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## The Week in Review

### One Small Step for the Environment, One Giant Leap for the Industry

Last week, in a tripartite agreement, an international shipping company, a developer of advanced hydrogen generation systems and a provider of financial solutions to the maritime industry began the process of joining together to take the industry's first step towards a decarbonized future through the use of an alternative fuel as a power source. Hydrogen has been viewed as one of the key zero-carbon fuels for the future but was challenged by both delivery and storage issues restricting its potential uses. The eureka moment was the uncovering of the work of **Element 1 Corporation** and finding the best application to marine systems, an opportunity developed by **Ardmore Shipping Corp.** and **Maritime Partners LLC**.

#### *This Ain't Ardmore's First Rodeo!*

Since its inception in 2010, Ardmore has been focused on improving the performance and fuel efficiency of its fleet fully understanding the immediate need to mitigate the impact of shipping on the environment and to prepare for the coming energy transition. To that end, it built its fleet by acquiring high-quality fuel-efficient vessels and an organization built upon professionalism, safety, and environmental protection. Not satisfied, it was a pioneer of the "eco-mod" concept which engendered new techniques to further reduce fuel consumption and emissions and used those to upgrade its initial second-hand tanker acquisitions with energy saving devices and adopting innovative operational measures. Ardmore then took it one step further and was also amongst the first companies to embrace purpose-built "eco-design" vessels, which took fuel efficiency to the next level. These were stop-gap measures but, nonetheless, progress. It was time to build the company for a sustainable future which led to the company's development of an "Energy Transition Plan" as described in detail in its Progress Report. In broad terms, the company, which defines itself as being in the business of liquid bulk transportation will over time migrate toward the movement of non-fossil fuel cargos for which demand will grow along with the global economy. Currently, 25% of Ardmore's business is non-fossil fuel cargos and prospects for fossil fuel

cargos will, by logic, decline as the energy transition proceeds. With sustainability in its DNA, the company will continue to pursue improvements in fuel efficiency in the near term while exploring the opportunities in adopting transition and zero-carbon fuels for the medium and long term.

#### *Overcoming the Challenge*

Most change begins with a problem and a solution. Some are revolutionary and others evolutionary, but what is most important, as Ardmore points out, is to make progress. What is known for certain is that hydrogen has become one of the key zero-carbon fuels for the future, but it has practical challenges which limit quantities. As a gas, hydrogen has a very low volumetric density requiring a large tank to transport a small amount of even highly compressed hydrogen. In liquid form hydrogen is even more challenging than LNG requiring a temperature of -253°C to maintain a liquid state and offers half the energy density making it questionable as a marine propulsion fuel. However, one solution to the problem is to utilize "carriers" which are simple chemical compounds which contain hydrogen and can be easily separated into its components.

Despite the challenges, the promise of hydrogen as a fuel remains alluring particularly as a feedstock for Proton Exchange Membrane ("PEM") fuel cells which are an excellent power solution for decarbonization broadly and much more efficient than internal combustion engines. Unfortunately, it cannot just use any hydrogen, low temperature PEM fuel cells require high purity hydrogen.

#### *The Black Box – Made to Order Hydrogen*

"Who ya gonna call?" Thankfully, Dr. David Edlund is a renowned expert with over 30 years' experience in hydrogen generation technology, who, together with Robert Schluter, formed Element 1 Corporation ("E1"), the leading developer of clean energy technologies including advanced hydrogen generation systems in support of the fuel cell industry. The E1 team has developed a unique patented technology for generating high purity hydrogen for specific use in low temperature PEM fuel cells. Critically, the process produces

ISO grade hydrogen reformed from methanol, a carrier, on demand at the point of consumption eliminating the logistical challenges and costs inherent in distributing compressed hydrogen.

A general schematic diagram of the hydrogen generator and fuel cell is shown below. The process begins with methanol and water being added to the reactor (hot box) where the solution is heated and becomes steam. A catalyst in the reactor separates the compound into its simple chemical components, which are then sent through a purifier, removing CO<sub>2</sub> and other residual gases which are returned to the reactor and re-heated. The now pure hydrogen is sent on to the fuel cell where it is converted to electricity.

E1 currently has three product lines to service demand in the various markets: the S-series, the L-series, and the M-series. The S-series is a small application of up to 10 kilowatts. The L-series is above 10 kilowatts and is essentially a land-based charging station. And the M-series is essentially a mobile version of the L-series currently scaled up to 100 kilowatts and is the one being adapted for maritime applications, for which it can be scaled up by packaging multiple units to fit the power requirement.

### E1 Marine – Hydrogen Power for Shipping

Seeing the opportunity of applying this unique and proven technology to the maritime industry, E1, Ardmore, and Maritime Partners, each bringing to the organization its own set of skills, experience, and expertise, formed a joint venture, **e1 Marine**. The new joint venture

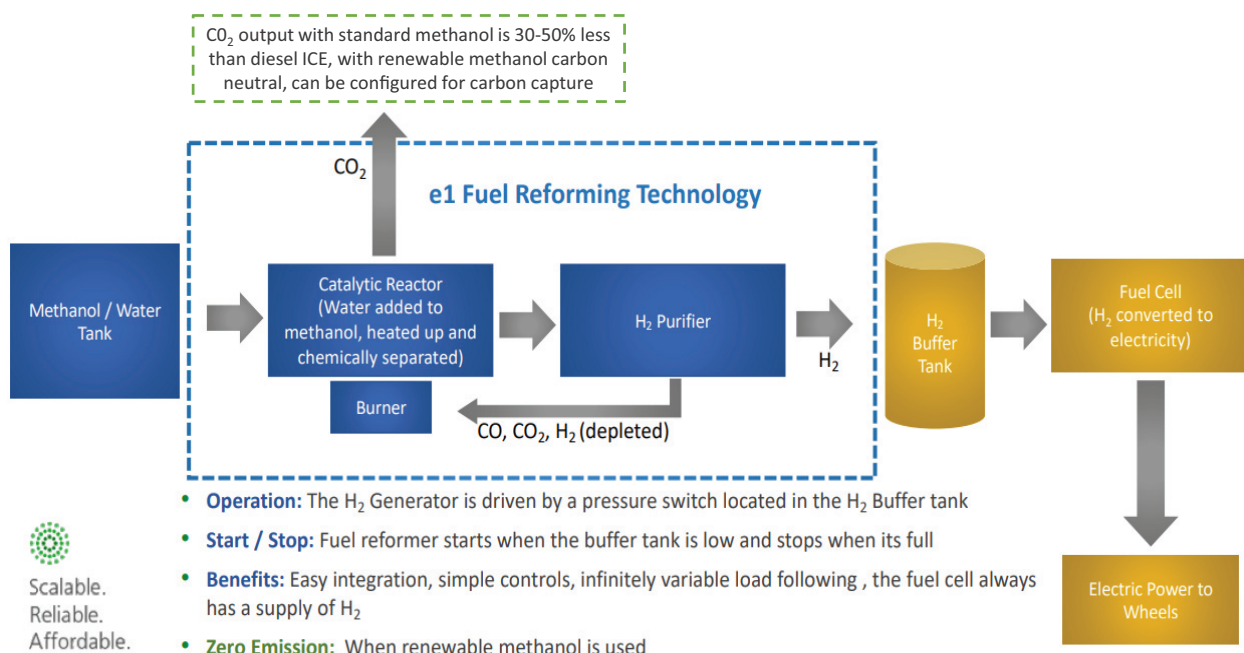
will have a worldwide mandate to develop, market, and sell E1's products and services to a very broadly defined maritime sector inclusive of all vessels and offshore support as well as port infrastructure.

With the knowledge that the E1 hydrogen generation system provides a safe and efficient solution for delivering hydrogen to PEM fuel cells, the question became what application to choose? In assessing the opportunity within the system's mid-size power capabilities, cost, and likely ease of sale, the partnership decided to focus initially on auxiliary power generation and main propulsion on small vessels.

The E1 system offers many advantages for these applications including the following:

- Consumes approximately 35% less energy than diesel-generators, and is thus more cost-effective option, even before considering new regulations or carbon tax
- With standard methanol, the hydrogen generator / fuel cell set produces zero particulates, zero NOX, zero SOX emissions, and approximately 30 – 50% less CO<sub>2</sub> than a diesel generator
- Ready to meet anticipated future regulatory requirements by switching to renewable methanol; the system can be potentially configured for efficient carbon capture and thus carbon negative
- Can be configured or retrofitted to run on ammonia
- Simple design and construction with high reliability and very few "moving parts" thus low maintenance and repair costs as compared to internal combustion engines

## E1 Hydrogen Generator and Fuel Cell Schematic



Source: Element 1 Corp.



- Potential further operational efficiency gains vs. diesel engines when matched with a battery bank to provide surge power and manage low loads.

What makes the concept work so well is that on-board hydrogen generation is a much more cost-effective solution than offsite production, transportation, and on-board storage. Readily available in all markets, methanol is a highly efficient source of hydrogen, has high energy content, and is easy to store and handle. Moreover, as the hydrogen generator / fuel cell set is modular in nature, it can be deployed in box form or integrated into existing engine room designs, whether retrofit or newbuilding, in power outputs ranging from 50KW to 2 MW, with larger sizes also possible. And, finally, while the environmental impact may be viewed as less than significant, it is a first step on the path to achieve “low-to-no” carbon emissions in compliance with IMO 2030/50 utilizing an alternative fuel.

### ***Business Light Model and Market Scope***

Not expected to be labor or capital intensive, the business model primarily involves licensing and royalties with some small scale manufacturing. The company will have its own organization and team across management, engineering, and regulatory expertise, marketing and administration.

The question, of course, is how big is the market? As a consequence of the energy transition, the expectation is that a significant portion of all vessels will begin installing alternative power sources through fleet renewal and selective retrofits. Based upon its initial research, Ardmore chose to focus on 500kw unit equivalent power systems. Although a “small” size generator for an ocean-going ship (Ardmore’s Japanese pump-room MRs have 600KW size units and its deep well ships have 850 – 950KW generators), the company believes this is a good size to start with, and it can be adjusted in size by just changing the number of M-series units used in the set — like a battery in a boat. Ardmore estimates a total market for 500kw units is in the range of approximately 200,000 units over a period of 10 years, exclusive of port infrastructure and offshore renewables. That number is based upon the hypothesis that owners will replace one of the three generators typically on board each ship with an E1 machine. On an annual basis that is 20,000 units of which E1 Marine estimates it can capture a 10% market share or 2,000 units. Based upon traditional royalties and licensing fees of 7 – 10% and the cost of an E1 system plus fuel cell at approximately \$800,000, equivalent to a diesel generator system, annual revenues could range from \$112 to \$160 million, with each partner receiving a third. Perhaps there is a way to make money in shipping even while doing good.



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The benefits to the owner in reducing generator consumption are substantial. Diesel generators on board ships run all the time even in port or while at anchor. Ardmore estimates its generator consumption is 25% of total consumption; by replacing even one diesel generator with an E1 system and running that unit more or less continuously, overall carbon emissions could be reduced substantially for a relatively low cost, not to mention SOX, NOX, and particulates.

### ***Ardmore Loved the Product So Much It Decided to Invest in the Company***

While we focus on things maritime, there is an entire world out there which will benefit from E1's technology which has a very broad application and a large addressable market across trucking, rail, land-based refilling stations, and power backup. The heavy lifting has been accomplished and E1 is now at a pivotal stage of its development. Through an intensive R&D phase, the focus now is on commercialization and scaled-up manufacturing, making it an optimal time for an investment.

To that end, Ardmore has elected to take a 10% equity stake in E1 in exchange for \$4 million in cash plus 950,000 Ardmore shares valued at approximately \$5 million based upon the closing price of the shares preceding the announcement. Alternatively, the total investment is \$11 million assuming Ardmore's shares are valued instead at its year-end NAV of \$7.37/share. E1 will also issue warrants to Ardmore and Ardmore will take a seat on the E1 board.

In connection with the joint venture, Maritime Partners will be entitled to participate to the extent of 20% in the profits received by Ardmore from its investment in E1, ensuring full alignment among the parties. Driving the investment is an appreciation of the business model and the potential for significant value creation as the company scales up and additional products are developed.

Ardmore's interest in the joint venture and its investment in E1 will be held by Ardmore Ventures, a newly incorporated holding company for existing and future potential investments related to Ardmore's Energy Transition Plan.

### ***Ardmore and Maritime Partners Build a Relationship***

In addition to the joint venture, Ardmore and Maritime Partners have found common ground for a direct relationship in which Maritime Partners would invest \$40 million directly, \$25 million initially with the balance subject to final approval from Maritime Partners, in exchange for Series A perpetual preferred shares. The issuance has been structured along the lines of a typical public preferred issuance, both in size and terms. The shares will carry a dividend of 8.5% per annum with an option for payment-in-kind for up to four quarters in a three-year period. The dividend rate is subject to escalation for certain credit-related triggers in line with its other

financing covenants. Non-amortizing, the shares are non-callable for three years, after which Ardmore has the option to redeem them.

In addition to providing capital for further selective growth, the financing provides considerable financial flexibility. As a hybrid security, it has some debt-like characteristics but for accounting, credit, and covenant purposes is treated as equity, thereby strengthening the company's balance sheet. While the coupon might seem rich, it is "cheap equity." How expensive is it? For perspective, these proceeds can be used to refinance the expensive subordinated tranche of its leases, thereby reducing Ardmore's cost of capital and its cash breakeven.

A privately-held company headquartered in New Orleans, Maritime Partners is a high-quality institutional investor with significant expertise in asset financing and structured products. The company specializes in providing tailored leasing solutions to the maritime industry with a specific focus on Jones Act vessels and inland marine transport.

Tony Gurnee explains the why. "So, just to take a step back, our core business is owning and operating product and chemical tankers. And in optimizing our performance, we work every day to innovate and devise new ways to sustain and improve our performance... We feel in this set of transactions and in this project, in particular, we're leveraging our existing strengths and providing what we think are potentially valuable technologies to the market and to the overall industry. This is the essence of our Energy Transition Plan ("ETP"): performance and progress interconnected. The ETP has three key areas: sustainable cargos, transition projects, and transition technologies. We're serious about all three. This happens to be the first step in one of the three areas, transition technologies. So, overall, we feel that this is consistent with our core strategy and the Energy Transition Plan and it builds off our strengths."

Together the partners will "get hydrogen to work." No doubt.



Click on the image above to watch Episode 9 of Chat With Matt with Special Guest Tony Gurnee



# WINNERS AND LOSERS



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25/03/2021

THIS WEEKS WINNERS					THIS WEEKS LOSERS				
Dry					Dry				
Type (dwt)	Week Change \$*	Year Change \$*	Annual Volatility*	YoY Volatility Change*	Type (dwt)	Week Change \$*	Year Change \$*	Annual Volatility*	YoY Volatility Change*
Cape (180k)	\$0.86	\$3.69	5.23%	-0.16%					
Panamax (80k)	\$0.74	\$7.70	7.72%	0.18%					
Supra (60k)	\$0.58	\$2.93	5.45%	1.48%					
Handy (30k)	\$0.45	\$5.32	17.48%	8.37%					
Wet					Wet				
Type (dwt)	Week Change \$*	Year Change \$*	Annual Volatility*	YoY Volatility Change*	Type (dwt)	Week Change \$*	Year Change \$*	Annual Volatility*	YoY Volatility Change*
Aframax (110k)	\$0.69	-\$7.63	6.63%	0.52%					
LR1 (75k)	\$0.28	-\$6.45	9.38%	3.86%					
Suezmax (160k)	\$0.13	-\$9.53	2.80%	-1.65%					
MR2 (50k)	\$0.13	-\$3.17	3.97%	-0.03%					
VLCC (310k)	\$0.05	-\$6.83	4.33%	-0.40%					
Container					Container				
Type (teu)	Week Change \$*	Year Change \$*	Annual Volatility*	YoY Volatility Change*	Type (teu)	Week Change \$*	Year Change \$*	Annual Volatility*	YoY Volatility Change*
Sub Pmax (2,500)	\$1.55	\$11.77	10.11%	5.79%					
Feedermax (750)	\$1.06	\$12.33	10.26%	0.00%					
Handy (1,400)	\$0.94	\$8.93	10.92%	7.50%					
Panamax (4,250)	\$0.83	\$32.15	11.42%	-17.80%					
P-Panamax (7,000)	\$0.78	\$16.81	9.28%	6.63%					

\*The \$ change in value is for standard specification resale vessels from top quality yards over the previous week or year

\*\* "Volatility" is calculated as the standard deviation of the changes in values across the rolling calendar year (expressed as a %)

\*\*\* "Volatility trend" is the change in volatility over the previous rolling calendar year

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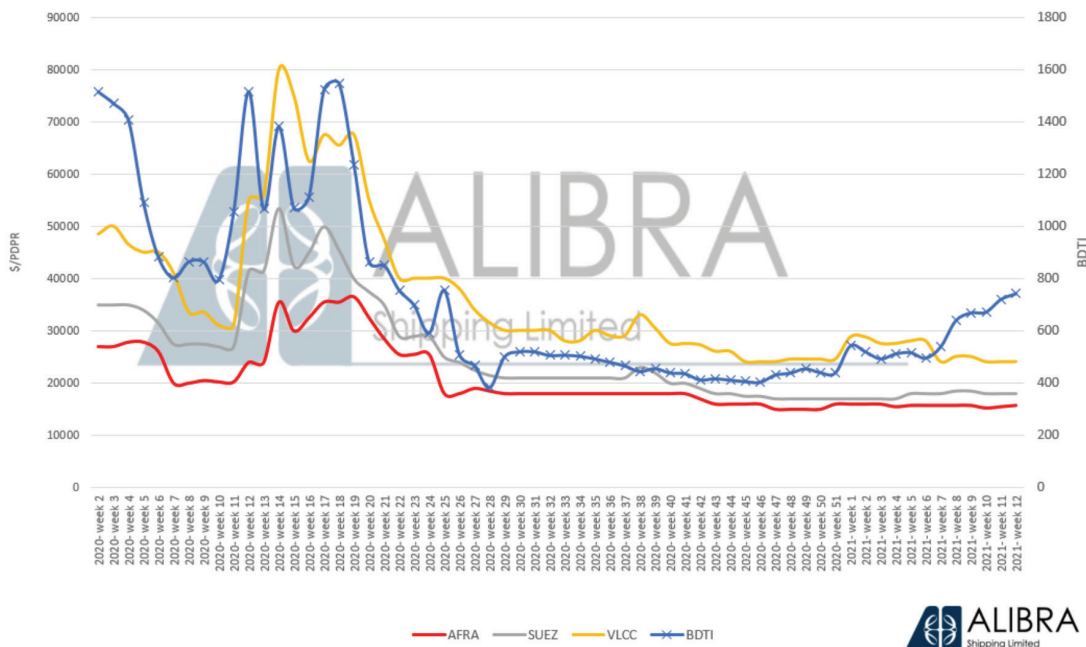
## Tankers

Crude timecharter rates remained stable this week and there have been a number of period fixtures reported in the aframax and VLCC sectors. The average rate for an aframax for one-year is currently estimated as \$15,750/pdpr.

On the clean side the general sentiment is more optimistic towards a market recovery later this year. The Atlantic basked for MRs has been on the rise although this has taken a small dip this week and steady export cargoes have been coming out of UK Cont.

Oil prices fell early in the week on demand concerns however, reports of the container ship blocking the suez canal sent prices rebounding. As yet it is unclear how long it will take to move the ship, there are thought to be around 70 vessels waiting at either end of the canal, for the most part crude carriers will be travelling north and clean products south. The longer situation this continues, more and more vessels will be added to this backlog which in the short-term, and depending how long it takes to resolve the situation, will have an impact on tanker supply. This could provide a short boost to spot rates although it is unlikely to have much of an impact on the period market. Charterers now face the decision weather to wait-it-out or to re-route the vessels which could add weeks on to a journey, whilst slightly increase tonne-mile demand.

### Dirty tanker 1 year TC rates



By Rebecca Galanopoulos Jones – Commercial analyst, Alibra Shipping Ltd.

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EVENT	DATE	CITY / TYPE OF EVENT
Marine Money Istanbul Virtual Forum	Apr 14th	Virtual
Marine Money Singapore Ship Finance Forum	Apr 20th	Singapore – Hybrid
Financing Offshore Wind Assets	Apr 28th	Virtual
14th Hong Kong Ship Finance Forum	May TBA	Virtual
22nd Norway Ship & Offshore Finance Forum	Jun 3rd	Virtual
<b>33rd Marine Money Week</b>	<b>Jun 21st - 23rd</b>	<b>Virtual</b>
10th Houston Offshore Finance Forum	Aug 18th	Houston – In-person
20th German Ship Finance Forum	Aug 31st	Hamburg – In-person
Copenhagen Members Only Private Event	Aug TBA	Copenhagen – In-person
14th Superyacht Finance Forum	Sep 21st	Monaco – In-person
Marine Money during UN Climate Week	Sep 23rd	Virtual
<b>19th Marine Money Week Asia</b>	<b>Sep TBA</b>	<b>Singapore – In-person</b>
23rd Greek Ship Finance Forum	Oct 21st	Athens – In-person
Brazil Offshore Finance Forum	Oct TBA	Rio de Janeiro – In-person
15th Korea Ship Finance Forum	Nov 3rd	Busan – In-person
China Ship Finance Summit	Nov 11th	Shanghai – In-person
22nd Ship Finance Forum	Nov 18th	New York City – In-person
17th Gulf Ship Finance Forum	Nov 25th	Dubai – In-person
13th London Ship Finance Forum	Jan TBA	London – In-person

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