

# Multisectoral decarbonisation strategies in Punta Arenas, Chile: A multi-renewable technologies approach

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## Abstract

This study evaluates multisectoral energy planning to decarbonize Punta Arenas, Chile, transitioning from fossil fuels to renewable energies by 2050. Scenarios aligned with the Carbon Neutral 2050 (CN2050) plan, developed under the Long-Term Energy Planning (PELP) program by the Chilean Ministry of Energy, were assessed using EnergyPLAN. In 2019, Punta Arenas emitted 1.32 million tonnes of carbon dioxide equivalent (CO<sub>2</sub>eq), projected to rise to 2.2 million tonnes by 2050 under a business-as-usual (BAU) scenario, with annual costs of 947 million euros. Implementing PELP CN2050 measures reduces emissions to 1.2 million tonnes and costs to 560 million euros, demonstrating that decarbonization can be achieved alongside economic savings. This validates the PELP CN2050 plan's effectiveness, highlighting that renewable energy integration supports sustainability and economic benefits. Reductions are achieved through energy efficiency, technological changes, and integrating renewable energies—particularly wind and solar thermal—in industrial, transport, and residential sectors. Electrification and green hydrogen for motive, thermal, and transport applications are crucial. Two cases were evaluated: importing green hydrogen or producing it locally via renewable-powered electrolyzers. Sensitivity analyses increasing wind capacity from 13 MW to 310 MW showed that higher renewable integration reduces CO<sub>2</sub>eq emissions and costs, indicating a negative abatement cost. Further decarbonization could be achieved by incorporating cogeneration, district heating, and synthetic fuels.

*Keywords: Multisectoral energy planning, Decarbonisation of cities, Energy efficiency, Integration of renewable energies, Wind energy, Solar thermal energy, Electrification, Green hydrogen, EnergyPlan©*

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