Mobility: identify, control and avoid

Mobility accounted for 36% of final energy consumed in Switzerland in 2016. Consequently, the institutions of the ETH Domain accordingly attach great importance to this issue and have taken numerous steps in recent years to reduce energy consumption and to lessen the associated environmental impact.

Although the greatest demand for energy within the ETH Domain can be attributed to the research activities which are carried out in just under a dozen large-scale research facilities, the institutions have long had an eye on the environmental impact and energy consumption associated with mobility. They are focusing here on the three strategic lines of attack, namely identify, control and avoid. The institutions have set up their own mobility management systems based on their locations and different needs and have implemented numerous measures for more sustainable mobility in recent years.

Up to 50,000 people travel around the various campus facilities during term-time at the Zurich Zentrum and Zurich Hönggerberg campuses (ETH Zurich) and in Ecublens (EPFL). With student and employee numbers rising rapidly in recent years, the pressure on transport capacity is also increasing. Therefore, it makes obvious sense to promote student housing near and on the campus, public transport (by providing discounted seasonal passes) and non-motorised traffic (pedestrian and bicycle). For example, Eawag made a specific contribution to the latter during the building work on Stettbach station, installing a separate bicycle storage facility which is locked and reserved for employees of Empa and Eawag.

ETH Zurich launched a mobility platform in April 2016 to promote sustainable mobility and to lower CO_2 emissions. The focus is on campus mobility, air travel, logistics and obstacle-free mobility. In order to reduce its greenhouse gas emissions from air travel, it has decided that the departments are to develop reduction targets with an action plan for achieving this. In terms of campus mobility, there is enhanced local provision of e-bikes, for instance, and the frequency of ETH Zurich's own shuttle service from the city centre to Hönggerberg has been increased with a third bus. A similar thing has happened at the PSI, where further improvements have been made to the connection with direct lines (Brugg-PSI and Siggenthal-Würenlingen-PSI). The EPFL campus in Ecublens is mainly accessible by the local "Metro", as is the neighbouring University of Lausanne. Consequently, the metro is used to its full capacity at peak times. Nevertheless, EPFL increased parking charges by 260% in 2016 and introduced an innovative parking management system that uses a smartphone app. The revenues are to be used for the benefit of environmental projects. Parking charges were also increased sharply at the Empa and Eawag campus in Dübendorf in 2017; the daily parking charge rose from CHF 1.50 to CHF 4 (from 2017), and the annual charge is set to rise incrementally by 50% (2017) and by 100% to CHF 600 from 2018.

Mobility monitoring, a process that allows the evaluation of air travel, among other things, and which has been working well for years at EPFL, has also been undergoing development and expansion at the PSI since 2016. The issue is attracting increased attention in all institutions because the CO_2 emissions caused by air travel have now exceeded those resulting from the heating and cooling of the buildings. The focus of the action plan is concepts for avoidance and offsetting. In 2017, the PSI expanded its video-conferencing facilities and built a platform to promote carpooling.

Since 2017, WSL has applied a system of offsetting entire CO_2 emissions from the previous year (buildings, road traffic, air travel). At Empa, heads of department have been entitled to request that staff offset CO_2 emissions from air travel within their areas since 2017, either through airline offers or through myclimate, for example. On the Empa / Eawag campus in Dübendorf, the 2017 revision of the master plan envisages parking cars in managed car parks on the edge of the campus in the future in order to keep the site largely car-free.

Energy and environment within the ETH Domain
The institutions are responsible for the operations-led energy and environmental management in the ETH Domain. The implementation of measures within "The Confederation: exemplary in Energy" project is due to run until 2020 and is on course.

ETH Zurich laid important foundations in 2017: Senior Management approved the Energy Master Plan for the Zentrum Campus, which will be implemented between 2018 and 2025. This includes, for example, the replacement of the existing decentralised cooling system with a cooling network and the long-term goal of connection to a lake-water pipeline. In addition to energy efficiency, this will also increase the security of supply. A planning project has been started for the supply of energy to ETH Hönggerberg, to ascertain how the protected HP area can be connected to the energy grid effectively. The Action Plan for Photovoltaics (PV), which was adopted in 2017, seeks to integrate a PV roof system on all new buildings. The aim is to create at least 500 kWp of additional PV capacity by 2022. ETH Zurich is breaking new ground in operational improvements by systematically optimising all the operating parameters of the HIB teaching, research and robotics lab, which was only opened in 2016, during the adjustment phase.

www.umwelt.ethz.ch

2017 was a particularly eventful year for EPFL in terms of new sustainability projects. The 4th "Act for Change" event in May inspired almost 700 employees on the campus to take part in the competition to find the best practice in social and environmental responsibility. On the issue of waste, a major trial was started in the restaurants and food trucks with washable dishes as a substitute for disposable table items. The initial results are very promising. Various mobility-related projects have emerged thanks to the new mobility fund: the introduction of a 15% employee discount on season travel passes on the Mobilis network, launch of the first self-service Cargobike hire scheme in Switzerland, creation of 600 new bicycle parking spaces (two-tier), and construction of the new Bike Center for the purchase of new and used bikes, as well as minor repairs.

exploitation-energies.epfl.ch
developpement-durable.epfl.ch

Numerous steps were taken at the PSI in 2017, particularly in the area of large-scale research facilities. The biggest project currently under way concerns the upgrading of the helium compressors of the refrigeration systems. The project was supported by a subsidy from the SFOE "ProKilowatt" programme and has an annual energy saving potential of approx. 1.28 GWh. The replacement of selected vacuum pumps on the Swiss Spallation Neutron Source SINQ (also backed by ProKilowatt) enables power consumption for pump operation to be reduced to about one-third of the previous value.

www.psi.ch/about/energieleitbild and
www.psi.ch/about/umweltleitbild

WSL has decided to offset all its CO_2 emissions retroactively from 2016, caused chiefly by air travel. WSL has been pursuing a CO_2-neutral strategy in its buildings for a considerable time. WSL now saves 280,000 litres of water and 42 MWh of electricity a year (equivalent to the consumption of ten households per year) by replacing a commercial dishwasher. The WSL Environmental Group has organised a recycling day and is currently working on ways of encouraging employees to avoid flying.

www.wsl.ch/umweltmanagement

The campus concept for Empa and Eawag includes extensive plans to boost energy efficiency and to generate renewable energy. One of the measures involved the installation of a photovoltaic system integrated into the façade, consisting of innovative thin-film solar cells with a maximum output of around 30 kWp. The CIGS cells are a product of the research cooperation between the Swiss start-up Flisom and Empa. The roll-to-roll production process allows fast, cost-efficient production with low material and energy consumption.

www.empa.ch/web/resources-environment

Employees from Eawag rode their way to the top of the leaderboard in the "bike to work" campaign in 2017. Eawag was in first place in the 500–999 employees category, with a participation rate of 30% and 47 teams over a two month period. Together with Empa and the Swiss Association of Environmental Cycle Paths, Eawag also opened an adventure station, which is especially aimed at families with children. This Eawag station demonstrates in a fun way how water power is used in Switzerland and showcases measures which help our streams and rivers to provide more habitat again.

www.umwelt.eawag.ch

Fig. 35: Environment and energy data

		ETH Domain 2015	ETH Domain 2016	ETH Zurich Total	EPFL Total	PSI Total	WSL Total	Empa Total	Eawag Total	ETH Domain Trend 2017[1]
Basic data										
Energy reference area (ERA)[2]	m²	1,434,194	1,471,508	686,431	435,389	169,900	28,246	123,442	28,100	
Full-time equivalent[3]	FTE	34,827	35,310	19,847	11,164	2,023	659	972	645	
Energy[4]										
Final energy, net[7]	**kWh / a**	**436,876,537**	**430,768,848**	**171,510,283**	**98,296,921**	**133,107,126**	**4,877,241**	**18,609,536**	**4,367,741**	**427,385,195.4**
Electricity, net (not incl. self-produced)	**kWh / a**	**365,894,796**	**360,612,906**	**135,086,000**	**81,504,656**	**125,870,773**	**3,064,754**	**11,687,273**	**3,399,450**	**357,769,426**
Consumption of uncertified electricity	kWh / a	56,595,832	60,638,256	9,706,000	1,466,261	47,490,157	42,000	1,933,838	0	
Consumption of certified electricity	kWh / a	316,964,326	306,751,078	125,380,000	84,880,985	78,380,616	3,022,754	11,687,273	3,399,450	
– Electricity (without naturemade star)	kWh / a	302,657,249	292,399,481	121,380,000	78,034,040	78,380,616	2,917,552	11,687,273	0	
– Photovoltaic naturemade star	kWh / a	2,135,781	2,078,078	0	2,000,000	0	52,601	0	25,477	
– Hydro power naturemade star	kWh / a	12,171,296	12,214,009	4,000,000	4,846,945	0	52,601	0	3,314,463	
– Wind naturemade star	kWh / a	0	0	0	0	0	0	0	59,510	
Sale of electricity	kWh / a	–7,665,362	–6,776,428	0	–4,842,590	0	0	–1,933,838	0	
Heat	**kWh / a**	**68,494,879**	**67,627,075**	**35,383,000**	**16,442,265**	**6,901,353**	**1,349,078**	**6,717,605**	**833,774**	
Fuel oil	kWh / a	3,468,116	4,540,980	710,000	3,215,696	423,773	165,951	0	25,560	
Natural gas	kWh / a	57,795,344	59,752,463	39,701,000	13,168,044	0	0	6,869,872	13,547	
Natural gas BHKW	kWh / a	0	0	0	0	0	0	0	0	
District heating	kWh / a	31,108,657	28,730,003	20,482,000	333,356	6,477,580	0	642,400	794,667	
Woodchip	kWh / a	1,520,337	1,463,127	280,000	0	0	1,183,127	0	0	
Sale of heat	kWh / a	–25,397,575	–26,859,498	–25,790,000	–274,831	0	0	–794,667	0	
Fuels (own vehicles)	**kWh / a**	**2,486,862**	**2,528,867**	**1,041,283**	**350,000**	**335,000**	**463,409**	**204,658**	**134,517**	
Energy: additional information										
Energy costs, electricity and heat[5]	CHF / a	50,046,943	47,499,551	23,967,909	10,075,657	11,989,081	498,036	1,733,420	502,221	48,189,035.6
Self-generated renewable electricity	kWh / a	520,813	520,813	217,100	0	102,550	28,000	29,159	144,004	
Total sale to third parties	kWh / a	–33,062,937	–33,635,926	–25,790,000	–5,117,421	0	0	–2,728,505	0	
Water (drinking water)	**m³**	**630,749**	**649,066**	**324,846**	**178,459**	**109,325**	**8,659**	**21,500**	**6,277**	**659,928**
Materials										
Paper	**kg**	**341,961**	**411,592**	**251,500**	**105,236**	**32,228**	**7,852**	**7,868**	**6,908**	**344,133**
Paper, new fibre	kg	120,462	173,722	136,500	21,970	10,074	3,054	1,892	232	114,284
Paper, recycled	kg	221,499	237,870	115,000	83,266	22,154	4,798	5,976	6,676	229,849
Key figures: environmental impact										
Primary energy[6]	**kWh / a**	**625,358,315**	**616,876,534**	**215,354,981**	**119,883,747**	**242,857,836**	**11,070,532**	**22,416,412**	**5,293,027**	
Proportion of renewable energies	**%**	**63**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	
CO_2 emissions	**t CO_2 / a**	**36,820**	**36,776**	**15,305**	**7,298**	**10,660**	**684**	**2,512**	**317**	

[1] Provisional figures for the year under review (trend), as at: start of March 2017.
[2] The energy reference area is the sum of all gross floor areas, above and below ground, which must be heated or air-conditioned in order to be used.
[3] The FTE (full-time equivalent) value listed here was supplemented by the number of students with an FTE value of 0.68 to produce the consumption per person.
[4] The key figures indicated for electricity and heat show the total consumption of both for buildings, as well as for teaching and research activities.
[5] The key indicator "energy costs" shows all expenditure (cash out) for the provision of energy (heat and electricity).
[6] In energy economics, primary energy as the energy is defined that is available using the original forms or resources of energy, such as fuel (e. g. coal or natural gas), as well as energy carriers such as sun, wind or nuclear fuels.
[7] Final energy is the portion of the primary energy that is left after losses due to energy conversion and transmission, after it is supplied via the consumer's domestic connection. Final energy basically corresponds to the purchased energy.