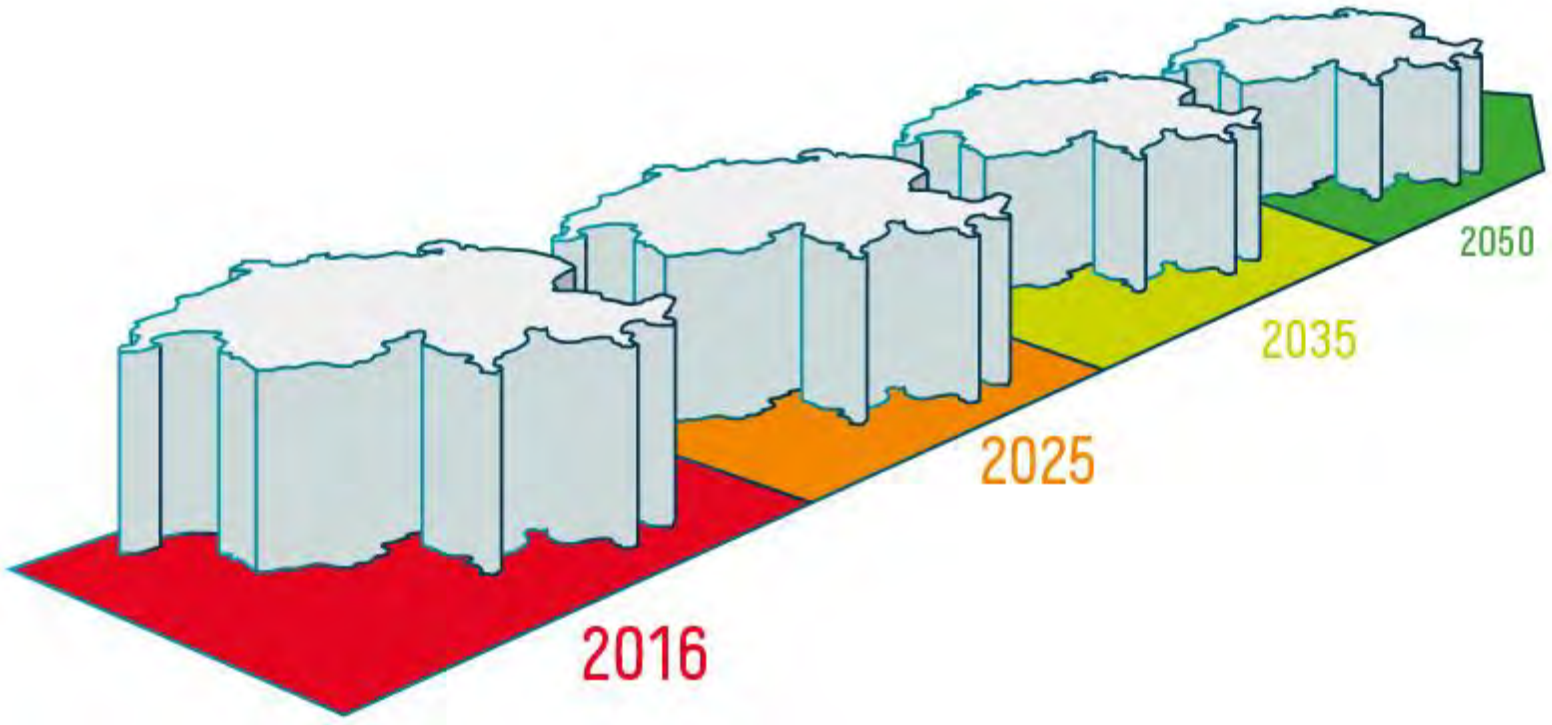
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE
Office fédéral de l'énergie OFEN
Ufficio federale dell'energia UFE
Swiss Federal Office of Energy SFOE



THE SWISS ENERGY AND CLIMATE POLICY IN A GLOBAL CONTEXT

LCA FORUM 22 APRIL 2018 ▪ LUKAS GUTZWILLER ▪ SFOE

CONTENTS

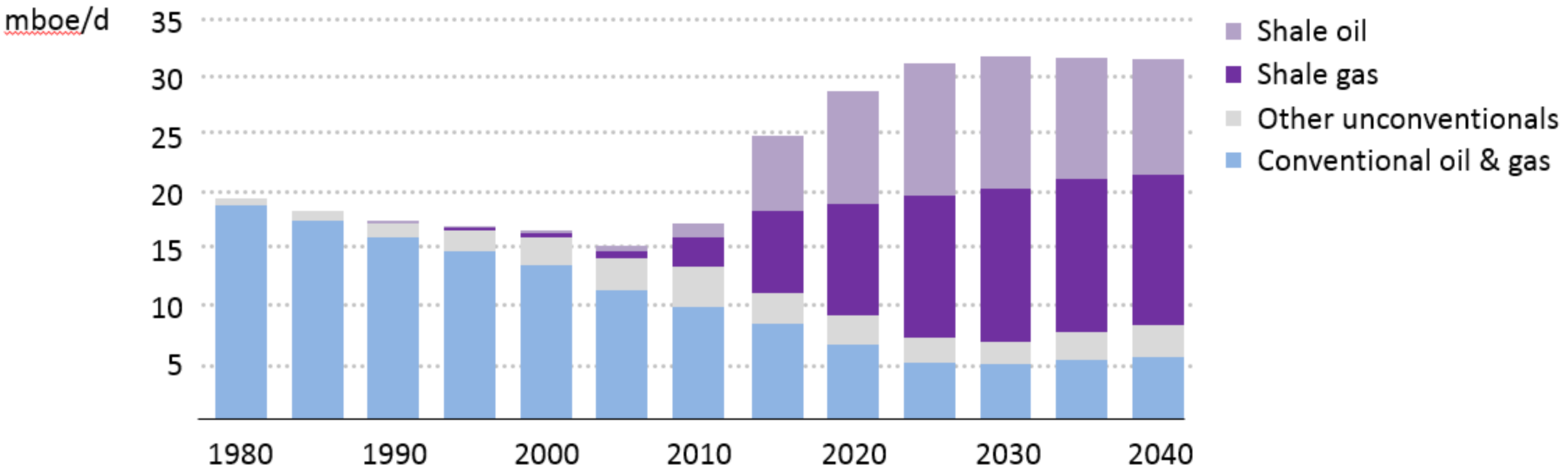
1. Global context: IEA World Energy Outlook 2017
2. Swiss Climate Policy 2030
3. Challenges for the Swiss electricity sector
    1. New market design, full market opening
    2. Seasonal storage electricity
    3. Seasonal storage heat
4. Conclusions

IEA WORLD ENERGY OUTLOOK 2017

Three large-scale upheavals in global energy set the scene for the new *Outlook*:

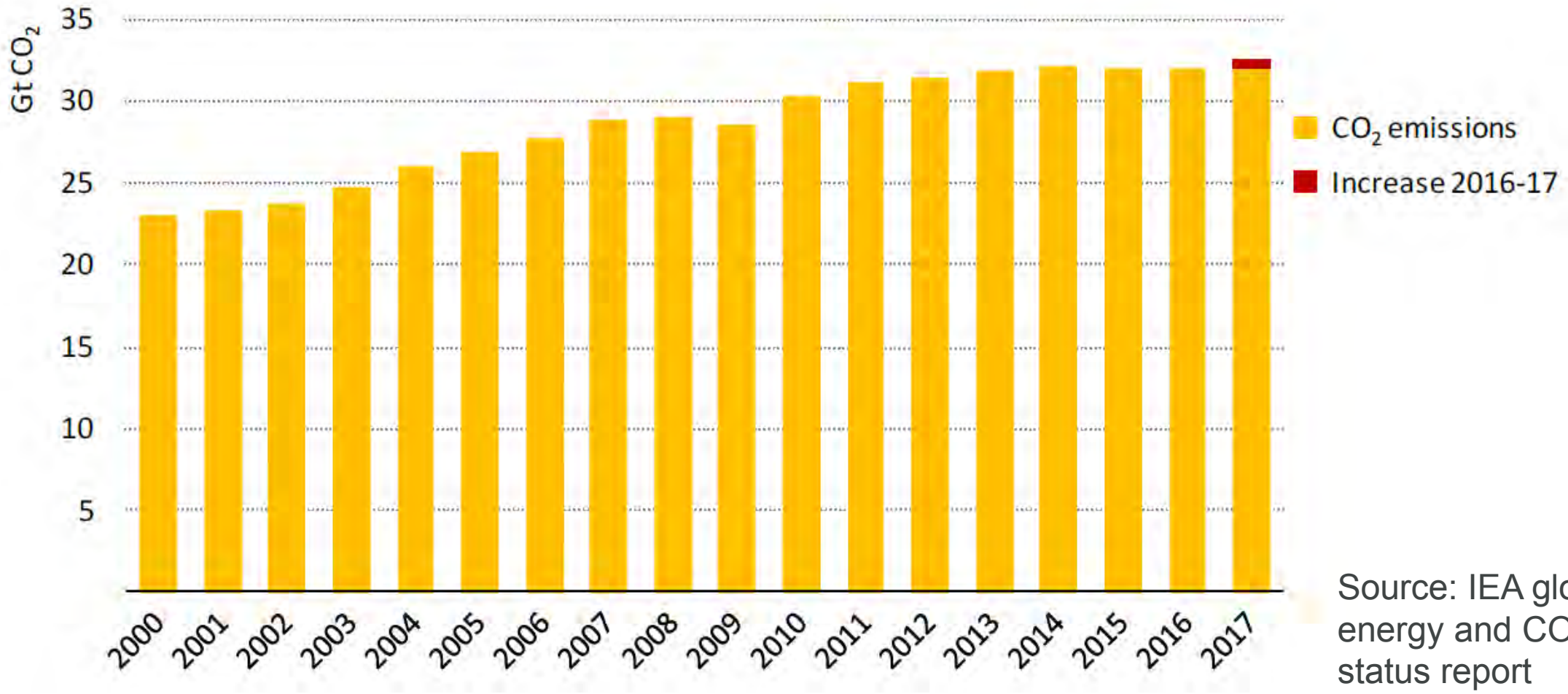
- The United States is turning into the undisputed global leader for oil & gas
- Solar PV is on track to be the cheapest source of new electricity in many countries
- China's new drive to "make the skies blue again" is recasting its role in energy, including roll-out of ETS

US BECOMES LEADER OF OIL & GAS PRODUCTION (IEA WEO 2017)



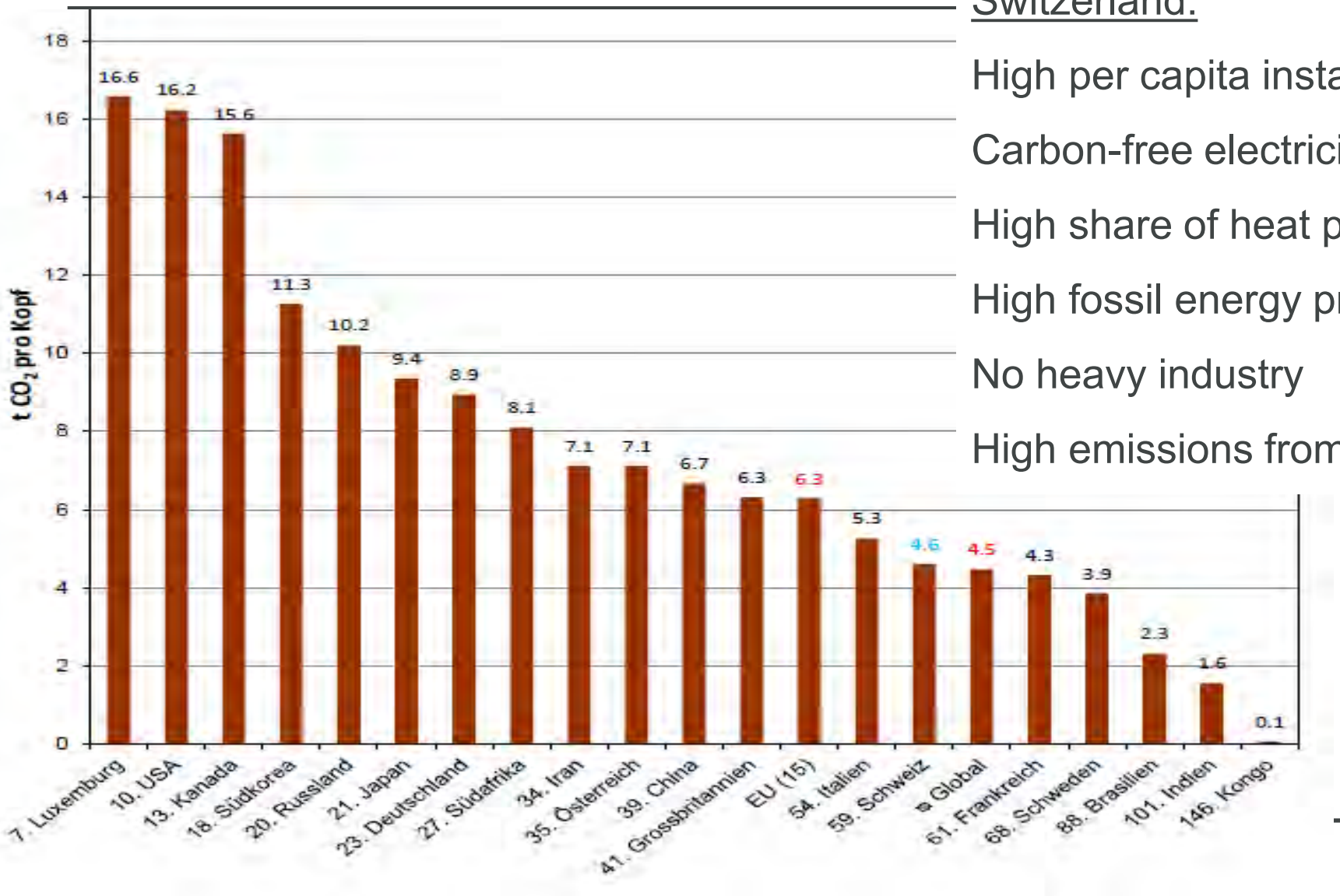
The US is already switching to become a net exporter of gas & becomes a net exporter of oil in the 2020s, helped also by the demand-side impact of fuel efficiency & fuel switching

GLOBAL ENERGY-RELATED CO_2 EMISSIONS



Source: IEA global energy and CO2 status report

PER CAPITA EMISSIONS OF SELECTED COUNTRIES



Switzerland:

High per capita installation of PV

Carbon-free electricity sector

High share of heat pumps and heat from waste

High fossil energy prices

No heavy industry

High emissions from aviation

Source: BAFU

PARIS AGREEMENT TRACKER (AS OF 13 APRIL 2018)

The Paris Agreement on climate change adopted in 2015 marks a critical turning point toward a zero-carbon and resilient world. Countries are now taking the steps to formally join the Agreement.

To date the Paris Agreement has been

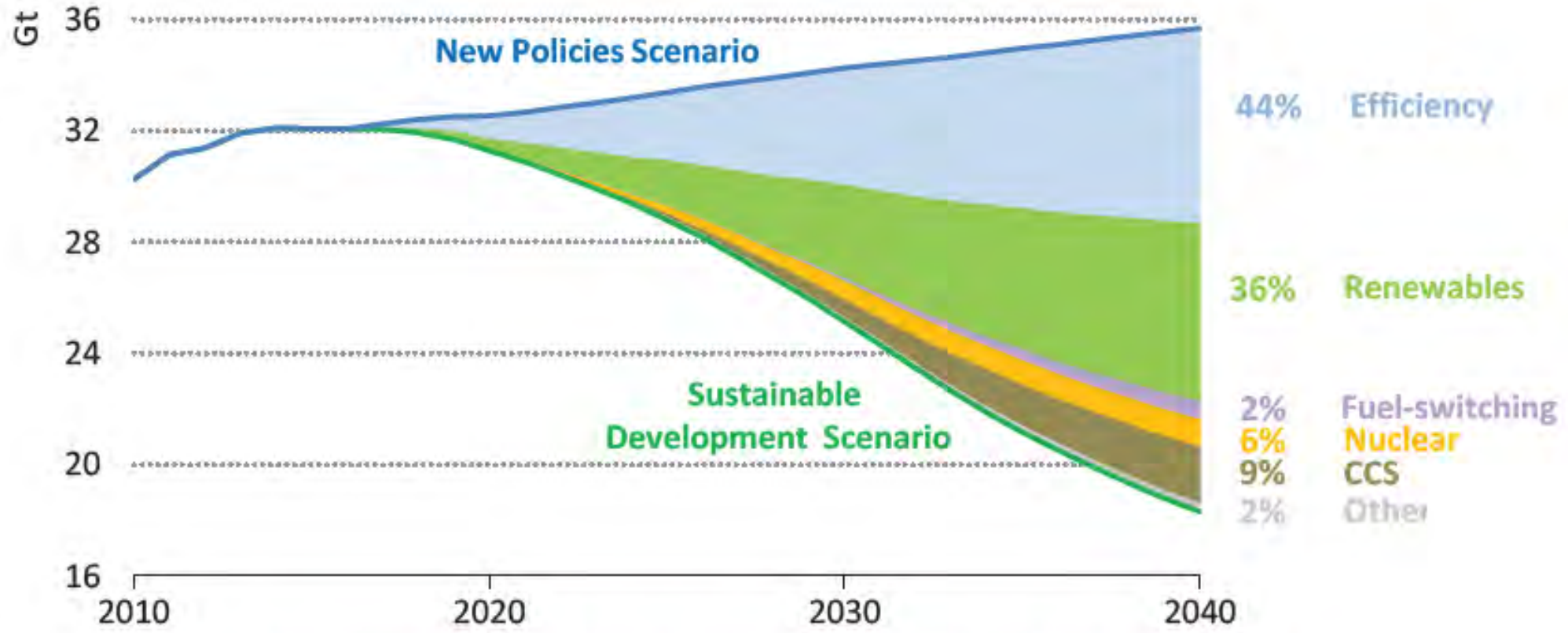
- signed by **195** Parties and
- ratified or otherwise joined by **175** Parties representing **88%** of global emissions.

The Paris Agreement entered into force when 55 Parties representing at least 55% of global emissions joined the Agreement. This threshold was achieved on Oct 5, 2016 and the Agreement entered into force on Nov 4 2016.

Source: http://cait.wri.org

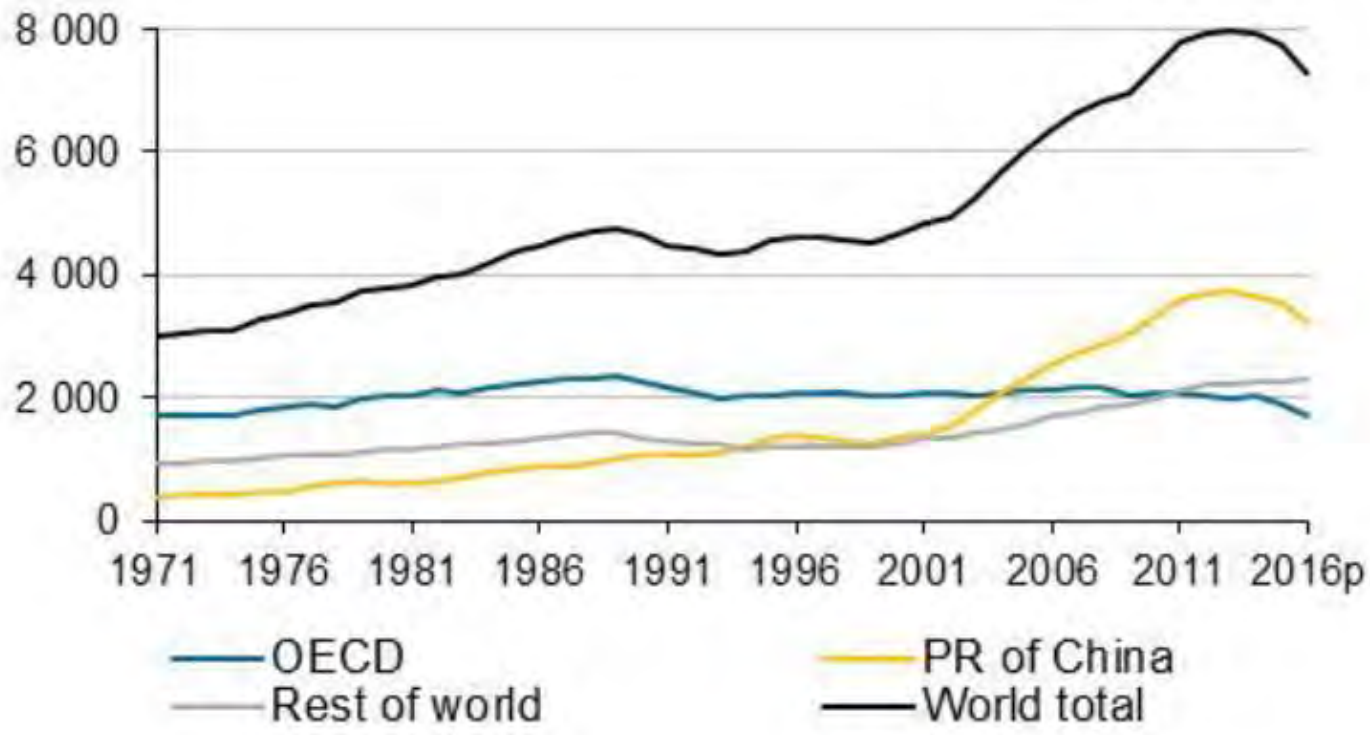
Principles:
NDC: nationally determined contributions
MRV: measurement, reporting, verification

IEA NEW POLICY AND SUSTAINABLE DEVELOPMENT SCENARIO (WEO 2017)



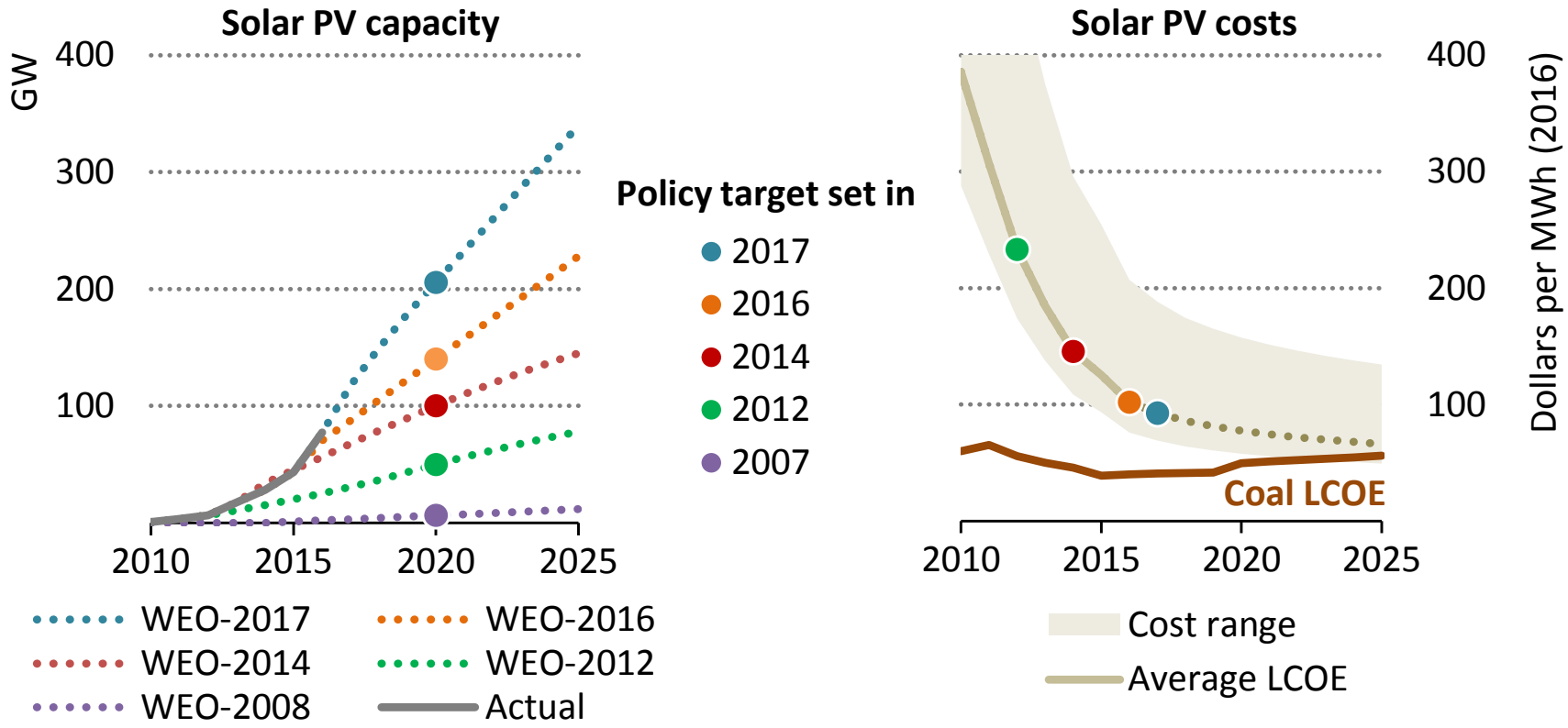
Energy efficiency and renewables account for 80% of the cumulative CO_2 emissions savings in the Sustainable Development Scenario

CHINA IS MOST IMPORTANT CONSUMER OF COAL, BUT DECREASING



Source: IEA, Coal Information, 2017

CHINA POLICY TARGETS AND *WEO* PROJECTIONS FOR SOLAR PV INSTALLED CAPACITY AND LEVELIZED COSTS



Successive WEO projections for China show a virtuous circle of policy-driven deployment & lower costs, bringing solar PV to competitiveness with coal

THE WALL STREET JOURNAL.

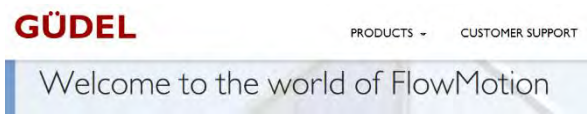
BUSINESS

There's a Global Race to Control Batteries—and China Is Winning

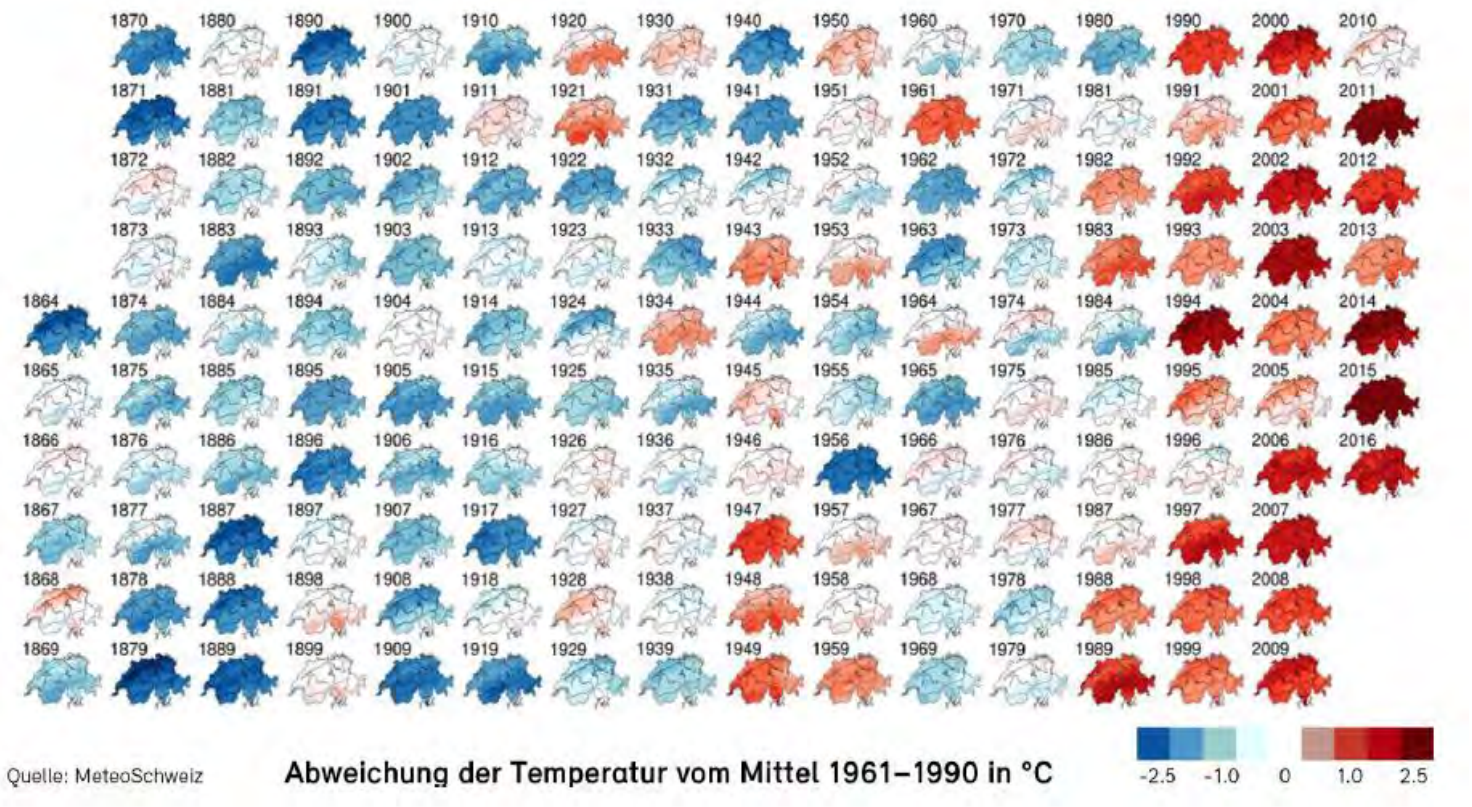
Chinese companies dominate the cobalt supply chain that begins at mines in Congo

Markt-EVI	
Rang	Land
1	Norwegen
2	China
3	Schweiz
4	Schweden
5	Niederlande
6	USA
7	Frankreich
8	UK
9	Österreich
10	Belgien
11	Südkorea
12	Deutschland
13	Japan
14	Italien
15	Indien

Industrie-EVI	
Rang	Land
1	China
2	Japan
3	Deutschland
4	USA
5	Südkorea
6	Frankreich
7	Indien
8	Italien

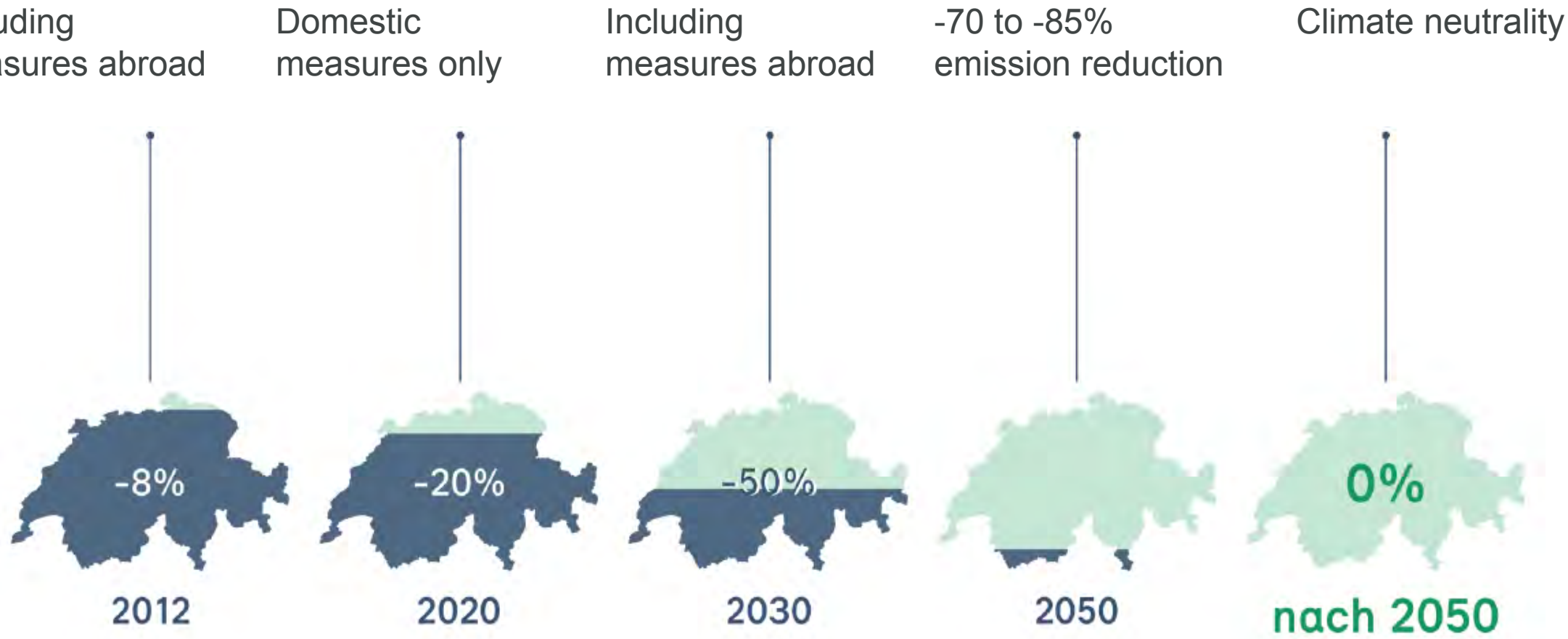


4. SWISS CLIMATE POLICY

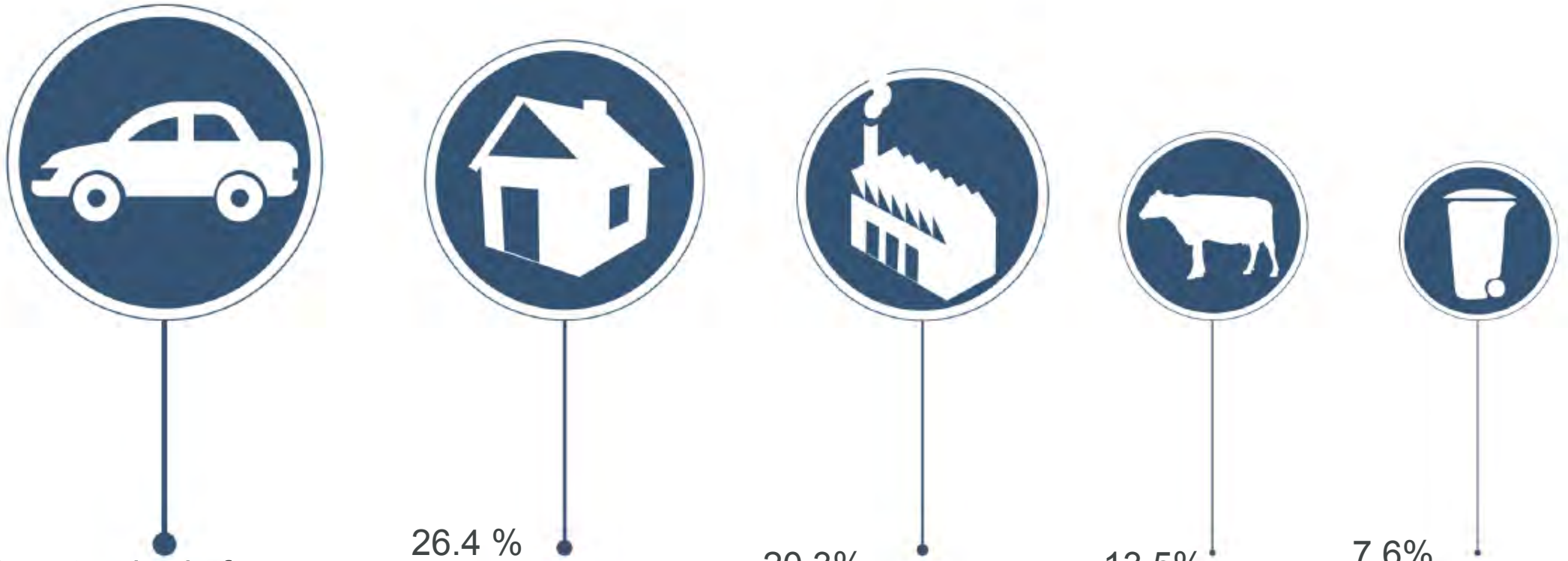


Average temperature increase of 2 degrees since beginning of measurement series!

MILESTONES OF SWISS CLIMATE POLICY



GHG EMISSIONS AND MEASURES BY SECTORS (2015)



32.1%
Emission standards for cars, compensation obligation for fuel importers, 5% biofuels quota

26.4 %
Building refurbishment program, cantonal standards

20.3%
Emission trading system linked with EU

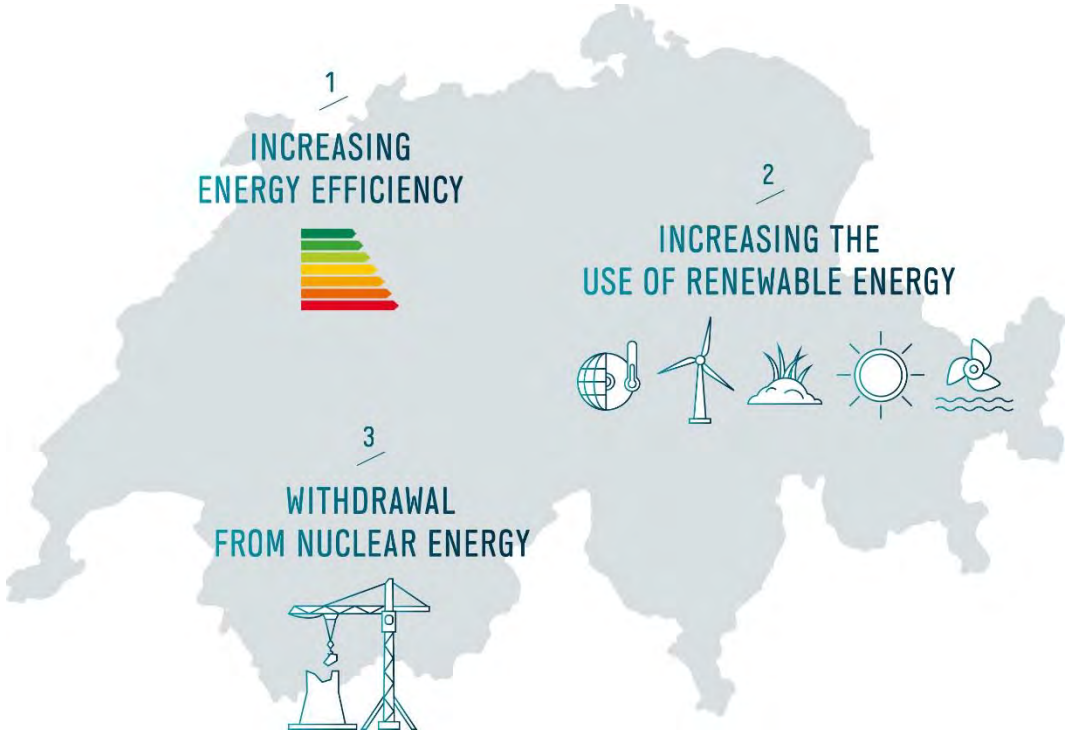
13.5%
Measures in agricultural policy

7.6%
Emission targets for waste incinerators

DETAILED MEASURES AND IMPACT

Domestic emissions 2030 reference scenario (BAU)	**41.8 MtCO2eq**
Additional reduction in the buildings sector • *Incl. CO_2 levy (further increases, up to max CHF 210/tCO_2)* • *Incl. Building Refurbishment Programme (CO_2 levy earmark up to CHF 450 million per 2018, implemented with ES2050)* • *Incl. Additional cantonal measures*	**3.5 MtCO2eq** *1.0 MtCO2eq* *1.5 MtCO2eq* *1.0 MtCO2eq*
Additional reduction in industry sector • *Incl. CO_2 levy (further increases, up to max CHF 210/tCO_2)* • *Incl. qualifying more SMEs for reduction covenants with levy exemption resp. simplifying procedures* • *Incl. ETS*	**1.5 MtCO2eq** *0.3 MtCO2eq* *0.2 MtCO2eq* *1.0 MtCO2eq*
Additional reduction in transport sector • *Incl. standards for passenger and LDV* • *Incl. increasing compensation obligation for fuel importers to 15-20%*	**0.9 MtCO2eq** *0.3 MtCO2eq* *0.6 MtCO2eq*
Additional reduction in agriculture	**0.5 MtCO2eq**
Additional reduction in synthetic GHG	**0.2 MtCO2eq**
Domestic emissions	**35.2 MtCO2eq (-35% vs 1990)**
International offsets	**8.5 MtCO2eq**
Domestic emissions minus international offsets	**26.7 MtCO2eq (-50% vs 1990)**

SWISS ENERGY STRATEGY AND CHALLENGES FOR THE ELECTRICITY SECTOR



Measures to increase energy efficiency

- Buildings
- Mobility
- Industry
- Appliances

Measures to increase the use of renewable energy

- Promotion
- Improvement of legal framework

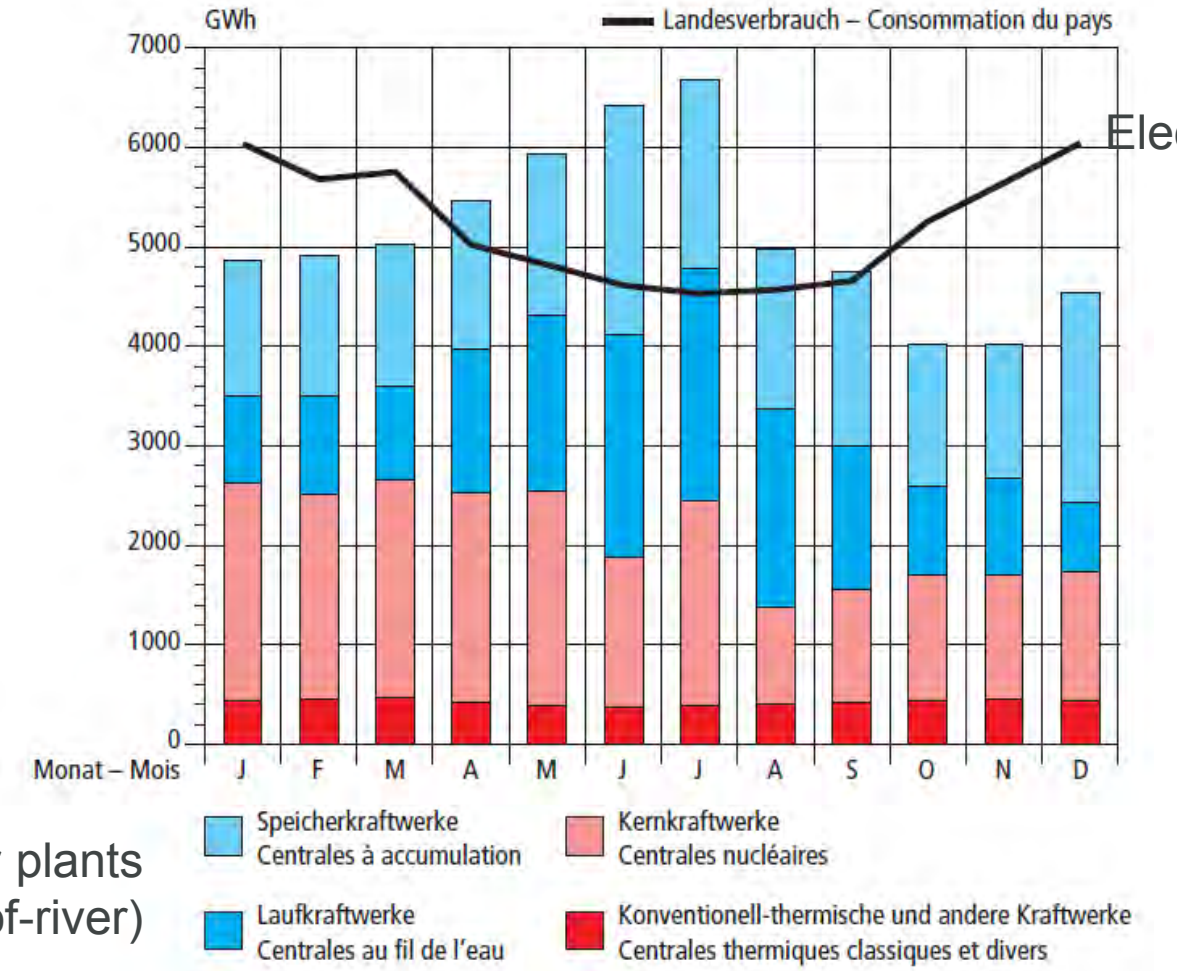
Withdrawal from nuclear energy

- No new general licences
- Step-by-step withdrawal – safety as sole criterion

Need for more flexibility, mainly in the electricity sector

=> Revision of the Electricity Supply Act

CHALLENGE: SEASONAL UNBALANCE ELECTRICITY, IMPORT DEPENDENCY IN WINTER



Electricity demand

Hydropower plants
(storage and run-of-river)

Thermal plants
(nuclear and waste incineration)

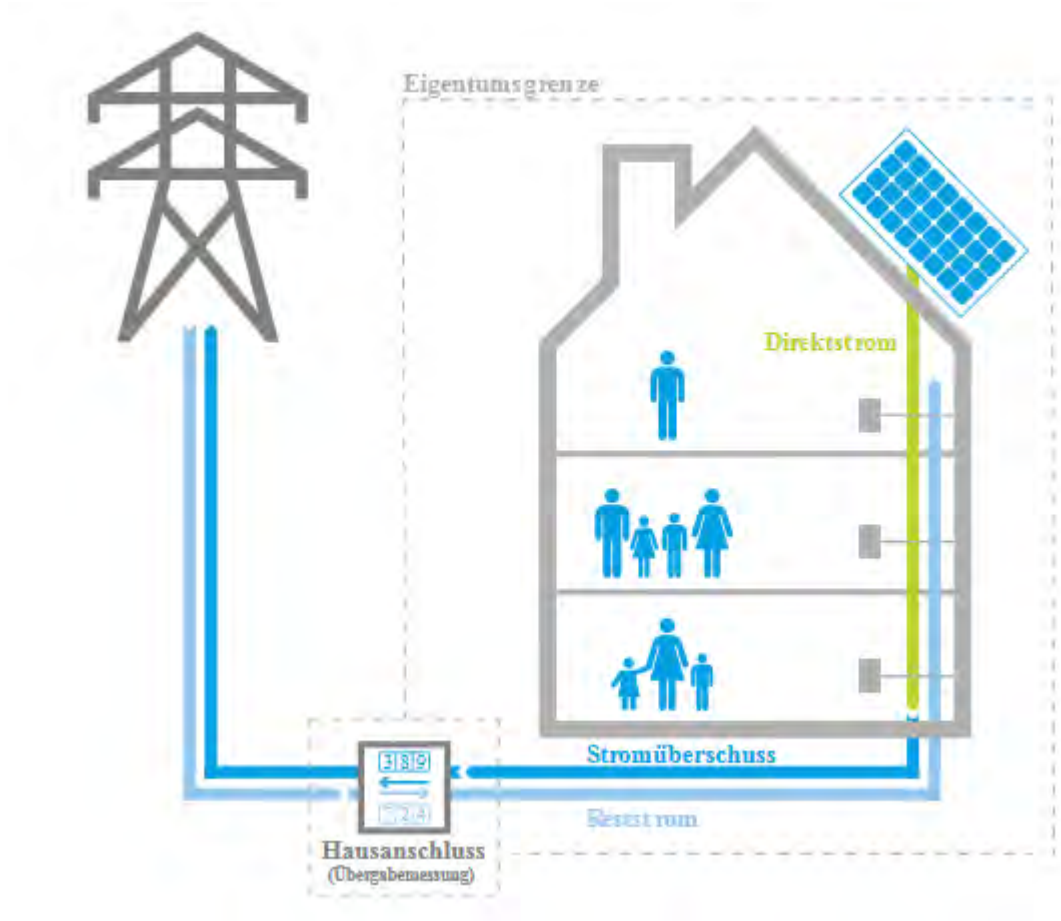
OBJECTIVES OF THE MARKET DESIGN

- **Overarching goal**: provide mid and long term security of supply (SS)
- Further goals / market framework:
  - minimal distortions in the Energy Only Market (EOM),
  - compatible with second step of market opening (full liberalization),
  - climate targets (CO2 law, Paris agreement),
  - in line with EU and WTO law and the Federal Constitution,
  - minimal financial burden for end consumers,
  - instrument which does not favor one technology over another (technology neutral)
- **Is not goal**: purely economic (support) measures of individual technologies

ELEMENTS OF A NEW MARKET DESIGN

- Full electricity market opening
- Strengthen integration with neighboring markets. Electricity Agreement with the EU remains a high priority.
- Optimize the energy-only-market, in particular: increase intra-day liquidity and improve price signals for balancing/flexibility (including for end users).
- No capacity mechanism needed.
- To ensure availability of energy in emergency situations, a strategic reserve (focus on energy) in addition to the energy-only-market is examined. It is to be technology-neutral and should minimize market impact and costs.

IMPLEMENTED WITH ENERGY STRATEGY 2050: CONCEPT OF SELF-CONSUMER MODEL



Building owner generates electricity for his own use and saves grid costs

Typical annual household consumption of 5000 kWh

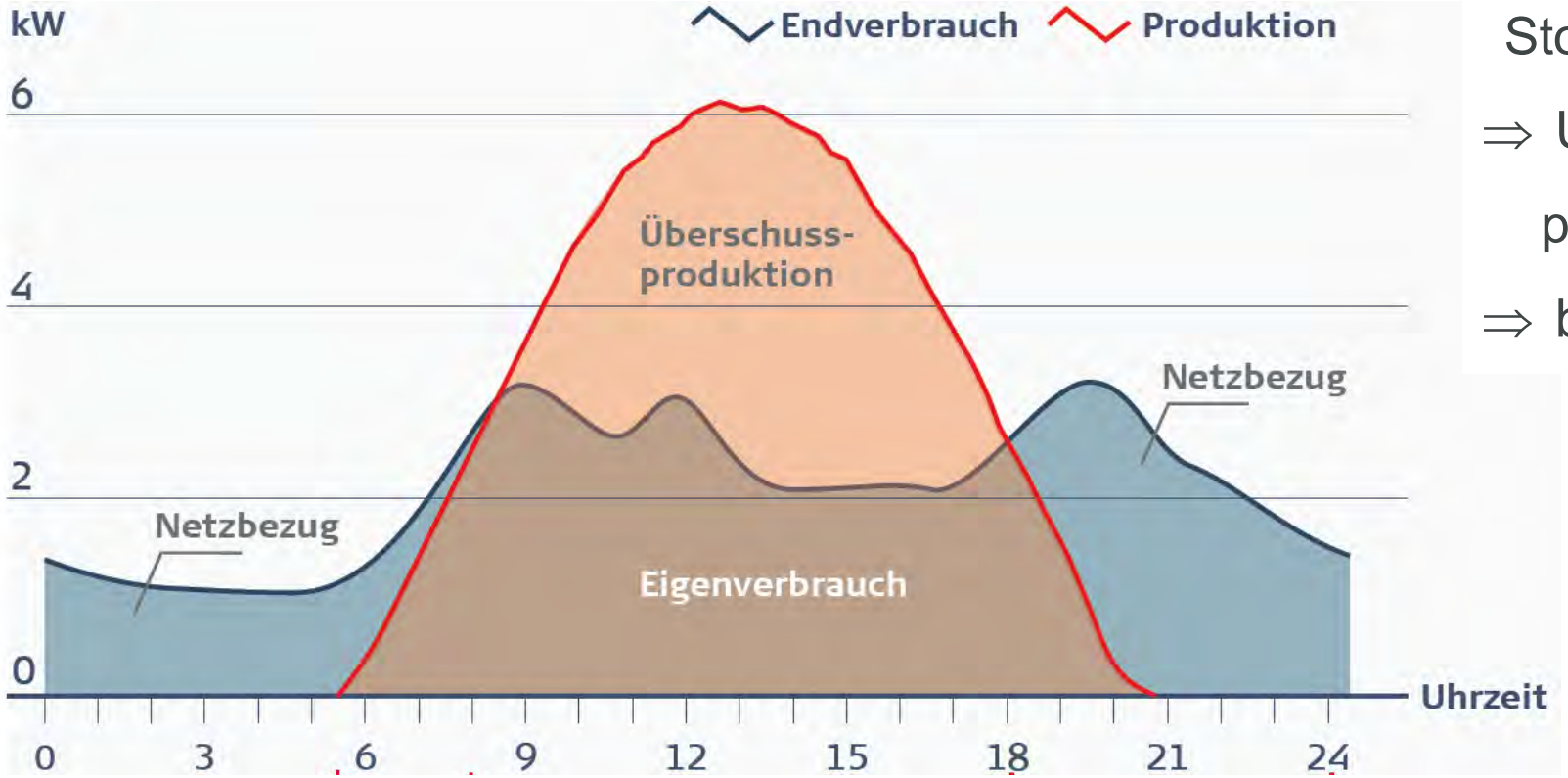
Grid cost saving at 10 cts/kWh: CHF 500.-

With new Energy law, pooling of prosumers is permitted provided that the pooling of the properties does not use the public distribution grid, and:

the generation capacity is at least 10% of grid connection capacity (min 15kVA)

=> Minimum size of 1.5 kWp

CHALLENGE FOR PROSUMERS WITH PV



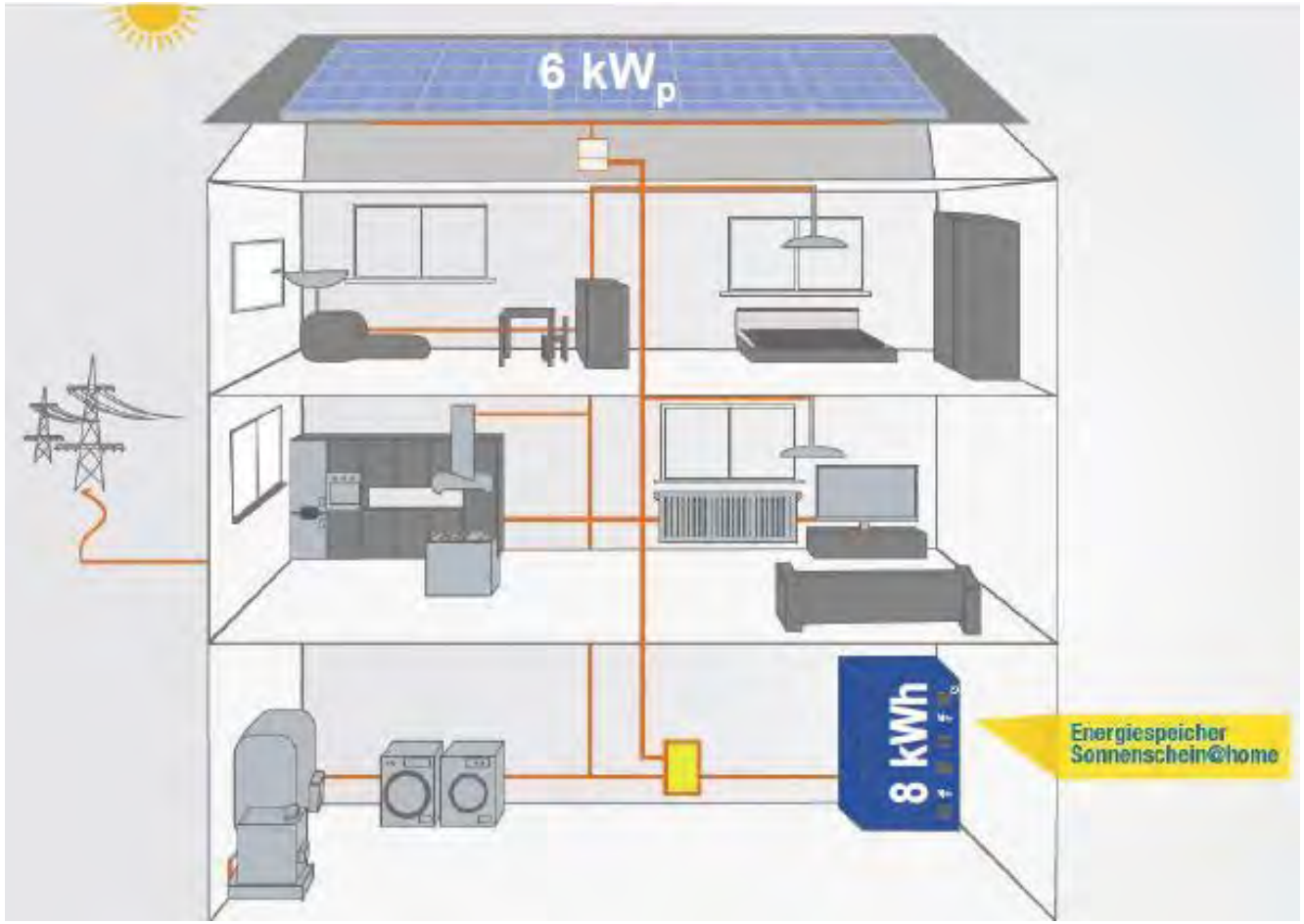
Basic principle:

Storage is inefficient and expensive

⇒ Use as little storage capacity as possible

⇒ but as much as necessary

ECONOMICS OF PV WITH BATTERY



Szenario 2025	Photovoltaik	Batterie
Leistung	6 kWp	
Nutzbare Kapazität		8 kWh
Zykluswirkungsgrad		90%
Spezifische Kosten	1'800 CHF/kWp	300 CHF/kWh
Capex (turn key)	10'800 CHF	2'400 CHF
Lebensdauer	30 a	10 a
Kalkulatorischer Zins	5.0%	5.0%
Annuität	6.5%	13.0%
Opex	1.0%	1.0%
Jahreskosten	811 CHF	335 CHF
Jahresenergieertrag PV	6'000 kWh	
Stromgestehungskosten	13.5 Rp/kWh	

Source: Stefan Roth, FHNW

MICRO-CENSUS MOBILITY AND EV-CHARGING

Daily average distance travelled

Public charging stations:

- CH has one of the highest density of charging stations worldwide
- Increase in 22kW stations.

Öffentliche Ladestationen Schweiz	2015	2016
AC bis zu 3,7 kW Ladeleistung	800	849
AC bis zu 22 kW Ladeleistung	460	636
DC bis zu 50 kW Ladeleistung	110	135
DC Tesla 120 kW Ladeleistung	10	10
TOTAL	**1380**	**1630**

FLEXIBILITY OPTIONS TO ABSORB PV PEAK AT NOON

- Centralized Hydropower pump and storage
- Electric car batteries
- Prosumers: batteries in buildings
- Demand-side management

HOW MANY CHARGING STATIONS ARE NEEDED TO TAKE UP SOLAR POWER BY EV?

Assumption for 2040:

- **10 GW peak PV** installed producing approx. 10 TWh solar electricity
- **Pump and storage** capacity: 3 GW
- Delta: 7 GW, without demand-side measures
- Typical DC charging station of 35 kW

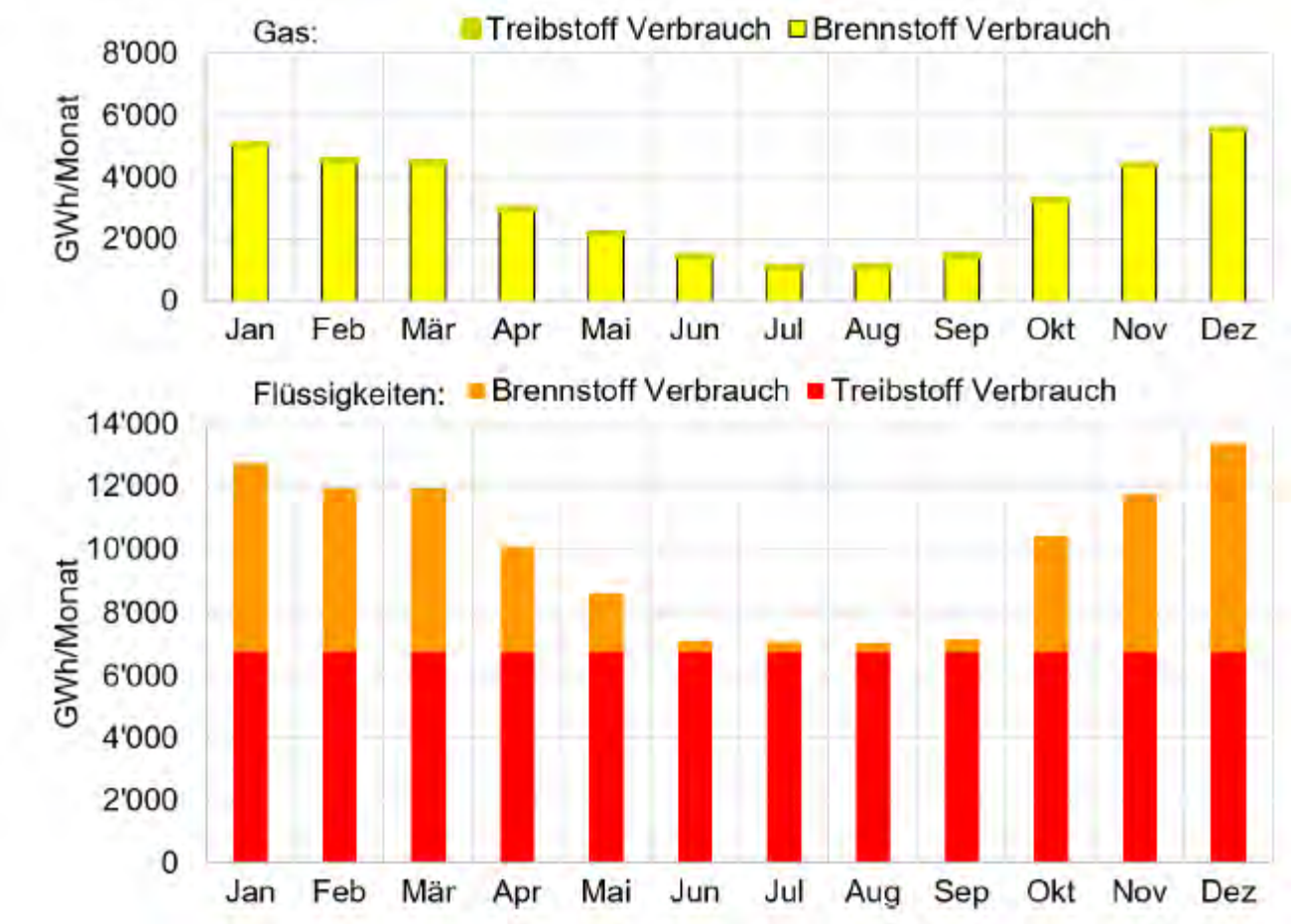
Number of charging stations needed to take up PV peak at noon: 200'000

Present car fleet: 4 mio. cars => if by 2040 all are electric, one car out of 20 needs to be charging around noon. Limitations: sharing economy and self-driving cars.

Prosumers: Approx. 2 Mio residential buildings and 50 GWh daily PV generation (5 hours x **10 GW**): 25 kWh storage capacity per building.

CHALLENGE: SEASONAL UNBALANCE HEAT

Demand natural gas



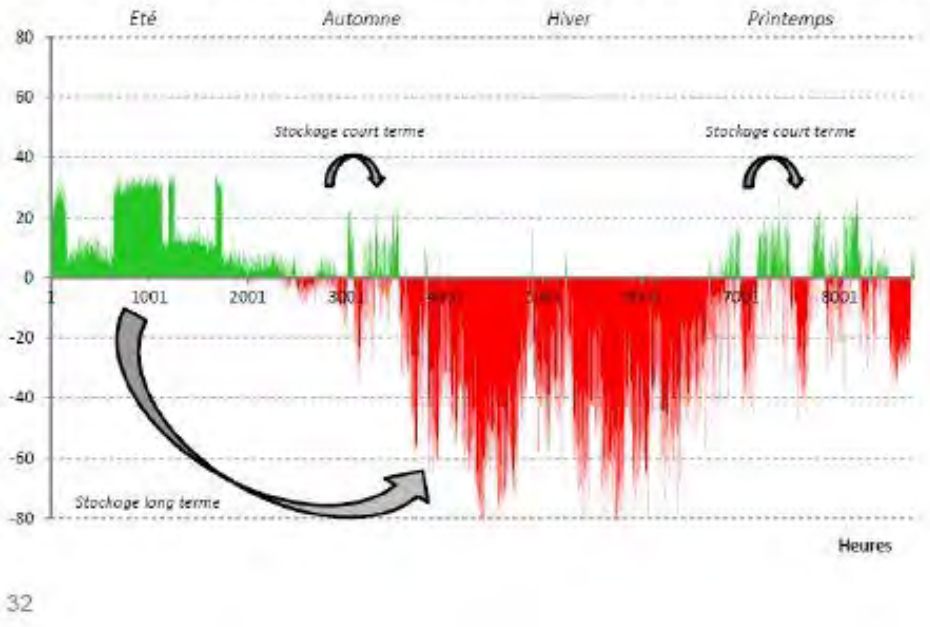
Demand liquid transportation and heating fuels

Similar seasonal variation for district heating from waste incineration

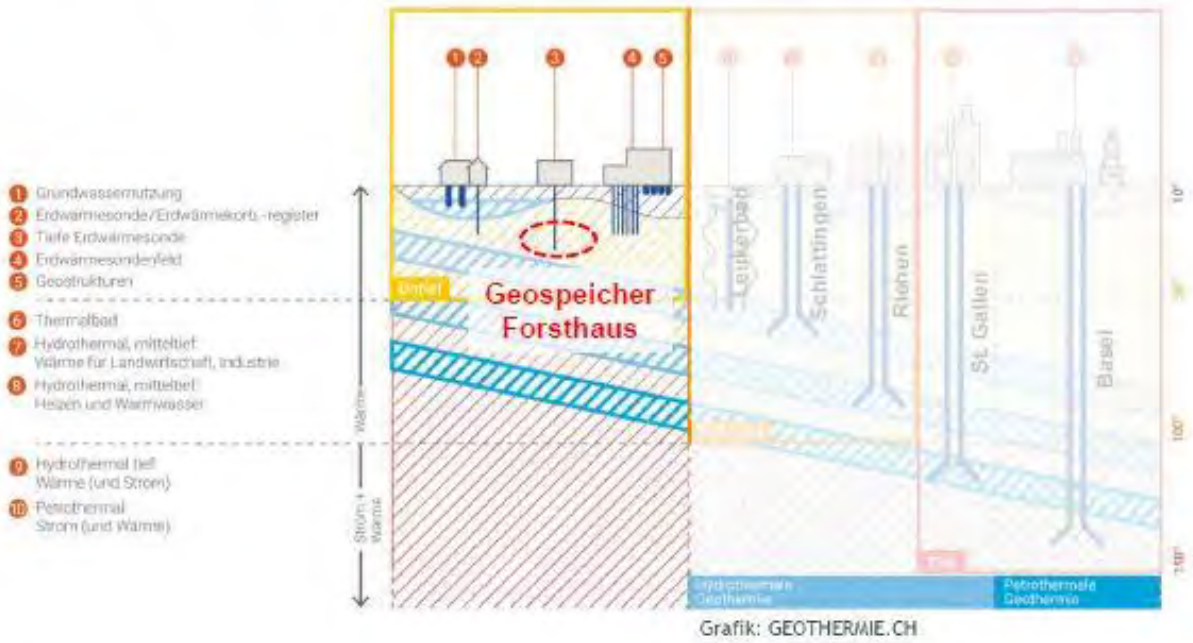
Seasonal heat storage?

EWB GEOTHERMAL HEAT STORAGE FROM WASTE INCINERATION

Seasonal shift from summer to winter



Seasonal heat storage



Cost estimate: CHF 7 to 14 mio.
Annual CO2-savings: 5000 to 7000 tons
(or 2000 tons of heating fuel, 20 GWh)

Permit expected for 2022
Depth: 200 to 500 m

CONCLUSIONS

China is becoming the forerunner regarding clean tech: decreasing coal, push for electric vehicles including batteries.

Swiss climate policy sets focus on CO2 tax, car emission standards, fuel importers and building sector (Cantonal competence), linking Swiss and EU ETS.

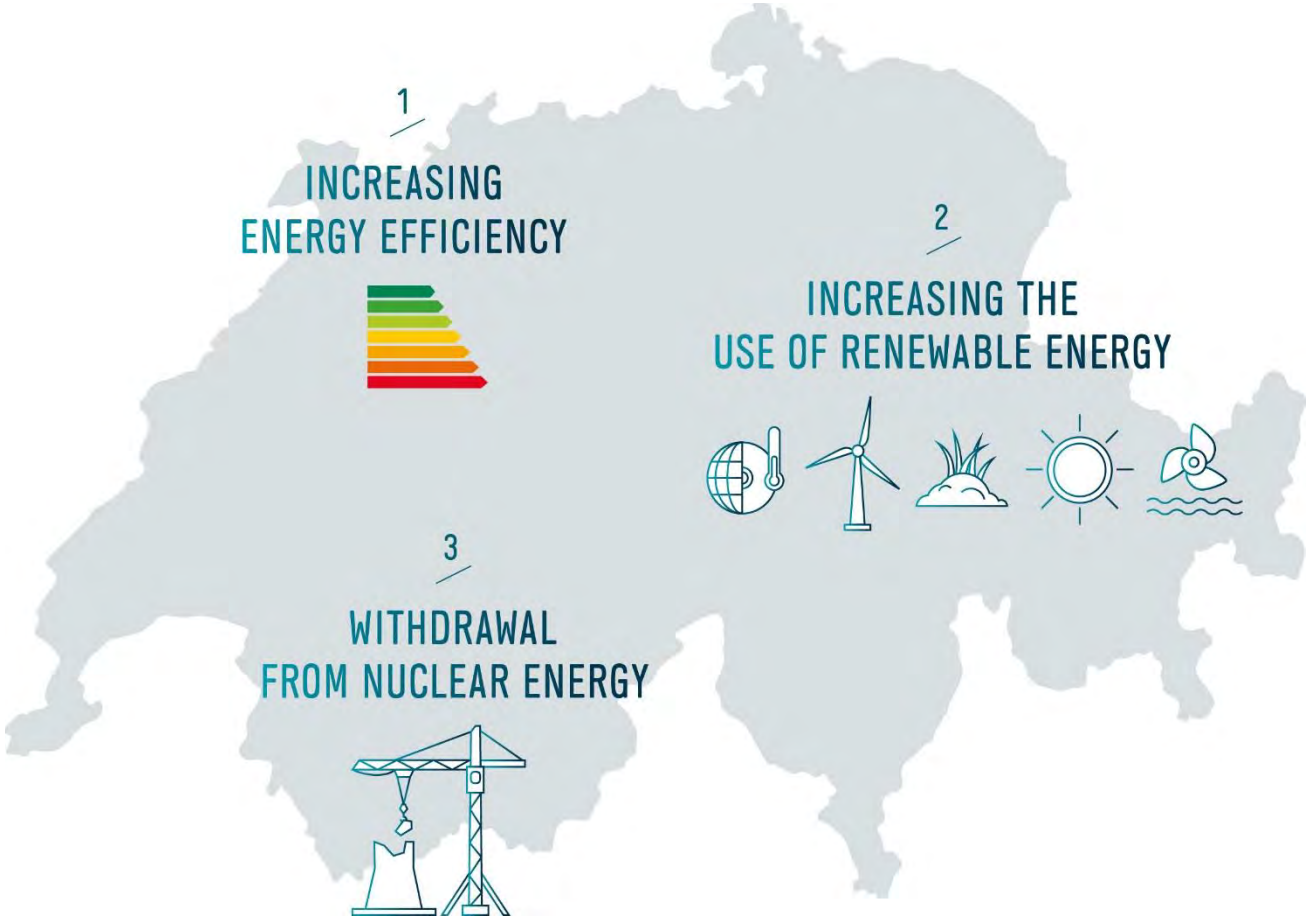
Challenges for Swiss energy sector: seasonal unbalance of electricity and heat

$\Rightarrow$ Need for seasonal storage

Opportunity: from centralized to decentralized: prosumers, stationary and mobile batteries allow for more flexibility, smart applications, digitization, sectoral convergence.

Full market opening and an electricity agreement with the EU are key for Swiss supply security.

FURTHER INFORMATION



ENERGIESTRATEGIE2050.CH

BFE.ADMIN.CH

GAS INDUSTRY APPROACH

Objective by 2030: 30% biogas share in gas supply for residential heating

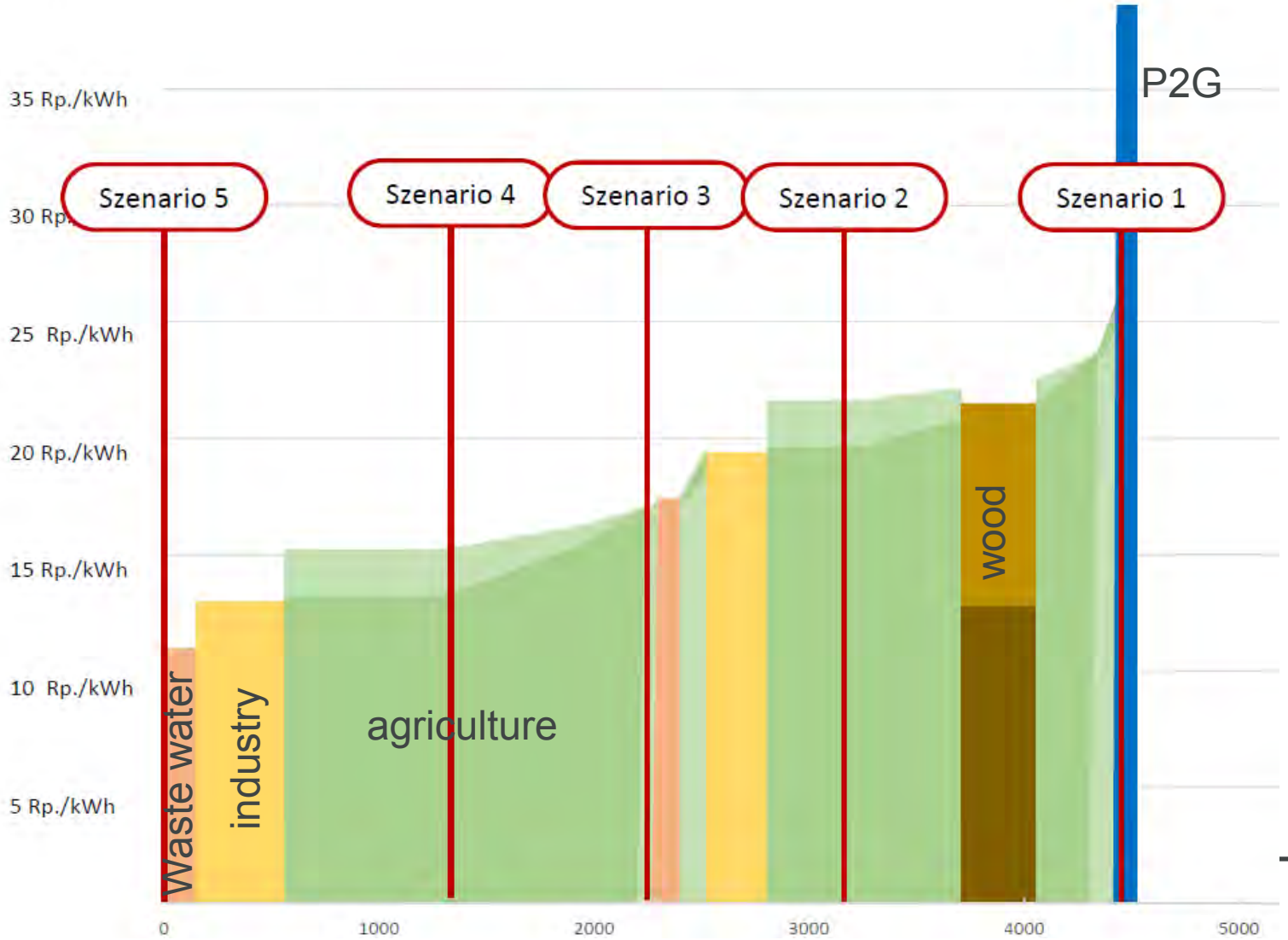
⇒ Increase of biogas by factor of 10 to approx. 4500 GWh biogas

Strategy:

- Increase domestic biogas production
- Power to gas (P2G), upgrade of raw biogas with hydrogen
- Imports

Present natural gas storage capacity: 80 GWh or approx. one day (source:

ADDITIONAL BIOGAS POTENTIAL AND MARGINAL COST



erdgas biogas