

Special Issue

New Technologies for Electrical Energy Generation and Electric Transportation

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Electric Energy production, especially from renewable fonts, together with transport electrification is one the key factors in the agenda for sustainable development.

This special issue brings together nine contributions on electrical machines, also considering examples of related power converters, for energy generation and electric transportation. Their shared focus is the relationship between electromagnetic design, operational flexibility, and reliability, addressing the demands of compact renewable energy converters and efficient electric drives.

Three studies investigate tubular linear–rotary switched reluctance machines, with potential applications in integrated actuation and marine energy systems. A comparative investigation combining geometric sensitivity analysis with alternative winding arrangements, identifying improvements in torque, thrust, and output smoothness is carried on in the first study. A second contribution considers H-shaped modular stators that accommodate rotary and linear magnetic circuits with limited electromagnetic coupling. A third examines a two-degree-of-freedom topology through static field analysis and dynamic simulations, clarifying saturation behavior and the interaction between motion modes. Together, these studies support the development of integrated electromechanical systems relevant to combined wind and wave energy conversion.

Thermal management represents an important performance index in renewable generation too. A lumped-parameter thermal network for a Dual-Stator Single-Mover Permanent-Magnet linear–rotary generator accounts for convection under helical motion and partial axial overlap. Comparison with three-dimensional finite element analysis identifies critical winding temperatures and informs cooling design.

The fifth contribution presents a 12-pole single-phase transverse-flux tubular switched reluctance linear motor. Its U-shaped modular stator shortens magnetic paths and improves iron core utilization. Prototype measurements support the modeling approach and the feasibility of the design for high-performance linear electric drives.

A further modeling contribution develops unified three-dimensional analytical models for surface-mounted Permanent Magnet axial flux machines with odd/even piece Halbach arrays. Accounting for air-gap fringing and slotting, the approach supports electromagnetic optimization of compact machines relevant to both generation and transportation.

As for electric drives, modularity is the common feature of two devices. The first is an E-type stator switched reluctance motor, whose performance in terms of manufacturability and continued operation under winding open-circuit faults are considered. The analysis of a modular double-stator motor shows how NSNS and NSSN winding polarities alter magnetic paths, revealing application-dependent trade-offs between torque production and efficiency.

At the converter level, the last contribution considers a dual-port integrated switched reluctance drive which combines flexible power supply arrangements with multilevel excitation and regenerative braking. Simulations investigate motoring and different braking intensities, linking converter reconfiguration to torque capability and energy recovery in electric vehicles.

Collectively, the papers offer analytical and simulation-based foundations for more integrated energy conversion systems. Prototype validation, thermal management, and coordinated machine–converter control remain essential steps toward practical deployment in renewable generation and electric transportation.