# Grahaeme Henderson

# Shell Energy Summit 3rd July 2019

# Pathways to Decarbonisation in Shipping

**Link to EC Key Points**

- We have heard today, from Ben and from Maarten, about the challenges we face – both in tackling climate change and in finding ways, as businesses, to thrive through the transition.
- As a company, we intend to cut the carbon intensity of the energy products we sell, in step with society, as it moves towards the goal of the Paris Agreement. And the shipping industry must also act to progressively lower the carbon intensity of our sector to meet the expectations of our customers and wider society.
- There are multiple alternatives being explored as to how we meet this challenge.
- As Maarten noted, one of the ways we are already meeting the challenge is investing in LNG-fuelled vessels and in more LNG bunkering infrastructure; and Sky lays out a scenario where biofuels and hydrogen play a bigger role.
- But this session is an opportunity to discuss the range of fuel options, each with their own advantages and obstacles.

**Context**

- Ships transport about 90% of world trade and generate about 3% of total greenhouse gas (GHG) emissions per year. This figure is set to rise quickly, if we don't focus our attention on this today, as we know developing solutions at a commercial scale takes time.
- As an industry, we are acutely aware of the challenge of reducing emissions. We have spent the last few years thinking about how we will best comply with the imminent IMO 2020 sulphur regulations.
- As we get closer to 1st January 2020, with implementation plans and investment decisions in place, we can start to turn our attention to decarbonisation and 2030. And 2050.
- The IMO is committed to reducing GHG emissions from international shipping as a matter of urgency, reducing the carbon intensity of shipping by 40% by 2030 and making total GHG reductions of 50% by 2050.
- Existing emissions reduction approaches and technology; vessel design, voyage optimisation, operational efficiency and technology, such as Air Lubrication and Flettner Rotors, will get us part of the way. Combinations of these could deliver in excess of a 20% carbon intensity improvement.
- But they are not enough to meet a 50% reduction in overall GHG emissions.
- The IMO targets are ambitious, but they are in line with the 2015 Paris Agreement and its implementation. Global freight demand is expected to triple by 2050, with

ships carrying more than three quarters of all goods movements by 2050. Consequently, freight transport by ships will grow at a compound annual growth rate of 3.6 percent through 2050, meaning the challenge is tough.

- I referred to the IMO 2020 sulphur regulations and let me say that this has been easy when compared to the complex decarbonisation challenge!
- There are choices to be made; between feedstocks, production methods and onboard technologies for future fuels. And, of course, ensuring that solutions are commercially viable.
- On a well-to-wake basis, we will need technologies which go further, including carbon neutral and carbon free solutions for the future of shipping.
- We also need to remember the scale at which any solution needs to be implemented, with availability of the fuel in a multitude of ports. Last year, 250 million tonnes of fuel oil equivalent were delivered around the world. That is a huge amount and achieving that sort of scale in ports globally takes time.

**Fuel Options**

- So, what are the options? Zero-GHG emissions solutions require the fuel and its application in shipping to be:
    - Safe
    - Sustainable
    - Commercially viable
- There are different pathways, which provide so many different options, and it's difficult to list them all. However, we can position them through two lenses; ease of application to shipping and ease of fuel production. This helps us to understand the challenges ahead, and our response.
- I would like to consider three types of pathways, namely:
    - Drop in fuels
    - New shipping fuels and
    - Other technologies
- The first pathway to decarbonise is to use so called "drop-in fuels**"**, which have the benefit that they can be applied to shipping in the same way as current fuel, for example:
    - Biofuels
    - Bio LNG
    - Methanol and
    - Synthetic hydrocarbons
- But, there are challenges in making these drop-in fuels at scale, because of the sustainability of feedstock, and the efficiency and cost of the production process.
- The second pathway develops completely "new fuels" for shipping, which are:
    - Hydrogen and
    - Ammonia

- These new fuels require a redesign of handling, engines, storage and infrastructure. How to adopt the fuel on the ship is as yet untested, and will require new technology, safety processes and regulations.
- The benefit for these new fuels comes from producing the fuel with renewable power. This is becoming increasingly commercially viable with reducing generation costs.
- The third pathway is using "new technologies", examples being:
    - Using LNG, and capturing the GHG emissions before they enter the atmosphere by employing a carbon capture and storage process, and
    - Battery power
- Considering all of these various pathways, as an industry, we need to deepen and mature these concepts.
- The industry is still at the early stages of developing these technologies. It's not about 'picking winners', but more about working collaboratively to quickly advance the most promising opportunities.
- Whilst making progress, we should remain open to currently unknown technology.
- This is the work that will occupy us in the future, but we need to start focusing on it now.

**Key Themes for Assessment**

- Let's go back to the key themes in developing a framework for how we should assess these developing technologies:
    - Are they safe?
    - Are they sustainable? And,
    - Are they commercially viable?

**Key Themes for Assessment - Safe**

- Starting with safety.
- The new fuels come with varying levels of operational hazards.
- It's worth remembering that to make LNG transportation as safe as it is today, it has taken 50-years with a considerable effort invested in the design and operations of the global LNG fleet.
- We can learn from this LNG journey and as an industry, and have the confidence that we are able to make real changes that materially impact the safety of our ships and crews.
- The sector will need to put in place a new mindset and focus, to develop the safety controls for new fuels, demonstrating agility and pace. We cannot rely on the traditional maritime model of organic incremental change.

**Key Themes for Assessment - Sustainable**

- Turning now to the key assessment theme of sustainability.
- The well to wake GHG emissions of all the alternatives currently being discussed, other than LNG, are higher than diesel, unless they are derived from renewable feedstocks.
- To meet the 2030 and 2050 ambitions, the pathways require "bio" feedstocks, with sustainable origins, or a "renewable power" feedstock.
- Currently, alternative fuels that can be used for shipping are being produced for specific outlets. For example, hydrogen is produced predominantly for use as a feedstock for chemicals.
- We will be competing for these resources with other industries including power generation, steel, and agriculture, in addition to other transport sectors.
- In diverting fuels from another industry to shipping in the name of GHG emissions reductions, we must be sure that those other industries can access sustainable alternatives. We should not negate our industry's GHG emissions reductions with a rise elsewhere. In addition, a higher allocation of available biofuels to shipping means less abatement options for say aviation and trucking.
- All industries will require investment in facilities like biomass production, renewable power generation, and CO2 capturing, to ensure there is feedstock to produce these fuels in the quantities required.
- Today's event is about bringing the most influential leaders, across industries, to acknowledge that, as Ben says, "We must work together, supply and demand, to progressively decarbonise the energy use sectors."

**Key Themes for Assessment - Commercially Viable**

- Finally, the third assessment theme of being commercially viable.
- Zero-GHG emissions solutions must first become feasible at scale and then competitive. Currently, the production costs of many of these new fuels are estimated at 2-3 times that of the hydrocarbon based equivalent, for example ammonia to green ammonia.
- To deliver the incremental molecules required for shipping, significant investment for expansion is required. Other than LNG, the current total global production of the new fuels that I have referred to here, will not come close to covering current fuel demand.
- Technology development, storage and infrastructure will all impact commercial viability.
    - The development of onboard technology is a critical factor, which requires significant research and development investment, testing and deployment.
    - Unlike methanol and LNG, these new fuels currently do not have an internal combustion engine that is commercially available – although research and pilots are underway.

    - And fuel cell development to increase delivered power is a critical area for most new fuels.
    - Carbon capture and storage or CCS is also an important component of several new fuels. Suitable CCS systems are yet to be developed for large ship applications.
    - The shipping sector will need an approach which uses agile technology development to narrow the technology gap, to make new fuels and associated systems, more viable more quickly.
- And there are considerations with the storage and infrastructure of the new fuels which involves additional capital in the value chain, for example in bunkering infrastructure, and new operational norms for the sector.
- Vessel design will also change to ensure greater operational efficiency, but also to accommodate these new fuels. Given the energy density of the alternatives today, larger fuel tanks would be required to deliver an equivalent performance. This is likely to result in either the potential loss of cargo capacity or the necessity to build larger ships.
- The storage for most of these new fuels requires some level of pressurised tanks or requires low temperature cryogenic tanks.
    - Methanol takes up 2.5 times as much storage space as marine gasoil, and is a gas at 65°C.
    - Ammonia requires 3 times as much storage as marine gasoil and is a liquid at -33°C.
    - Hydrogen takes up 4 times the space required for marine gasoil, and it becomes a liquid at -252°C, requiring new materials to be developed.
    - LNG uses 1.5 times the amount of space and is a liquid at -162°C.
- For the new fuels, bunkering infrastructure does not exist.
- Although further investment is required, LNG's infrastructure has grown rapidly recently, particularly the 'last mile' connectivity. And Shell is making great progress in building this out for our customers globally, as you will have heard from Maarten earlier and you will hear more from Steve later today.
- In the future, this developing LNG bunkering network could also be used for bio-LNG.
- Setting out these parameters is not to try and dissuade us from embracing new fuels. Instead, it is to underline the enormity of the challenge and highlight how crucial it will be for us to work together to develop, test, trial and deploy these technologies.

**The Need for Industry Collaboration**

- To cut through this complexity and meet the GHG ambitions of the IMO, we all need to collaborate across the industry, as well as with other industries.
- It is important that we deliver practical proof points and pilots across the value chain. From production, through to the port infrastructure, supply chains, and the ships themselves.
- And work together with interested customers, as drivers of demand; the leaders in our sector who want to play a role in developing low carbon shipping solutions.

- We believe that LNG is a credible fuel solution for a low carbon future, and one that is available now.
- When we say 2050, it sounds like a long way off and may lull us into a false sense that we have time on our hands to wait and see what develops. But, in the next 5-10 years, we will all be making decisions on ships, and associated technologies, that will endure through the energy transition.
- Let's tackle this with urgency, to ensure we are ready to make those decisions, with the confidence that they will be providing safer and cleaner shipping. Thank you.