



Case 72

Power from Containers

This article introduces a new form of energy recovery from container transport as one of the 100 innovations that shape "The Blue Economy". This article is part of a broad effort to stimulate entrepreneurship, competitiveness and employment.

The Market for Container Transport

The market value of global container shipment services was estimated in 2010 at \$480 billion. This form of transport shipped the same year a combined total of 500 million standard containers over more than 600 billion kilometers. The cargo capacity of the world's container fleet increased from 4 million containers in 2000 to 12.5 million today. Containerized ocean freight flows are expected to maintain a growth rate of 6.9 percent over the decade 2008-2017. Experts predict that the Asia/Europe intercontinental trade will expand fastest averaging 9.8 percent in volume and 9 percent in revenues since Europe is considered five years behind the United States in shifting production to Asia. The attraction of ocean containers is apparent in the cost of fuel per 40-foot equivalent unit (FEU): transporting a container from Shanghai to Atlanta is cheaper than from Guadalajara (Mexico) to Atlanta.

The global container transport network is the backbone of the globalized supply chain carrying some 60 percent of world trade value and over 90 percent of its volume. The value chain that moves a container from shipper to receiver covers five distinct sectors: (1) shipment origination, routing and capacity procurement, (2) containers, (3) vessel operation, (4) loading and offloading shipments, and (5) the inland delivery. The operation of vessels commands half of the total cost, whereas the on and offloading is good for 17 percent. Hamburg became the center for financing and operating new ships. Germany owns 35 percent of container ships (1,644 out of 4,619) and close to 60 shipping banks and financiers are headquartered there. A.P. Møller-Maersk (Denmark) which acquired P&O Nedlloyd is the leading ship operator with worldwide invoicing in excess of €43 billion in 2010.

Container transport has revolutionized world manufacturing. It costs \$10 to ship a TV from Asia to Europe, \$1 for a vacuum cleaner, and one cent for a bottle of beer. It is even cheaper the other way. The cheap cost of shipment makes it worthwhile to send Spanish tomatoes to China for processing into ketchup, and then ship it back to Europe for consumption. However new research shows that in a single year, one large container ship emits the same volume of pollutants as 50 million diesel cars. Cargo ships are powered by low grade bunker fuel which contains up to 2,000 times the amount of sulfur emitted by diesel automobiles. The world's largest container ship owned by Maersk can carry 15,200 forty foot containers at a steady speed of nearly 50 km/hr consuming 380 tons of fuel per day while at sea.

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The Innovation

The fuel used in ships is waste from oil, left-overs from refining. It is the cheapest source of energy available. All ships around the world combined burn 7.3 million barrels per day, equal to the output of Saudi Arabia. This makes shipping by far the biggest transport polluter in the world, emitting -according to The Guardian- 260 times more sulfur oxide than the world's entire car fleet. The 15 largest ships of the world emit as much SO_x as the world's 760 million cars. The United Nations' International Maritime Organization (IMO) indicates that the present fleet could save up to ten percent in energy, and that a new ship could adopt technologies that reduce consumption with 30 percent. Nuclear energy has been promoted as an alternative power source for ships. There are 150 ships in operation that use nuclear propulsion, most submarines. However, the nuclear option is largely discarded due to the complexity of maintenance and the risk factors in case of accidents. The shift to clean fuel would add costs and put pressure on oil prices while leaving the industry with a low grade product that has no buyers.

Vatche Artinian is an American of Armenian descent graduated with a Master of Science in Electrical Engineering and an MBA from the University of Southern California, after getting a bachelors degree in Electrical and Computer Engineering from the California State Polytechnic University. He was fascinated by flywheels that have been in use since the Bronze Age to store kinetic energy. He realized that new high speed motor technology, combined with magnetic bearings stores energy efficiently. Mr. Artinian and his team built energy storage systems based on a magnet motor that can cycle continuously at rapid rates (12 seconds discharge, 18 seconds idle, 12 seconds recharge, 18 seconds idle). The team complemented these designs with magnetic bearings that levitate the flywheel, rotating the unit up to 60,000 rounds per minute (RPM) without friction or heat. The team realized that magnetic bearings reduce maintenance to nearly nil since there are no bearings to replace or lubricants to refill.

Mr. Artinian (Chairman) and Larry Hawkins (Chief Technology Officer) went on to create Calnetix, a privately held high technology company which emerged over the past 20 years as an industry leader in high speed motors, magnetic bearings and magnetic drives for distributed energy systems. In 2004, they decided to spin out their flywheel technology and created Vycon, a company that designs and manufactures high speed DC energy storage flywheels. After its initial success in demonstrating the technology, the company raised successfully \$13.7 million in 2010 from American, Danish and New Zealand investors to strengthen production and meet increased demand for clean energy storage.

The First Cash Flow

A mobile crane can load and remove a container from a truck or a rail wagon onto a container ship in about one minute. Mr. Artinian realized that the power to lift and the energy required to time the drop requires a lot of fuel. Actually this action represents the second most important cost in container transportation, after operating the ship itself. Mobile cranes are powered by on-board diesel generators. When the crane lifts, power is drawn, and during

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the lowering and braking the regenerated power is sent to a resistor bank where it is dissipated. Vycon designed and now delivers flywheels that recover and store this energy ready for use in the next lift thus reducing energy consumption by 30 to 35 percent, cutting back on noise while enhancing the life of the generator. The flywheel operates with such precision and reliability that Vycon offers its customers a 20 year warranty. This technology can be retrofitted on to existing cranes enabling immediate savings. The first system was installed at the container terminal in Long Beach, California where it has been in operation since May 2006.

The Opportunity

This application in the container industry only represents a minute reduction in the dramatic emissions of the shipping industry. However, the same flywheel system proven at this large scale is a platform technology that represents an alternative to the lead-acid batteries used as a back-up for the uninterruptible power supply (UPS) which is required for data centers and servers. The technology provides information storage and communication networks with battery-free alternative. This Vycon technology received in April this year the seismic certification from the Office of Statewide Health Planning and Development (OSHPD) in California after tests demonstrated normal operation before, during and after simulated seismic activity.

The existing operations demonstrate that the flywheel technology has a return on investment (ROI) of two and a half years, outperforming the total cost of ownership of a traditional battery-reliant UPS system. Vycon has been named by Inc. magazine for two years in a row (2010 and 2011) as one of the most entrepreneurial and fastest-growing private companies of America with a three year sales growth of just under 800 percent, the highest in the energy sector for the whole of the USA. Levitation based technologies that operate stable and safe over longer periods of time, offering better service at lower cost is certainly part of the portfolio of the Blue Economy innovations.

GUNTER PAULI

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Further information on the 100 innovations at www.blueeconomy.de.

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Zen and the Art of Blue

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