100% renewable energies – PV and EV in the last 40 years and future challenges

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PV specialist since 1975

Chair Implementing Agreement “Hybrid- and electric vehicles” International Energy IEA 1998 - 2018

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8. Ausblick

Energiewechsel – weg von fossilen Energien und Uran – Dekarbonisierung:

Dekarbonisierung => weg von Gas und Öl

➔Mobilität elektrisch

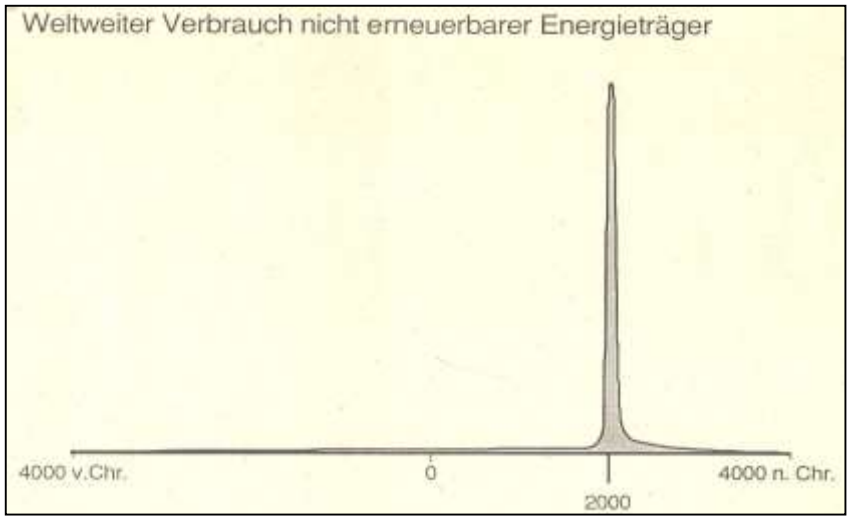
➔Heizen mit WP und Biomasse

➔Ausbau Fernwärme (Biomasse/ Solar etc.)

➔Rückbau Gasnetz angehen

➔Rahmenabkomme mit EU machen

- Notstromversorgung mit Gaskraftwerken (mit Gastank aus Biogass/ Power to Gas)
- 40-70-jährigen Investitionsstop beenden
- Massive Investitionen in Erneuerbar
- CH Photovoltaik (40 TWh) + Wind (4TWh)
- Ausbau Speicher Wasserkraft (regional) +bidirektionale E-Mobile (lokal)
- Energieeffizienz-Potentiale ausreizen
- Strom von Bandenergie-Konzept (AKW) auf fluktuierende erneuerbare Energien – **smart grid!**



Subventionen fossile Energien
2013: 550 Mia US$ (IEA)
2021: 687 Mia US$
Subventionen erneuerbare Energien 2013: 120 Mia US$

Positiv: Klimaherausforderung inbegriffen

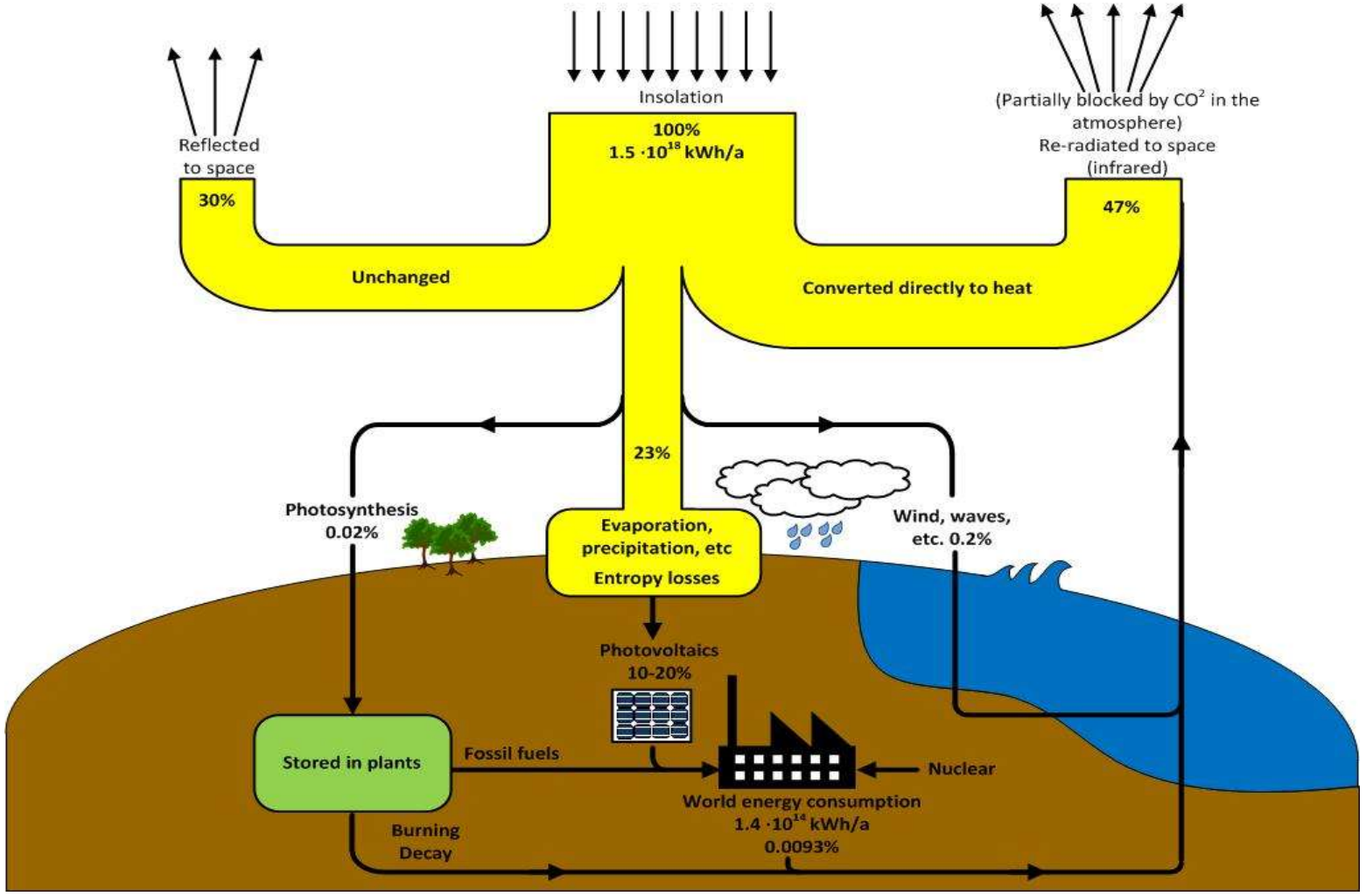
IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

Fahrzeugbestand weltweit:

Zahlen 1998	Bevölke-rung [mio]	Privatautos [mio]	Autos/ 1000 Personen
IEA Länder	852	516,4	606
„Tiger“-Staaten	1‘767	159	90
Entwickl.-Länder	3‘235	31,6	10

Bestand Privatautos 1998: ca. 700 Mio./ 2021: 1,2 Mia. Autos
300 Fahrzeuge/1‘000 Einwohner →ca. 2 Mia. Autos (x 3) → 3 l-Auto!

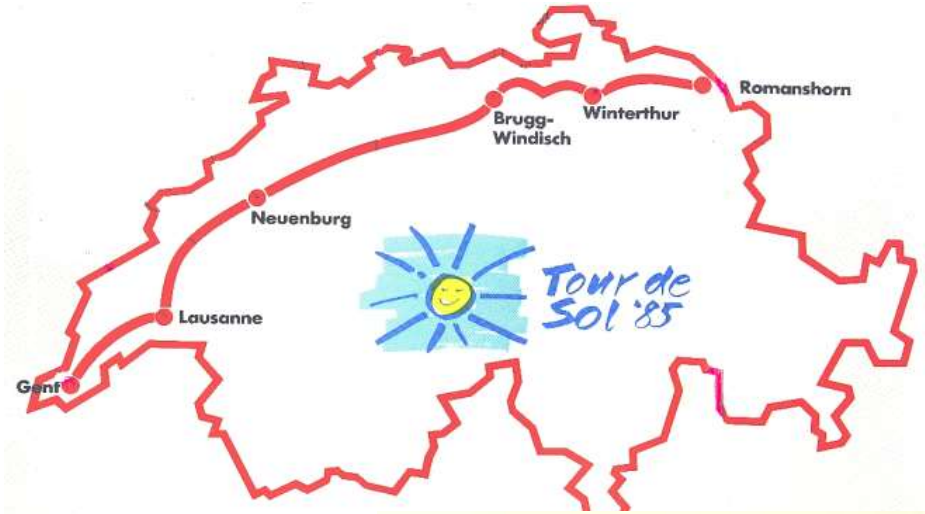
Bilanz: Energie von der Sonne auf die Erde



Die Effekte auf die Erde sind sehr unterschiedlich, daher lohnt es sich, zu schauen, wo die Wirkung am Besten ist.

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) in 1985



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. This led to an early boom in grid-connected PV plants in Switzerland.

PV Flächenpotentiale Schweiz (BFE/ ZHAW etc.)

Dächer: **50 TWh (ZHAW)**

Fassaden: **18 TWh**

Infrastruktur/ Strassen: **10** TWh

Freiflächen: **16 TWh**

Vehicle integrated PV VIPV: 2-3 TWh

Gesamt: 96 TWh➔nötig ca. 45 TWh

Weitere:

- Belastete Alpenflächen
- Agri-PV: 10-18 TWH
- Floating PV ...?

Energiestrategie 2050: Das Menü ist „Photovoltaik“ – der Rest ist Beilage!

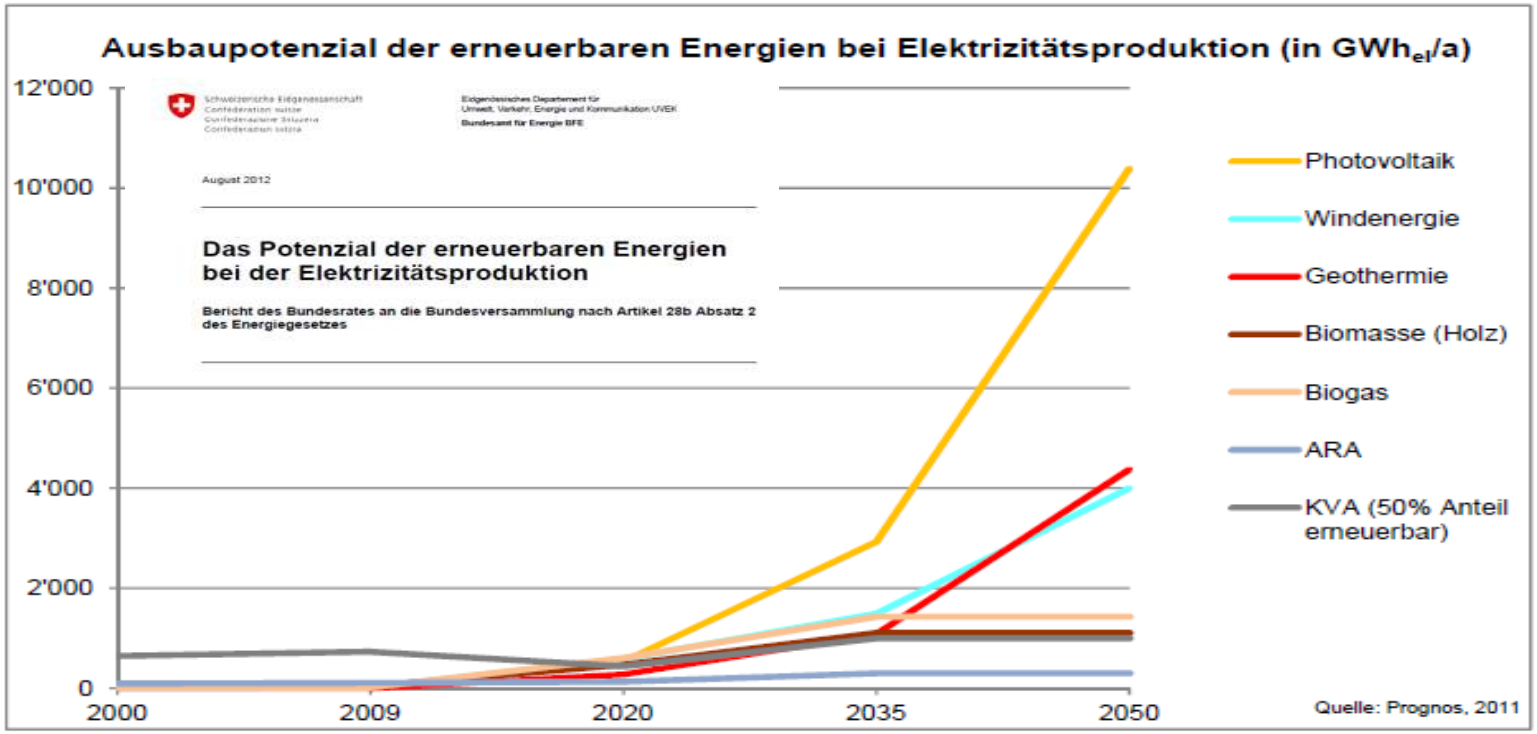
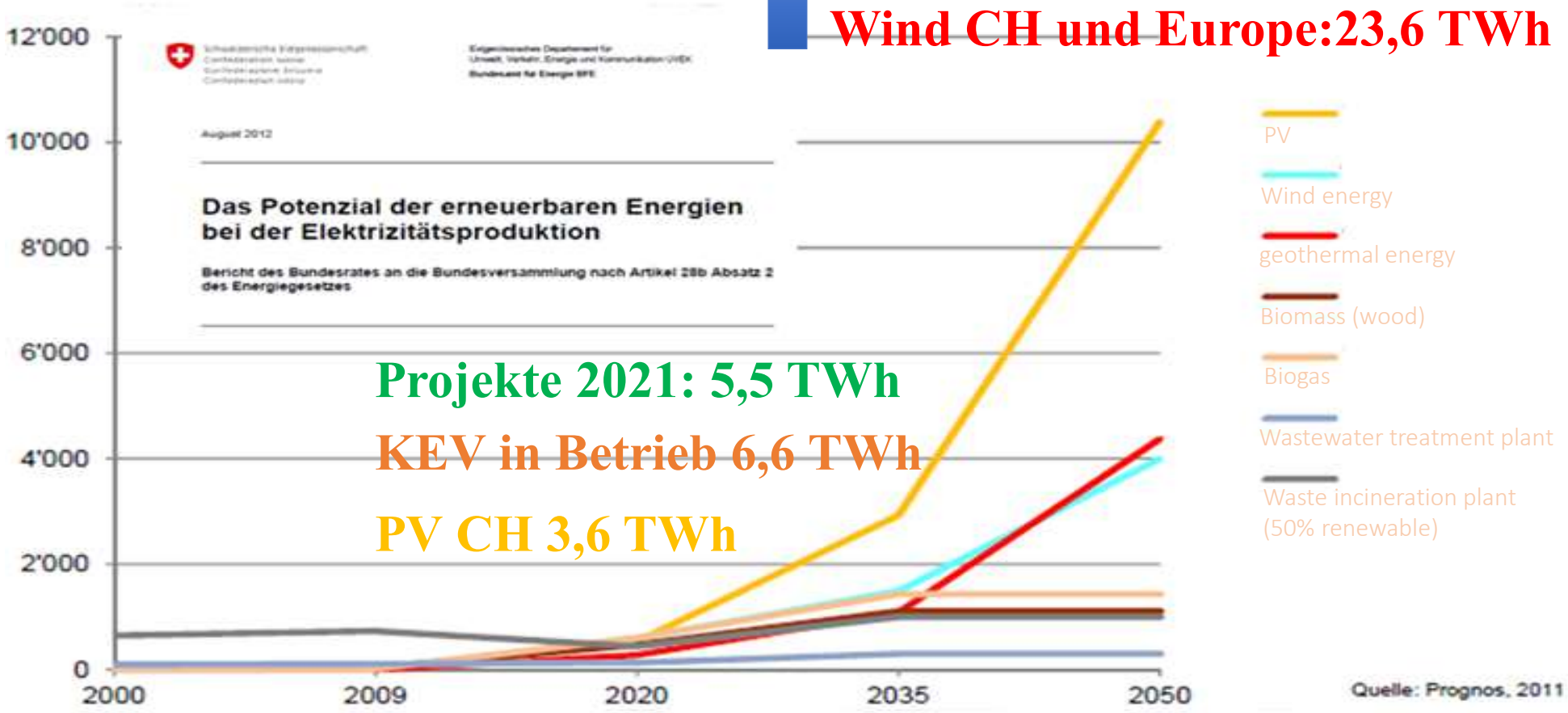


Abb. 3: Ausbaupotenzial der erneuerbaren Elektrizitätsproduktion nach Technologie[9]

Geothermie ist schwierig – also null und **plus** 4 GWp PV!
20 TWh PV heisst – 2,5 kWp PV und 12 – 15m² Fläche pro Person – das kostet nur 3–6’000.– pro Person!

Stand “Energie Strategie 2050” im 2022

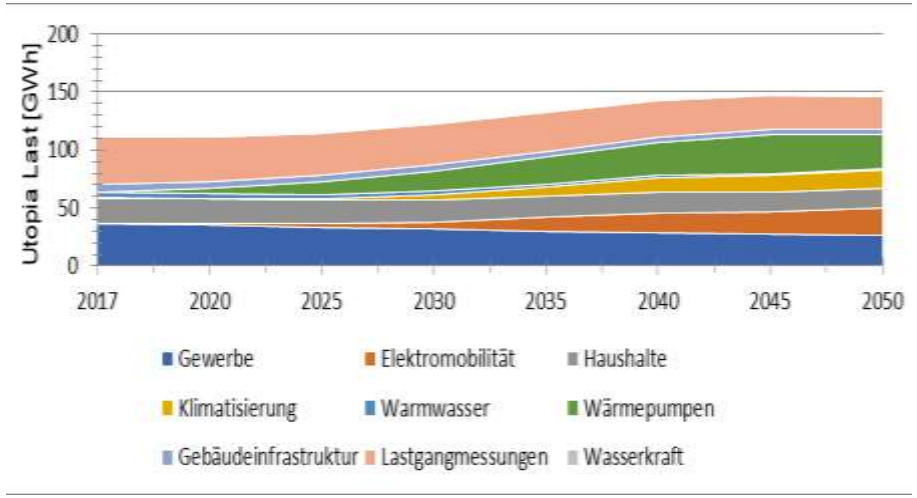
Wind CH und Europe:23,6 TWh

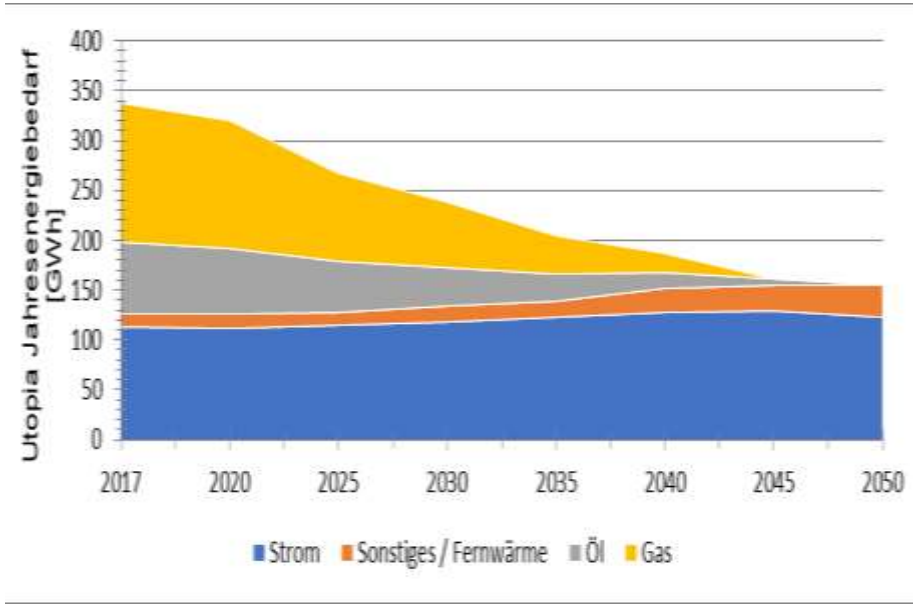


2022: PV 4,5 TWh/ Biomasse+Wasser+Wind: 3 TWh
CH PV + Wind Ausland: 11,5 TWh (2020)
Pos. Entscheid und Warteliste: >5,5TWh
➔**Gesamt: >25 TWh**

Studie Burgdorf 2050: «Utopia»

- Utopia bringt eine deutliche Steigerung des Stromver-brauchs mit sich, trotz Effizienzsteigerungen – Ersatz der fossilen Energien für Wärme und Mobilität!
- Sanierungsrate: 2% / Jahr.
- Geringere Sanierungsraten würden den Energieverbrauch deutlich steigen lassen.
- Gas + Öl 100% ersetzt.
- Ebenfalls konsequente 1% / Jahr Effizienzverbesserung für Bestandskunden.





6 Challenges in the EV- market and -application

1. EV system integration (traffic system/ streets etc.)

2+3. Electric boats and planes – future challenges and fun for the Engineers

4. PV + Wind preferred charging and bidirectional EVs

5. Energy consumption and weight of EVs

6. Vehicle integrated PV VIPV IEA IA PVPS Task 17

4. PV + Wind preferred charging of EVs and bidirectional EVs

PV preferred charging of EVs (above) will be a popular way to use excess PV production of private and commercial users.

With the «bidirectional charging mode» (below) EVs can contribute to manage PV power in several ways as:
- Local storage
- Power peak management
- Improved own consumption
- Etc.

EV charging at PV LAB (CH)

5. Weight and consumption of EVs

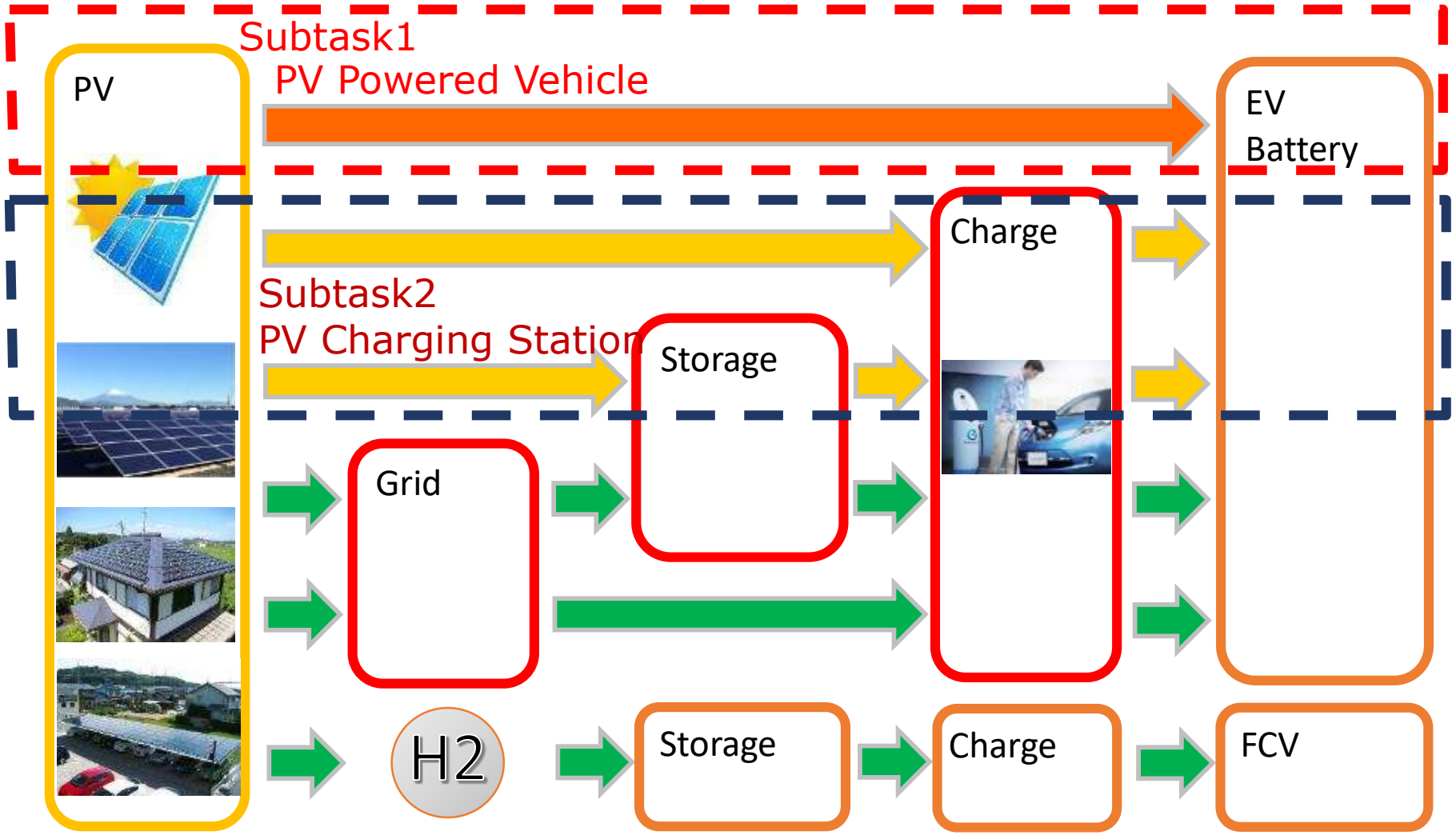
The weight of the EVs is in the range of 1’600 – 2’000 kg. Their consumption is around 20 kWh/ 100 km. **This is to heavy and to much consumption.**

The goal should be a consumption of 10 – 12 kWh/ 100 km and the weight below 1’200 kg.

To run the 5 Million cars in Switzerland we need 7,2TWh (8 GWp) PV (12’000 km/ year with 12kWh/100km).

Opel Ampera charging at the solarcarport in Burgdorf – the solar carport (2,5 kWp) saves in 30 years 27’000 l gasoline for Fr. 5’000.--!

IEA Working group vehicle integrated PV Task 17 (PVPS)



«Business models» – for the early majority/ late majority market

Scope and content «Business models» – part 2

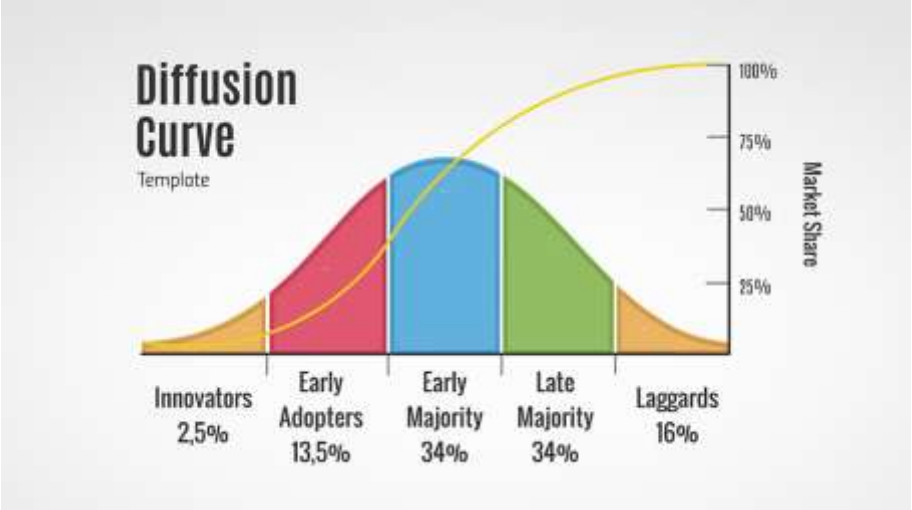
«enough capacity»:

Crossing the chasm (Geoffrey A. Moore) - diffusion of the VIPV innovation into the mass market group

- What is the benefit which turns early majority and late majority into VIPV users?
- How can we «cross the chasm» (between «opinion leaders» and «early majority»)?
- Where are the differences in car categories from light EVs, over EV's to heavy duty vehicles?

What are the differences due to different climate regions and infrastructures? What are efficient promotion measures?

Expected deliverable (s) 2024



Crossing the chasm approach (Geoffrey A. Moore): between the late adopters and the early majority there is a total new apporach needed to attract the «early majority and the late majority».

Example: Innovators are willing to buy expensive high performance EVs over the internet by an unknown US company.

Early adopters are willing to follow them but the price must be lower!

Early and late majority want to buy EVs from car companies and local dealerships.

Outlook

- PV is now the cheapest source of electricity (2 – 5 Rp/ kWh).
- With windenergy + hydro power 100% renewable is possible.
- Switzerland needs about 40 TWh PV and some TWh from other renewables as Wind, Biomass etc.
- Cheap and efficient PV modules brings the Tour de Sol idea «PV + transport» back in the form of VIPVs.
- PV and Wind grows quicker as the car market.
- Switzerland is behind most of these efforts – thanks to resistance of the lobby in politics and trade associations.
- The vision of 1985 has fullfilled – driving with «solar».
- There are still some challenges and many improvements.

Thanks you for your attention!

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