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Scenarios for the Energy Transition in Residential Buildings for the European Regions

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Abstract : Starting from the current context in which the Russian invasion in Ukraine has highlighted Europe's dependence on natural gas imports for heating buildings, this study proposes solutions to resolve this dependency and evaluates related scenarios in the near future. In the first part of this work the methodologies and results of the economic impact are indicated by simulating a massive replacement of boilers powered by fossil fuels with electrically powered hightemperature air-water heat pumps for heating residential buildings in different European climates, without changing the current energy mix. For each individual European region, the costs for the purchase and installation of heat pumps for all residential buildings have been determined. Again for each individual European region, the economic savings during the operation phase that would be obtained in this future scenario of energy transition from fossil fuels to the electrification of domestic heating were calculated. For the European regions for which the economic savings were identified as positive, the payback times of the economic investments were analysed. In the second part of the work, hypothesizing different scenarios for a possible greater use of renewable energy sources and therefore with different possible future scenarios of the energy mix, the methodologies and results of the simulations on the economic analysis and on the environmental analysis are reported which have allowed us to evaluate the future effects of the energy transition from boilers to heat pumps for each European region. In the third part, assuming a rapid short-term diffusion of cooling for European residential buildings, the penetration shares in the cooling market and future projections of energy needs for cooling for each European region have been identified. A database was created where the results of this research relating to 38 European Nations divided into 179 regions were reported. Other previous works on the topics covered were limited to analyzing individual European nations, without ever going into detail about the individual regions within each nation, while the original contribution of the present work lies in the fact that the results achieved allow a specific numerical analysis and punctual for every single European region.

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