



# PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

**THEMATIC Research Field: DEVELOPMENT OF A HYBRID ABSORPTION-COMPRESSION HEAT PUMP FOR HIGH TEMPERATURE RESIDENTIAL APPLICATIONS**

<b>Monthly net income of PhDscholarship (max 36 months)</b>
<b>€ 1600.0</b>
In case of a change of the welfare rates during the three-year period, the amount could be modified.

<b>Context of the research activity</b>	
<p><b>Motivation and objectives of the research in this field</b></p>	<p>The electrification of the space heat and domestic hot water services is currently seen as one of the keys for reducing the environmental impact of the building sector. In this context heat pumps are gaining market share at the expense of gas boilers. However, while heat pump fit very well in new buildings, which require low heating capacity (due to the high performing envelope) and low supply temperature (due to presence of an underfloor heating system), they struggle in existing building, which require high capacity and high supply temperature. In this context, a heat pump able to reach supply temperatures suitable for systems based on radiators and to maintain high efficiency and heating capacity at high thermal lift could enable the use of heat pumps in existing buildings. Hybrid absorption-compression heat pumps represent a promising technology in achieving this goal. However, while investigated for large industrial application has never been developed targeting the capacity and temperature ranges typical of the residential market.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>The research will be carried out through both theoretical and experimental activities. After an initial study on the working fluids, and heat pump prototype will be designed and built. This will be supported by literature review on possible working fluids, by heat transfer analysis to design the heat exchangers and by the cycle simulation to</p>



	<p>determine the most promising configuration and select the best fluids for the given application. The prototype will be tested in the laboratory Relab of the Energy Department of Politecnico di Milano, verifying the design choice and investigating possible issues due to the cycle implementation not foreseen in the design phase or which analysis is not easily done theoretically. The experimental activities will also confirm the design choices or suggest revising some of them. The final prototype will be further developed defining and implementing the control strategy to enable smooth, reliable and efficient operation in a real environment (field test). Field test could also be replaced by a hardware in the loop approach to emulate the actual operation of the heat pump in representative building systems.</p>
<b>Educational objectives</b>	<ul style="list-style-type: none"> <li>- To deepen knowledge in heat pump cycles and heat pump interaction with building energy systems, including heat transfer, fluid properties, and machine and system control.</li> <li>- To provide modelling skills and knowledge in the use of dynamic simulation tools.</li> </ul>
<b>Job opportunities</b>	<ul style="list-style-type: none"> <li>- R&amp;D within the heating industry (heat pump manufacturers).</li> <li>- Research in academia or public and private institutions.</li> <li>- Energy Services Energy Management and Energy Auditing Companies.</li> </ul>
<b>Composition of the research group</b>	<p>2 Full Professors                  3 Associated Professors                  2 Assistant Professors                  7 PhD Students</p>
<b>Name of the research directors</b>	Mario Motta; Livio Mazzarella

<b>Contacts</b>
<p><i>mario.motta@polimi.it</i>  <i>tommaso.toppi@polimi.it</i></p>

<b>Additional support - Financial aid per PhD student per year (gross amount)</b>	
<b>Housing - Foreign Students</b>	--



<b>Housing - Out-of-town residents (more than 80Km out of Milano)</b>	--
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<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	800.0 €
<b>By number of months</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>
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