

Energy Systems Are A-Changing and so Is Its Technical Committee

The IEEE Control Systems Society (CSS) Technical Committee on Energy Systems (TC-ES) is a forum dedicated to the exploration of the dynamics, control, and optimization of energy systems. The TC-ES addresses the complexities of modern energy systems, including electric power systems, renewable energy integration, distributed energy resources, and natural gas and water networks. The committee's focus on energy system responsiveness, distributed control, and optimization is critical in meeting the growing challenges posed by decarbonization, electrification, and the rise of distributed energy resources (DERs). The TC is led by Chair Mads R. Almassalkhi and Vice Chair Veronica Adetola.

MISSION AND RESEARCH FOCUS

The TC-ES supports a broad scope of research and collaboration across diverse domains, all aimed at improving the responsiveness of energy systems (e.g., the reliability and resilience of the electric power grid). The committee's interests include

- » modeling and control of increasingly complex energy networks
- » developing distributed coordination methods to improve energy system reliability
- » optimizing the economic performance of energy systems while addressing nonlinearities and uncertainties inherent in modern energy systems.

As energy systems become more interconnected and decarbonized, TC-ES members are advancing theory and methods for improving grid

There is no shortage of challenging energy systems topics of relevance to CSS members.

responsiveness and reliability. These efforts are supported by advanced control systems that can handle the hybrid (mixed continuous/discrete) dynamics of converter-based renewable energy sources, such as wind and solar photovoltaic generation. Furthermore, the committee emphasizes modeling techniques for aggregating a large number of heterogeneous energy resources, which are critical for managing the grid's growing complexity. The changing nature of energy system dynamics calls for new analysis techniques and control strategies, with distributed control playing an increasingly important role. In short, there is no shortage of challenging energy systems topics of relevance to CSS members.

GLOBAL MEMBERSHIP AND REGULAR ENGAGEMENT

With 161 members from around the world, the TC-ES is an inclusive and collaborative community. Members regularly meet at major control systems conferences, such as the American Control Conference, the IEEE Conference on Control Technology and Applications, and the IEEE Conference on Decision and Control (CDC). These conferences provide an important platform for members to exchange ideas, share research, and organize technical workshops and invited sessions. As TC-ES lead on invited paper sessions, Enrique Mallada has facilitated

a number of invited paper sessions, including one at CDC 2023 in Singapore on "Computational Techniques for Automation in Energy Systems."

SUPPORTING EARLY-CAREER RESEARCHERS

One of the key goals of the TC-ES is its commitment to fostering the next generation of control systems professionals. To this end, the committee has established the Outstanding Student Paper Prize (OSPP), which recognizes outstanding research contributions from students across major CSS conferences. In 2022, the OSPP was awarded to Mingyu Chen (advised by Junjie Qin) for the paper "Scheduling and Pricing Non-Preemptive Electric Loads: A Convex Approach," presented at CDC 2022 in Cancun, Mexico [1]. In 2023, the prize went to Chris Orrico (advised by Dinesh Krishnamoorthy) for their work, "Mixed-Integer MPC Strategies for Fueling and Density Control in Fusion Tokamaks," presented at CDC 2023 in Singapore [2]. The award committee is led by John Simpson-Porco and is important to TC-ES's commitment to nurturing future leaders in the energy systems community. [Figure 1](#) shows a luncheon meeting of TC-ES members at CDC 2023. [Figure 2](#) shows Junjie Qin accepting the OSPP award certificate on behalf of his advisee Mingyu Chen.

RECOGNITION OF LEADERSHIP AND EXPERTISE

The contributions of TC-ES members extend beyond the TC itself, with several members assuming key leadership roles within IEEE and the CSS. Ian Hiskens, for example, has recently taken on the role of editor-in-chief of *IEEE Transactions on Power Systems*, while Anuradha Annaswamy has become editor-in-chief of (our very own) *IEEE Control Systems Magazine*. The TC-ES thanks them for their service to the broader IEEE community.

EXPANDING FOCUS: MERGING OF POWER GENERATION AND ENERGY SYSTEMS

In recognition of the evolving landscape of energy systems, the TC changed its name from “Smart Grid” to “Energy Systems” in 2023 and will soon merge with the TC on Power Generation (and will still be called the TC-ES), pending approval from the CSS Executive Committee. This merger reflects the increasing overlap between energy generation and system operations, driven by the rise of DERs and decarbonization efforts. By combining both committees, the TC-ES aims to address the challenges and opportunities posed by this energy transformation, fostering interdisciplinary collaboration and innovation.

NEW INITIATIVES AND FUTURE DIRECTIONS

The TC-ES continues to engage with members who push the boundaries of energy systems research with new initiatives aimed at addressing pressing challenges in the field (Figure 3). One such initiative is TC-ES participation in CSS Day 2024, themed “Control Enabling a Carbon Neutral World.” As part of the event, the committee will host three panel sessions:

- » “Data-Driven Control,” featuring Veronica Adetola, Riddhi Padariya, and Vladimir Dvorkin
- » “Climate, Carbon, and Cyber,” led by Jan Drgona, Hamid Ossareh, and Draguna Vrabie

By combining both committees, the TC-ES aims to address the challenges and opportunities posed by this energy transformation, fostering interdisciplinary collaboration and innovation.



FIGURE 1 TC-ES members attend our lunch meeting at CDC 2023 in Singapore in December 2023.



FIGURE 2 TC-ES Chair Mads Almassalkhi presents the Outstanding Student Paper Prize certificate to Junjie Qin, accepting on behalf of his advisee Mingyu Chen, who was unable to attend.

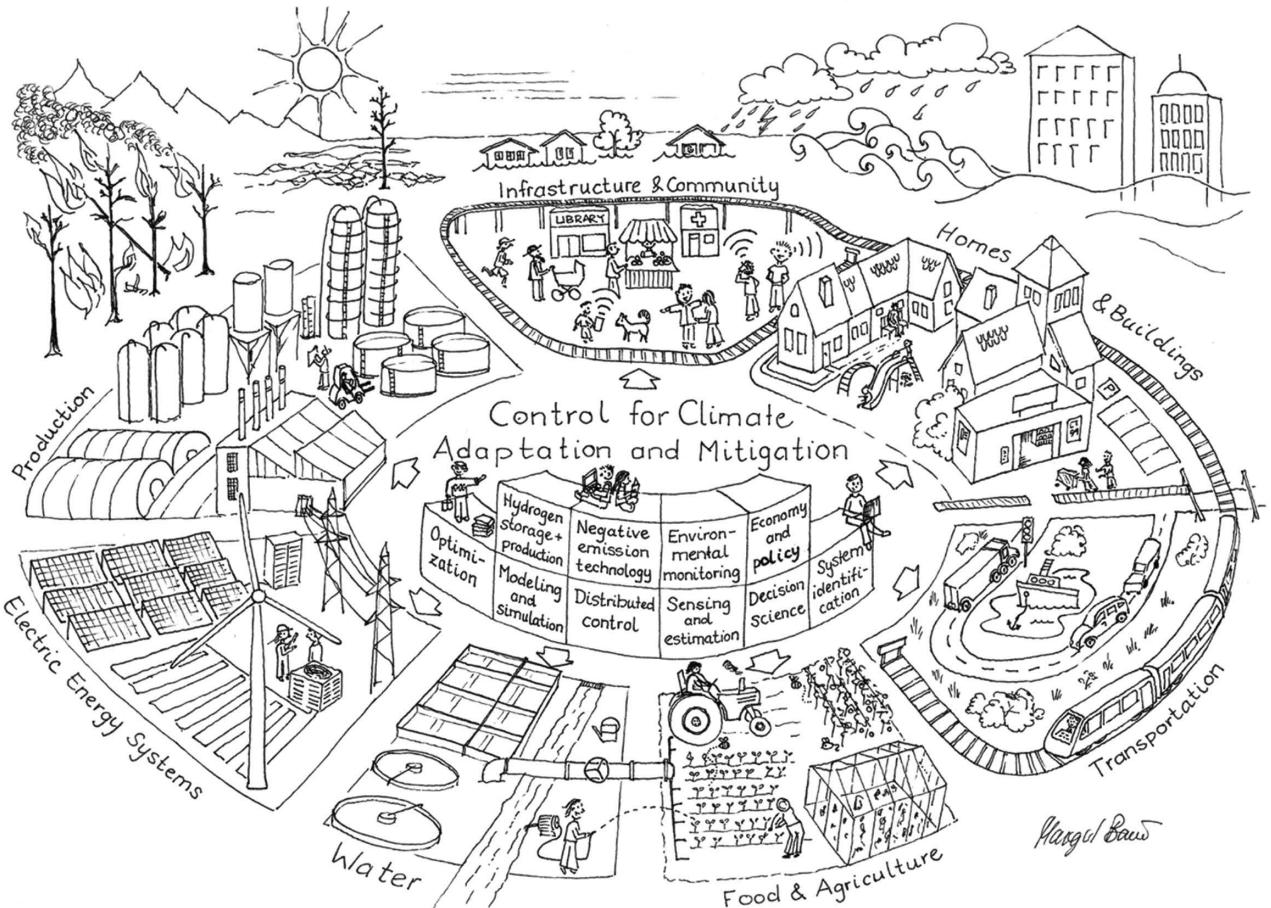


FIGURE 3 Control technologies and tools associated with energy systems play a critical role in climate change adaptation and mitigation. (Figure is borrowed from the excellent IEEE CSS Technical Report [3]).

» “Dynamics of a Clean Transition,” with presentations from David Hill, Elizabeth Ratnam, and Mingxi Liu.

These panels will showcase the research being conducted by TC-ES members and highlight the role of control systems in enabling a sustainable energy transition.

In addition, TC-ES has formed a new “interest group” focused on “Control Theory for Grid Codes/Interconnection Protocols.” This group aims to promote workshops, white papers, and tutorials that explore the intersection of control systems and system-aware grid standards, an increasingly important area as grids become more distributed and responsive.

LOOKING AHEAD: KEY EVENTS AND PARTICIPATION

Next, the TC-ES is looking forward to CDC 2024 in Milan, where the committee is organizing a group lunch meeting and an invited paper session on “Incentives, Flexibility, and Human Factors in Large-Scale Distributed Energy Resources Control.” This session will present results and discuss innovative approaches to managing distributed energy systems and the human/policy factors involved in control and optimization of energy systems.

The TC-ES invites all CSS members with an interest in energy systems to join the committee and contribute to its ongoing efforts. Prospective

members are encouraged to reach out to TC Chair Mads R. Almassalkhi at malmassa@uvm.edu.

Mads R. Almassalkhi 

REFERENCES

- [1] M. Chen and J. Qin, “Scheduling and pricing non-preemptive electric loads: A convex approach,” in *Proc. IEEE Conf. Decision Control (CDC)*, Cancun, Mexico, 2022, pp. 5048–5055, doi: [10.1109/CDC51059.2022.9993199](https://doi.org/10.1109/CDC51059.2022.9993199).
- [2] C. A. Orrico, M. van Berkel, T. O. S. J. Bosman, W. P. M. H. Heemels, and D. Krishnamoorthy, “Mixed-integer MPC strategies for fueling and density control in fusion tokamaks,” *IEEE Control Syst. Lett.*, vol. 7, pp. 1897–1902, 2023, doi: [10.1109/LCSYS.2023.3282891](https://doi.org/10.1109/LCSYS.2023.3282891).
- [3] A. M. Annaswamy, K. H. Johansson, and G. J. Pappas, Eds., *Control for Societal-Scale Challenges: Road Map 2030*, Piscataway, NJ, USA: IEEE Control Systems Society Publication, 2023. [Online]. Available: <https://ieeecs.org/control-societal-scale-challenges-roadmap-2030>