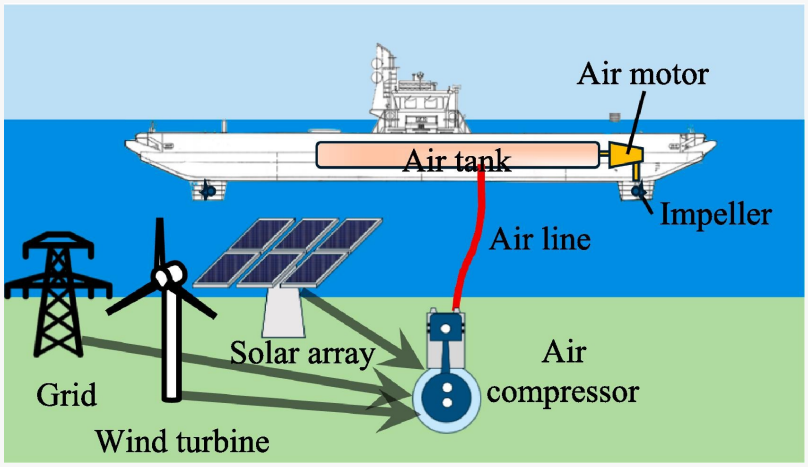
Scientists develop pneumatic propellers that could replace diesel engines powering ferry boats

Scientists have created a method capable of driving a ferry over a predetermined route relying solely on air motors.

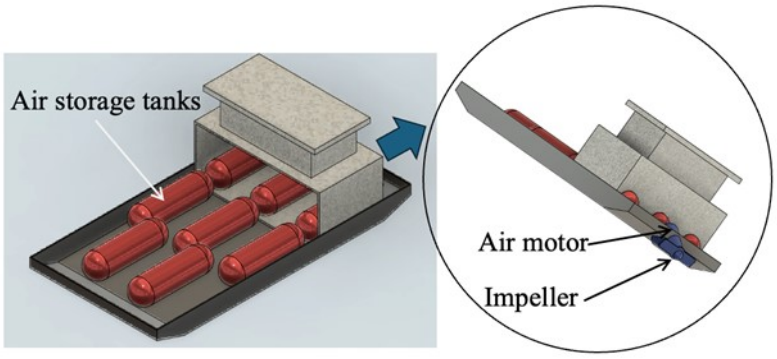
SHARJAH, EMIRATE OF SHARJAH, UNITED ARAB EMIRATES, April 21, 2025 /EINPresswire.com/ -- Scientists say they have created a methodology that could replace two diesel engines powering a ferry boat with pneumatic propellers.

The two air motors replacing the diesel engines, according to the scientists, generated 250 kW each and provided enough power to take the ferry back and forth on a predetermined route within the context of Finland's maritime transport system.

The study in the journal Energy Conversion and Management was "conducted to evaluate the technical and economic feasibility of replacing the conventional diesel engine with a pneumatically propelled one on an existing ferry boat within the context of Finland's maritime transport needs," the scientists write. (Original source URL: https://doi.org/10.1016/j.enconman.2025.119613)

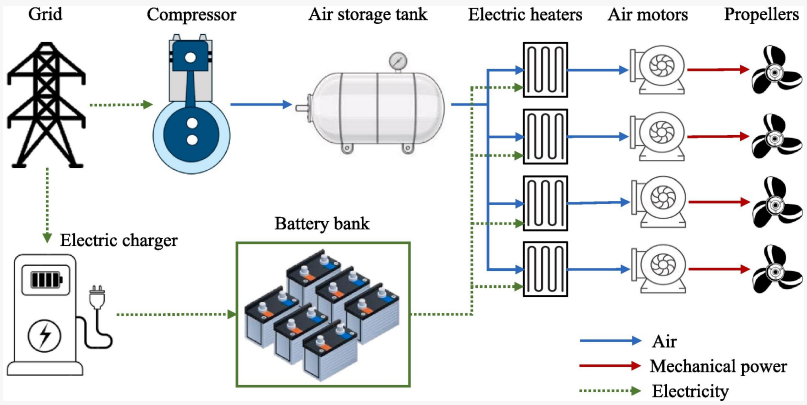


Schematic of the proposed pneumatic propulsion with multi-option for connectivity, be it grid and/or renewable energy connectivity. Credit: Energy Conversion and Management (2025). DOI: https://doi.org/10.1016/j.enconman.2025.119613



The research findings are based on experimental results and realistic calculations using polytropic relations to realistically calculate the behavior of the air from being pressurized in the tank, flowing into the air motor that is used to rotate the prop

“It is demonstrated that pneumatic propulsion, while unconventional, holds a promise as a sustainable and energy-efficient alternative to conventional marine engines, particularly for short-distance ferry operations.”



Energy flow of the proposed pneumatic system. Credit: Energy Conversion and Management (2025). DOI: https://doi.org/10.1016/j.enconman.2025.119613

Diesel engines are currently the most reliable internal combustion engines in terms of power density control and robustness. However, they require large amounts of diesel fuel to power them. Moreover, they can be fairly noisy, and worse they are a major source of pollution.

“Replacing these engines with pneumatic ones is a cleaner and more effective option as these engines can also be incorporated into the ferry body to store air either within the structure of the boat or on auxiliary tanks, which will enhance buoyancy,” said Abdul Hai Alami, the lead author.

The research findings are based on experimental results and realistic calculations as the authors use polytropic relations to calculate the behavior of the air from the time it is pressurized in the tank to its flowing into the air motor used to rotate the propeller.

“Using this method for maritime vessels is attractive from economic, practical and environmental vantage points and could be easily adapted to most ferry boats even in harsh conditions,” added Alami, who is also Sharjah University’s professor of sustainable and renewable energy.

Pneumatic propellers depend on the power of compressed air to drive motors, cylinders or other mechanical devices instead of diesel, electricity or batteries. The authors’ pneumatic propulsion method involves using compressed air stored in tanks at high pressure and released into a vaned air motor that is coupled with a naval impeller.

The authors present what they call “a techno-environmental study … with a life-cycle assessment” to replace a diesel engine-powered ferry with a pneumatic propulsion system.

“The proposed system has lower operational cost and an attractive payback period. The proposed system is reliable with significantly smaller environmental impact context,” they write.

The novelty value of the authors’ approach stems from their attempt to apply it on an existing ferry that was built in 1985 and is currently powered by a diesel engine in Finland.

Co-author Kaj Jansson, a Finnish ferry maker from the Finnish K. J Marineconsulting Ab, oversaw the replacement of the diesel engines with air-driven motors as well as the ferry's journey with its pneumatic propellers on the designated route.

"Pneumatic propulsion is the future of sailing on fixed maritime routes. The predictability of pace, payload and destination of ferry boats allow replacing conventional diesel engines that are efficient and reliable but are polluting, noisy and sensitive to fluctuating oil prices with pneumatic ones," said Jansson.

The authors note, "From a technical perspective, the proposed pneumatic system exhibited satisfactory performance, meeting the same propulsion requirements as diesel engine system. The modular design of pneumatic system offers scalability and adaptability to varying operational needs, aligning with the growing demand for flexible and environmentally conscious transport solutions.

"Economically, the proposed pneumatic system offers competitive advantages in terms of reduced fuel costs and lower maintenance requirements due to its simplified mechanical design. When analyzed from a lifecycle perspective, the pneumatic ferry presented a feasible option for cost reduction in comparison to diesel-powered counterparts. A staggering cost saving of USD 73,000 is calculated with a payback period of 8 years."

Prof. Alami said he was optimistic that the new pneumatic propeller method he and his colleagues have developed would be noted and adopted by the ferry industry.

"The research and development in vaned air motors will allow using more advanced materials resulting in stronger pneumatic engines. The research has concluded that the payback period of retrofitting the ferry with air motors instead of diesel engines to be around 8 years. This is a very conservative claim as the best case scenario was not applied all the time when making assumptions."

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