The Swiss «Solar Plan»

Learnings for PV advocacy

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Only PV Can Deliver Enough Power to Decarbonise

Agenda

1. The starting point
2. Specific circumstances
3. The challenge of the power generation
4. Reversal of paradigms: PV as the main pillar
5. The features of my basic scenario
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8. Results in the basic scenario
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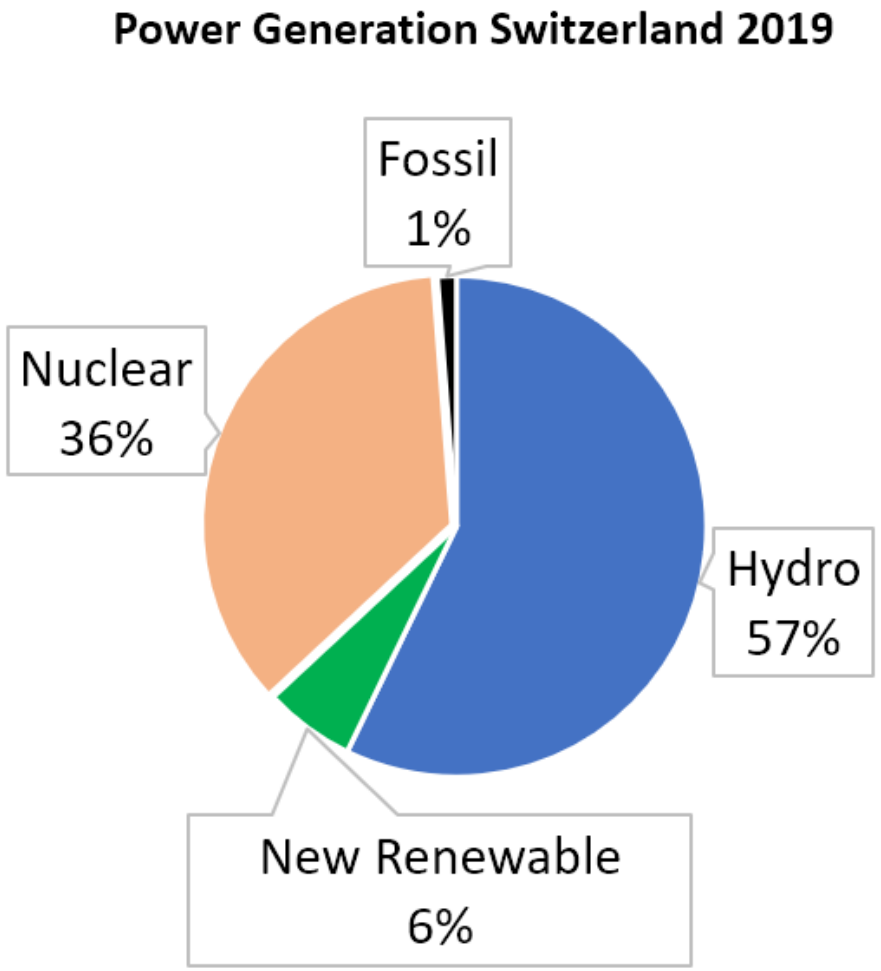
10. Only a basic scenario, not an optimal
11. Learnings for PV advocacy

1. The starting point



2017: 58 % approval in referendum to ban new nuclear power plant.

This bill only finances half of substitution of nuclear electricity.

Furthermore: We need much more electricity for decarbonisation.

2. Specific circumstances

Difficulties

- The lack of space limits biomass, wind power and ground-mounted PV
- Most hydropower in late spring when snow is melting, but higher consumption in winter for heating
- Little additional potential for hydropower

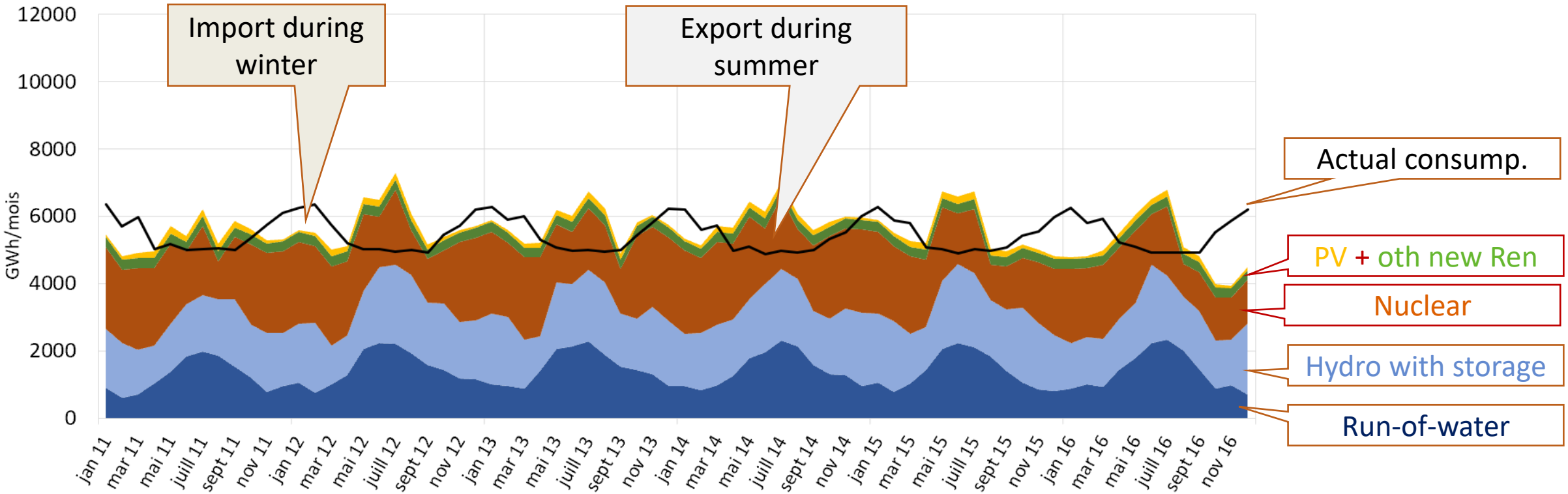
Opportunities

- High solar potential, in priority rooftop
- Huge existing hydro storage capacity:
  1000 kWh/capita, 500 W/capita.
  - No problem for additional short-run and weekly grid balancing
  - but no reserve for additional storage from summer to winter.

Image: wikipedia

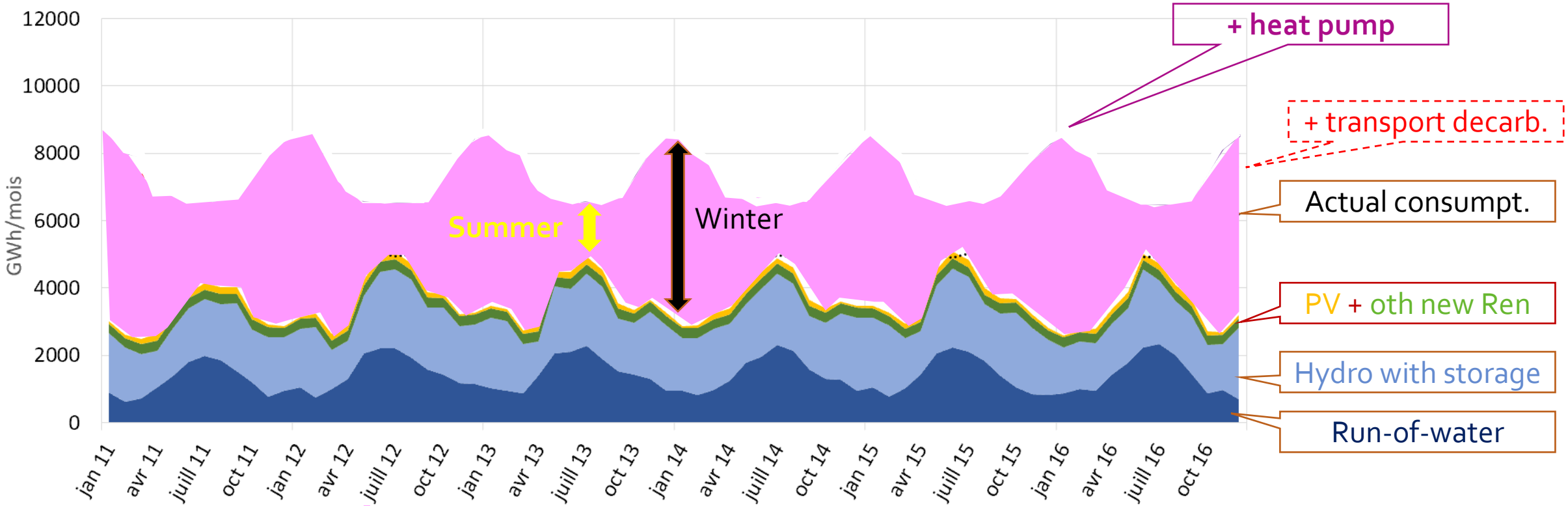
3. The challenge of the power generation

The monthly electricity production and consumption in Switzerland:
72 months 2011-2016



3. The challenge of the power generation

The monthly electricity production and consumption in Switzerland:
nuclear removed + new consumption



40 to 45 TWh / year **(current consump= 62 TWh/y, future c. = 85 TWh)**

4. Reversal of paradigms: PV as the main pillar

Emphasising the winter problem brought us more credibility

Only PV has the quantitative potential to deliver (120 GW possible)

→ PV from «nice to have» to «main source»

Need to counter widespread prejudices

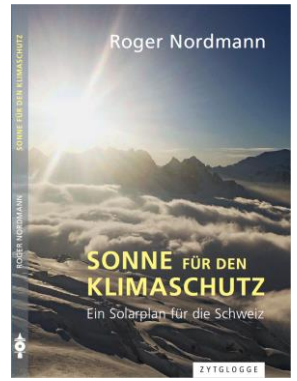
Also to overcome prejudices of ecologists against more electricity

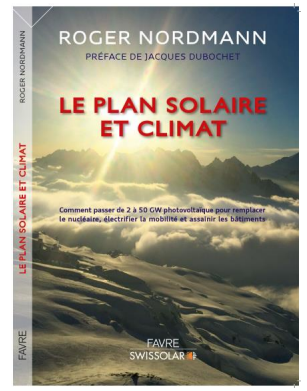
Two key technical challenges

– how to guarantee electricity supply in winter
– how to manage the grid when the sun is strong

5. The features of my basic scenario

- Consumption remains constant for actual use of electricity
- Additional consumption included for full decarbonisation of building and transport (without aviation)
- Only PV is growing. Other renewables don't develop (= pessimistic)
- Every summer month: 1 TWh → Power-to-gas → 0,3 TWh/m. in winter
- No increase in monthly export during summer or import during winter
- Only minimal grid improvement





<u>Proposed PV deployment:</u>

- **from 2.5 GW to 50 GW (equivalent to 500 GW in Germany)**

=from 0.3 to 6 kW/capita

6. Peak-shaving and gas

Perception as an extremist proposal?

No, because I coped with the two main challenges:

1 temporarily too much solar electricity?

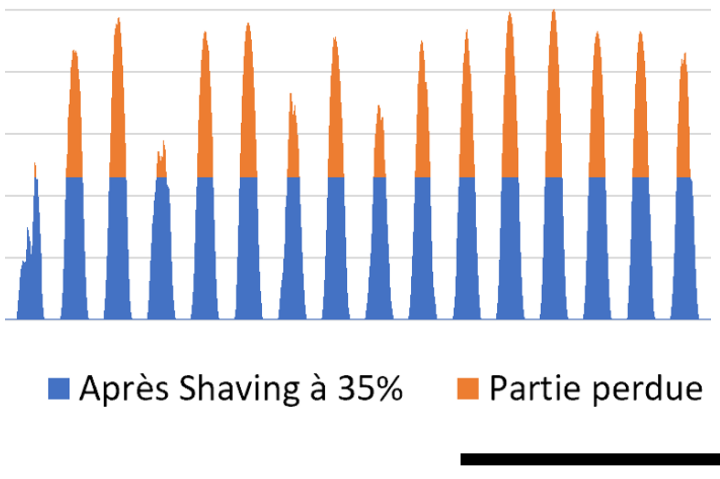
– **real-time peak-shaving** (=curtailment= excessive energy isn't harvested)

2 temporarily not enough electricity?

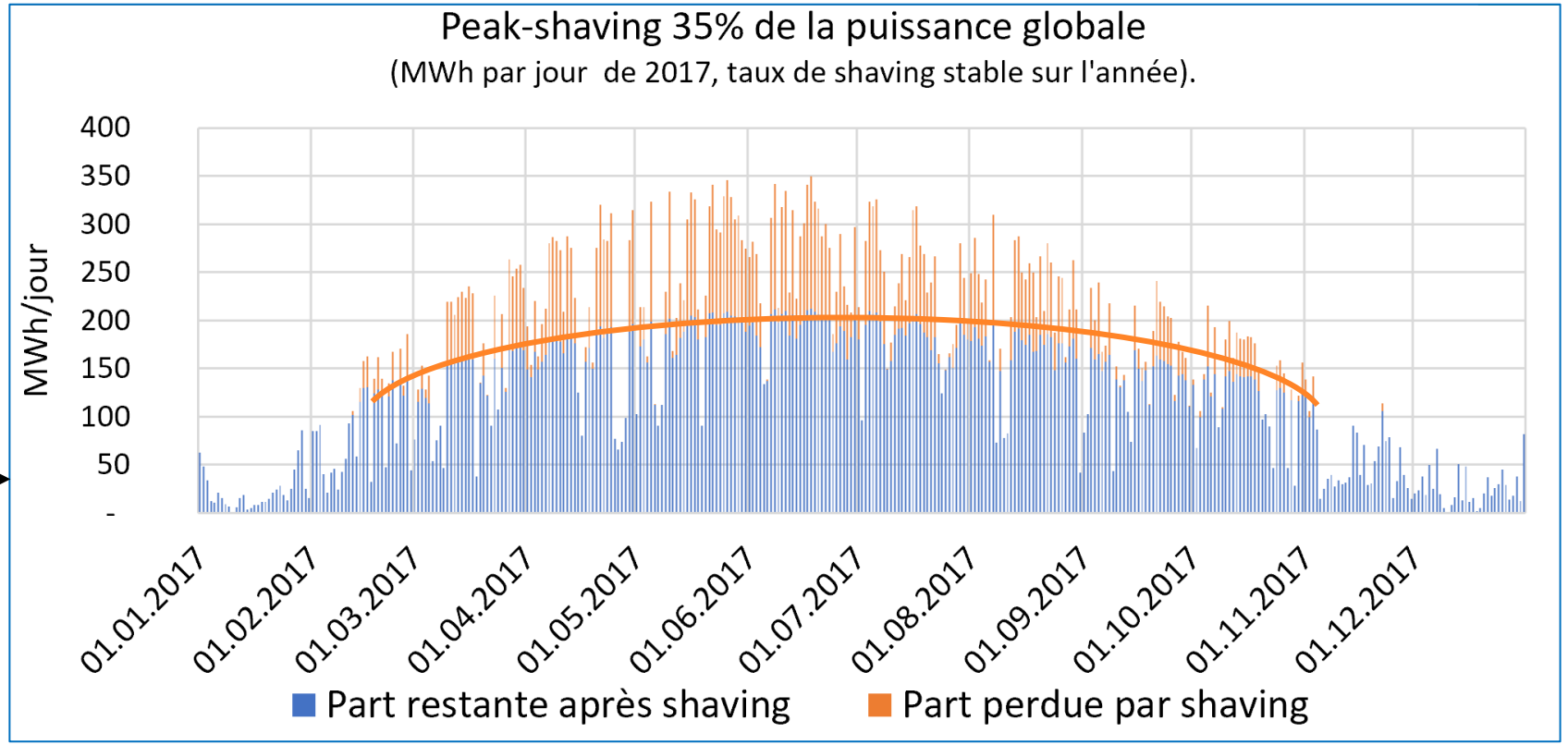
– first hydropower reserve, and if necessary **gas power generation** (fossil = +/- taboo in Switzerland).

7. More PV thanks to Peak-shaving

Example: static peak-shaving at 35 % of nominal power



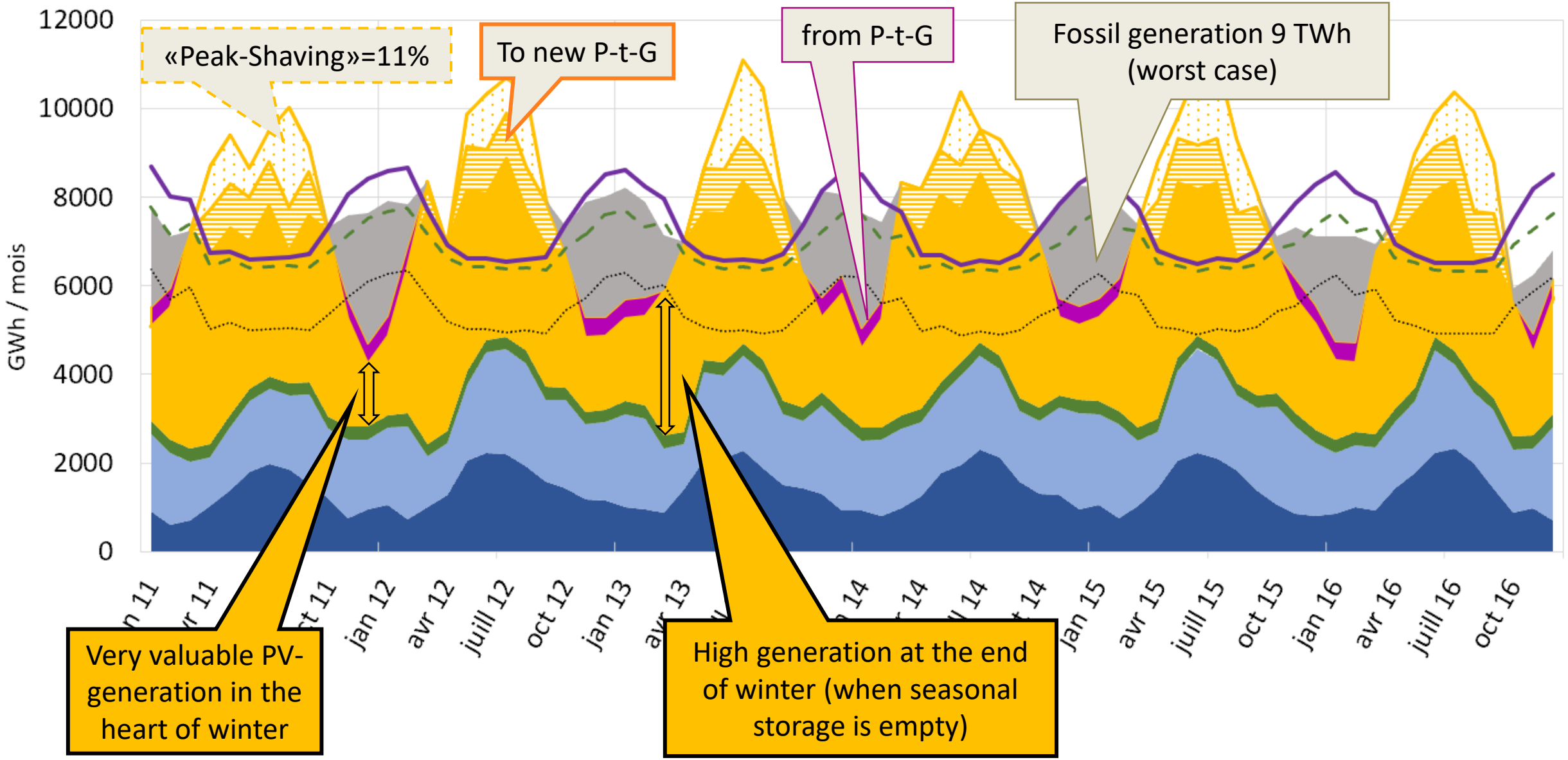
real data 52 MW sample, CH



Only 20% loss of production (when electricity price is low)

Allows more installation and higher PV production in winter, spring and fall

8. Results in the basic scenario



9. The CO2 balance sheet of the basic scenario

= 3/5 of overall Swiss GHG Emissions

Million tons CO_2	2017	Full decarb (off-) road and buildings
(off-) Road	16	0
Buildings	14.8	0
Fossil power Generation	0	4.4
Total	**30.8**	**4.4**
Decrease CO_2		-86%

10. Only a basic scenario, no optimum

Technical improvement is possible. No doubt . (Computed as variants in my book)

Economical improvement too. Peak-shaving is a kind of practicable base-line .

But the main advantage of using conservative parameter is to open the discussion with conservative people.

The burden of proof changed side: it's up to our opponents now…

The quantitative ambition of my plan helped to trigger the financing discussion: how to overcome the investment weakness of the "Energy only market"?

11. Learnings for PV advocacy

Diagnostic

Proposition

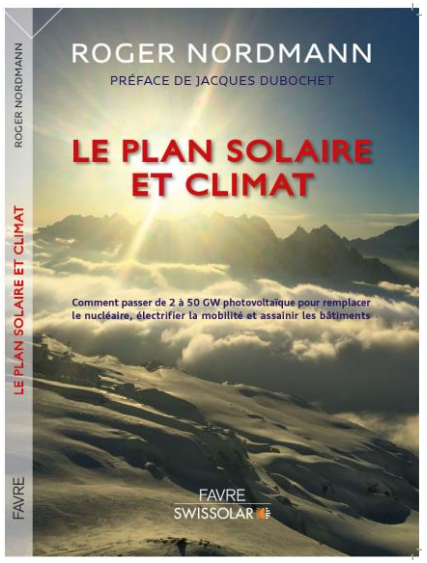
Persuasion

1. Non only list the problems, but structure them
2. Focus on the main questions
3. Understand existing cultural representations
4. Trace a way and remove obstacles, including prejudices of your allies
5. Don't hide the difficulties. Address them
6. Assume pessimistic hypothesis to make your plan more robust
7. Not only facts and arguments matter. Ask your opponents how they would solve the problem.
8. Consider the interests of your opponents. It helps them to leave their dead-end road.
9. Keep in mind: "energy" is not only a technical and physical concept, but touch also psychology, health, way of life ….

More information:

www.roger-nordmann.ch

www.swissolar.ch



French edition May 2019

https://www.editionsfavre.com/livres/le-plan-solaire-et-climat/

German translation August 2019

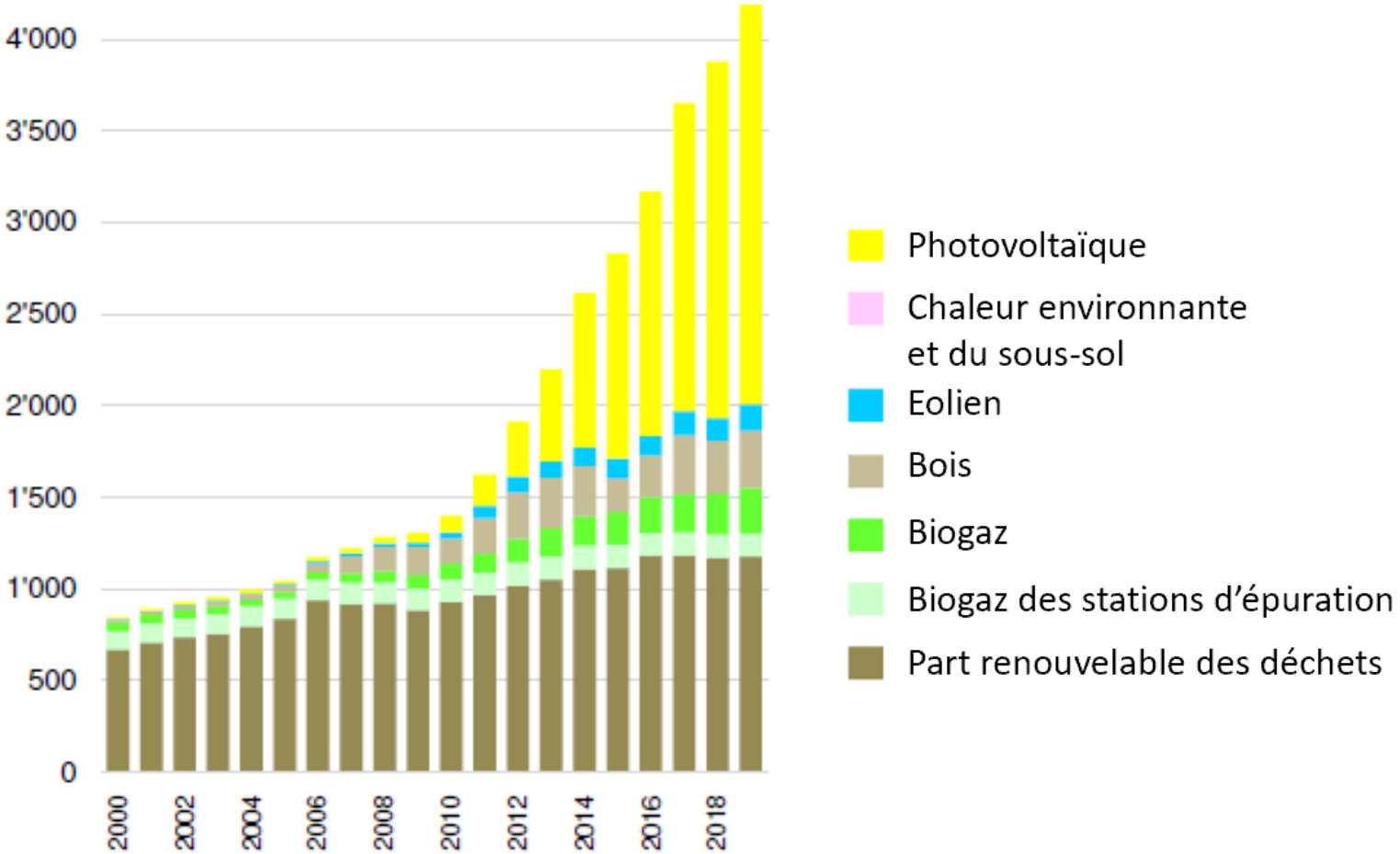
https://www.zytglogge.ch/sonne-fuer-klimatschutz-solarplan-solarenergie-sonnenenergie-roger-nordmann

Annexe/Reserve

Le potentiel en Suisse

TWh	Potentiel exploitable	Exploitatble à court et moyen terme	Surface au sol [km²]
Toits	49.1	23.3	153
Façades	17.2	8.2	(Surf. verticale: 107.4)
Routes	24.7	2.5	16.2
Parking	4.9	3.9	25.7
Bordure d'autoroutes	5.6	3.9	25.7
Alpes (Pâturages)	16.4	3.3	31.3
Total	**117.9**	**45.1**	251.9 (Sans façades)

Electricité renouvelable hors hydro



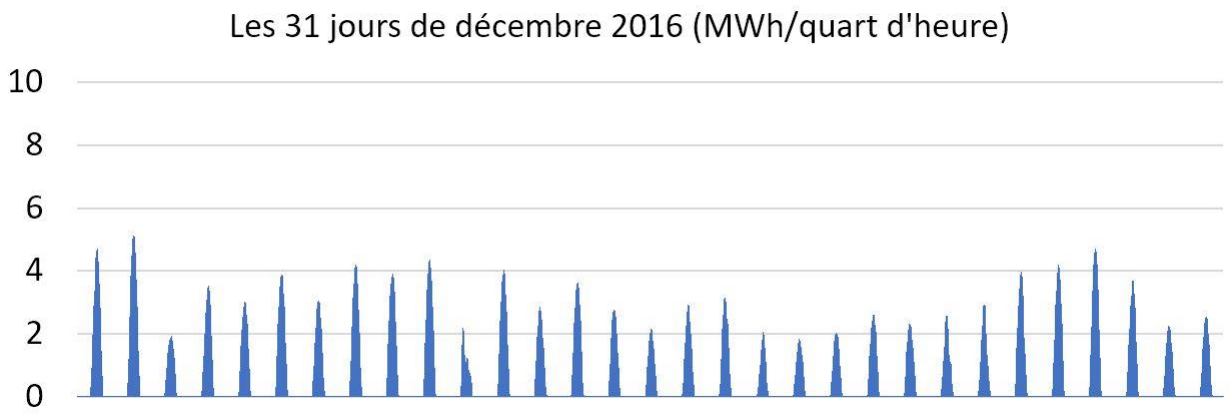
Situation 2018:
2 GW produisant 2 TWh

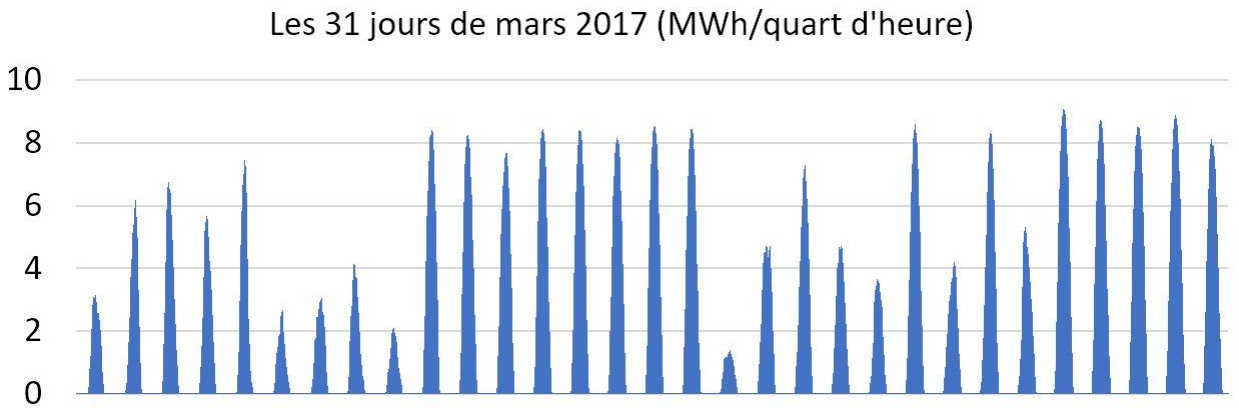
Potentiel économique: 118 TWh
Dont 45 TWh à court et moyen terme

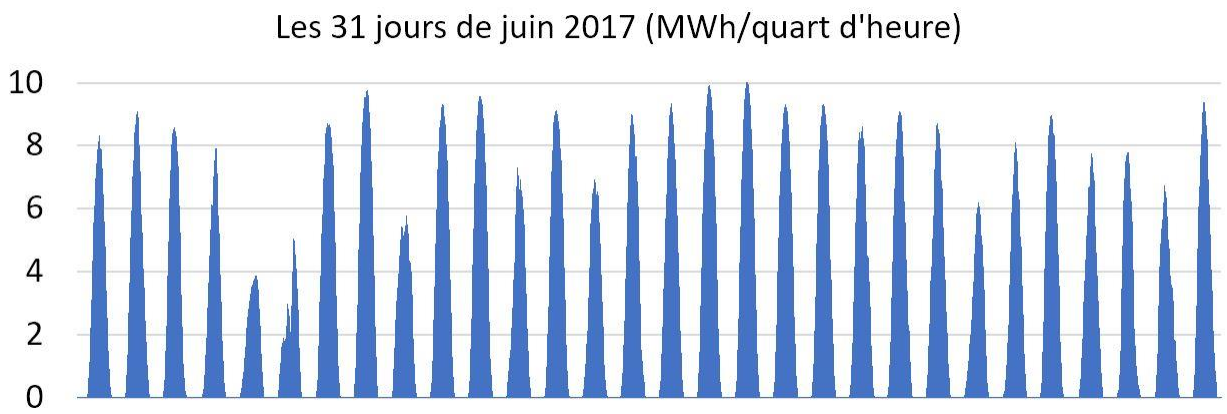
Notre proposition:

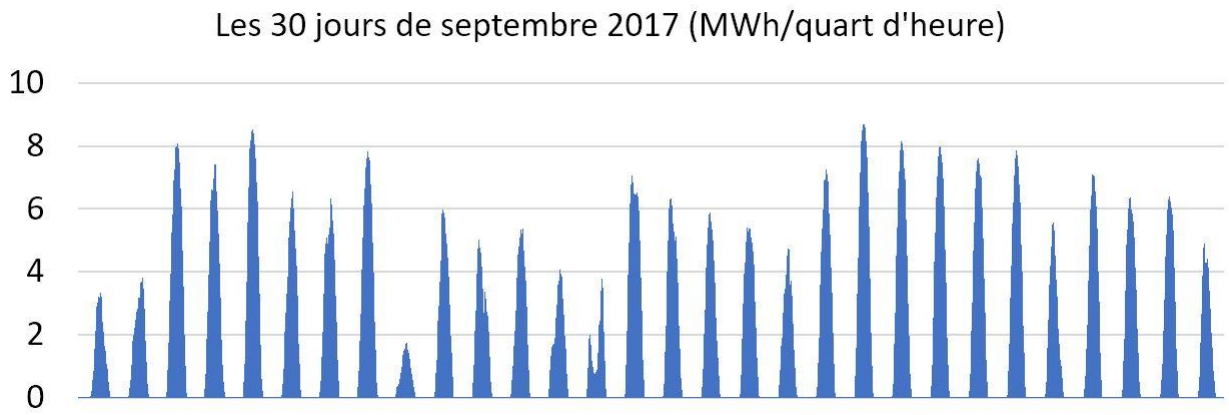
Passer de 2 à 50 GW de photovoltaïque d'ici 30 ans. (2018 x 25)

La variabilité du photovoltaïque



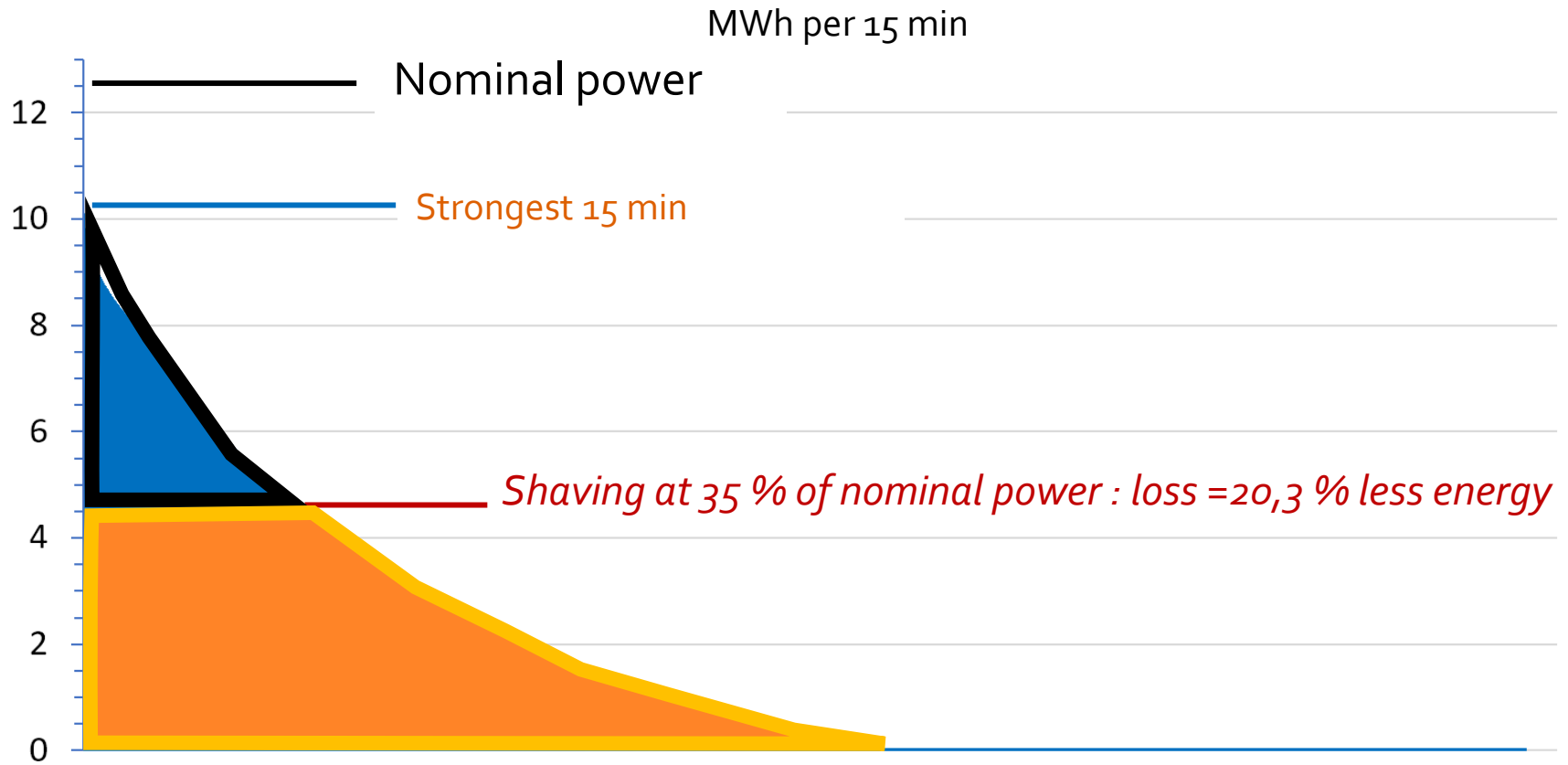




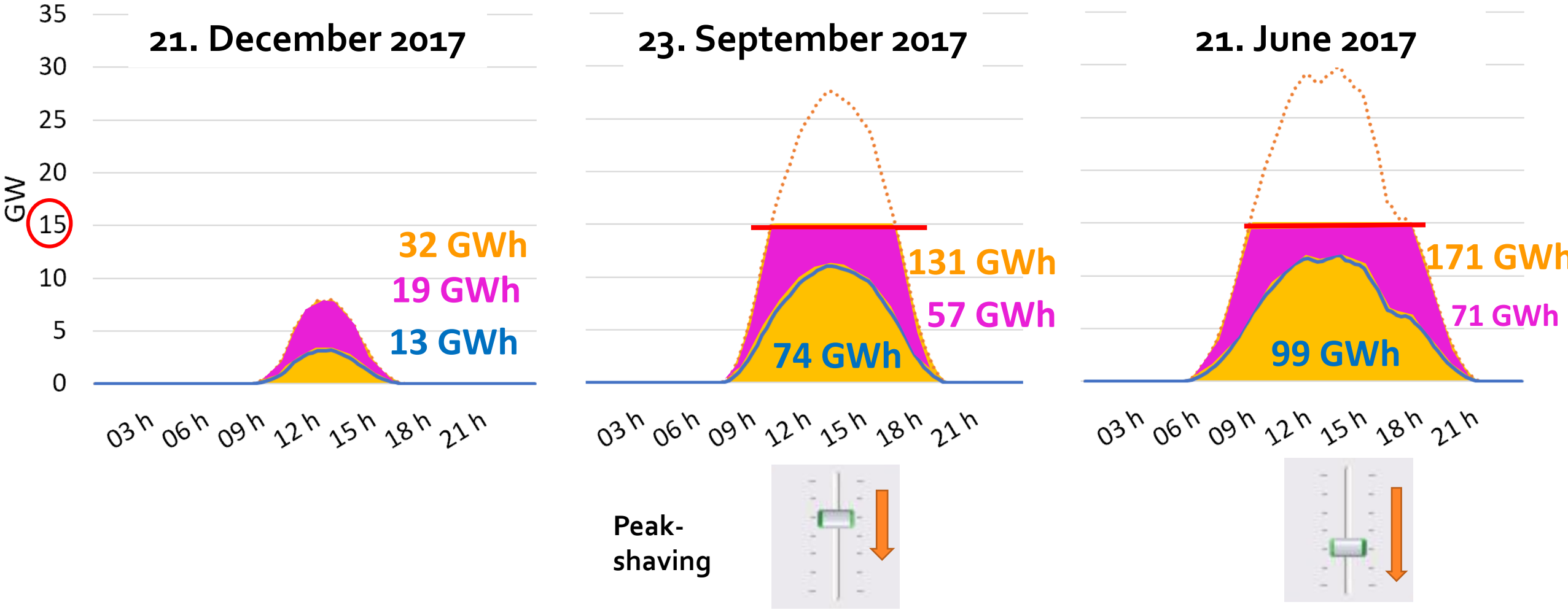


Extreme Peak-shaving at 35% of nominal power (static in this exemple)

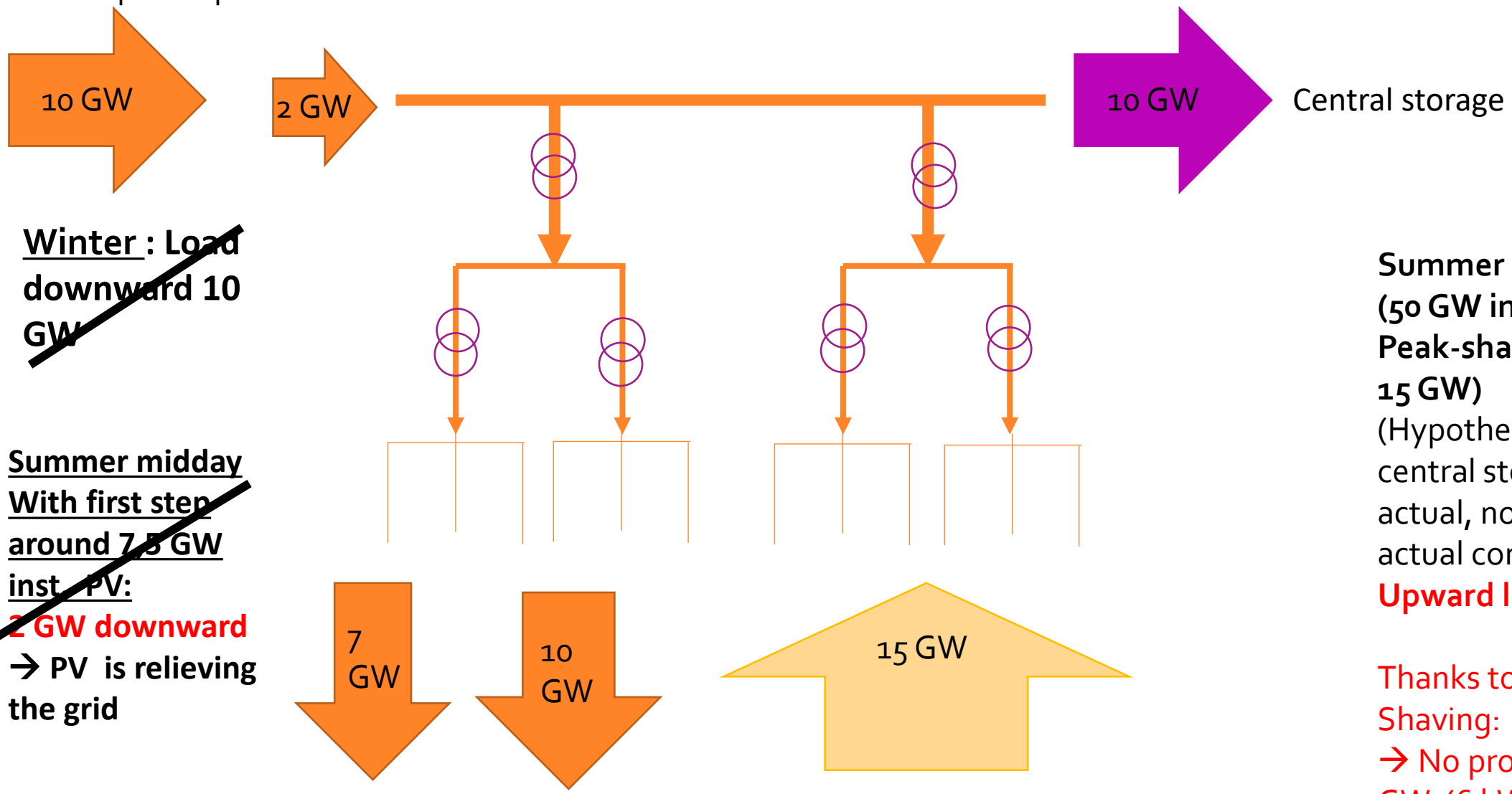
All ¼ hours, classified from the strongest to the weakest



1st step: PV at 20 GW = 10x more than 2018
2nd step: PV at 50 GW = 25x more than 2018



Central power plants



Winter : Load downward 10 GW

Summer midday With first step around 7.5 GW inst. PV:
2 GW downward
→ PV is relieving the grid

Summer midday (50 GW inst. PV Peak-shaving 30%= 15 GW)
(Hypothesis: only central storage 2x actual, no electrical car, actual consumption)
Upward load 8 GW

Thanks to Peak-Shaving:
→ No problem until 50 GW (6 kW /per capita)