### lateral

/'lat(ə)r(ə)l/ adjective involving lateral thinking. synonyms: unorthodox, inventive, creative, imaginative

### futurology

/ fju:t[ə'rɒlədʒi/ noun systematic forecasting of the future, especially from present trends in society. synonyms: futuristics, foresight, forward-looking

## Lateral Futurology /'lat(ə)r(ə)l/ /,fju:tʃə'rɒlədʒi/ way of thinking

ability to conceive innovative superyacht technical platforms which enable design via the application of engineering and technology. Breaking from established thoughts, theories, rules, and procedures; changing the paradigm.

synonyms: meaningful innovation, ask new questions

### FUTUROLOGY

**Futurology** is the study of postulating possible, probable and preferable futures, and the worldviews that underline them.

How do you think about THE FUTURE of superyachts?

Think back 100 years; yachts were powered by steam. Now try to imagine the year 2119. What technologies do you foresee as underpinning your view of the future?

No matter what your perspective is, there are many outcomes that may equally come to pass, but what can we say for certain?

### THE FUTURE IS ZERO

We believe this with conviction; ZERO carbon, ZERO emissions.

Zero, driven by a worldview that is rooted in the need for greater sustainability in all areas of our lives, including the business and pleasure of superyachts.



HOW WILL WE **ACHIEVE ZERO?** 

It is easy when looking at the future to quickly lose sight of the wood for the trees; the frenetic pace of technology development can quickly lead to overchoice; where the complexity and diversity of available options leads to a tendency to revert to the simplest most familiar and perceived lowest risk solution.

Over time this factor can lead to a stagnating and risk aversion pathway developing, and paradoxically, choice leading to a narrowing of engineering innovation rather than widening it. To avoid overchoice we need to 'dial out' to a simpler, higher level view and set a methodical narrative that underpins our choices.

Lateral Futurology is the framework and methodical narrative that underpins how we strategise our technology and engineering choices. It is based on the idea that there are three key elements that shape the choices we can make;



1. Long term technological improvements



2. Challenging design & operational paradigms



3. Alternative fuels and energy sources





## "Marginal gains: it's not just about the bike."

DAVE BRAILSFORD



We are all familiar with the progress of technology via innovation. It is at the heart of what engineers, designers, yacht builders, equipment suppliers and a whole plethora of our industry do every day.

However, the pace of innovation is progressive, in short it is a long-term game and generally delivers benefits in an incremental gains approach. It would be unrealistic optimism to assume, in a mature industry, that a single technical innovation is going to deliver a very significant gain, similarly it would be arrogant to assume that there

We believe that, in the long term, the progressive development of Technology Advancement may deliver up to 20% of progress to Zero.

# 1 TECHNOLOGY ADVANCEMENT



# 2 CHALLENGE THE PARADIGM

Challenging The Paradigm is often not comfortable. as it dictates a different outcome to the norm, but can enable designs which stand apart.

Take a look at the world's supervacht fleet. Aside from a highly diverse range of adventurous and iconic styling, audacious lifestyle features and artisan interiors, the yachts all follow a similar technical format. That similarity is embedded deep within the statistical data of principal dimensions, Gross Tonnage and general proportions and form. If we challenge this - the very fundamentals - then there are significant potential gains to be made.

When you explore what Challenge The Paradigm can produce, it is a powerful tool because it has the potential to deliver in a short timescale and at low technical risk. We believe that Challenge The Paradigm can deliver a relatively easy 30% of progress to Zero.



"If I had asked people what they wanted they would have said faster horses."

**HENRY FORD** 

LATERA





Alternative fuels hold the promise of achieving the full 100% required to get to zero. It is possible to engineer and build a yacht today that would achieve zero, with a relatively low technology risk. However, it is the operation that presents the barrier because the mechanism to deliver alternative fuels across a prolific and well-established distribution network remains very embryonic.

One vision of the future, based around the use of hydrogen, is that energy generated via renewable sources is transported via the electrical network, and converted locally at the point of distribution to hydrogen. This is then used onboard via fuel cell technology to generate electrical energy. There is a key theme here, and that is electrification. We believe that electrification is the gateway to fully exploiting the use of future fuels, cleanly produced via renewable energy.

LATERAL

## ALTERNATIVE FUELS

## QUESTIONS

What technical innovations will your next project invest in?

1

3

Are you brave enough to 2 **Challenge The Paradigm?** 

How will your project be ready to take advantage of alternative fuels in the future?

LATERAL



**Technical innovation focused on electrification;** E-Hybrid read about @ **INCEPT(•N** technical platform



### Challenge The Paradigm;

Oceanco / Lateral LIFE technical platform, 15% more length = 30% closer to Zero

3

### Alternative Fuels;

Investment R&D in hydrogen technologies read about @ project AQUA

## LATERAL FOCUS

### LATERAL







## Is a battery powered **Yacht feasible today?**

Ask new questions.



## THE FUTURE IS ELECTRIC...

#### Electrification is the gateway to future technologies.

With an electrical architecture on board, Inception is configured to take advantage of future technologies, within an integrated energy system covering both hotel and propulsion loads.

Keeping pace with rapid advancement in battery technology, the next development of hybrid will see batteries becoming the primary power source on board, dictating that the next step beyond hybrid is perhaps not diesel electric, but rather electric diesel.

The Lateral **G-HYBRID** system is designed to incorporate the use of batteries as a primary source of energy. Diesel generators are provided for higher speed propulsion and battery recharging.

Batteries allow the varying power demands of a modern superyacht to be seamlessly met. This also enables the diesel generators to be selected purely on the basis of efficiency and optimum energy density.

The result is an elegant solution for now and the future using technology currently available.



## INCEPTI • N



- Higher fuel efficiency.
- Reduced emissions.
- Flexible in operation.
- Future proof.
- Compact design to fit on a single deck.
- Optimised generator loading.
- Noise silent mode at anchor and underway.



## MODE OF **OPERATION**

The Lateral **&**-Hybrid has two principle modes of energy management;

- Battery Discharge.
- Battery Charge.

The Lateral **&**-Hybrid system uses these two modes of energy management to support four typical operating scenarios:

- At Anchor
- Silent Cruise
- Extended Cruise
- Performance Cruise



All power is supplied via the battery pack for 6 - 8 hours with zero emissions. The battery is charged during a 2 hour period with generators operating at maximum efficiency. The generators are selected not to match variable power requirements (as is current practice) but to provide optimum fuel efficiency and energy density for the extended operation of the vacht.

### Silent Cruise okts



Power is provided via the battery pack only to assure silent cruising and zero emissions. The battery offers 3 hours operation at 10 knots or 6 hours operation at 6 knots.



For efficient relocation or efficient long distance cruise, the power is provided by diesel generator(s) depending on speed requirement. Generator(s) will operate at peak efficiency to allow extended periods of zero emission cruising.

### Performance okts

Cruise -



10kts



16kts

16kt



All the electric power is used to achieve a top speed up to 16 knots for up to 3 hours. In this mode the three generators and the battery pack work seamlessly together to deliver maximum power.

## **INCEPTION**

### SYSTEM ADVANTAGES

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- Allows periods of zero emissions to suit sensitive environments and improve the onboard experience.
- Complete flexibility of power management to suit any yacht operation without compromise.
- Allows for future upgrade to make use of alternative sources of energy when new technology allows.
- Fits in a single deck height engine room.
- Lower machinery running hours to give reduced maintenance.

### SYSTEM DISADVANTAGES

- There will be a significant cost and weight increase related to the batteries, this will be offset by the reduced number of prime movers.
- Additional technical space is required for batteries, this does however allow novel technical space layouts to be integrated.
- The system has additional complexity that requires detailed engineering solutions throughout design and commissioning.
- Through life cost of battery replacement will be significant although this will be partially offset by reduced generator and machinery maintenance. .





### SINGLE TIER ENGINE ROOM DESIGN

### LEVERAGING TECHNOLOGY TO OPTIMISE TECHNICAL SPACE

The single tier engine room design is enabled by three fundamental features;

- A highly efficient, extensively optimised, long and slender hull shape leading to a reduction in overall propulsion power demand.
- The design is developed with a maximum speed and operational profile representative of real world operation.
- The hybrid propulsion system is optimised to minimise machinery space whilst allowing the yacht to make use of the latest energy saving technology.

These principles result in the design entering a 'virtuous circle'. At the center of the virtuous circle is the result - a single tier engine room. As the yacht becomes more efficient the technical space volume reduces, which in turn allows greater utilisation of space to luxury areas.





## ENERGY SYSTEM OBJECTIVES

- Compact design to fit on a single deck.
- High efficiency.
- Reduced environmental footprint.
- Flexible in operation.

### DESIGN FOR ENERGY REDUCTION

- Best in class hydrodynamic efficiency.
- Integration of battery systems to allow optimum machinery operation at all times.
- Heat and energy recovery systems.
- Intelligent energy optimised air conditioning.
- Intelligent specification of systems combining commercial marine best practice with yacht requirements.

## DESIGN FOR ENVIRONMENT

- Carbon use reduced fuel usage, reduced energy consumption, higher fuel efficiency.
- Able to meet all possible ECO class requirements.
- Air emissions able to operate in all Emission Control Areas (ECAs).







Auxillary equipment

Hotel switchboard & control room

2 x Bowthrusters @ 300kW each



### ALTERNATIVE FUELS

Green Hydrogen created from renewable sources is a zero carbon, sustainable fuel source. There are many evolving options for how to best store, transport and use hydrogen to generate electricity for use onboard.



Electricity is created from renewable sources such as wind and/or solar.





Electricity distributed by land based grid.

Water is electrolysed to create hydrogen at locally distributed

facilities.



## PEM Fue







#### Zero carbon fuel used on board the yacht.

el Cell	SOFC Fuel Cell	Combustion
luivalent achinery	+ Approx. equivalent to normal machinery	+ Machinery as per current yacht
t system	+ No exhaust system	+ Machinery as per current yacht
safety	- Additional safety integration	
	- High temperatures	
cient	+ Highly efficient	+ Low efficiency
oment	+ Some development	- Not generally developed in sizes to suit yachts
	+ Quiet	No N&V benefit

### 'TREADWATER' - Novel combinations of existing technology

AQUA is fitted with Lateral's TREADWATER propulsion concept, an example of the technical innovation pillar. This combines existing and proven technology in a novel application to deliver a system that provides the ultimate yacht manoeuvrability whist simultaneously improving efficiency. The TREADWATER system combines the use of 2 Voith Schneider Propeller (VSP) units and a single Contra Rotating Propeller (CRP) resulting in:

- Ultimate precision manoeuverability for harbour and DP operations. Superior response compared to pods due to instant thrust in any direction from VSP units.
- No rudders or propeller shaft drag. Improved propulsion performance. Efficiency gains of 9% at range speed and 7% at top speed.

### HULL FORM - Challenge The Paradigm

The main dimensions of AQUA challenge the norm. Her waterline length is very long compared to her gross tonnage (volume), and therefore weight. A high length to displacement ratio brings significant benefits to the hull form development:

- Wider freedom and effectiveness of hull optimisation.
- 30% reduction in resistance compared to a similar volume yacht of typical dimensions.
- Inherently good seakeeping and comfort performance.





2 x Voith Schneider Propellers – **Ultimate manoeuvrability** for DP and harbour operations with instant thrust in any direction.

Provides propulsion and steering thrust when underway. **No rudders required**.

Units can direct thrust to reduce rolling motion at sea. This allows a reduction in the size of fin stabilisers, leading to further reduced resistance.







MAND GAR

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SINOT YACHT ARCHITECTURE & DESIGN © 2019

AQUA

### **TECHNOLOGY READINESS LEVEL**

There are a number of ways to approach and address the use of new technologies in Superyacht technical platforms, but whichever is taken it must be appreciated that someone has to build and warrant the final vacht, and beyond that the end user has to have a reliable and robust yacht that they can enjoy in line with their original vision.

The adoption of future technology can present both technical and commercial risks. Finding the right balance between risk and reward is critical to the success of any project wishing to push the boundaries.

Lateral employ a structures system of Technology Readiness Level (TRL) to differentiate technology maturity vs technical and commercial risk.



### TRL vs Diffusion of Innovation

• TRL 0 - Blue Sky Idea

Anecdotal concept with no analytical proof of feasibility.

• TRL 1 - Paper Concept

Exists only in paper proposals or academic research, analytically proven.

• TRL 2 - Industrial Development

Product is not being developed for a marine industry application however a test rig or prototype product exists to develop the technology to a real world application.

- TRL 3 Marine Product Development Product is not offered for sale, however a test rig or prototype product/installation exists.
- TRL 4 First User

At least 1 reference yacht, concept fully certified by authorities for marine use.

• TRL 5 - Common Practice

Multiple reference yachts and vendors available.

• TRL 6 - Obsolete Obsolete by increased regulation or alternative technology.





## **ASK FURTHER QUESTIONS**

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