On energy transitions, clean cooling, and societal needs and implications. A European overview.

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ABSTRACT

The European Union (EU) is pursuing ambitious goals to reduce greenhouse gas emissions, promote renewable energy, and improve energy efficiency. The built environment accounts for around 35% of greenhouse gas emissions, and with 85% of European buildings over 25 years old, decarbonising heating and cooling is a central European climate objective. Achieving fully renewable heating and cooling requires transforming existing systems, focusing on efficiency, flexibility, and large-scale integration of renewables.

European goals prioritise deploying clean and efficient heating and cooling systems, improving performance, reliability, and adaptability to various building types and climates. Ensuring thermal comfort while reducing energy demand is essential, particularly in renovations. Key challenges include increasing system efficiency, enabling higher operating temperatures, simplifying installation, and integrating smart control. Thermal energy storage is a strategic enabler, enhancing flexibility and better use of intermittent renewable energy. Objectives also include improving integration with the wider energy system, digitalising design, operation, and maintenance, and developing harmonised assessment and cost–benefit methods.

Achieving these goals requires inclusive strategies addressing social vulnerabilities, especially energy poverty. Renovating buildings is crucial for efficiency and reducing costs, but clean heating solutions—like heat pumps and renewable district heating—must be accessible and affordable. Electrification must avoid additional financial burdens on vulnerable consumers, and heavy biomass use in energy-poor homes raises air quality and health concerns.

European and national initiatives support a fair energy transition. Collective systems—district heating, positive energy districts, and renewable energy communities—strengthen local participation and energy autonomy. One-stop shops provide tailored advice, energy coaching, and renovation passports to help households make informed, cost-effective choices. Societal readiness encourages public engagement and addresses social and behavioural barriers. By combining social, economic, and technical strategies, these efforts aim to ensure a fair energy transition, particularly for vulnerable citizens, while promoting innovation in building and industry sectors in a safer, more stable way.

KEYWORDS

Energy Transition, SET Plan, European policy, HVAC, society