Modernisation of existing NPPs in Switzerland

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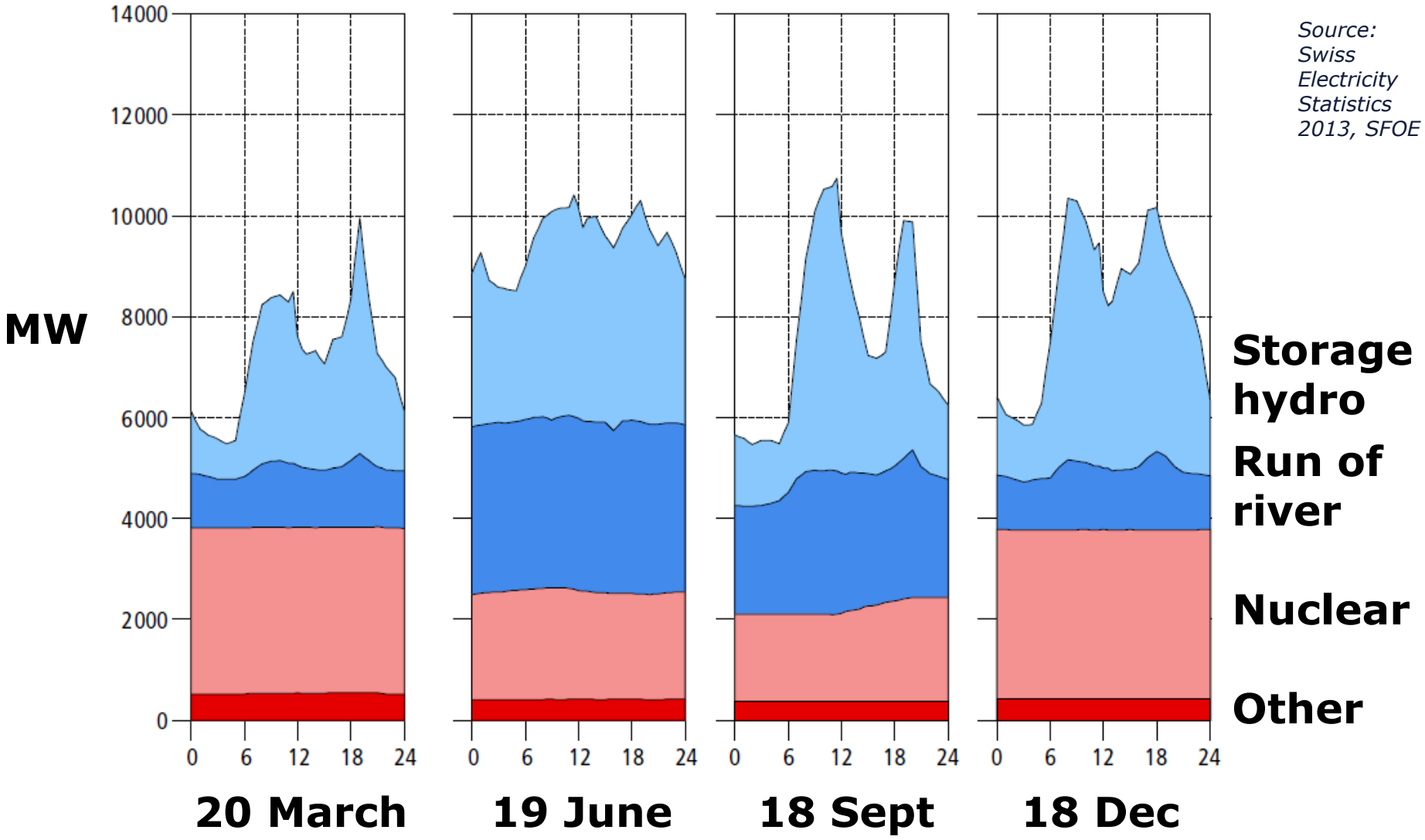
Daily generation profiles 2013
Spring, Summer, Fall, Winter



Source: Swiss Electricity Statistics 2013, SFOE

Domestic Nuclear and Long Term Contracts Supplying Switzerland with 42 TWh Electricity

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	COD Foundation	Plant/LTC Capacity	Generation/ Import 2013
Swiss units			
Beznau 1&2	1969/1971	730 MW	5.9 TWh
Mühleberg	1971	373 MW	2.9 TWh
Gösgen	1979	1010 MW	6.4 TWh
Leibstadt	1984	1220 MW	9.7 TWh
Nuclear imports (LTC from France)			
CNP (FES, CAT)	1972/1985	830 MW	5.1 TWh
AKEB (BUG, CAT)	1972/1984	521 MW	2.9 TWh
ENAG (-)	1990	400 MW	3.5 TWh
Others		~1000 MW	~5.5 TWh

Sources: SFOE, annual reports, internal sources ("Others")

25 TWh

17 TWh

Total supply for Switzerland 2013: 42 TWh

(Total domestic consumption: 64 TWh)

Backfitting of Swiss NPPs for severe accidents and accident management

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Since the 1980s

- Backfitting of systems to prevent hydrogen explosions (passive autocatalytic recombiners, H2 mixing systems, H2 ignition systems in the primary containment, and N2 systems to inert the primary containment)

Since the 1990s

- Backfitting of independent special emergency systems in separate, bunkered buildings in Beznau and Mühleberg NPPs (part of design for the for Gösgen and Leibstadt).
- Backfitting of filtered containment venting system to mitigate the consequences of severe accidents
- Gradual backfitting of alternative feed lines to the reactor pressure vessel and the primary containment

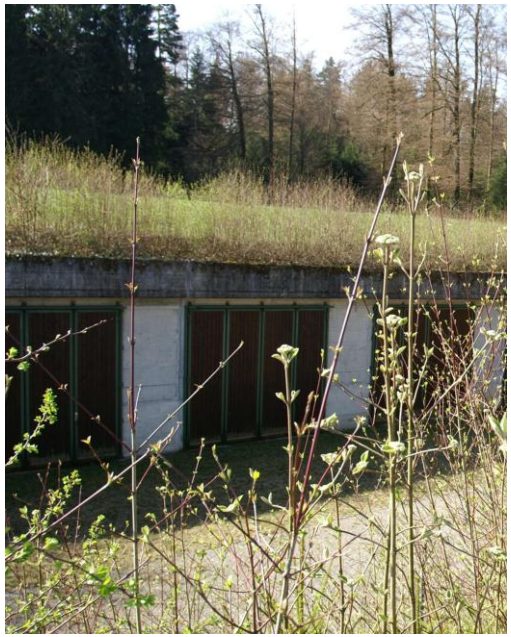
Since the 2000s

- Written decision-making aids to mitigate the effects of severe accidents (SAMG) have been developed both for power and nonpower operation

Post-Fukushima action plan

Since 2011

- Further strengthening of preventive and mitigative measures against consequences of accidents (onsite and offsite):
- Establishment of a Central Offsite External Storage Facility Reitnau in a former Swiss military bunker
- Further safety improvement measures ongoing in all Swiss NPPs



Retrofitting of Gösgen NPP over the last 35 years Examples

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- 1979 Start of commercial operation
- 1993 Retrofit of filtered venting system
- 1993 Gross power increased from 970 MW to 990 MW
- 1995 Gross power increased from 990 MW to 1020 MW
- 1999 Third independent cooling line for the spent fuel pool
- 2001 Process computer replaced by data information system
- 2005 Retrofit pressure release system reactor coolant system
- 2008 New external wet spent fuel pool storage building
- 2010 Cooling tower internals optimization completed
- 2010 Gross power increased from 1020 MW to 1035 MW
- 2013 Low pressure turbine, condenser, main generator
- 2013 Gross power increased from 1035 MW to 1060 MW

Historical operating results Gösgen NPP

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Year	Operating hours	Load factor	Electricity Generation	Annual costs	Generation costs
a	h	%	Mrd. kWh	Mio. CHF	Rp./kWh
1996	8220,4	93,6	7,928	399,5	5,04
1997	8196,4	93,6	7,908	401,0	5,07
1998	8129,5	92,8	7,840	398,0	5,08
1999	7825,5	89,3	7,534	378,0	5,02
2000	8105,5	92,3	7,804	320,0	4,10
2001	8175,5	93,3	7,870	320,0	4,07
2002	8152,9	93,1	7,853	319,0	4,06
2003	8277,4	94,5	7,989	324,8	4,07
2004	8292,6	94,4	8,016	326,3	4,07
2005	7840,7	89,5	7,583	329,1	4,34
2006	8370,5	95,5	8,099	333,6	4,12
2007	8434,2	96,2	8,159	297,3	3,64
2008	8235,7	93,8	7,964	316,6	3,98
2009	8349,1	95,3	8,072	374,8	4,64
2010	8182,6	93,4	8,029	333,3	4,15
2011	8061,4	92,0	7,910	315,1	3,98
2012	8227,9	93,7	8,074	378,0	4,68
2013	6543,9	74,7	6,410	319,20	4,98

Long-term operation management
Example: Leibstadt NPP

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Equipment/Investments

Mechanical

Electrical

Civil Engineering

External Factors of Influence

Electricity Market Development

Political Environment

Nuclear Law: Backfitting Imperative

Vendors/ Market Environment

Post Operation Phase

Decommissioning

Disposal of Radwaste

Fund development / Finances

Other Factors of Influence

Staff development

Techn.power uprate(s)

Spare Parts Storage

Fuel

Long Term Contracts

Purchase

Business Economical Analysis

Needs/ Plans for Investments

Consumption of Fixed Capital

Net electricity generation

Annual and Generation costs

«Energy strategy 2050»

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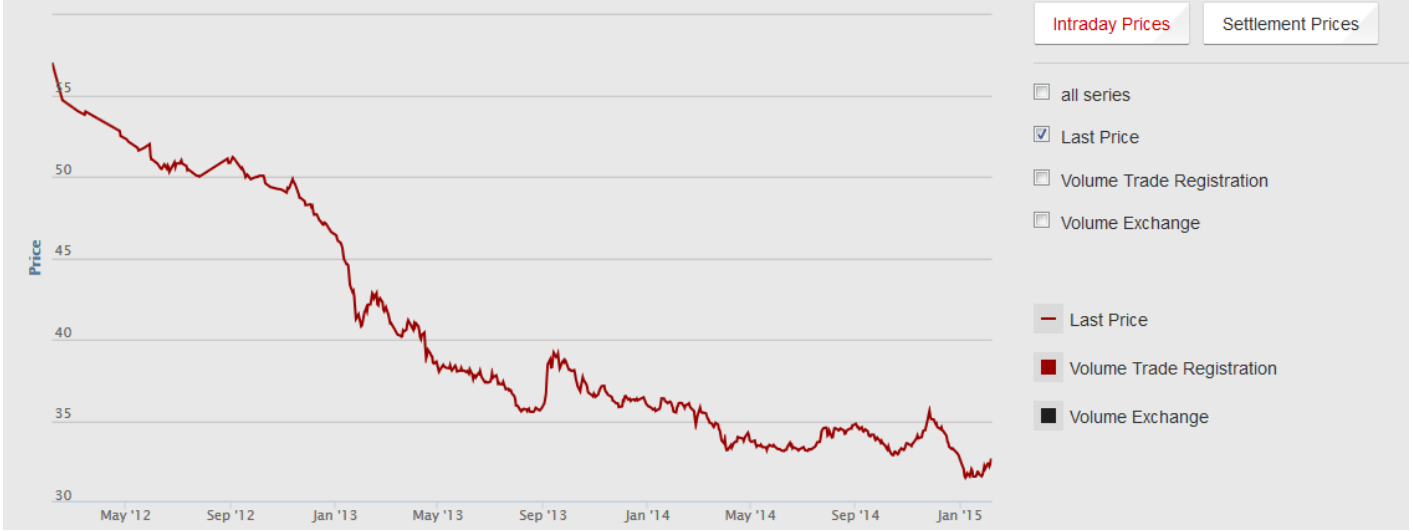
- New long-term energy policy
- Decision to withdraw from the use of nuclear energy
- Intention: decommission Switzerland's NPPs when they reach the end of their service life
- NPPs not to be replaced with new ones
- Focus on energy efficiency, hydropower and new renewable energy sources

Outside forces

- Massively reduced electricity market prices in Western Europe triggered to a large part by German subsidy policy
- Strong Swiss currency but surrounding electricity markets all priced in EUR/MWh

Name	Best Bid	Best Ask	No. of Contracts	Last Price	Abs. Change	Last Time	Last Vol.	Settl. Price	Vol.	Vol. Trade Registration	Open Interest Prev. Day
Cal-16	32.66	32.70	132	32.70	0.23	11:59	17,568	-	1,159,488	1,010,160	22,354



Conclusion

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- Large component replacements and modernizations ongoing (plant improvement and plant ageing management)
- Further safety improvements ongoing (continuous improvement & Fukushima lessons learned)
- Modified/additional legal requirements for the nuclear industry (for example: emergency measures/iodine tablets, fuel transport insurance, decommissioning cost studies & funds)
- Swiss electricity utilities under financial pressure (also run of river and storage hydro power plants not as profitable as in the past)

→ Very challenging environment for NPP long-term operation management

Thank you very much!

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