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Economic and Environmental Benefits of Reusing Thermal Energy from Pool Water

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INTRODUCTION & AIM

Public swimming pools are among the most energy- and water-intensive municipal facilities, leading to high operational costs and environmental impacts. Conventional systems dissipate significant amounts of waste heat from circulation pumps into technical rooms without recovery.

The aim of this study was to develop and evaluate a heat recovery system that captures and reuses thermal energy generated by pool circulation pumps to preheat recirculated water. This approach improves energy efficiency, reduces dependence on external heating sources, and contributes to sustainable operation of pool facilities.

METHODS & MATERIALS

The study was conducted on Herborner X-C circulation pumps, equipped with an integrated heat exchanger that transfers up to 95% of motor waste heat directly to the pumped pool water. This design ensures simultaneous cooling of the motor and recovery of thermal energy, eliminating heat emissions to technical rooms and increasing the overall system efficiency.

Fig. 1 Herborner X-series circulation pump with integrated heat recovery for pool water applications.

https://hebo-pompy.pl/produkty/pompy-dla-technologii-basenowych/herboner-x/

- Analysis included 34 pumps with a total installed power of 600 kW, operating on average 3 520 hours per year.
- Thermal and hydraulic calculations were performed to estimate recoverable energy and efficiency improvement.
- Economic evaluation assessed investment cost, annual savings, and payback time depending on recovery efficiency.
- Environmental assessment quantified the reduction of CO_2 emissions based on the national electricity emission factor.
- Data were derived from manufacturer performance curves and real operating conditions in a public swimming pool installation.

RESULTS & DISCUSSION

Parameter	Unit	Value / Range	Description
Number of pumps	–	**34**	Circulation pumps installed in the system
Total installed power	kW	**587**	Combined electrical power of all pumps
Power range per pump	kW	**4-37**	Range of nominal power for individual Herborner.X-C units
Operating time	h/year	**3 520**	10 h/day annual operation
Annual electricity consumption	MWh/year	**2 464**	Total energy input to pumps
Recoverable heat (efficiency 70–95%)	MWh/year	**1 725 – 2 341**	Thermal energy recovered via Herborner.X-C system
CO_2 emission reduction	t CO_2/year	**1 240 – 1 680**	Calculated using national emission factor
Average payback period	years	**2 – 3**	Depending on pump size and recovery rate

The results demonstrate that integrating heat recovery directly into circulation pumps can significantly improve the energy performance of swimming pool systems. Even with moderate recovery efficiency (70 %), the recovered heat covers a substantial portion of the facility's heating demand, leading to short payback periods (< 3 years) and notable CO_2 emission reductions. Larger pumps achieve the highest economic benefit due to greater continuous operation and higher thermal losses. The findings confirm that Herborner.X-C technology offers a practical and scalable approach to enhance sustainability in water-intensive facilities without requiring major infrastructural changes.

CONCLUSIONS

- Integrating pump-based heat recovery offers a practical and low-cost method to enhance energy efficiency in swimming pool facilities.
- Up to 95% of motor waste heat can be recovered and reused for heating recirculated pool water, reducing the demand for external heat sources.
- The analyzed installation achieved annual savings of 1.7–2.3 GWh of thermal energy and reduced CO_2 emissions by 1 200–1 700 tonnes per year.
- Payback periods below three years confirm the high economic viability.
- The solution minimizes heat emissions in technical rooms, improves operating comfort and supports sustainable water-energy management.
- The methodology can be easily replicated in other public pools or aquaparks, contributing to the decarbonization of municipal recreational infrastructure.

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