



Hong Kong Boating
Industry Association
香港遊艇業總會

The Low Impact Boating Initiative

What we can do now to reduce the environmental impact of our industry

Hong Kong Boating Industry Association

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Prepared by:

**Simon Boyde
Lawrence Chow
Louise Connolly
Chris Maden**

Summary

This paper seeks to introduce multiple measures to reduce the immediate environmental impact in the build and operation of leisure marine vessels.

The Low Impact Boating Initiative (LIBI) is a new framework to address areas in which the world wide leisure marine industry, from paddle boards to Superyachts, can work together to reduce the environmental impact of our industry.

There is an overwhelming scientific consensus that human activity is raising world temperatures, leading to unsettled climatic conditions and the potential for catastrophic rising sea levels on a world wide scale.

Our energy intensive lifestyles, increasingly adopted worldwide, are working against our ability to reduce greenhouse gas emissions and pollutants.

Where consumer campaigns around the world have had a huge impact on other industries - from plastic straw manufacturers to cars - our industry has failed to keep up with the changing commercial and regulatory environment outlined in the Appendix to this paper.

In general the Leisure Marine Industry has been a receiver, not an initiator, of environmental regulations mostly generated by National authorities. Few initiatives to address these issues have come from us as an industry.

While commercial maritime has been adopting increasingly strict criteria for build and operation of new and existing vessels, in comparison the leisure marine industry on a worldwide scale is still looking for exemptions on fuel use, exemptions on emissions, and much of the fleet is constructed out of materials which are impossible to recycle except with high energy inputs.

The Low Impact Boating Initiative seeks to rectify that deficit. We need to be leaders, not just followers, or we are in danger of received regulations putting our entire industry's existence in question.

An Industry Campaign: LIBIrate

A leisure marine industry campaign to reduce environmental impact will have a different focus to any public mass campaigns. Public campaigns are targeted to persuading the end user or consumer to alter their behaviour and to support political efforts to reduce the impact of the problem.

Internal industry campaigns need instead to focus on waste reduction, material selection, CO2 emissions and energy consumption as part of the build and future operation process.

In this respect, LIBIrate needs a two pronged approach. The first is an industry forum where members can share ideas, consider what innovations lie in the public and private domains, how to prioritise our efforts, how to fund areas of joint research; and how to present this to our customers so adherents can use this as a positive selling point.

The second is to work with public facing organisations on a national and international basis (for example the RYA and World Sailing) to promote these ideas: consumer preference has shown itself to be a powerful driver of change, and while many boaters are passionate about the marine environment, harnessing that passion will ensure both that our initiatives are aligned with what matters to our customers, and that our customers are educated.

This paper seeks to kick-start the process by outlining potential areas for research and reward, as well as discussion on reducing our long term environmental impact without causing detriment to the industry or imposing unmanageable cost increases.

What is important is to make sure that these changes are discussed, well planned, perhaps even regulated in the same manner as the International Maritime Organisation's (IMO) conventions which are adopted by the industry so real changes are made. We need to make a real impact, not just superficially in some form of green-washing, whilst trying to minimise any impact on industry competitiveness.

There are multiple points in the industrial cycle of leisure marine around which we have built our businesses where significant changes could be made to reduce the impact our industry has on the environment, on communities and on climate change. Most are obvious. In this paper we propose some quick wins, and some areas needing more extensive change:

- Speed and Design
- Energy Consumption
- Recyclability
- Single Use Plastics
- Legal/Contracts
- Water and Air Pollution

We have chosen these areas as a means of instigating discussions. The list is by no means complete or exhaustive.

Although the leisure marine industry has a much smaller impact compared to the commercial shipping industry, small scale innovations from the leisure marine industry can be scaled and improve commercial shipping. LIBI becomes the missing piece that forms the cyclical feedback loop between commercial shipping and leisure marine.

[A] Speed and Design

[1] *Speed*

For some boat owners speed is key. For many others, speed is not the driver to the boat purchase.

Initiative: Encourage naval architects, boat designers, boat builders and boat brokers to understand this: to make sure that, where possible, boats are offered with a range of powering options. The car industry has been doing this for years.

Smaller engines inevitably consume less fuel, emitting fewer greenhouse gases and other pollutants.

[2] *Design*

We should look at the design of the low impact boat with a view to reduce energy consumption while under way to maximise efficiency.

Modern boats are wider and with fatter sterns compared to their predecessors as a result of:

- [a] Mooring and licensing fees which in most countries penalise long thin boats.
- [b] Operator licensing which in most countries where it is applied works on length limits.
- [c] Cheap fuel resulting in more powerful engines being fitted to overcome higher drag.
- [d] Modern, lighter, materials enabling the build of larger planing boats.

Initiative: Naval architects have known for years that the best way to go faster in a displacement hull with the same power is to make the boat long and thin. By enabling long thin boats to be competitive in the market place we can reduce the propulsive power consumption.

National organisations need to consult with national authorities to make boat and operator licensing more one of area rather than one of length to remove the short fat boat advantage. Campaigns for slow boating can encourage non planing hull forms thus greatly reducing both fuel consumption and use of non-recyclable (but lightweight) recyclable material.

[B] Energy Consumption

[1] *Insulation*

Most modern boats are constructed without interior insulation or double glazed windows. This means in a cold climate that excess heat is required; and in a hot climate that excess cooling is required.

Initiative: Make insulation and double glazing mandatory for the construction of boats with significant interiors.

Most countries in Europe already have made the construction of a house without insulation or double glazed windows illegal. This has not made any impact on the selling price of the house, nor

of the construction cost, as the market being sufficiently large has reduced the prices of these items to compensate.

We should as national organisations promote the same, and engage in dialogue with national authorities to mandate such changes in law. There is simply no reason not to except on boats designed primarily for racing where no heating or cooling system is fitted or practically can be fitted.

[2] *Heat Scavenging (for cold climate boats)*

Most modern boats are built either with no heat scavenging devices on board or limited to domestic hot water only.

Initiative: For boats where interior heating is needed we should be promoting heat scavenging systems such that excess heat from the inboard diesel engine is recovered not only for domestic water heating (as is common on sailing boats) but that once the domestic water is hot enough, that additional excess heat can be diverted for use in central heating via a suitable heat exchanger.

[3] *Efficient Cooling (for hot climate boats)*

Most modern boats if fitted with air-conditioners use the most basic off/on compressor systems which both consume outsize amounts of energy for the cooling they produce and mandate the fitting of large generators on board to deliver the start-up loads for these systems.

Initiative: Fitting the new variable speed compressor air-conditioning systems should be encouraged. National organisations should consult industry and national authorities with a view to phasing out the old on/off compressor air conditioning systems as simply too wasteful in energy.

For those operating areas where cold water but hot air is common - especially inland waterways where flowing water is kept cool from the heat sink effect of the ground below the river or canal bed - so called “free air conditioning” can be employed. If the temperature of the surrounding water is below 14°C then it can be used directly in a heat exchanger to cool circulating water for air-conditioning cooling on board without running a compressor.

[4] *Genset Sizing*

Many modern boats have aggressively large generators fitted for no good reason except to “future proof” the boat against any high power toys which may be fitted after the boat leaves the yard. However in actuality this rarely happens. Nonetheless owners frequently ask for enormous power generation to be placed on board leaving the hapless boat builder with no choice except to comply.

Initiative: A regulatory change here would work well. We could make it part of the ISO standard set (ISO/TC 188) that a boat's peak power consumption is calculated and that the largest genset which is permitted to be fitted (say 20% larger than peak) is then stated on its builder's certificate. Genset size can then be checked on registration by national authorities.

[5] *Renewable Source of Power*

Very few boats are constructed with the fitting of solar panels or wind generators in mind. If fitted by the manufacturer these are normally an afterthought.

Initiative: Add to the ISO standard set a new standard mandating a minimum level of renewable energy power generation on board. We could recommend, for example, 20W per metre of boat length or 10% of generator size, whichever is larger. Using Ken Wittamore's proposal from the METS "How Much Greener Are We" panel discussion to add a fossil fuel usage per kWh rating to each boat should be considered. Owners can be incentivised to purchase boats which meet this standard via reduced licensing fees from national authorities.

[C] Recyclability

[1] *Hull Materials*

Almost all leisure marine boats are now built out of some form of composite material - be it glass or carbon, constructed with polyester or epoxy resins. The buying public has become used to the modern double curvature shapes and glossy smoothness this building method makes straightforward to produce. But very few of them, it seems, are aware that there is not, currently, a single economical use for such composites once the boat is disposed of. (See yachtrecycling.org)

Work is being done on this of course - ICOMIA is in the process of agreeing an End-of-Life (EoL) policy paper on the disposal of old vessels; research has been done in Europe on the incineration/pyrolysis of composite material to use in cement; and in the Netherlands (Windsheim University) in the re-use of such material to make piling sheets. Costs however far exceed using new material for the same, even if it was appropriate (See IMO paper "End-Of-Life Management of Fibre Reinforced Plastic Vessels 2019").

The scale of the current problem dwarves such efforts: figures suggest that in the EU alone 80,000 boats need deconstructing each year and that means, currently, that 97% of them get ripped up and put into land fill (see ICOMIA EoL Policy Paper). The industry needs to stop adding to this issue in the absence of a economically viable recycling method..

The industry needs to recognise this issue. The industry associations should start promoting alternative boat building materials and the re-use of existing hulls.

Initiative: Examine and promote alternative hull construction materials. Examine and promote alternative designs which can use such materials effectively

Alternative Materials:

At METS in 2019 there was a panel discussion on EoL boats which focussed mainly on open loop solutions - ways to re-use shredded boat hulls constructed from thermoset composite materials in other products for other industries. It was clear that none of these solutions (with the possible exception of carbon fibre) produced a recycled material which was cost competitive with virgin material. So the obvious solution, surely, is not to use thermoset composites in the first place.

Obvious replacement materials are wood (which despite modern coatings is still mainly a biodegradable material) and mild steel. Both are capable of high re-use rates on deconstruction of boat hulls. Steel has approximately the same greenhouse gas “bill” as composite materials, half that of aluminium, yet over 90% of the original material is recyclable and being recycled (see <https://www.euric-aisbl.eu/position-papers/download/591/335/32> - this paper states with confidence that 70% of steel EVER produced is still in use)

Wood suffers from a high maintenance rate which currently makes it unattractive to buyers. Additionally the cost in today's world of constructing wood hulls puts the finished product beyond the reach of most boat buyers - even if stunning boats like those from Spirit Yachts are possible. For many hardwoods the growth time is so long that sustainable supply is already fully committed (though recent developments in engineered wood by companies such as Lignia look promising).

With few exceptions the vast majority of boat builders have not looked at steel as a material for more than fifty years. Available designs therefore tend to be old and to the modern eye unattractive. Customers think that steel rusts, is unattractive, hard to keep the steel true etc...

All of these ignore the huge progress made with steel coatings and automatic welding machines amongst many other advanced production methods used every day in commercial maritime. Steel has a similar carbon footprint to thermoset composites of around 2 tonnes CO2/tonne of steel (see Worldsteel “Steels Contribution to a Low Carbon Future”) . If energy inputs for recycling come from renewable sources then the CO2 impact drops considerably.

Awards

We recommend that awards are made for best boat design in steel or other CURRENTLY economically recyclable materials.

We recommend plans are put in place for awarding research into alternative boat building materials and assessing the economic cost of recovery of such recyclable materials such as Filava; that all national associations put in place prize schemes for best boat NOT built out of composites; that the confusing and erroneous advice that steel is not environmentally friendly is challenged at all levels. This may help to modernise the image of steel boat building and bring it back into the purchasing scope of customers who probably mostly still associate it with ageing rust heaps.

[2] Re-using Hulls after their operating life.

Going back to that figure of 80,000 boats a year needing disposal leads to a parallel effort: re-use of existing hulls for new boats. As an industry we market the new. It should be easy for us to market old hulls as new with a little thought and preparation.

To do this effectively we need to make the purchase of a re-manufactured old boat as an equally attractive idea as the purchase of a newly built boat. We need to encourage such closed loop recycling, so called because the recycled materials are used in the same industry where they were originally deployed, where we in our own industry make economical use of old boats.

Initiative: To develop a set of standards and policies making the reuse of existing hulls for new boats economically attractive and marketable.

We need as an industry to come up with a standard of what needs to be done to ensure that the purchaser gets the same anticipated life out of a re-manufactured hull (say 30 years) that they would expect from a newly constructed hull.

We need ISO/TC 188 standards to understand re-used old hulls; we need Notified Bodies and Classification Societies (and their surveyors) to be aware of and promote the effort; and that national organisations are briefed to provide information to potential customers.

We should promote research into what is viable - there may be differences depending on boat size for example - on this front.

[3] *Boat Interiors*

Modern boat building methods prioritise reducing the build cost of the boat to a much greater extent than previously. As a result many modern boat interiors are constructed in such a way that it is effectively impossible to change the boat interior in any significant way.

Modern standards and naval architectural practice on small vessels also makes this difficult if not impossible for anyone other than the original designer/boat builder to do this as mandatory plan reviews are required. This normally means access to original plans which are frequently not available resulting in throw-away vessels as the interior cannot be refreshed except superficially.

Marnix Hoekstra of Vripack noted in the METS EoL panel discussion that by using CAD anything is possible and designing a boat for deconstruction just needs the will to do so as making these changes at the design stage is a comparatively low cost.

The aforementioned general panel discussion at METS on “How Much Greener Are We” also agreed that “construction materials of the future must have an inherent end-of-life commercial value” which indicates support for these concepts.

Initiative: Promote changes to standards for new boat construction to simplify the maintenance of boats, enable the interior (and hull) to be more cheaply repaired or refitted, enable the use of interior materials that are capable of being removed and recycled. Updated regulations should mandate that build plans are made available for later reuse.

There are public campaigns about the “Right to Repair” in many countries which feed into this.

There should be a method to assist builders to be able to comply with this. A central register for all boat plans would make this easier, perhaps with an international organisation such as the IMO or ICOMIA or even on a future LIBIrate website. At the very least it could be with the national organisation of the country in which the builder is registered. If the plans still have commercial value an access fee can be charged.

A possible change in standards would be to prevent new build boats from being designed such that the interior fit out is part of the structural strength of the hull. By this we do not mean building boats without bulkheads (bulkheads are part of the hull which impinge on the interior fit out rather than the other way round). We mean instead to have rules in place to reduce the use of interior mouldings which act as structural members.

Boats constructed in this way are enormously difficult to repair in the case of serious collision as such interior mouldings are typically only capable of being fitted when the deck is not on the boat. Inevitably this means that many boats after an accident are put beyond economic repair.

The ability to de-construct needs to be made an important part of the design phase. In time this should lead to many more hulls being capable of being used in re-manufactured boats as described above; and significant changes to boat interiors being made possible after build.

[D] Single Use Plastics

ICOMIA has issued a policy statement on single use plastics which closely mirrors the worldwide public campaigns against usage of straws and plastic water bottles. While this of course should be encouraged we should in the industry look at additional ways to reduce the amount of single use plastics we use in the boat building process, in the packaging of components for supply and in boat maintenance and storage.

Initiative: commission studies in single use plastic use in boat building/maintenance and storage to deliver alternatives using reusable materials to avoid waste.

In boat building we should encourage build processes where wrapping of the boat components during build to reduce damage is minimised - possibly by fitting components later? By increasing the modularity of the build process so boats are built as sub modules which are later fitted together? This will need significant thought by builders and designers on how to achieve this.

With packing of components we should encourage manufacturers to use minimal packing materials and avoid the double wrapping which is so common in part packaging.

In many cold climates boats are wrapped in winter to prevent weathering while dry stored during the winter season. This wrapping is simply discarded in the spring when the boat is put back into use. Surely re-usable wrapping is possible and should be promoted? They used to be used of course, we called them tarpaulins.

[E] Legal and Contracts

We should look to see what legal restrictions are imposed in standard contracts which inadvertently have a significant impact on the environmental impact of the entire boat building and operation practice.

Whereas purchase contracts in most markets used to be one off affairs created between purchasers and providers, nowadays most contracts are based on standard terms discussed and agreed by national organisations (both for industry and consumer). Many of these contract improvements around the world have come out of consumer protection laws - making sure that bad operators have fewer opportunities to defraud customers.

Penalty clauses for late delivery can be so onerous that the builder (or builder's supplier) may need to discard items already purchased; or require urgent delivery of fittings requiring airfreight to deliver them. Contracts in general frequently provide for late changes by purchasers to be made thus shortening the lead time available for suppliers to get the required fittings to the builder.

Initiative: National organisations, both business and consumer, should review standard clauses which encourage such behaviour, enabling longer lead times to be established thus enabling lower impact shipping to be used to deliver components. Perhaps making it standard for optional fittings to be pre-paid by the purchaser and stored at the builder's yard? Other changes are possible and this has to be one of the first places to look to make real changes to production and supply waste.

Another area where waste and late delivery is encouraged is from manufacturer's warranties. Most builders want a 2 year warranty on fittings, and want that 2 year warranty to occur on the date of commissioning or even from handover to customer. However while some manufacturers offer this, many have more limited warranty arrangements - from 12 or 24 months from date of invoice to vendor being common. Again this encourages as late an order as possible from the builder which means air freight or express shipment in some other form, rather than slower and less polluting delivery methods.

[F] Water and Air Pollution

[1] Water Pollution

In most developed world markets leisure marine vessels are restricted from dumping sewage into the waterways. However we should expect (and pre-empt) further restrictions to apply in the near term - after all commercial vessels are restricted under IMO regulations from dumping oily bilge water, from grey water output in inshore waters etc. The most recent ISO standard set has been updated to mandate the installation of black tanks but not to prevent their discharge from on board. Sink grease traps are not required.

Initiative: A regulatory change to the ISO standard set (ISO/TC 188) to require new build vessels to be fitted with bilge water filters, sink grease traps and to at least require space for grey water tanks to be fitted.

National associations could explore with their members the addition of grey water tanks and grease traps to new build vessels, together with collection facilities onshore. Perhaps this can apply only to vessels capable of overnight use? Habitable boats only?

There is continuing research on effective anti-fouling methods. National organisations should work with ICOMIA and other international bodies to encourage adoption of proven technologies which reduce water pollution. This has been covered in depth by other committees within ICOMIA.

[2] Air Pollution

Fuels for propulsive engines fitted to boats are overwhelmingly petrol or diesel, which release pollutants into the air.

In commercial shipping, Liquefied Natural Gas (LNG) is increasingly being used and alternatives like ammonia are being explored.

Initiative: Support research into alternative fuels for existing engines. Support research into multi-

fuel engines - permitting diesel burn where LNG is not available for example.

Many companies are now marketing electric boats where the refuelling operation is a recharging operation.

Regulations on emissions, driven by national governments, are coming to the leisure marine industry. It seems inevitable that electric drive systems are very shortly going to become mainstream. For example World Sailing has changed its regulations this year to drop the minimum fuel requirement to be carried while racing to accommodate electric drive systems. The EU has announced strict emission regulations are on their way.

Initiative: Support mass roll out of electric recharging points for boats, especially those used in city environments.

[G] Conclusion: LIBIrate and Awards

We should come up with a metric for a business, for a product, for a boat, which lets the purchaser know that the ideas above - practical methods of reducing the environmental impact of our industry - have been considered and used where appropriate.

We can develop a website where companies can register under the Low Impact Boating Initiative and LIBIrate themselves - with, preferably to stop green washing efforts, some form of national organisation vetting of the rating to make sure they are not just making this up.

As ICOMIA we control METS. As national associations most of us have at least a large say in our national boating press and national boat shows. We have the ability to reward and especially Award companies and products which prove practical steps to reduce their environmental impact.

We must change awards like the DAME award to recognise truly innovative products which reduce environmental impact in their different sectors.

We must change Boat of the Year awards to promote low impact boats and their designs. At the very least we should modify the award criteria to include an environmental assessment.

We must add awards for boats built out of recyclable materials and for low emission boats.

We should add awards for designers and builders who make their boats de-constructable, who re-manufacture hulls, who use recycled material in their build processes. Who design and build boats to simply use less energy to do the same job.

We should award best boat NOT built out of composites; that the confusing and erroneous advice that steel is not environmentally friendly is challenged at all levels.

We must use our ability to generate publicity to make these statements. These must be at the forefront of what we do and promote.

If we do not it is clear it will be done for us with the consequent bad press and the erosion of our industry.

Appendix - Background to LIBI

There is an overwhelming scientific consensus that human activity is raising world temperatures, leading to unsettled climatic conditions and the potential for catastrophic rising sea levels on a world wide scale. These changes are closely coupled to a rising world population and the concurrent rising standards of living: natural and human responses to availability of comfort, easy access to powered devices and globalisation with its promotion of both international travel and trade.

Coupled with this world wide temperature rise we have the natural corollary from increased human industrial activity of widespread environmental pollution and the consequent imposition of regulations in order to limit it.

The logical consequence is therefore, as a minimum, to make sure that any activities which we perform have a lower impact on the environment where this is possible. Leisure marine, be it paddle boarding or a super yacht charter, needs to follow this pattern.

It is the purpose of this paper to provide a framework in which the Low Impact Boating Initiative can be stated; to provide a reference place for ideas which national organisations - Marine/Boating Industry Associations; customer membership National Associations - can enter into dialogue with their members and National Authorities (governments, coast guards, marine/boat standards bodies).

Climate Change

Human activity since the dawn of the industrial age has been generating a rise in world temperatures triggering climatic changes. A primary cause has been identified as green house gas emissions, principally carbon dioxide, from the burning of fossil fuels; quite likely coupled with excess waste heat from human activity, forest clearances triggered by agricultural product demand then reducing CO2 absorption, huge growth in high level clouds from aircraft reflecting heat back to the ground etc...

There is a strong and vocal minority which refutes this, but nonetheless it makes poor business sense to plan for the minority viewpoint. To restate Pascal's Wager (made for the belief or not in God for an individual) for business in climate change terms:

Pascal's Wager on Climate Change: Business Response	Situation: Human Caused Climate Change Is Happening	Situation: Human Caused Climate Change Does Not Exist
Action: Reduce Environmental impact of products and services	Delays or prevents fundamental environment change preserving future of current business while selling to the majority	Preserves future of current business – selling to the majority
Action: No change.	Accelerates the end of current business – selling to a minority in a rapid changing environment.	Endangers future of current business – selling to the minority

As a short summary, as soon as you are selling to a market which believes that anthropogenic climate change is real, your most successful outcome from the matrix representing Pascal's Wager

above is to operate your business the same way, and to make sure the products and services you offer are tuned to match this market. Out of the matrix of solutions above there are no circumstances where it makes sense to run a business on the assumption that climate change is not happening.

It is not relevant in this context whether anthropogenic climate change is real or not; though this paper's authors are convinced from the evidence that it is.

Human Population

The lead correlation for the increase in fossil fuel burning and the consequent recent increase in CO₂ in the atmosphere, plus ancillary global warming effects, unquestionably has to be human population growth. Between 1950 and today the world population tripled: from 2.5 billion to 7.5 billion. (See population.un.org) This expanding population in turn consumes more resources per person than the generation before (a human and natural reaction to availability) as technology, agriculture and medical progress has made a lower percentage of the world population operating in starvation mode.

This is as you would expect to happen, and we would hope want to happen, as people's lives round the world get somewhat easier, on average, each generation.

However we don't have more land and we don't have more sea than we used to. This inevitably means there is a growing conflict between resources wanted, used or needed for humans, and those left for the rest of the species on the planet.

We may have passed peak child – or are near to do so. Latest projections expect just 2 billion children to be in existence going forwards, with numbers starting to drop by the end of this century (see <https://population.un.org/wpp/Graphs/Probabilistic/POP/0-14/900> for details). However total population, due to longer effective life spans, is likely to grow throughout this century, likely to exceed 11 billion before the end of it before starting to reduce early in the 22nd Century. Expect another couple of centuries after that before human population can reduce even to the levels of today.

Unquestionably this means a massive increase in energy consumption at current rates, and unless alternatives to fossil fuels become cheaply available, it will mean increased fossil fuel production and consumption with likely catastrophic results.

Obvious changes on the horizon include huge increases in wind and solar power – though of course solar power generation carries the risk of a huge increase in waste heat – to help reduce this fossil fuel increase together with other environmental generation systems (geothermal and hydroelectric being the most promising). Within fifty years it is likely now that fusion power will be in place – again though with the caveat here about waste heat – after the recent developments in China, the EU, UK and the US on this front.

Many governments round the world have given commitments to massively reduce their CO₂ emissions by mid century, and in several countries to act as net CO₂ sinks. CO₂ capture technology is being developed as well.

Nonetheless world energy requirements are still increasing at 2% a year, which means providing

more energy generation EACH year than the entire current world installations of wind and solar power (see <https://www.spectator.co.uk/article/wind-turbines-are-neither-clean-nor-green-and-they-provide-zero-global-energy> for a somewhat over the top summary of the situation which nonetheless states some cold hard facts).

Environmental Degradation and Pollution

All of this human activity, which inescapably is going to continue increasing at a minimum for well over a century, results in waste products which end up in the world around us. This environmental degradation can take many forms from the obvious air/water pollution and contaminated ground-water/land to the hidden like damaged river banks, lack of water capture, increased flooding, environmental noise etc.

Even efforts to move from fossil fuels to agriculturally renewable liquid fuels like ethanol made from sugar cane or maize are not without criticisms – for example one research paper reports 50% of Amazon forest clearances could be simply to accommodate displacement of other forms of farming which have moved due to increased bioethanol acreage. (See <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2840431/>)

Recently several European cities have reacted strongly to PM2.5 air pollution exceeding their alarm levels, resulting in banning of diesel road vehicles. It is likely for inland waterways boat operators that restrictions similar to those recently introduced in Amsterdam, requiring all vessels on its inner waterways circuits to be solely electric powered, may well become more widespread. (See <https://www.bbc.com/news/business-45783085>)

In the EU, with the new European Green Deal, more restrictions are likely, and not just those on air pollution. They have announced promotion of the concept of the circular economy, have announced near term dates for zero pollution environment planning, as well as shifts to sustainable and smart mobility.

Globally the IMO has refused to permit current exemptions for non commercial vessels over 24m (Superyachts in other words) from the Tier III Emission Control Areas to continue after 2021. While these areas may not affect the majority of the world, they can be expected to spread, and currently cover the Baltic, Caribbean and US coastal waters.

In the UK research papers have recommended reduced speed limits and even baffle plates below props to prevent damage to canal bottoms (see <https://canalrivertrust.org.uk/media/original/24189-montgomery-canal-hydraulic-aspects.pdf>). Restrictions on wood burning stoves are being enacted.

There have been worldwide calls by environmental action groups to have vessels offshore navigate at a slower speed to create less noise to reduce the risk of marine animal impact and aural disturbance. (See <https://www.frontiersin.org/articles/10.3389/fmars.2019.00505/full>)

Many countries have restrictions on black water and grey water emissions – tagging on to IMO regulations which also restrict dumping of sewage effluent. Even in Hong Kong where the regulatory touch is very light indeed, all marinas insist on the installation of black water tanks and specifically prohibit black water output into the marina waters.

IMO and Commercial Maritime

The International Maritime Organisation and commercial maritime in general is being a leader in this respect. There is a new low sulphur fuel directive which became international law on January 1st this year. Already there have been prosecutions – including in Chinese waters since January 1st – over excess sulphur emissions from burning low end heavy fuel oil.

Multiple vessels have already been put into operation which either solely burn LNG or are dual fuel and can switch between diesel and LNG. Natural gas in this respect is considered to be a greener alternative to diesel as it has lower CO₂ output per kWh of energy produced. Ammonia is being considered as a serious alternative to diesel as a future fuel already with two ships being ordered which ammonia 2 stroke engines. Ammonia is considered to be a possible long term replacement due to the ability to produce it from renewable sources. (See <https://www.offshore-energy.biz/ammonia-fuelled-23000-teu-boxship-design-gets-aip/>)

Overall the IMO has made it mandatory for all new ships by 2025 to have 30% lower emissions and all new large container ships to emit half the CO₂ of the existing fleet even earlier in 2022. The IMO is indeed aiming to be carbon neutral soon after 2050.

But these are only the most recent efforts being done by this world body. Over the last several years multiple conventions have been approved which control emissions from commercial maritime, from black water to oil in bilge water, replacement of gases in coolant systems to less damaging alternatives trials of more efficient propulsion systems on a large scale – including commercial use of wind once again! Eyes are out looking at the full cycle of the ship existence with conventions on ethical ship scrapping now accepted by most major maritime nations.

National efforts – in Japan, Hong Kong, China and amongst multiple European countries have produced battery powered ferries and barges on short routes to see how their efficiencies compare with conventional small ships.

In comparison the leisure marine industry on a worldwide scale is still looking for exemptions on fuel use, exemptions on emissions, and much of the fleet is constructed out of materials which are impossible to recycle except with high energy inputs.

Although the leisure marine industry has a much smaller impact compared to the commercial shipping industry, small scale innovations from the leisure marine industry can be scaled and improve commercial shipping. LIBI becomes the missing piece that forms the cyclical feedback loop between commercial shipping and leisure marine.