AKE 3: Poster

Time: Tuesday 14:00–16:00 Location: Tent

AKE 3.1 Tue 14:00 Tent

The Role of Regulatory Frameworks in Reducing Carbon Emissions: Insights from the Energy and Lighting Sectors — •Jörg Cosfeld — University of Applied Sciences Düsseldorf, Düsseldorf 40476, Germany

Sustainability requires the cessation of carbon dioxide and other greenhouse gas emissions to prevent irreversible and abrupt climate tipping points. This work provides a concise summary of carbon dioxide emissions from the US energy sector and evaluates its greenhouse gas (GHG) abatement potential by 2030. Feasible solutions in a mid-range scenario suggest a reduction of up to 3.0 gigatons of CO2-equivalent emissions at costs below 50 USD per ton. Key opportunities lie in energy efficiency improvements and advanced technologies, particularly in buildings, appliances, and power generation, offering both environmental and economic benefits.

The study emphasizes that regulatory frameworks are often better suited for industry sectors than for individual actions, especially in developing countries, where affordability remains a significant barrier. For instance, 5 USD may buy a single LED light but also 10 incandescent bulbs, highlighting the economic trade-offs for low-income households. Comparing US and European regulations, the study discusses the EU ban on incandescent bulbs and Germany's Building Energy Act (GEG), which faced significant public opposition.

In conclusion, regulatory frameworks can effectively support climate change mitigation but require careful design to ensure both practicality and applicability, particularly in economically diverse regions.

AKE 3.2 Tue 14:00 Tent

Molybdenum-induced modifications in the quantum capacitance of graphene-based supercapacitor electrodes: A DFT study — •David Ansi, Henry Martin, Linus Labik, and Eric Abavare — Department of Physics, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Electrochemical Double-layer Capacitors (EDLCs) offer high power density but low energy density due to limited surface area. Graphene, with its high theoretical surface area and capacitance, is a promising material for enhancing EDLC performance. However, the capacity of graphene is restricted by the limited density of states near the Fermi level, resulting in low quantum capacitance (C_Q). Doping is a suitable technique for enhancing graphene's C_Q toward improved supercapacitor efficiency.

Inspired by the molybdenum cofactor, this study investigates molybdenum-induced modifications to graphene's C_Q. Electronic structures of 15 electrode models were obtained using DFT calculations with the GGA-PBE functional and ultrasoft pseudopotentials in Quantum Espresso. Structures were optimized using the BFGS algorithm with a 3x3x1 supercell for simulations.

The study demonstrates that modifications involving Mo, N, S, and vacancy defects significantly enhance the C_Q of graphene-based supercapacitor electrodes. The highest C_Q values were observed when Mo was introduced, due to contributions from Mo's $4dz^2$ and 4s states. The presence of Mo may introduce pseudocapacitance. These findings highlight Mo-modified graphene as a promising material for EDLCs.