Sitzungen - Sessions

Energy Day

Monday, 18.08.2025, Room Großer Festsaal

Time	ID	Energy Day *Chair: Tomoko Muranaka, EPFL; Stephan Wirths, Hitachi Energy*
09:00	1	**Renewable energy production and sustainable material design** *Anna Fontcuberta i Morral, EPF Lausanne* The transition to sustainable materials is essential for advancing renewable energy technologies, particularly solar energy conversion, as well as information technologies. III-V semiconductors currently offer the highest efficiency in photovoltaics and quantum information systems but rely on scarce, hard-to-extract elements. In this work, we present our pathway toward alternative materials that hold strong potential as sustainable candidates for these applications, combining high performance with greater material abundance and improved environmental compatibility: zinc phosphide solar cells and germanium nanowires for spin qubit devices. Finally, we will demonstrate the results on the device efficiency and functionality.
09:45	2	**Efficiency in Computing and Energy Conversions** *Bruno Michel, Energy Efficiency Consultant, IEEE Fellow, Member of US National Academy of Engineering* Increasing negative impacts of human energy use render investment into efficiency improvements and fast deployment of novel efficient bio-inspired micro- and nano-technologies urgent. Results are shown of massive efficiency improvements in datacenters with hot water cooling and in computers with more compact designs based on reduced thermal- and mass-transport resistances. Efficiencies of thermally mediated energy conversion were improved by reducing thermal resistances in high concentration photovoltaic thermal systems, heat-driven heat pumps, and rapid thermal swing adsorption carbon capture. A universal recognition efficiency measurement was demonstrated to accelerate development of AI towards higher efficiency. Important for this more efficient “Green” AI are reduced data movements, better computers and accelerators, as well as better ways of training and inference.
10:30		***Coffee Break***
		Chair: Robert Hauser, FH Kärnten; Christoph Reichl, AIT
11:00	3	**Energy Efficient HPC in the Exascale Era** *Siegfried Höfinger, Markus Hickel, Austrian Scientific Computing Research Centre* With the advent of true exascale computing the power demand of supercomput- ers has risen to the 20 MW level. Mission critical applications from science and research together with an ever increasing demand for AI have led to this devel- opment and the trend is likely to continue. However, electricity prices have risen dramatically in recent times. It is therefore of utmost importance to operate such supercomputers in the most energy efficient way possible. Austria’s largest HPC facility is operated by the ASC Research Centre where energy efficiency has always been a key concern. Here we discuss relevant settings of VSC-5 and/or MUSICA, ie the latest additions to the national HPC infrastructure and highlight important design choices that make these systems particularly energy efficient. In addition, general trends in current HPC architectures of top level installations shall be described and analyzed in terms of energy efficient system architecture. Moreover, the results of a recent survey concerning user awareness regarding energy efficient HPC shall be presented and lessons learned there be brought up for discussion and further dissemination.

11:30	**4**	**Energy Efficiency and Cooling Strategies at ASC** *Valentin Hirschbrich, Austrian Scientific Computing Research Center* As high-performance computing (HPC) systems become increasingly central to academic research, the challenge of managing their escalating energy consumption and heat output has never been more critical. This talk explores the pivotal role of energy efficiency in the operation of a university-run HPC data center in Austria, with a particular focus on the evolution from oil immersion cooling to the current implementation of direct water cooling. **The Importance of Energy Efficiency in HPC** HPC clusters are among the most energy-intensive infrastructures in academia, driven by the relentless growth in computational demands from fields such as physics, climate modelling, and artificial intelligence. With energy costs rising and sustainability targets tightening, optimizing energy use is both an economic and environmental imperative. Efficient cooling is a cornerstone of this effort, as traditional air-based systems are no longer viable for the high power densities of modern HPC hardware. **From Oil Immersion to Direct Water Cooling: Lessons Learned** Previous VSC cluster generations utilized oil immersion cooling, a technique that submerges servers in dielectric fluid to absorb and dissipate heat. Oil immersion offers significant energy savings and supports high-density deployments, but presents challenges in terms of maintenance complexity, fluid management, and integration with standard hardware ecosystems. The currently operational clusters leverage direct water cooling, circulating water through cold plates attached to CPUs, GPUs, and other heat-generating components. This approach capitalizes on water's superior thermal conductivity and lower viscosity compared to oil, enabling more efficient heat removal with less energy expended on pumping and circulation. Direct water cooling supports higher rack densities while simplifying maintenance and integration with existing infrastructure. **Opportunities for Future Improvement** Despite these advances, further gains are possible. Integrating energy reuse systems—such as capturing waste heat for campus heating—can boost overall site efficiency. Enhanced monitoring and AI-driven optimization of cooling and workload scheduling can further reduce energy consumption. As compute densities continue to rise, ongoing research into new cooling fluids, modular cooling architectures, and hardware-level energy management will be essential. **Conclusion** For physicists and academic stakeholders, understanding the interplay between cooling strategies and energy efficiency is vital for the sustainable growth of computational research. By embracing direct water cooling and continually seeking innovative improvements, university HPC data centers can lead the way in responsible, high-performance computing.
12:00	**5**	***Panel Discussion*** *Moderation: Herbert Störi, TU Wien*
12:30		***END; Lunch***