



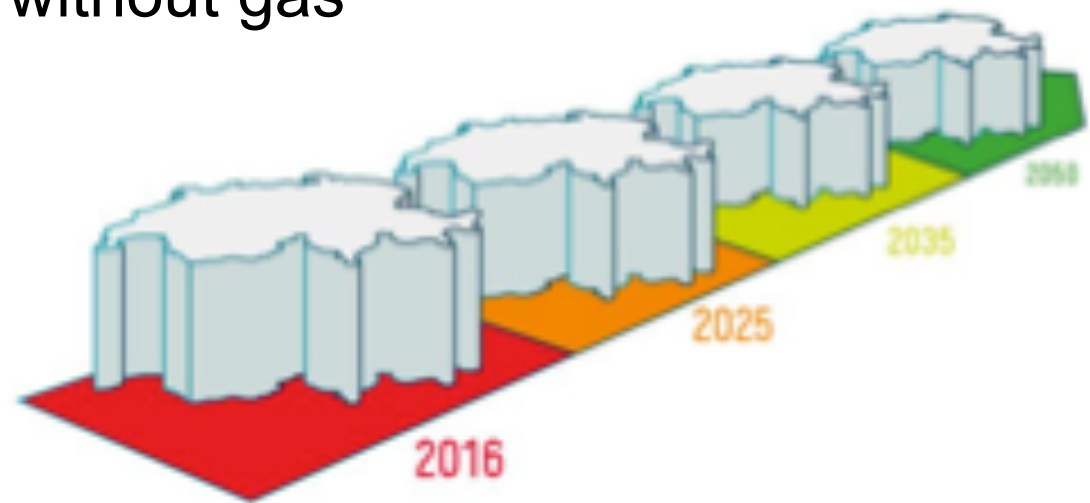
Do we need gas as a bridging fuel?

A case study of the electricity system

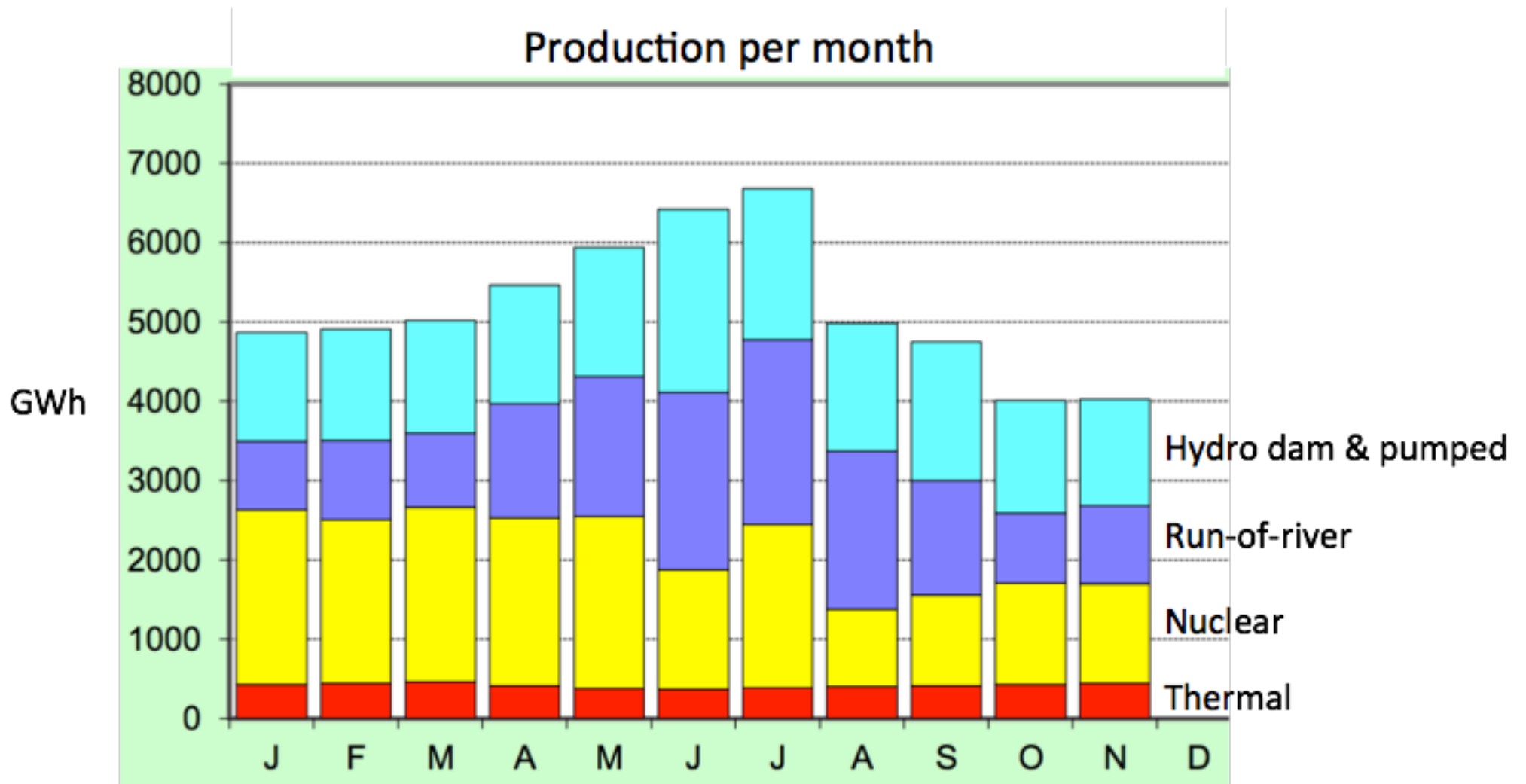
Paula Díaz & Oscar van Vliet / CP / D-USYS

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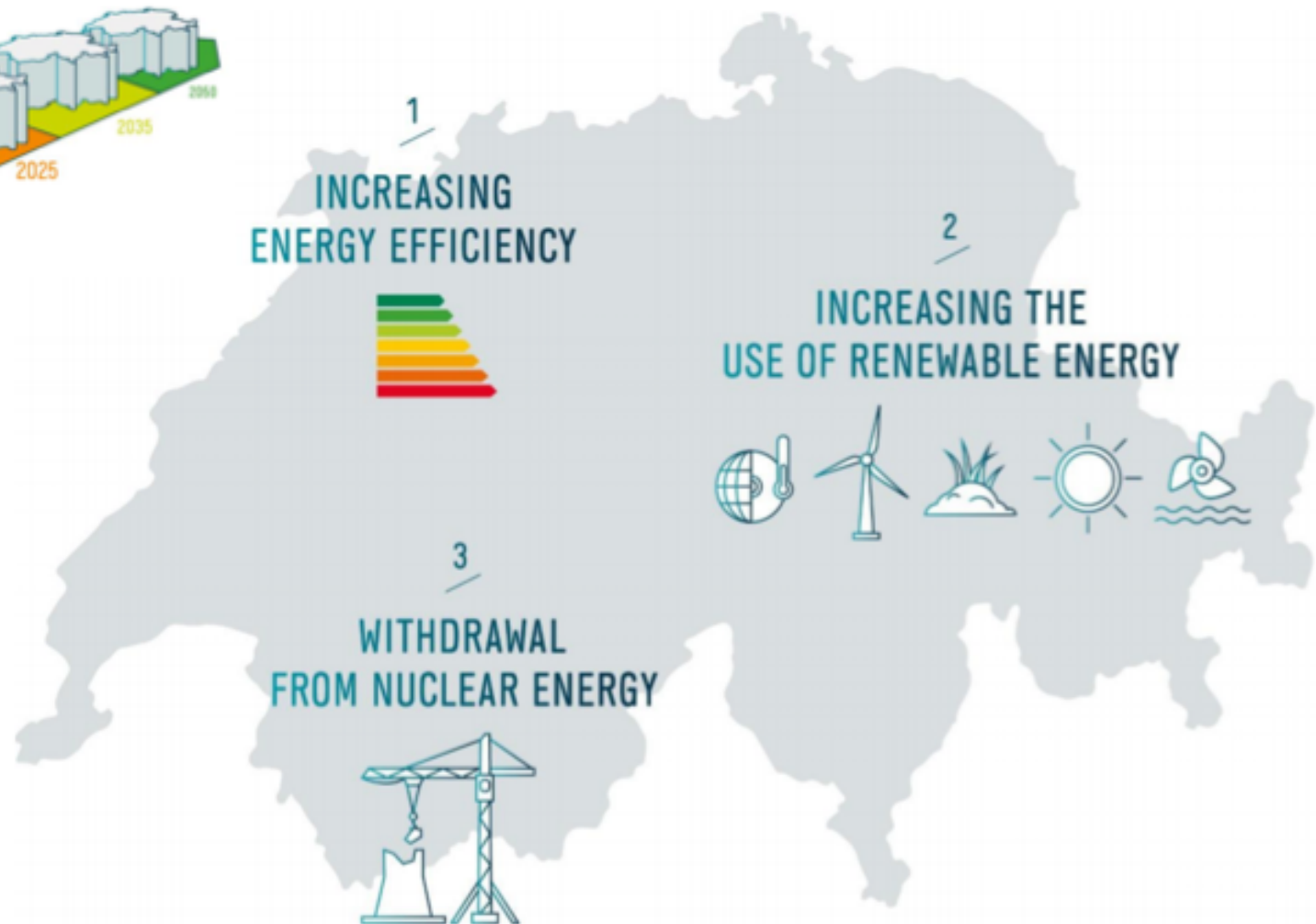
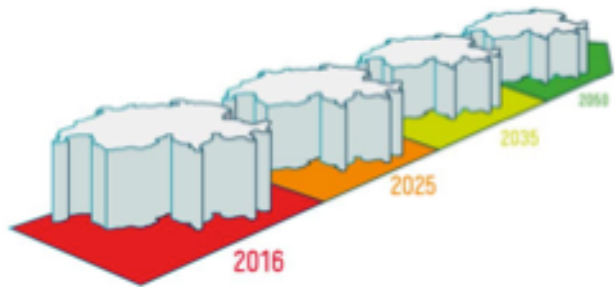
- Swiss electricity system & Energy Strategy
- Impact of renewables and gas as a bridging fuel
- Implications for other countries
- Outlook for renewables without gas



Current electricity production in Switzerland



Swiss Energy Strategy 2050



Scenario analysis



optimise
intermittent supply
vs.
variable demand
over time

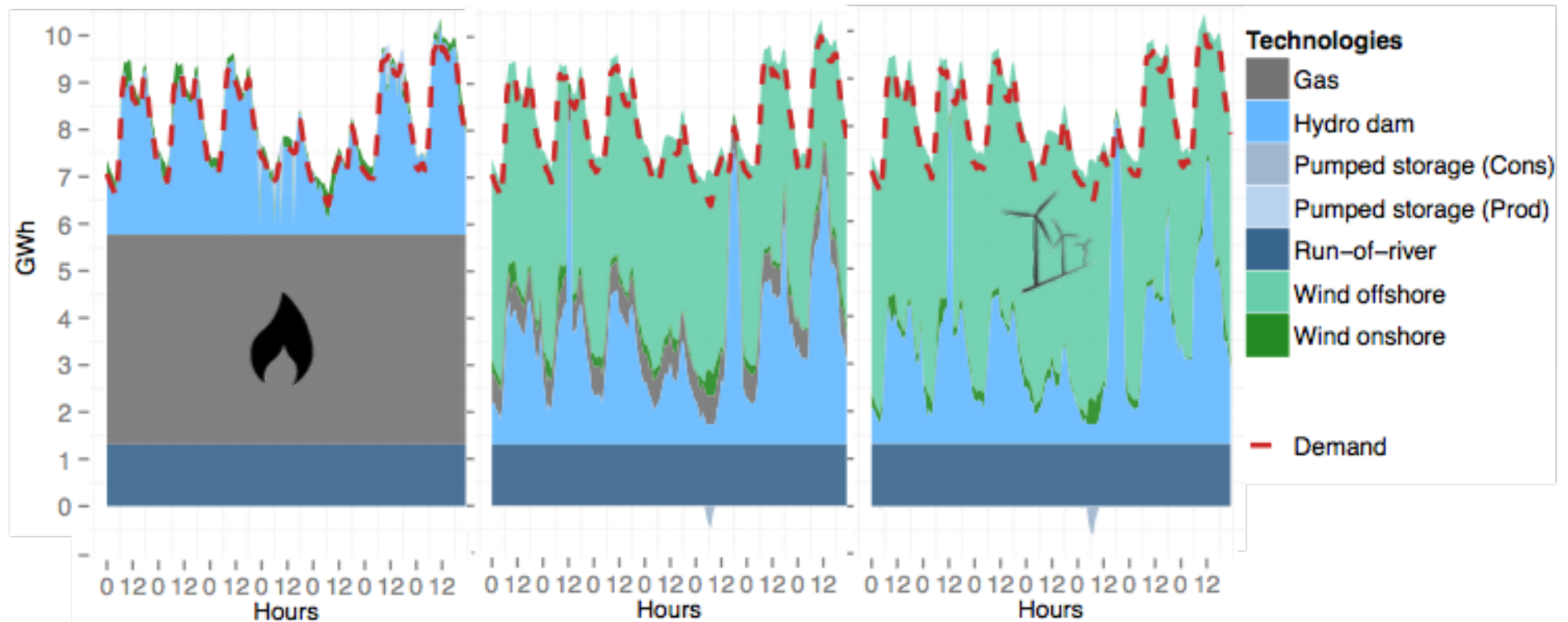
Swiss renewables
+ natural gas



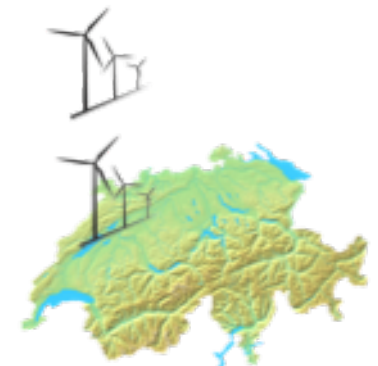
Swiss + imported
renewables



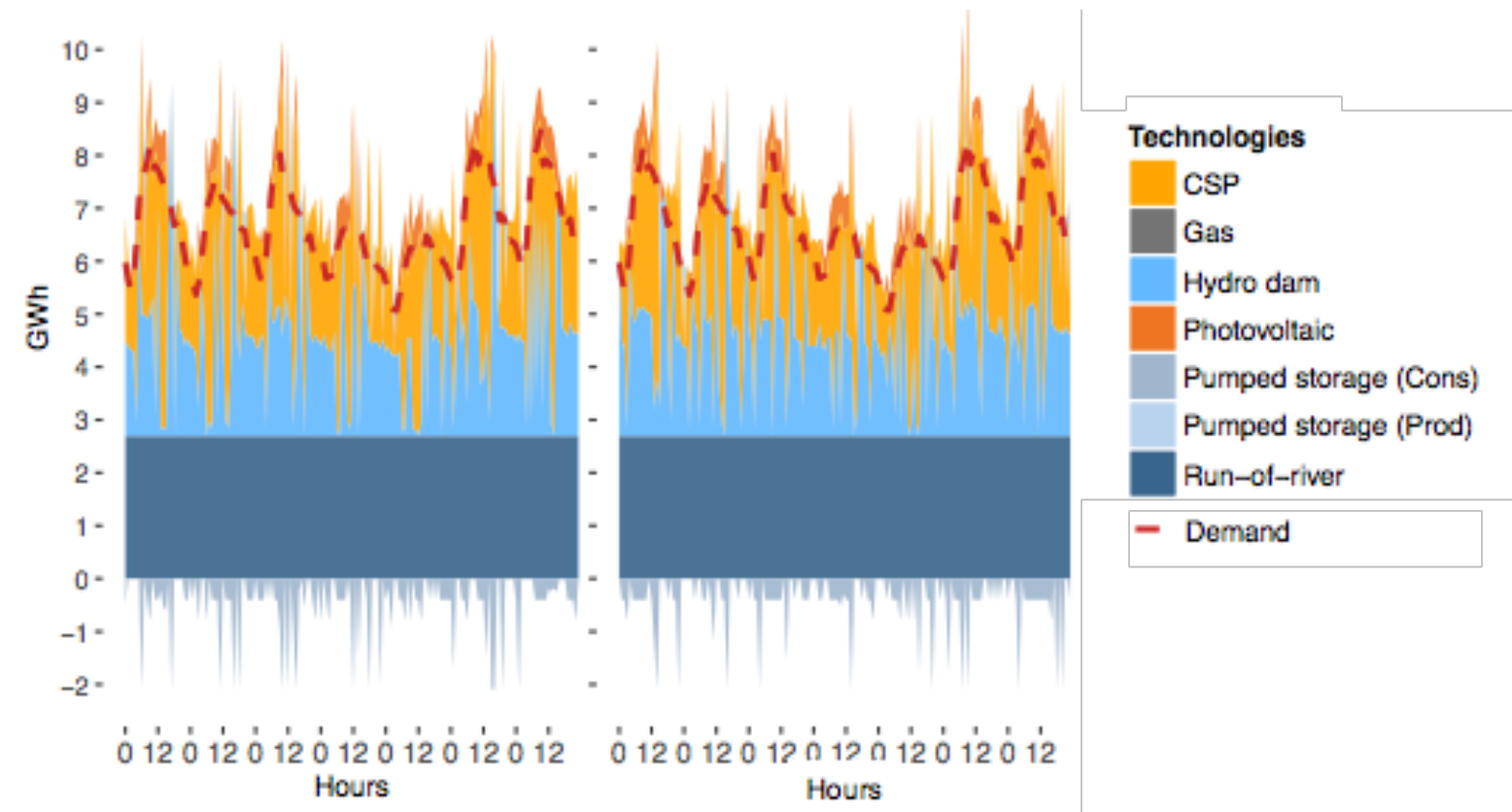
North Sea wind imports in Winter



- (A) Gas intensive
- (B) Gas as a bridging fuel
- (C) 100% renewables



Moroccan CSP imports in Summer



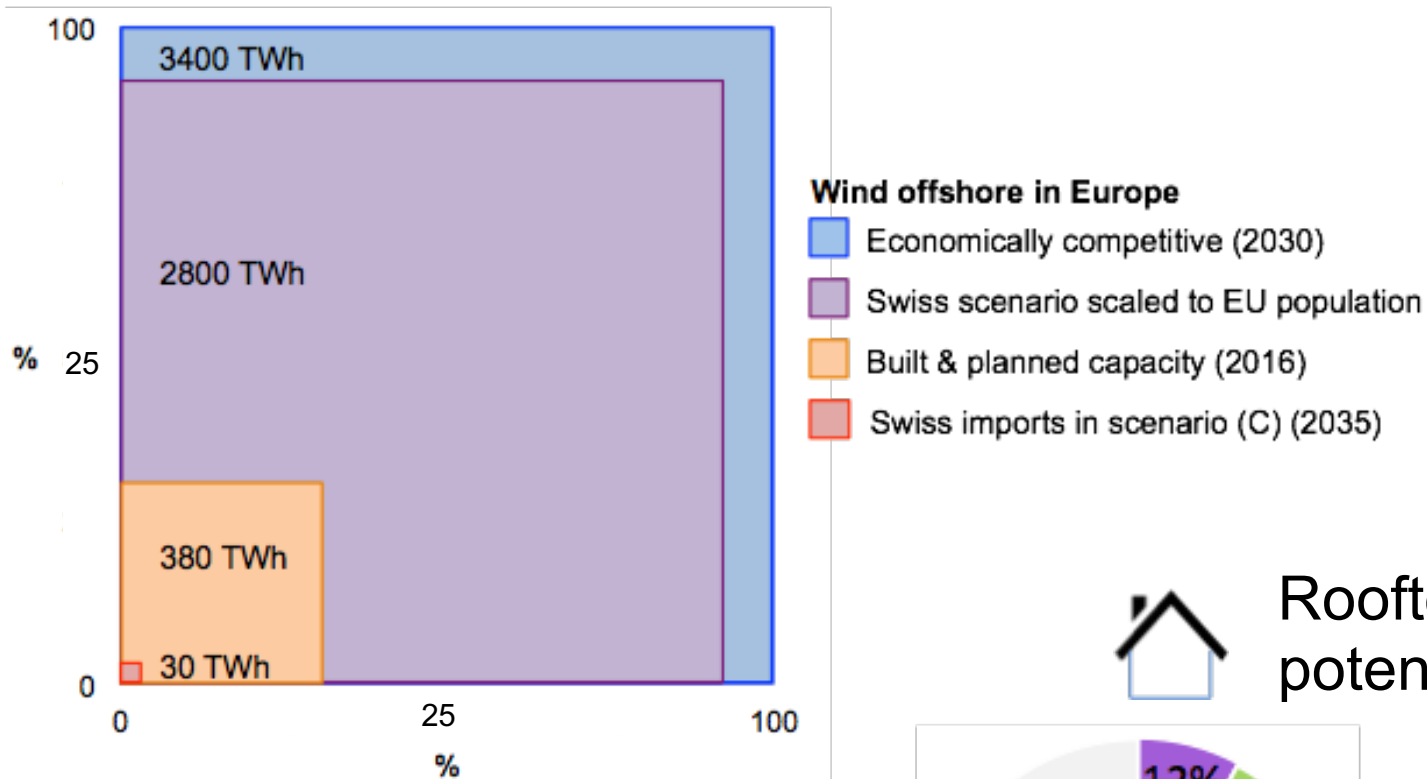
- (B) Gas as bridging fuel
- (C) 100% renewables



100% renewables is not a problem for Switzerland

- Wind and/or CSP can cover demand
 - Complementary production profile, mix is cheaper
- Not enough hydro to cover all PV without batteries
- Rooftop PV and imported wind are generally supported (*Plum et al.*, in preparation)

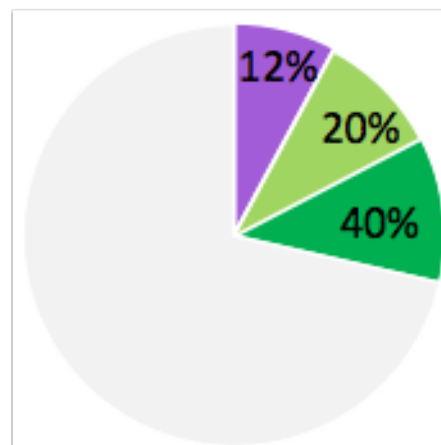
We can build that.



Díaz et al, 2017



Rooftop & facade potential: 4.4 TWh

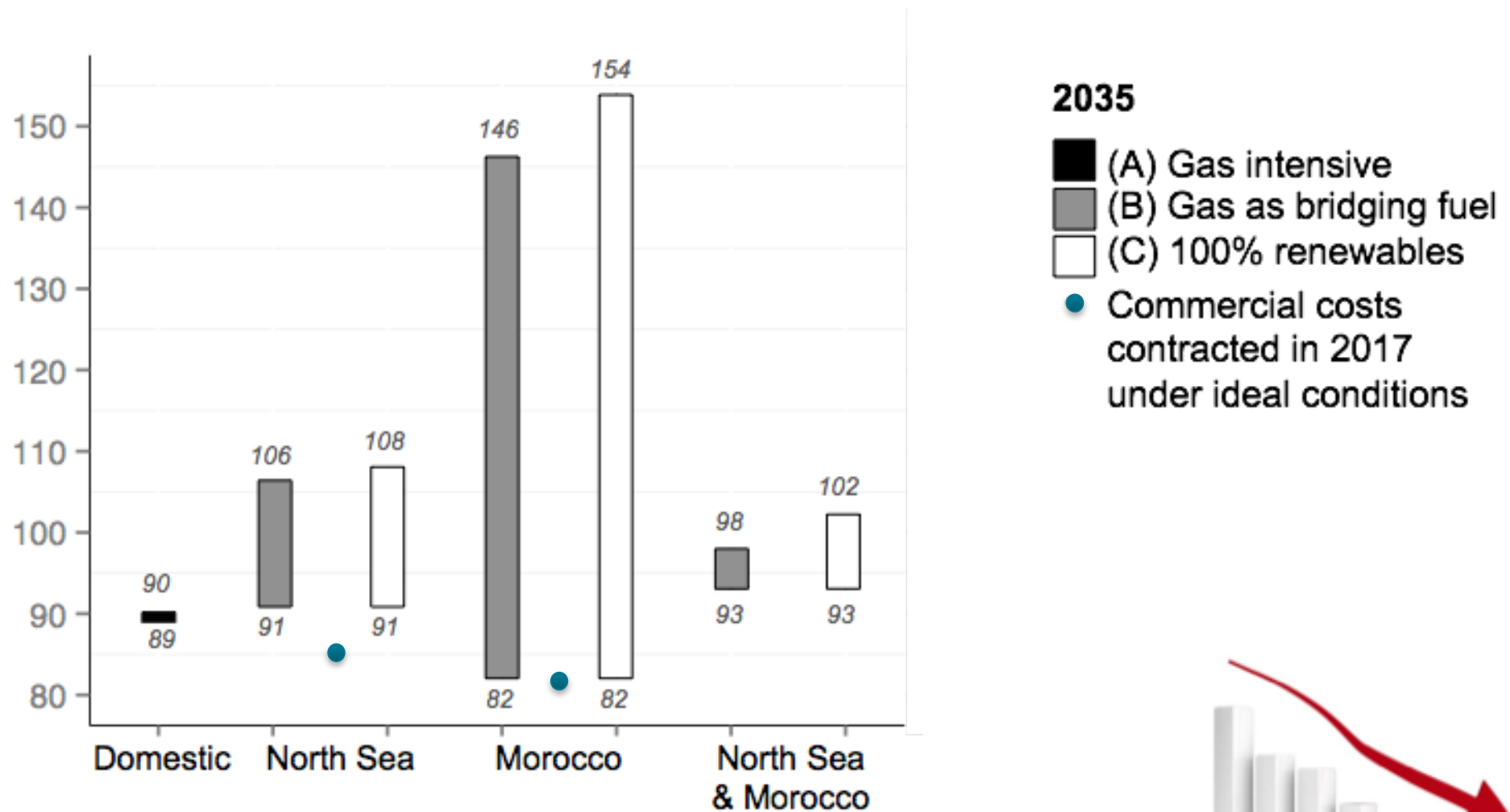


Needed for ES 2050

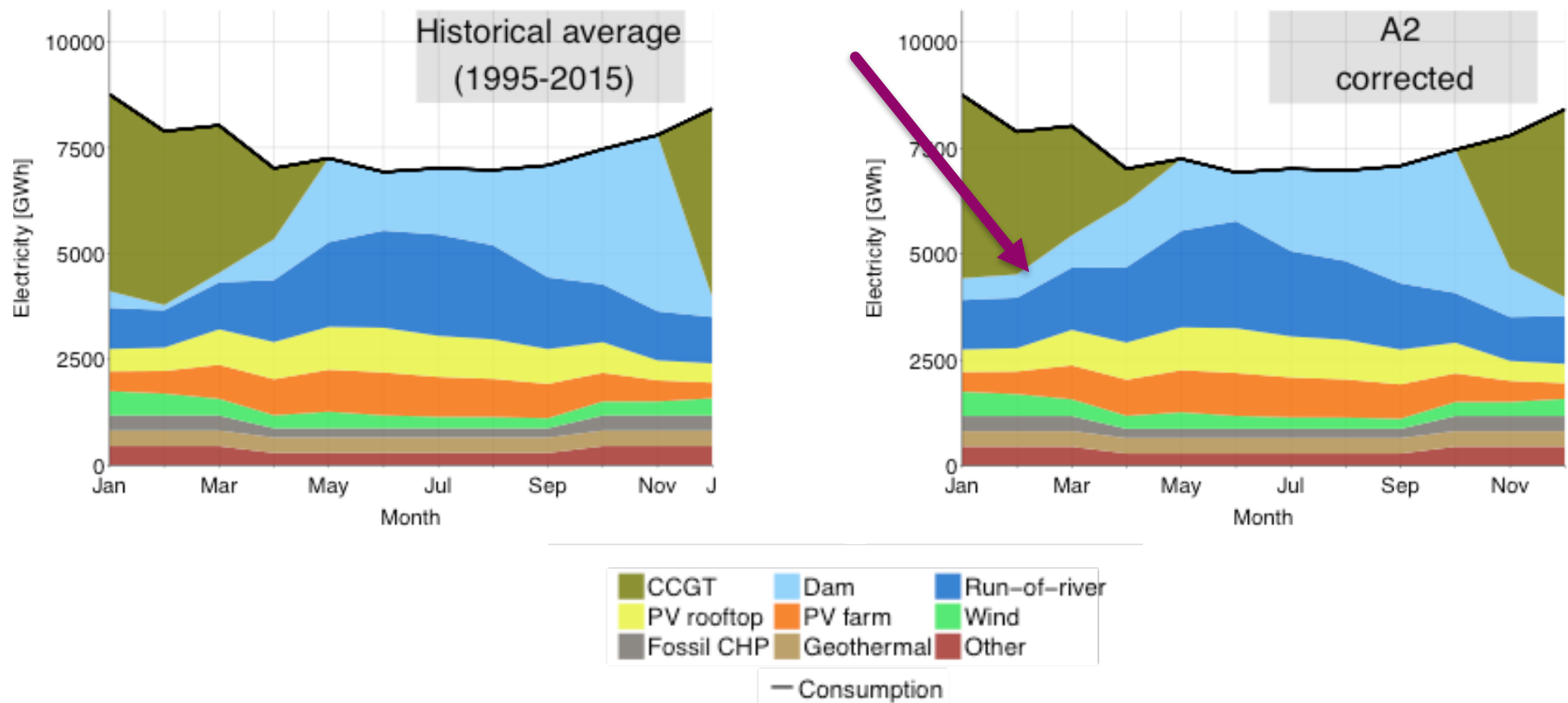
Useable - Compagnon, 2004

Useable - IEA-PVPS, 2002

Cost implications



Climate change impacts on hydropower



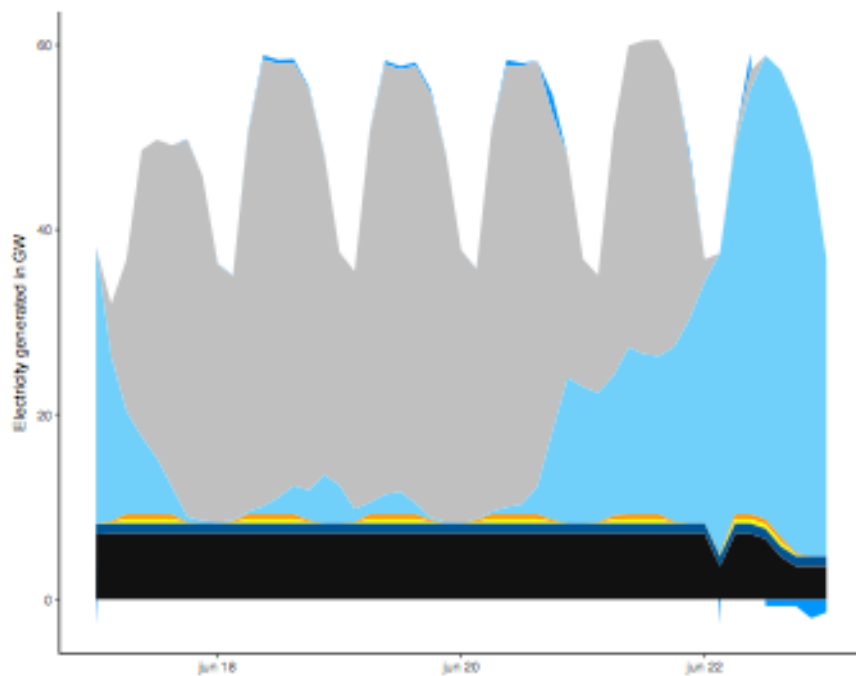
What about countries without 60% hydropower?

- Poland
- United Kingdom

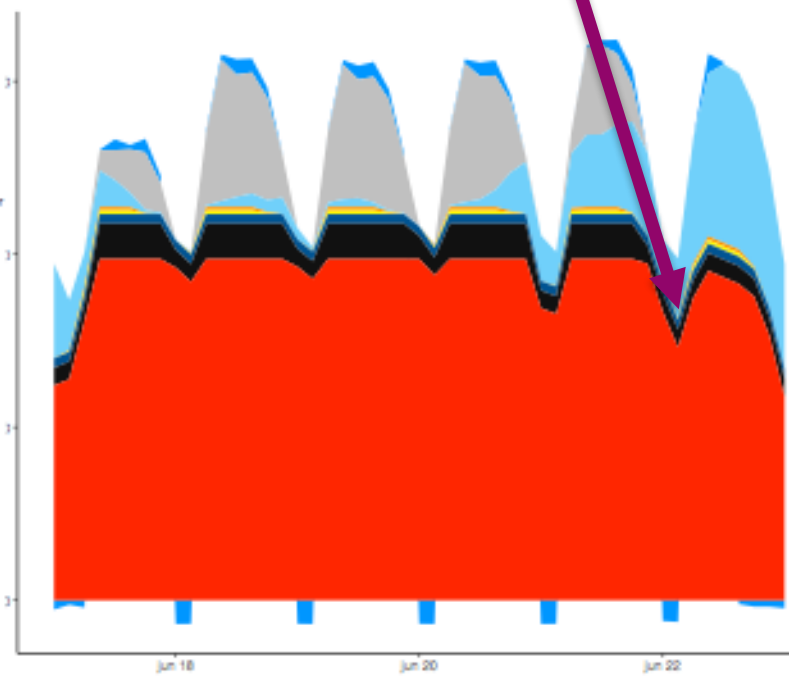
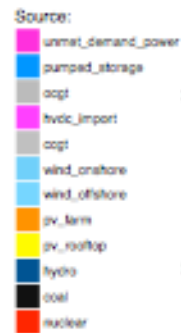
- ... everywhere in Europe except Switzerland and Norway

Renewables vs. base load

Electricity for a midsummer week in the UK electricity system

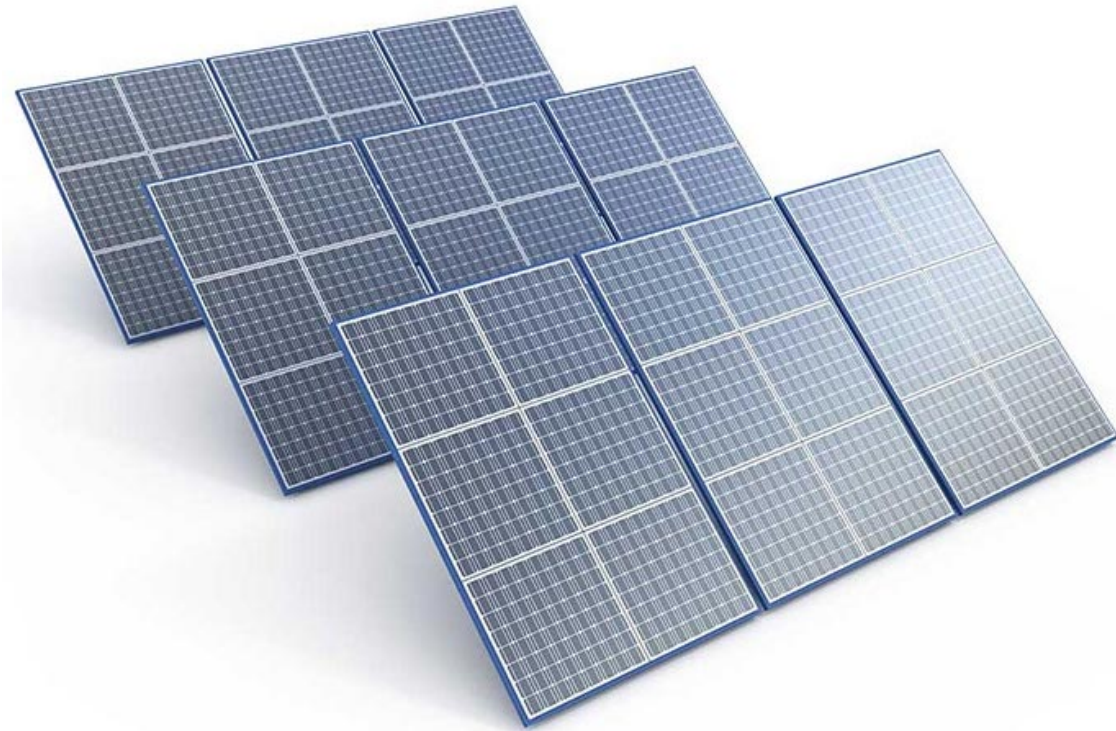


Gas + Renewables



40 GW of Nuclear

Making PV less intermittent



Making CSP less intermittent

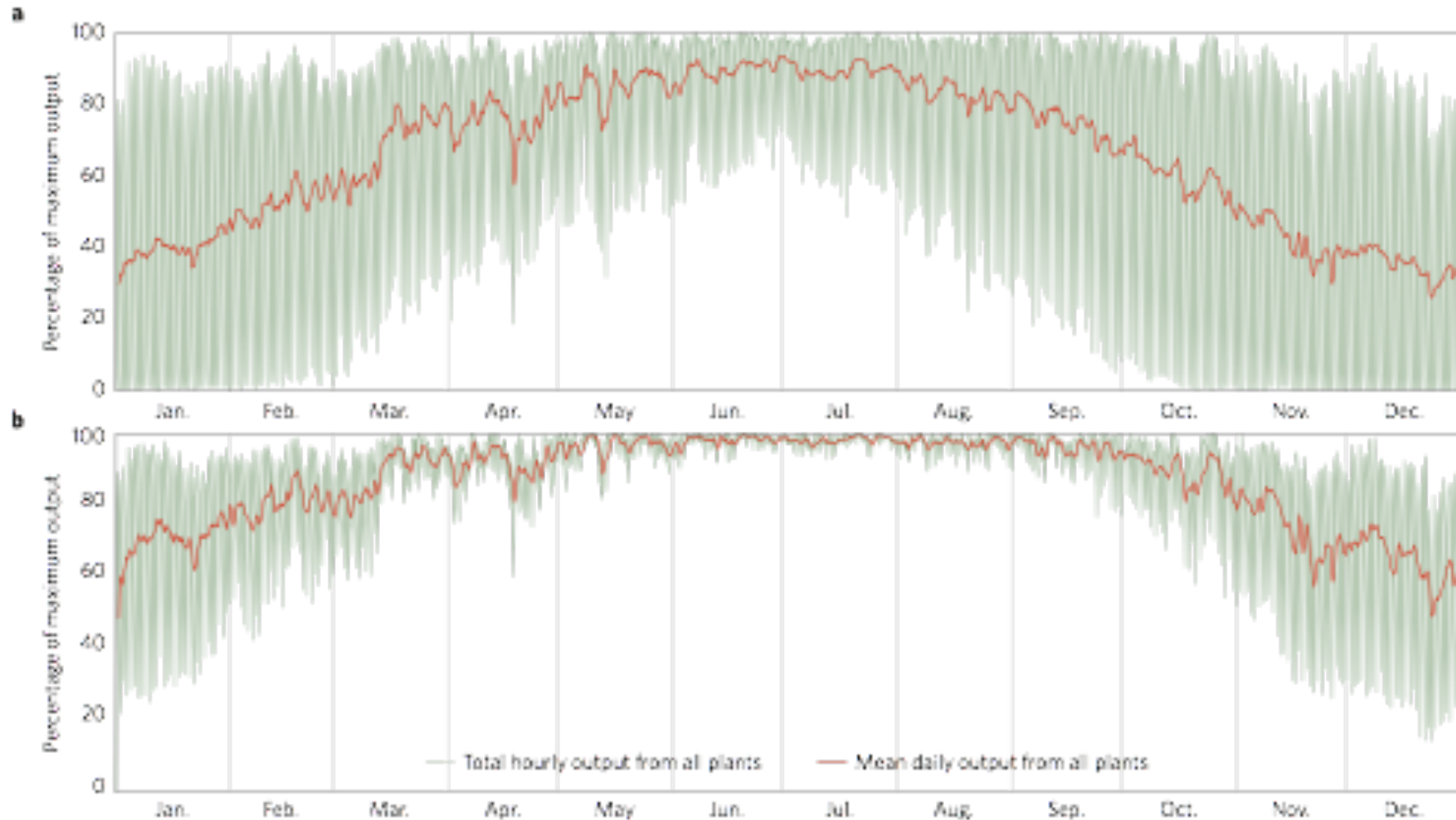
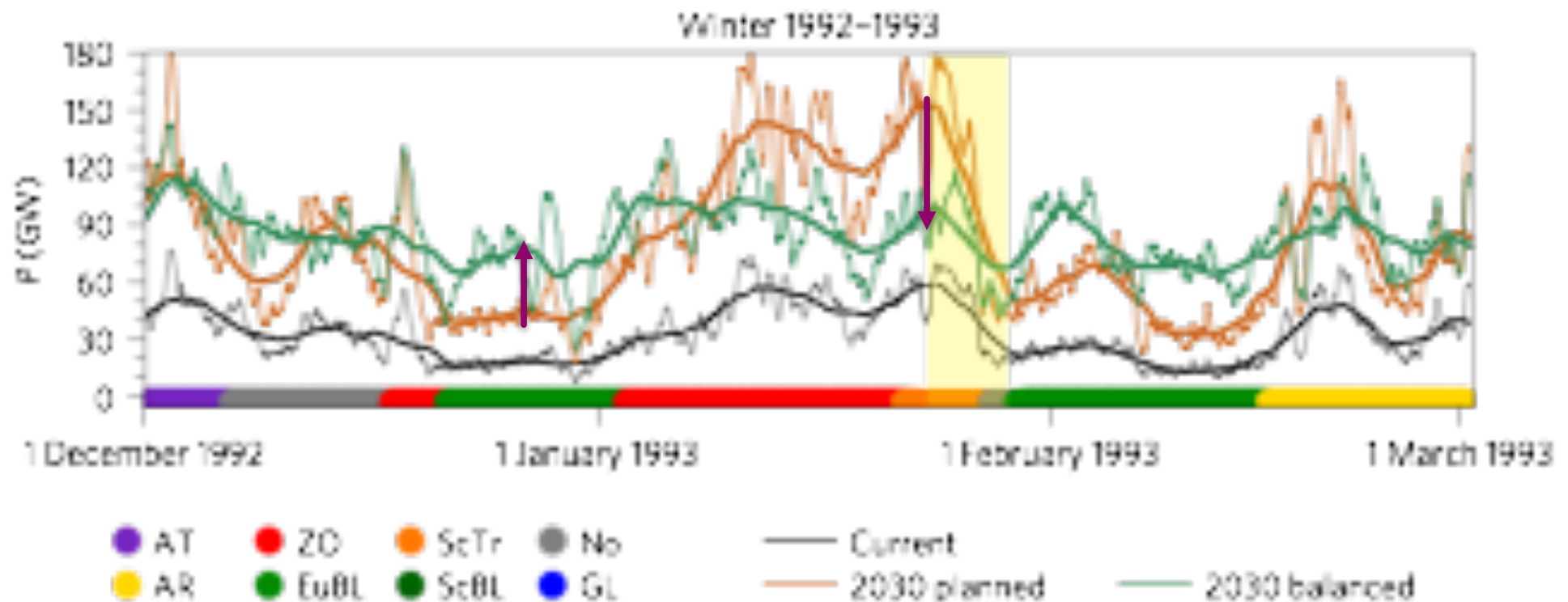


Figure 1 | Total output for the year 2005 from 100 plants spread across locations in the Mediterranean basin. a. The plants are operated without concern for demand or coordination: in each hour, each plant produces as much power as possible. See text for plant dimensions. **b.** The size of the solar field is doubled, while the power block and storage size is kept constant.

Making wind power less intermittent



Do we need gas as a bridging fuel?

- Not in Switzerland, would be more expensive
- Probably not elsewhere

- Coal and nuclear face unfavourable conditions in open EU power market

Thank you

Questions? Comments?

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References

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