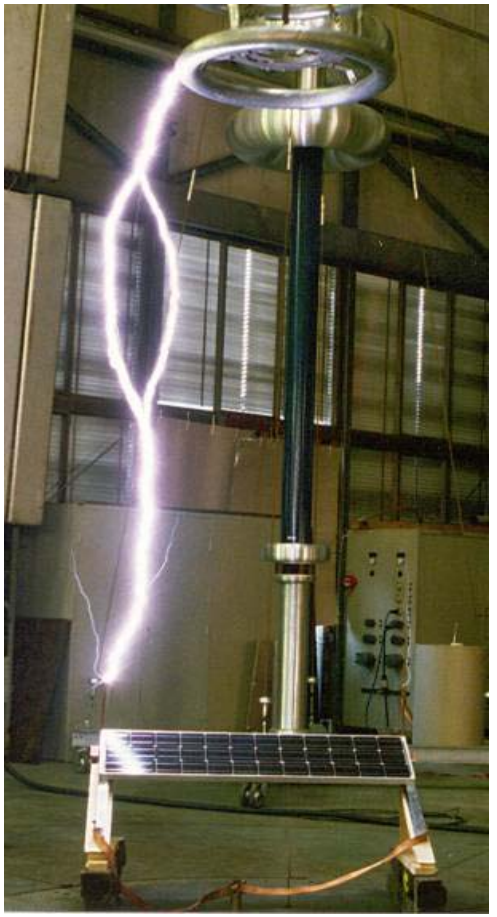
heinrich.haeberlin@bfh.ch

PV system technology

- **Components tests for PV-installations:**
- Tests of inverters for grid connected and of-grid installations
  (end of 2011: inverter tests as paid services)
- Development of test equipment (PV-generator-simulators up to 100 kW), measurment of I-U-curves etc.)

Photovoltaic system technology

- Lightning protection and safety of PV-installations
- Measuring the influence of lightning
- Development of overvoltage devices
- Arc detector for PV-installations
- Projects with industry
- Inverter test devices up to 100 kVA



heinrich.haeberlin@bfh.ch

Size of PV-installations

- Size of PV-installations off- and on grid
- Analysis of simulation programmes
- Comparison of simulated data and real time data
- International consulting
- Combination between EVs and PV
- Power supply in developing countries
- Courses / books and publications

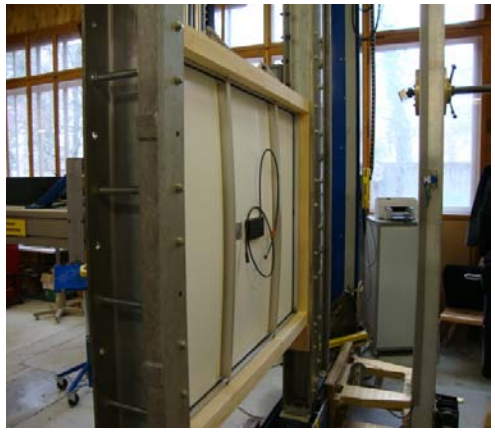
... wrong planned roofs in Bern 2011 ...

Future: …working together with the BUAS architects…

Actual - BSc-student works in Burgdorf:

- **Evaluation of 3 + 4 PV-calculations programmes** (Heiniger)
- **Comparing PV-calculations programmes with the PV-longterm measurement of BUAS**

  (Hauser)
- **PV-facades for two 60 m sky scrapers** in Zürich: Calculation of the production and best wiring
- (Reber/ Bützer)
- **Concept PV – electric vehicle charging stations: parking places of BUAS in Tiergarten-Burgdorf**
- (Ajeti Besnik)
- **PV and best charging of electric vehicle:**
- project ETHZ Suncar - Emobil (Meier)
- **Digital sensors P-I-U- for PV-longtermn measurement** (Blaser)



Thank your for your attention!