18 March 2024 - Zero emission group @ EPFL

# A path to zero-net in Switzerland

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Author of the Book

"*Urgence Energie et climat – Investir pour une transition rapide et juste*"

# Content

1) The classics: housing and mobility
2) Electricity: the current situation in winter and summer
3) The challenge of decarbonising industry
4) Synergy between industry and winter electricity supply
5) The electricity generation mix we need

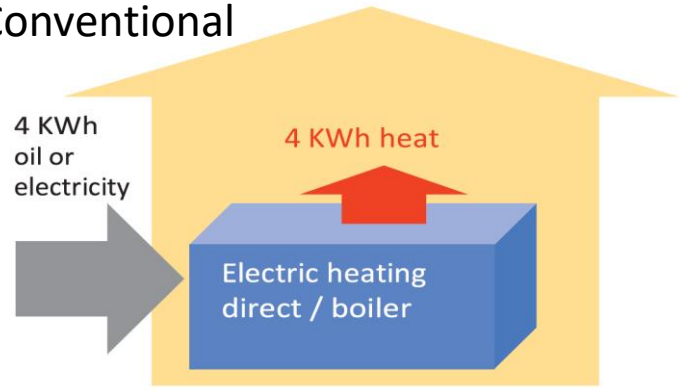
A reminder and a warning:

1) 80% of GHG emitted in Switzerland are coming from burning fossil energy (worldwide 75%)
2) Technology alone cannot solve the climate problem (I estimate it can bring 2/3 of the solution)

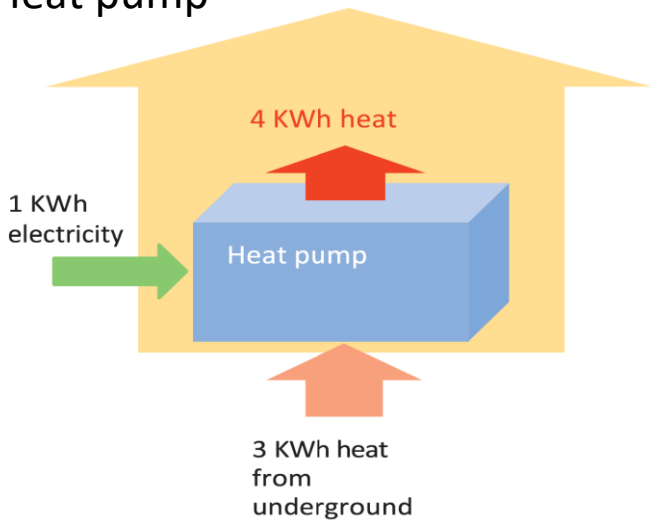
# 1. The classics: housing and mobility

**Heating a house**

Conventional




Heat pump

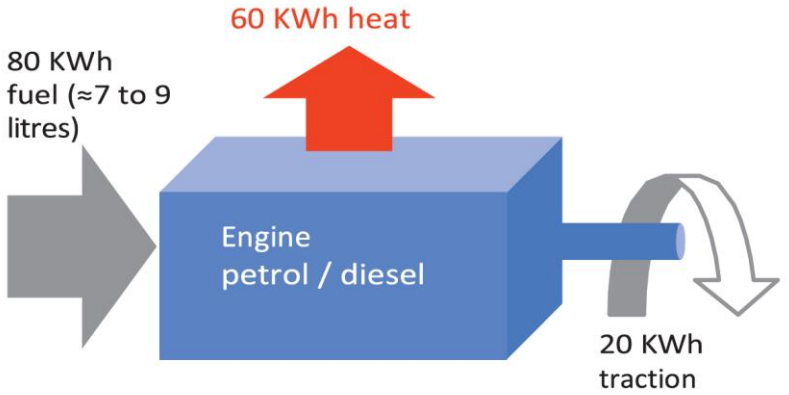



**+ 6 TWh electricity consumption, mainly in winter** (also insulation and non-electric heat)

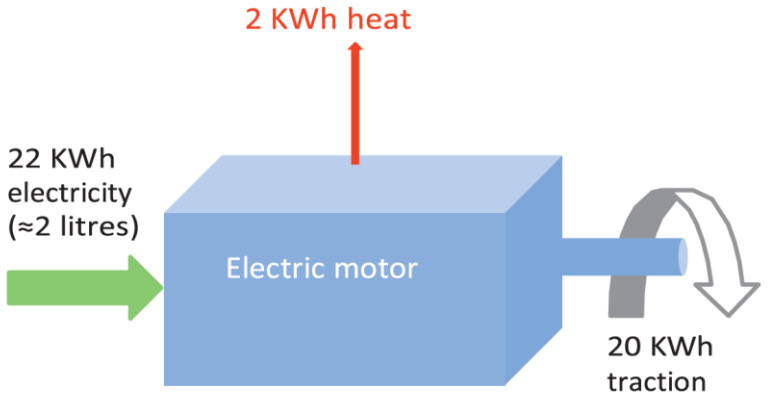
**And replace 20 TWh of nuclear power at the end of its life**

**100 KM by car**

With a fossil car

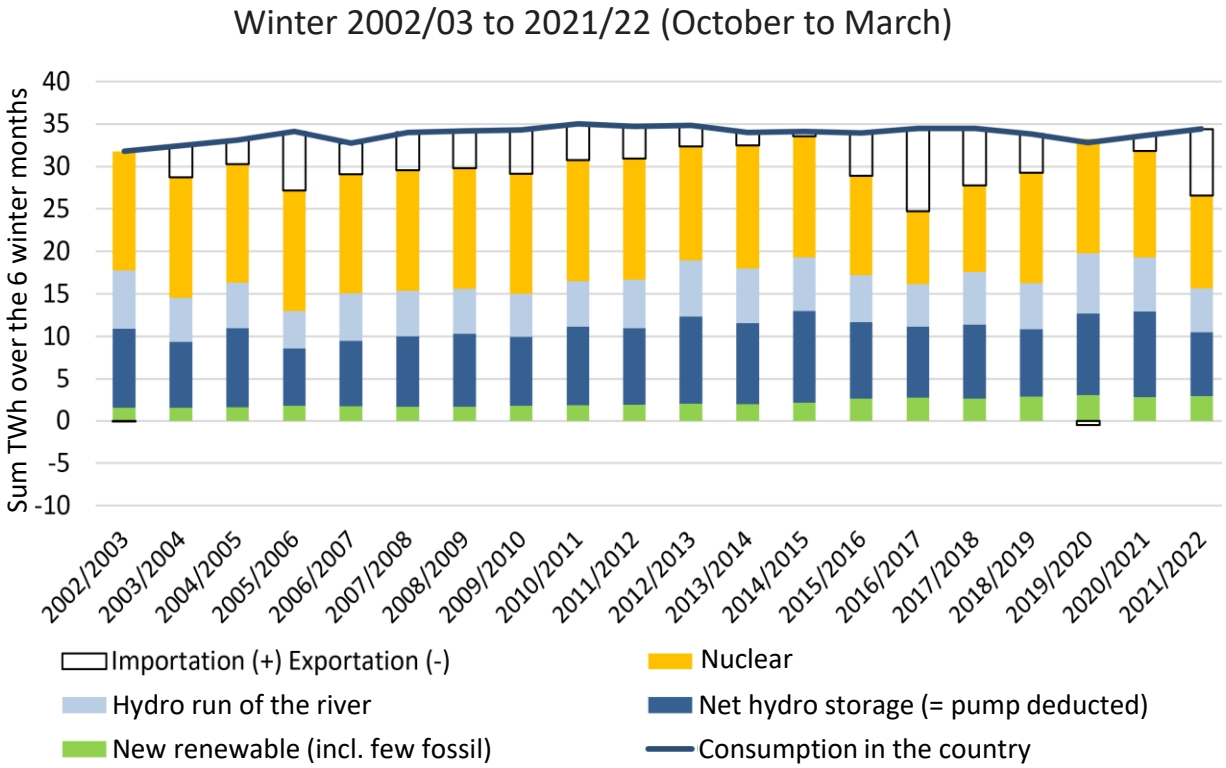


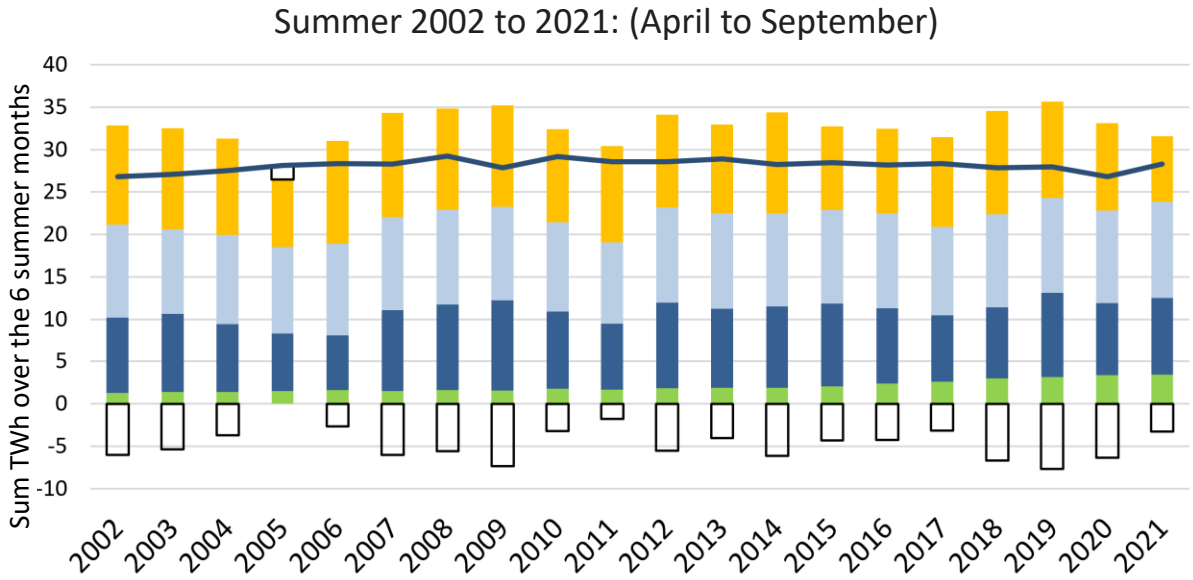

With an electric car




**+ 17 TWh electricity consumption (evenly spread)**

# 2. Electricity: the current situation in winter and summer




**For climate neutrality (excluding aviation):**

Replacing declining nuclear power

+ 6 TWh per year, mainly in winter, for heating.

+ 17 TWh per year for mobility (spread evenly over seasons)

+ Decarbonising industry

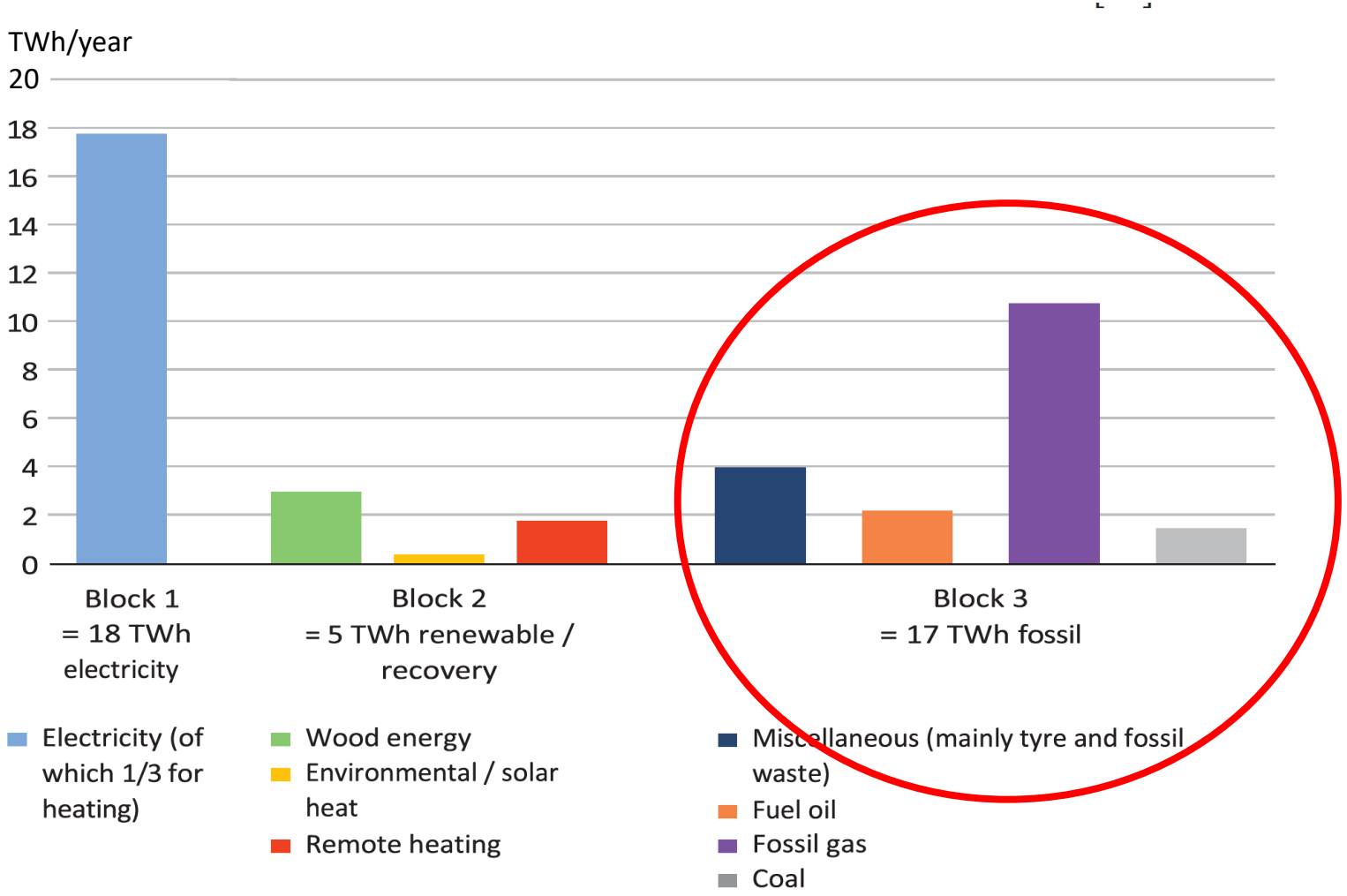
+ No use of fossil fuels in winter to generate electricity

= Huge challenge → invest massively

# 3. The challenge of decarbonising industry

## Energy use in Swiss industry in 2019

(excluding fuels, which are included in transport).




**17 TWh fossil**

Figure 23. Energy use for heat production in industry by temperature level (processes and buildings)

| All uses, renewable and non-renewable sources | TWh | Share |
|---|---|---|
| Heating, hot water and process heat up to 100˚C | 9,0 | 31,0 % |
| 100-200 ˚C | 3,3 | 11,4 % |
| 200-400 ˚C | 1,6 | 5,5 % |
| 400-800 ˚C | 8,9 | 30,5 % |
| 800-1200 ˚C | 4,4 | 15,3 % |
| >1 200 ˚C | 1,8 | 6,3 % |
| Total | 29,2 | 100,0 % |

Source of calculation data: [45]

# 4. Synergy between industry and winter electricity supply

## If we treat the problems separately

**Industry:**

17 TWh Fossil → 17 TWh Syngas produced in summer
→ 34 TWh electricity *(because of 50% conversion losses during syngas production).*

**To avoid winter electricity shortfall:**
(with decarbonised land transport and buildings, 50 GW PV):

10 TWh → 20 TWh Syngas produced in summer *(due to new 50% conversion losses Syngas → electricity)*
→ 40 TWh electricity

Total = 74 TWh electricity in summer to produce syngas and storage of 37 TWh Syngas.

= enormous quantity! Unrealistic

## By exploiting synergies and efficiency

**Winter electricity:** harvesting enough electricity directly in winter to rarely need to use syngas

**Syngas**

Summer production of syngas for winter:

Mainly for industry, to avoid conversion losses into electricity

Use of summer electricity surplus:

Direct consumption in industry + just-in-time syngas for industry

# Strategy for replacing the 17 TWh of fossil fuels used by industry

(including old tyres)

**Maximum efficiency strategy.**

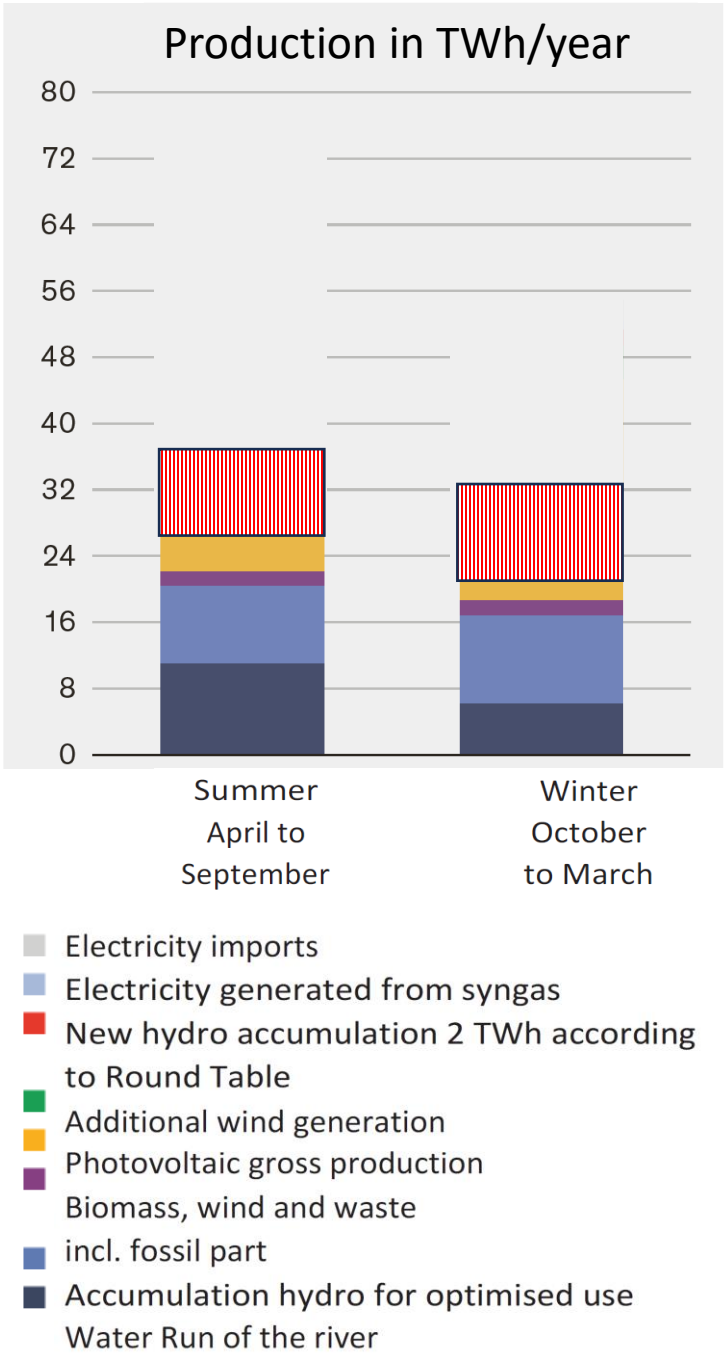
| | | |
|---|---|---|
| All year | **Heat in industry for heating + processes up to 100°:**<br><br>**5 TWh,** half of which for processes (constant over the year) and the other half for heating (mainly in winter) | High-temperature heat pumps, mainly in winter. Heat pumps consume **2.5 TWh**<br><br>→More need of electricity, 2/3 of which in winter |
| Summer half year | **1ère Half of the summer heat > 100° of fossil origin in industry**, summer half-year **3 TWh** | Direct use of electricity to produce heat > 100° :<br>**3 TWh**<br><br>(hybrid electric & gas installation! No efficiency gains because no heat pump!)<br><br>→More need of electricity during the summer |
| | **2nd half of summer heat > 100° of fossil origin in industry**, summer half-year: 3 TWh<br>(Where electricity is not feasible) | Use of 3 TWh of syngas, which requires **5 TWh of** electricity to produce it, no seasonal storage.<br><br>→More need of electricity during the summer |
| Winter half year | **Replacement of 6 TWh of industrial heat > 100° during the winter half-year.** | Use of 6 TWh of renewable syngas to be produced during the summer and stored for the winter. Requires **12 TWh** during the summer<br><br>→More need of electricity during the summer |

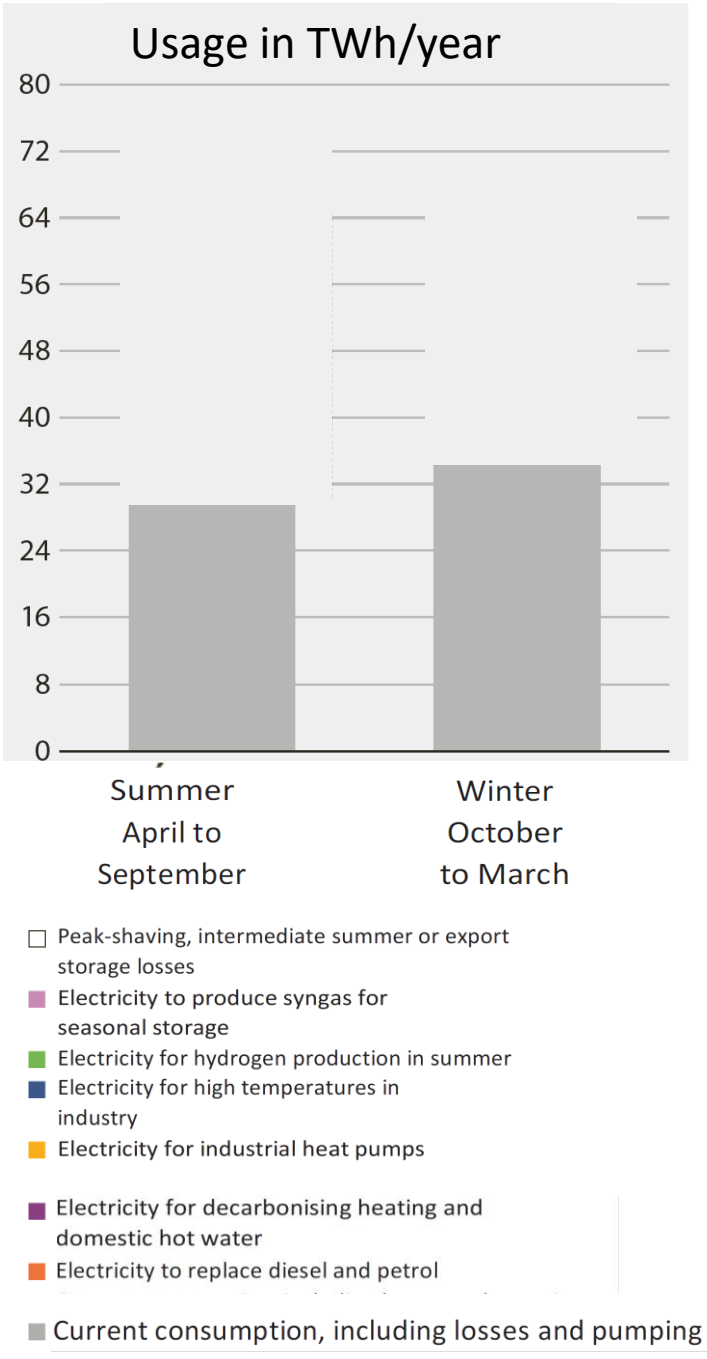
# 5. The electricity generation mix we need

- Existing hydropower
- Existing biomass
- 4 GW wind power (1000 machines) → 6 TWh, including 4 in winter
- 15 "Round Table" projects: 2 TWh of additional hydro storage
- A total of 72 GW Photovoltaic → 76 TWh (12x more than today).

  - Currently: **7 % of roof potential is used for PV, for around 6 GW**
    (source: https://www.uvek-gis.admin.ch/BFE/storymaps/DO_Energiereporter/ )

**The average situation during the summer and winter semesters**



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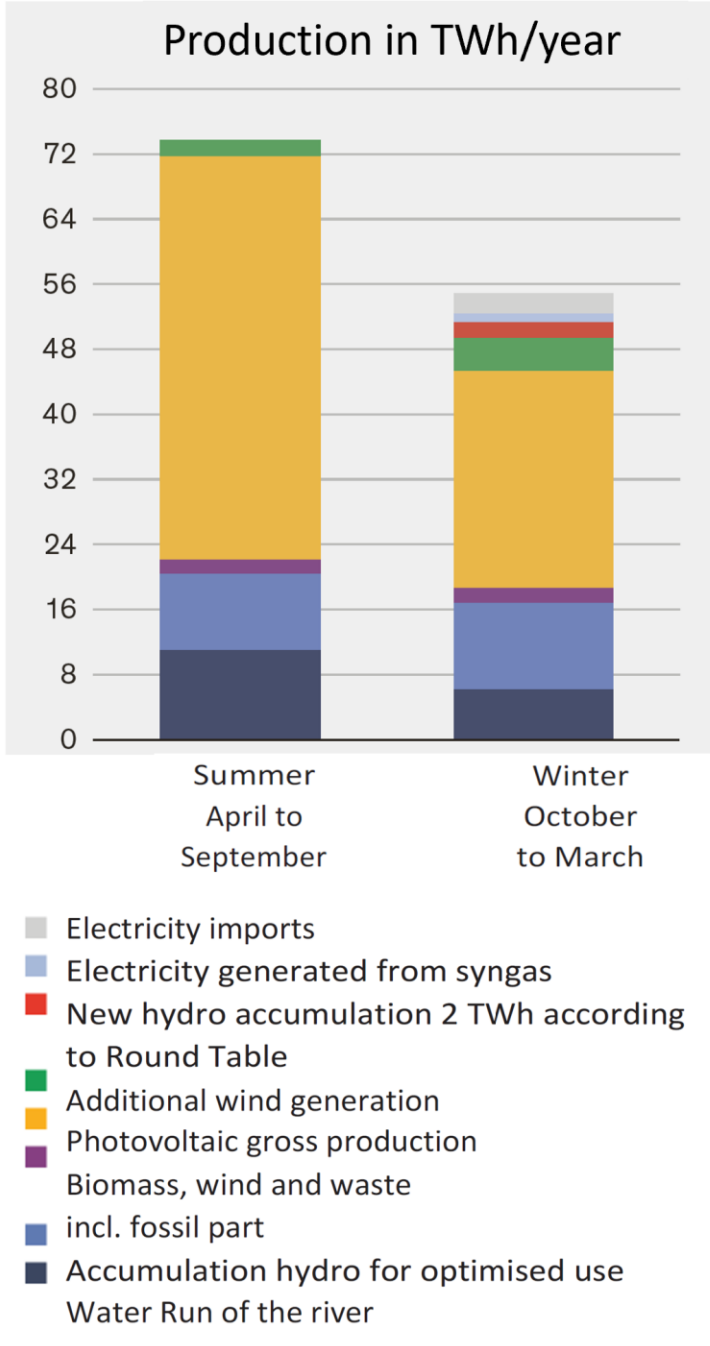
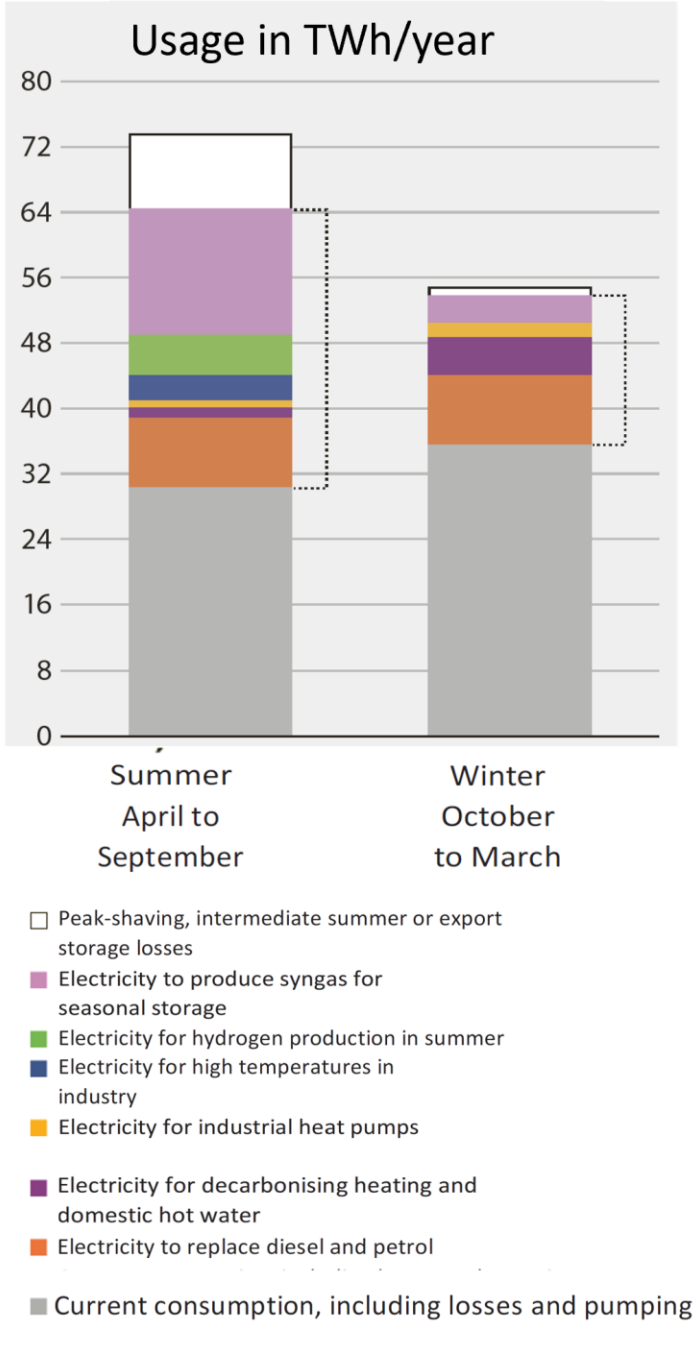
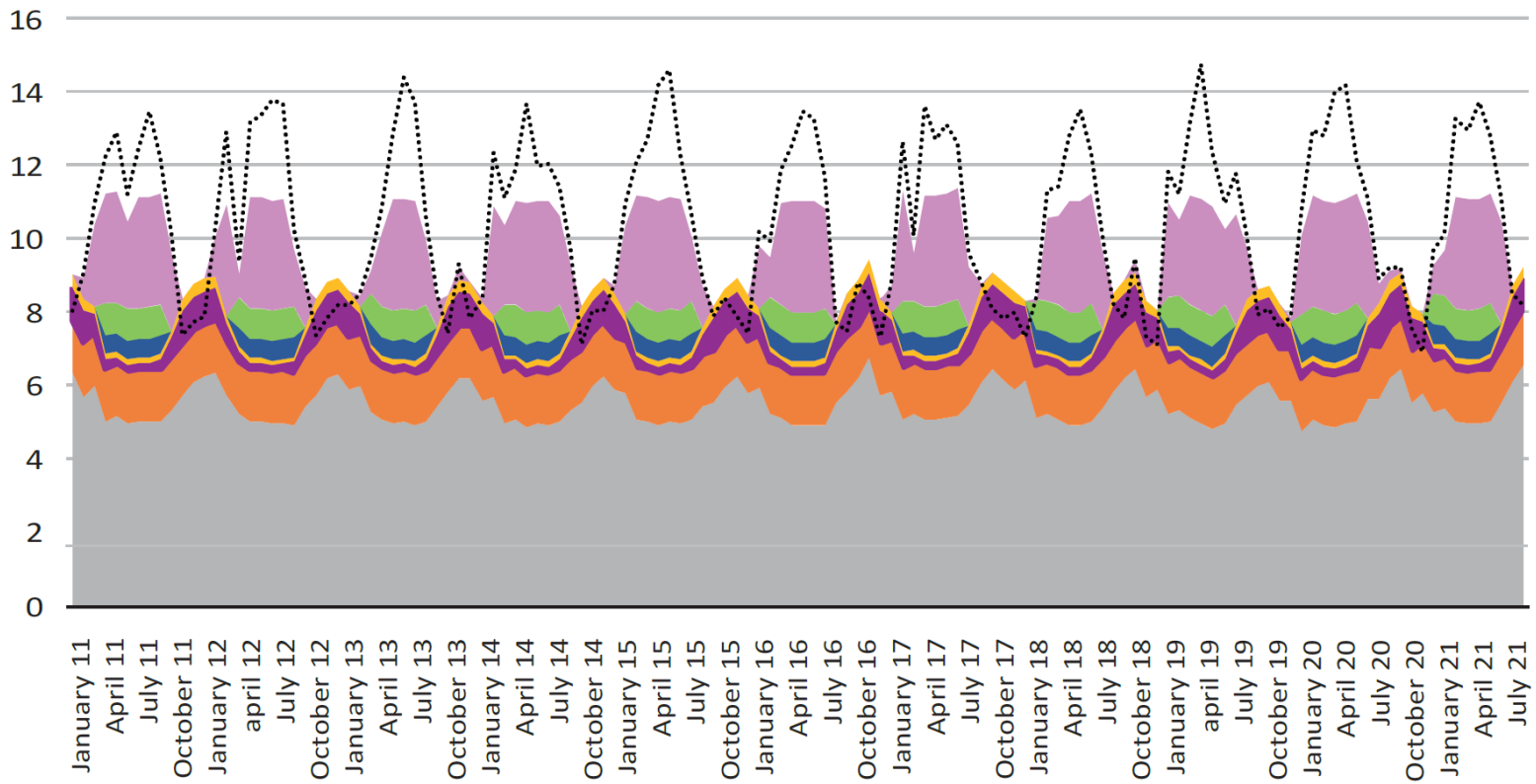
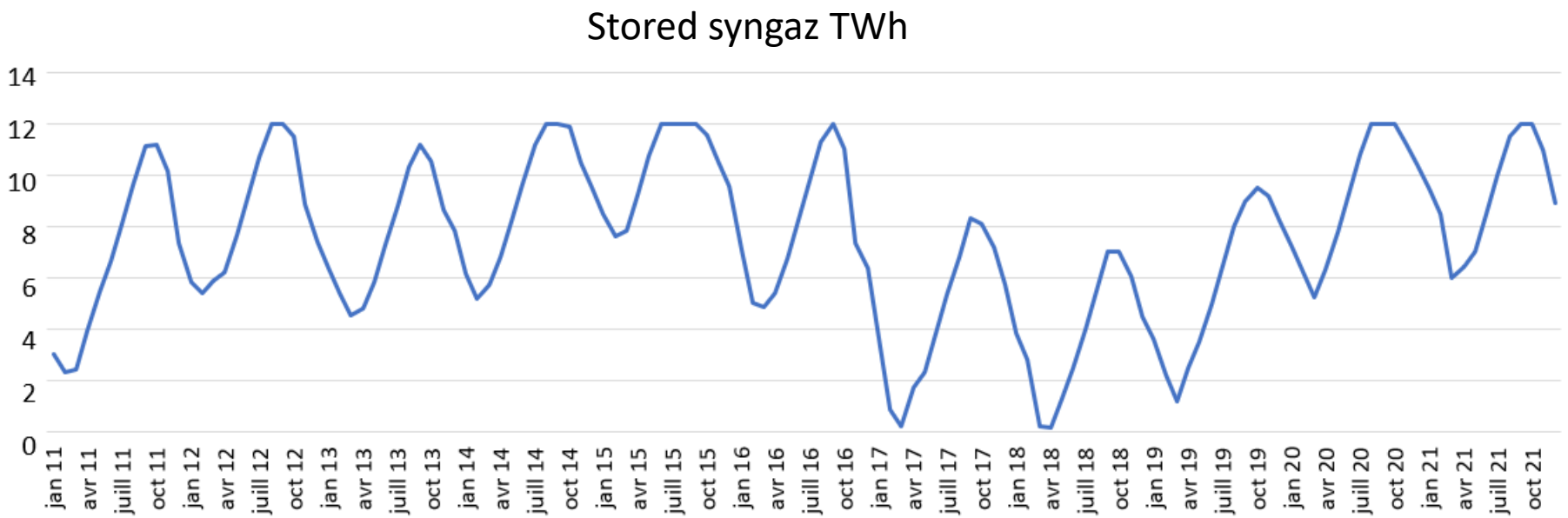


Use of electricity TWh/month




- Electricity to produce syngas for seasonal storage
- Electricity for hydrogen production in summer
- Electricity for high temperatures inindustry
- Electricity for industrial heat pumps
- Electricity for decarbonising heating and domestic hot water
- Electricity to replace diesel and petrol
- Current consumption, including losses and pumping
- .... SSI electricity generation, including syngas-based generation



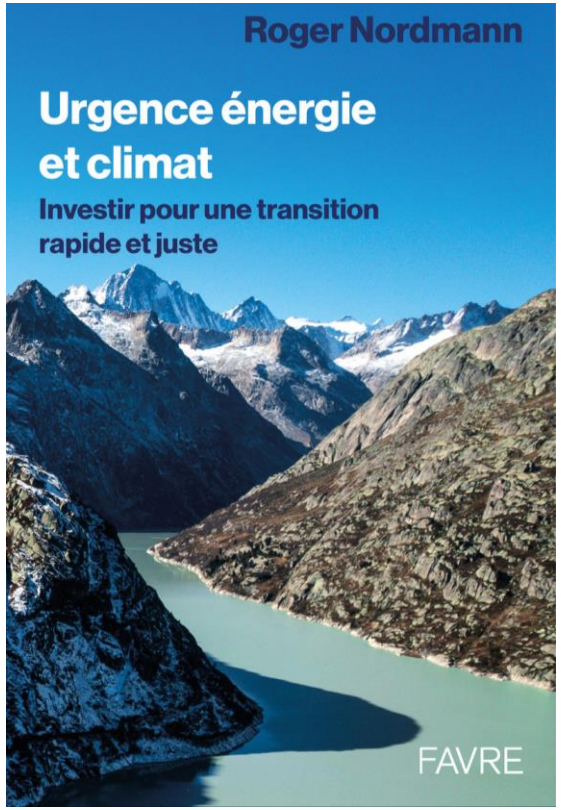

Syngas stock = 12 TWh
= fraction of current petroleum product stocks

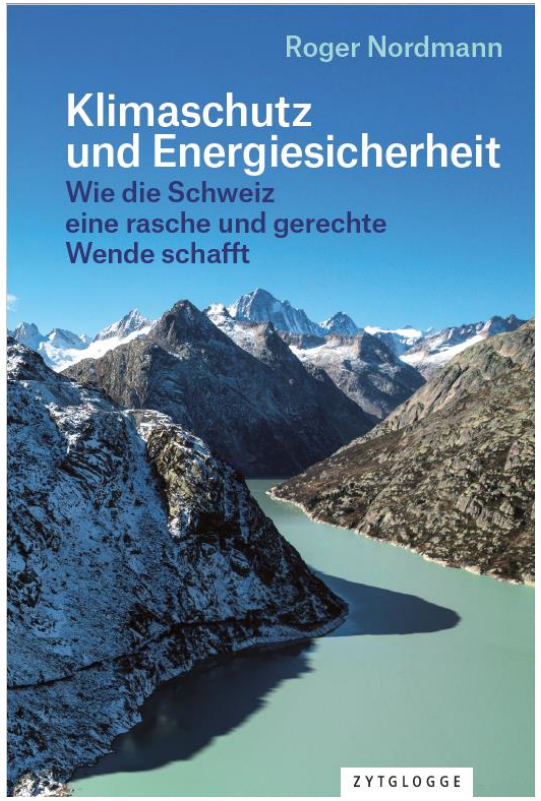
**Summary**:

| TWh | Currently | Everything decarbonised except aviation |
|---|---|---|
| Petrol, diesel, fossil gas, heating oil | 121 | 0 |
| Electricity (gross consumption) | 67 | 118 |
| **Total** | **188** | **118** |
| (kerosene) | (20) | (20) |

To get there:
Huge investments are necessary.

The second focus of my book is the **climate fund** and the corresponding constitutional initiative.
The goal is to move fast and on a fair basis.





The message of the book:

**Between denial and despair, there is a rational path**

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