



# ELECTRIFICATION OF FERRIES

## Possibilities for Manly Ferries

### Abstract

Discussing whether or not ferries on the harbour should be electric in ten years' time or even possibly 5, it will be a given and expected for public transport in such a densely populated environment.

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## Executive Summary

- Electrification of ferries globally is the result of a process that has been gathering speed for a decade with marked acceleration in past few years and is based on both economic and environmental fundamentals.
- The drivers will not change, on the contrary they will accelerate.
- Ferries are a long-term investment with a life typically of 40+ years thus decisions made now to embrace diesel engines is not a decision that history will judge favourably.
- Conversion of existing ferries to battery/hybrid is now an established practice. We do not have to re-invent the wheel.
- There is capability and interest within the Australian shipbuilding industry to build/convert any ferries required for Sydney Harbour.
- There is then the possibility to convert or rebuild traditional double ended Manly ferries thus maintaining 100 + years of maritime history as well as reducing costs and effectively removing emissions whilst enhancing the passenger experience.
- Sydney Harbour is the jewel in Australian Tourism Industry crown and Australian Shipbuilders have shown themselves to be world beaters in ferry construction through such companies as Incat Tasmania and Austal ships. It will be a sad day if we chose to decorate our crown with cheap overseas versions of yesterday's technology when we could produce home grown gems.

## Pre Amble

In order that electrification of ferries as a concept is understood it is necessary to first contextualize the situation in a global sense with respect to fossil fuels and environmental consequences then transpose this into Marine Transportation and ferries in general and finally what this will mean for Sydney ferries and in particular Manly Ferries.

## Fossil Fuels

During the recent decades there has been ever growing body of evidence that man made emissions predominantly from burning fossil fuels are causing climate change and other damaging environmental changes, so whilst the price of oil and gas has always been known, what is increasingly clear is that there is also a cost of oil and gas which we are only just starting to realise is potentially extremely high, this has long been understood by scientists assigned to UN, but as these changes manifest themselves in more and more obvious ways it is increasingly harder for governments to ignore.

The result of which is seen in a patchwork of actions and edicts across the world as governments come to terms with this reality of bush fires, floods, rising sea levels, acidification of ocean etc. As Winston Churchill stated.

*"The truth is incontrovertible. Malice may attack it, ignorance may deride it....but in the end...there it is"*

As Tobacco companies fought valiantly to defend the indefensible, in the end circumstantial evidence becomes overwhelming, so too with the detrimental effects of burning fossil fuels.

One of the reactions more recently has been increasingly stringent requirements on diesel engines both in trucks and in cars, with tighter and tighter emission controls and more recently the total banning of diesel cars in many cities with the main concern being Particulate Matter (PM). This has been also identified in Australia as a serious issue. The current NSW Liberal party environmental policy is stating *"Many recent scientific studies have confirmed that PM is associated with increased mortality and hospital admissions."*

Merchant Shipping for decades has been used as the incinerator for the heavy fuels that land based industry did not want, this too, has been undergoing change with IMO (United Nations) bringing down new requirements for fuel quality and emissions.

There is a growing understanding and concern about emissions from fossil fuels causing climate change but also other dangerous side effects to environment and directly and indirectly to people's health. This has resulted in recent clamp down on use of diesel engines in cities in such diverse cities as Paris, Mexico City, Copenhagen, Delhi, Amsterdam, with Amsterdam now also requiring boats under 10 metres to be electric and is systematically electrifying all canal systems etc. etc.

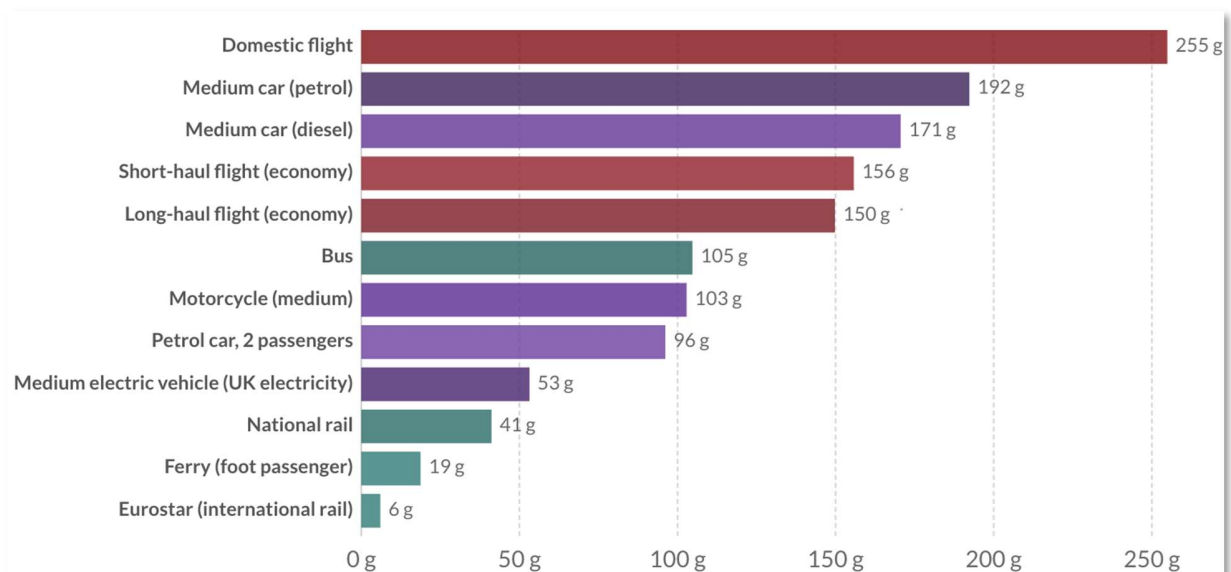
UN through IMO has also belatedly been imposing improved performance for fuels and engine performance for merchant vessels and flag states creating emission control areas ( ECA's ) thus imposing additional controls nevertheless they still fall well short of many local land based requirements for truck, bus and car engines.

A recent EU study found that cruise ships in Europe emit 19 times more Sulphur oxides than the 260 million cars on the continent. In Norway cruise ships emit 1.4 times more NOx than all the cars etc.

China identified in 2015 that shipping emissions including inland and coastal shipping emissions was responsible for the early deaths of 18,000 people.

Times are changing, many modern cruise ships will in the future burn LNG, big mining companies such as BHP and Rio Tinto are supporting the transportation of ore by LNG powered bulk carriers etc. Nevertheless, for ferries whose commercial life is often well in excess of 40 years and who operate in inner city areas, the emissions, especially PM's pose a significant health risks to populations

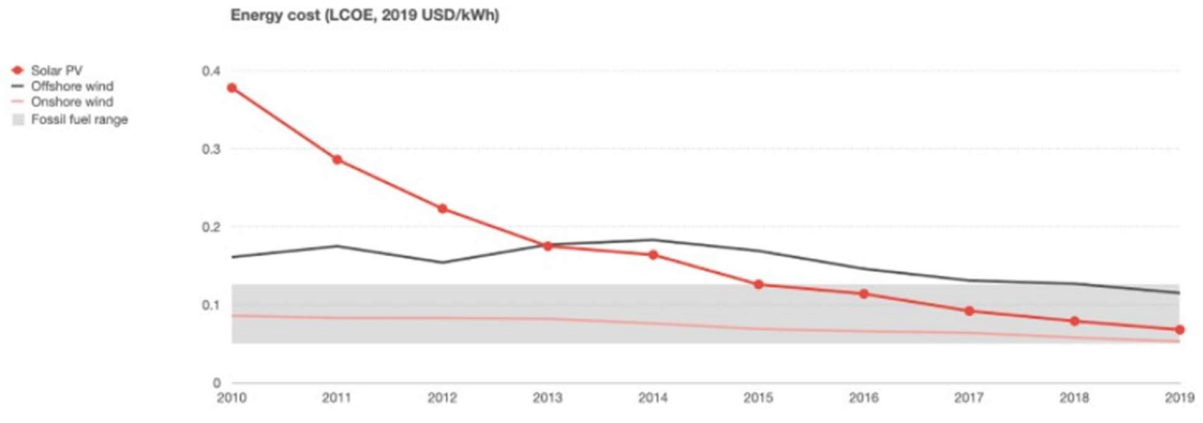
Whilst painting a bleak picture for environmental performance of ships in general, it is worthwhile to remember that as a means of transport, particularly for passenger transport still they easily outperform virtually all other forms as measured by emissions per passenger kilometre.



## Economics of Energy

## Putting it on commercial terms with fossil fuel

From science project to product

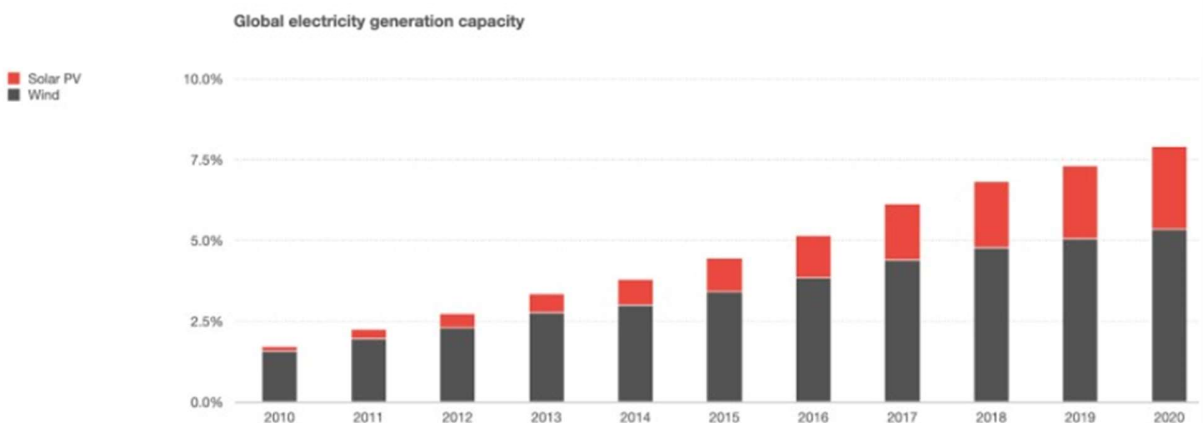


The price for fossil fuel in particular oil has fluctuated considerably over the years depending on political and global economic circumstances, however it is generally not thought that it will drop appreciably more as the results of this quickly manifest themselves in reduction in investment and exploration plus as we have seen recently with Saudi Aramco selling shares in 2019 and again in January 2021 the industry struggles.

As opposed to this we have seen a steady decline in the price of renewable energy with more expected and predictably a dramatic increase in renewable energy in total feeding into grids. The result of this has been and is, a reduction in costs as now clear in South Australia.

## Becoming real

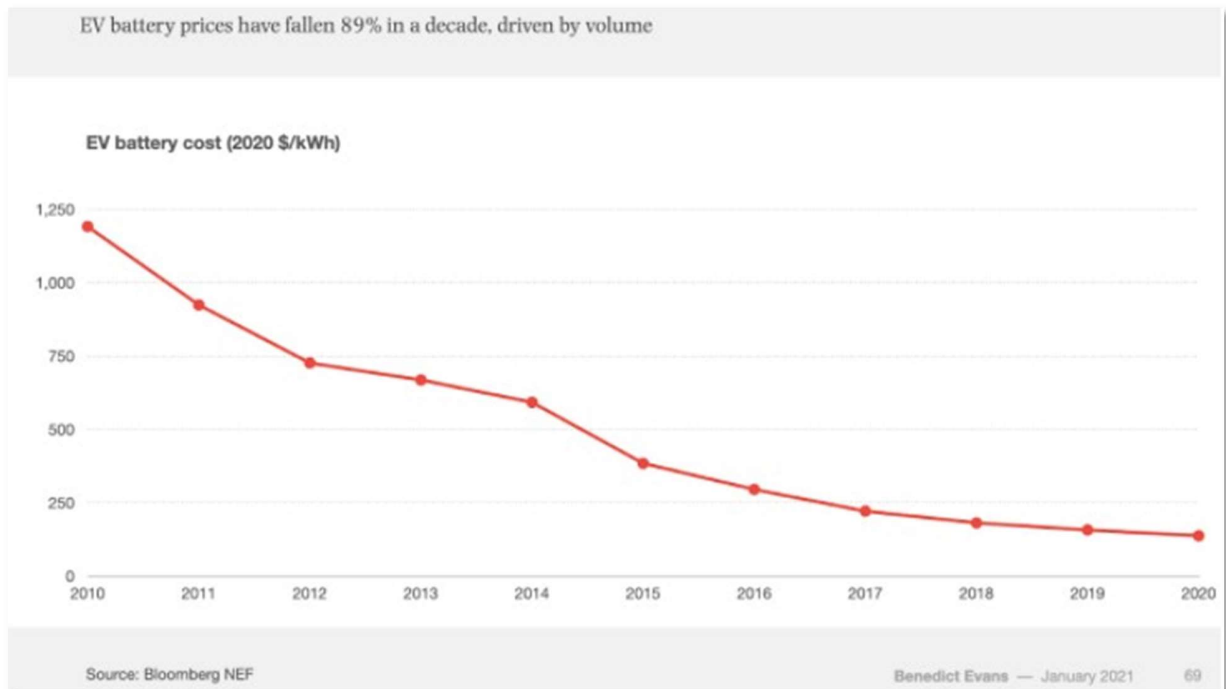
Global installed base share of solar PV + wind has increased 4x since 2010



Source: IRENA, IEA

Benedict Evans — January 2021

Along with steadily declining cost and continued improvement of performance of batteries.



The economics of battery/electric system for transport, even allowing for increase CAPEX are now stacking up leaving aside significantly improved environmental performance and the fact that renewable energy costs continue to fall along with battery prices whereas fossil fuel are already marginally profitable with many oil majors seeking to diversify into “energy companies” and embracing renewables.

### What does this mean for the Ferry Industry in particular?

Ferries are uniquely suited to electrification due to the following reasons

- 1) They generally will serve their life out in limited confines, with repetitive routes thus recharging becomes infinitely easier than vessels engaged in international trade.
- 2) Long term energy agreements can be reached with electrical power suppliers who are hungry to expand and are generally reducing costs as renewable energy increases.
- 3) Maritime transport is already one of the most efficient of all forms, electrification allows the efficiency to improve significantly more over diesel plus effectively removing emissions.
- 4) Vessels generally will remain in service for 40+ years thus allowing any Capex to be affectively amortized over double the period of a conventional cargo ship.

- 5) With the dramatic simplification of mechanical components, the maintenance costs will reduce considerably with reduced labour and improved reliability.
- 6) With the removal of large central trunking needed for diesel engine exhausts and forced draft ventilation, enclosed deck space is opened up for more passenger use.
- 7) With no exhaust stacks and forced draft fans the top deck of the ferry can be used by passengers as fumes and noise and heat are removed.
- 8) The areas that typically create the major corrosion hot spots in double bottom and tank tops on conventional vessels are not exposed to the same environment on electrified vessels thus removing one of the high-cost maintenance elements of steel renewal and structural weakness as the vessel ages.
- 9) Electric ferries are a very visual confirmation that Authorities are taking steps to protect population and walking the talk in terms of environmental commitments.
- 10) Noise and smell dramatically reduced thus providing passengers with much more pleasant environment on board.
- 11) They typically operate in densely populated areas where there is growing understanding and resistance to harmful emissions.

### **Norway's Role**

Norway has shown strong support for electric cars with 74.7% of new cars sold in 2020 being plug in electric it is not surprising that they also lead the way in Electric Ferries and is anticipated to have 58 electric ferries in service by end of 2021 the first one entering into service in 2015, many more are on order. With a commitment to reducing emissions by at least 50% by 2030 from 1990 levels, Norway continues to pioneer sustainability.

### **Global Trend**

EU have supported the initiative and quickly other European countries such as Denmark, Sweden, Greece, Germany have followed suit. China has and is, as with electric cars also focusing on electrification of ferries with what will be the largest ferry globally to date being commissioned in July this year plus many river and coast commercial boats now being electrified along with unprecedented growth in renewable energy production.

New Zealand will introduce their first locally built electric ferry into Wellington during 2021, Auckland has already put into service their first electric harbor tug.

In the US, the second largest ferry operator in the world, Washington State Ferries are well advanced on their program of electrification of their fleet with a combination of new vessels and retrofitting older vessels.

In Vancouver, British Columbia ferries are following a similar ambitious program of electrification.

A recent study undertaken on behalf of I.A.D.B Inter-America Development Bank ( the equivalent of Asia Development Bank ) on potential for electric ferries in Latin Americas in February 2021 concluded in summary that:

*In the average Latin American country, electric ferries' higher capital costs are more than offset by their lower maintenance, staff and fuel costs – even when taking into account the likely cost of periodic battery replacement during vessel life – for an average discounted net benefit of \$2.7 million per vessel.*

*The roll-out of electric ferries in Latin America presents opportunities along the entire marine transportation supply chain in the region. Overall, we believe it represents an estimated cumulative addressable market by 2040 of \$6.8 billion.*

India has 23 electric ferries on order/in operation with further 78 on order.

Singapore is currently undertaking study for electrification of their port vessels and has just signed a design contract for 3 double ended passenger/car ferries. etc.

***In summary this is a global phenomenon.***

### **Shipbuilding Reaction**

Predictably the shipbuilding industry is responding to these changes and market opportunities some details of reaction from major players as below:

Damen HQ in Holland, one of the largest global shipbuilders of harbour vessels has now included e-ferries in their portfolio and are selling well

Penguin of Singapore and Indonesia another major supplier of harbour and coastal vessels also now e-ferries and boats

Cochin Shipyard in India, building 23 e-ferries currently

Tersan Shipyard (Turkey) building and delivering electric passenger/car ferries.

Closer to home Incat Tasmania, a global player in large High Speed Ferries is in discussion with Tesla and Austal Ships (WA) another major player in global High Speed ferries, introduced in January 2021 their latest range of e-ferries "Volta" Details below.

### **AUSTAL LAUNCHES VOLTA SERIES OF ELECTRIC POWERED HIGH SPEED FERRIES**

*Austal Australia has launched the VOLTA series of electric-powered high-speed ferry solutions, with the introduction of the Passenger Express 46V, a fully electric-powered 46 metre catamaran ferry design.*



*Austal's new VOLTA series is distinct from existing, electric-powered vessels in the marketplace by going beyond the replacement of diesel engines with an electric (battery) power plant, to offer a completely integrated design, construction and support solution - including on-shore charging infrastructure and in-service support programs for operators.*

*Austal Chief Executive Officer Paddy Gregg said the new VOLTA series of high speed ferries represent the future of commercial maritime transport, offering operators a cost-effective electric-powered vessel; capable of zero emissions, lower operating costs, a quieter and more comfortable ride, and outstanding reliability.*



The direction then is clear with demand driven by combination of economic and environmental factors and supply responding including very much Australian shipyards.

### **The Manly Ferry**

The double ended Manly Ferry is an iconic vessel that has been a part of Sydney harbour for over 100 years, it is the preferred choice of any tourist wishing to see Sydney Harbour and visit Manly as well as many commuters who prefer the slower pace and possibility to sit in the open air.

Clearly feasibility studies have been done in different parts of the world which have indicated and resulted in not just the building of new ferries but the conversion of existing ferries. These have successfully been done with results that have exceeded expectations and typically with payback period of 4-8 years.

Washington State Ferries (WSF) are dealing with a large number of steel hulled double ended ferries and have shown an openness to share their experiences and even feasibility studies, they are well advanced in their program so not only have theoretical studies but practical confirmation and knowledge acquired as they work their way through the program. They have in many cases been able to retain some of the generators on their vessels which both enable them to reduce cost but also build in flexibility to run the generator if for whatever reason they are unable to charge the vessels. Their feasibility studies are deliberately conservative and build in provision to change out batteries every 6 years.

Another smaller but perhaps equally relevant example is that of the The Föri, which is a 117 year old ferry in Finnish city of Turku. Originally built in 1904 it was steam driven until 1955 when converted to Diesel. In 2015 it was deemed to have served its time, was dirty and noisy and to be scrapped. A large backlash occurred from the population which resulted in the State Authority reviewing their decision and instead of scrapping the vessel, to rebuild it but employing modern energy saving technology, more comfort and removal of all diesel engines replaced by batteries and electric motors. The vessel was back in service in 2017 and has exceeded expectations of both passengers and operators as well maintaining maritime history.

Due to go into service within the next few months another elderly ferry refitted and converted to battery the Älvsnabben 4 operated by a division of Transdev in Gothenburg.



The above are examples of what has successfully been carried out in different parts of the world and what could be possibilities for the Manly ferry.

I do not believe that we will be discussing whether or not ferries on the harbour should be electric in ten years' time or even possibly 5, it will be a given and expected for public transport in such a densely populated environment.

Currently Freshwater class ferries are typically carrying 100-200,000 litres of fuel on board hence this gives considerable flexibility when considering for example battery packs which will come in considerably below this weight with electric motors of equivalent power also considerably lighter than equivalent diesels with all necessary ancillary equipment. It may also be possible to retain existing generators thus reducing costs and adding flexibility.

It will not be the case that a conversion of existing Freshwater Class ferries to battery/hybrid is impossible, all things are possible from an engineering standpoint. At the end of the day the economics and complexities may make the conversion prohibitively expensive and the opportunities for a new build that will incorporate all the new technology and improved

passenger experience more attractive, This can only be decided by a detailed feasibility study as has been conducted elsewhere in the world as the basis for such decisions.

Sydney Harbour is arguably the jewel in the Australian Tourism crown, it will be deeply embarrassing and damaging to our brand if instead of highlighting our environmental and technological prowess with sparkling gems we end up by ferrying tourists and residents around the harbour for decades using yesterday's polluting technology bought for cheapest possible price in China.

There is full capability to undertake both conversion and new building work in Australia from yards with international track history.

It is also perhaps relevant to again quote from the environmental policy stated on NSW Liberal Party manifesto :

*"Where there are technologies that can reduce both our emissions and costs for households and businesses, we want to roll them out across the State. Where these technologies are not yet commercial, we want to invest in their development so they will be available in the decades to come," Mr Kean said. "Global markets are rapidly changing in response to climate change, with many of the world's biggest economies and companies committed to reach net zero emissions by 2050. NSW already leads the nation with its economic and investment plans and from today, NSW will lead the nation with its Net Zero Plan"*

**If the NSW government is truly committed to the above then this would appear to be a very good place to start.**

## **Objections**

***Battery Technology is developing fast is it not possible that if batteries fitted now will not be outperformed by new technology?***

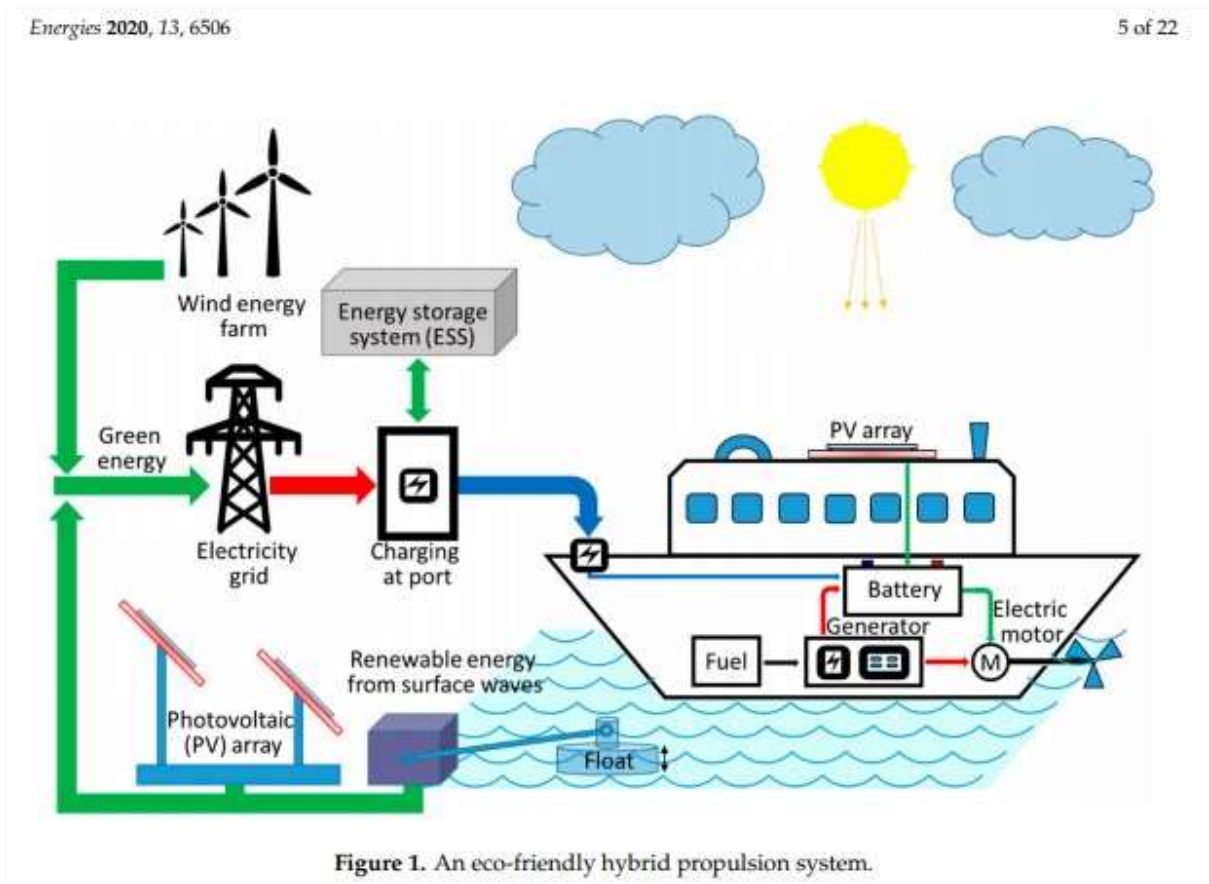
It is very likely new technology will surpass current battery design, however the financial modelling can account for replacement batteries after a period of time, (Washington State Ferries have used conservative nominal 6 years). It is unlikely that new batteries will be heavier, larger or more expensive and replacing the electric motors should not be necessary. Hence if the modelling works for current technology, it should only be a bonus if battery performance is improved.

***The cost of putting in place shoreside infrastructure to enable fast charging at the wharf will be prohibitively high.***

In looking ahead it is inevitable that Sydney Harbour ferries into the future will all be converted or replaced by electric ferries which will also have to be charged whilst alongside the wharf, hence such an investment will not only benefit Manly Ferries but can be shared in due course with others as they come on line. The Financial modelling similar to Washington State Ferries of this should shine light on this. However, it is worthwhile noting that there is considerable interest

in Battery and Power Companies such as Tesla and Origin Energy in becoming engaged in such a high profile project as clearly they too see the potential business value in this sector and would welcome the opportunity to establish first mover advantage.

Schematic Hybrid electric ferry set up that could be basis for Sydney Ferries.



There is in fact infinite opportunities for creation of renewable energy in and around Sydney Harbour. Below is Cockatoo Island in which it can be seen you have very large expanse of effectively unoccupied commercial property roofing for solar systems. Two docks that could be used for capturing tidal energy and possibility for erecting windmills. In summary this site alone could probably generate enough power on its own for all the ferries in Sydney Harbour.

I hasten to add that this has been put up as a possibility in order to generate some creative thinking, there are however many industrial areas past and present on and around the harbour that could be utilized for generating renewable energy.

Cockatoo Island





### Final Comment

Above, these are the ferries from China and Indonesia arriving in Newcastle in December 2020. Arriving in Australia with the main structures complete, and the engines and all components installed.

“People need to know 70 per cent of the work has happened here in Australia, and two thirds of the component parts in the vessels are Australian,” Mr. Constance said.

Having spent my entire career in shipping I am struggling to see or believe that these constitute 70%+ Australian content or have 2/3 Australian sourced components without some extremely imaginative accounting.