



LEAN PROPULSION



SILENCE IS GOLDEN

LEAN AND GREEN



**THE BEST SOLUTION  
FOR YOUR YACHT**

LET US GO ELECTRIC

## STADT LEAN PROPULSION®

Yacht owners need *reliable vessels* that are efficient to operate, year after year, in all seasons and weather conditions. Most importantly, the yacht must have a *reliable* and quiet propulsion system with propellers and power systems that never fail. One that enables them to operate safely anywhere on the planet. As a vendor of electric propulsion systems for many years, we asked the question: “Can a new way of thinking also give us a new generation of propulsion systems that are prepared for tomorrow’s environmental challenges” ?

STADT AS has taken these challenges seriously, when developing the STADT Lean Propulsion®, based on patented, STADT Dynamic Ultra Low Frequency Switching Technology, now available for the most powerful crafts. An electric propulsion system that is amazingly *reliable*, and also reduces service costs, weight, fuel, emission and waste, while freeing up space by its compact design. Ready for zero emission solutions.

A sophisticated and silent system performance, documented extremely long lifetime, far ahead of competitors and excellent manoeuvrability.

The new drive technology has been awarded several times for its unique characteristics, and many ships are now sailing with the Lean Drive technology all over the world.



**Hallvard Slettevoll**  
*Director , CEO*

## STADT - AWARDED TECHNOLOGY LEADER

STADT GROUP AS was established back in 1985 by Hallvard L. Slettevoll. In 2015 a modern STADT Maritime Center was opened in Gjerdsvika harbour.

For many years STADT AS has been a leading company in AC drive innovations. Long experience from development of motor drives has resulted in the *patented STADT Lean Drive technology*. This has huge advantages compared to traditional PWM-technology, since it is *free from electric disturbances*. The STADT Lean Drive is also a very efficient



power drive system and *brings reliability up to a new standard*.

The first STADT electric propulsion delivery went to the Norwegian coastguard K/V Tromsø in 1996, representing a technological breakthrough.



*One of the 150 ship propulsion references*

The Lean Drive technology has been awarded several times for its unique characteristics and its reliability is well documented over the last 15 years of operation worldwide.

## AWARDED TECHNOLOGY LEADER

*”The STADT Lean Propulsion® system has features that has not been achieved in previous propulsion solutions. Its most impression feature being is its completely silent, stealth operation, which is already been adopted in a series of naval ships and commercial vessels.*

*The systems impressive efficiency comes from its very low power loss. At time contributing to lower emissions and a reduced carbon footprint.”*

*-The RINA awarding committee*



Awarded by The Royal Institute of Naval Architects (RINA) in London



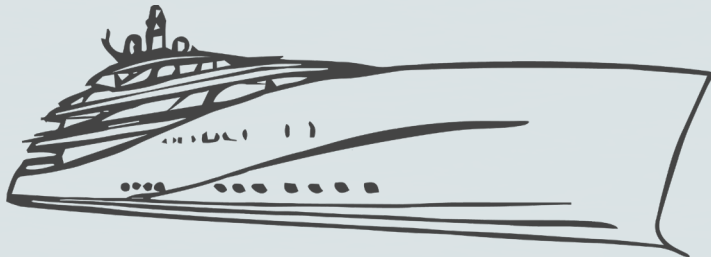
**INNOVATIVE PROPULSION FOR YOUR NEXT SHIP**

# SUSTAINABLE, LEAN AND GREEN

Ensures that the propeller never stops.

## STADT LEAN PROPULSION WILL GIVE:

- ▲ Silence by all means, lowest Underwater Radiated noise (URN) - increased comfort
- ▲ Reduced NO<sub>x</sub>, SO<sub>x</sub>, BC and CO<sub>2</sub> emission, Zero emission ready
- ▲ Reduced OPEX/CAPEX and high redundancy
- ▲ Scalability (power from 100 kW to 50 MW)
- ▲ Fit any size of yacht



**LEAN DRIVE FOR ANY YACHT**

## THE MOST IMPORTANT DESIGN CHOISES:

### **CPP** OR FP PROPELLER?

-SEE OUR PRESENTATION

### **AC** OR DC GRID?

-SEE OUR SPECIAL BROCHURE

### **GEARED** OR GEARLESS?

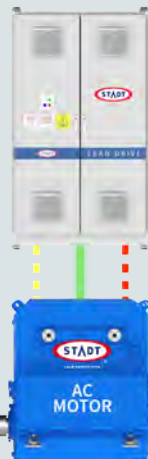
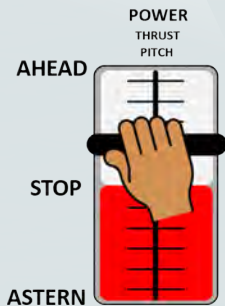
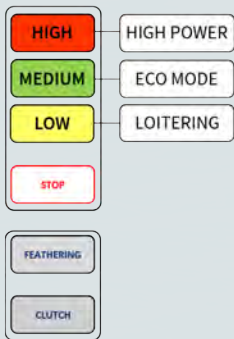
-SEE OUR SPECIAL BROCHURE



### **LEAN PROPULSION®**



# DYNAMIC POWER - AT YOUR FINGERTIPS



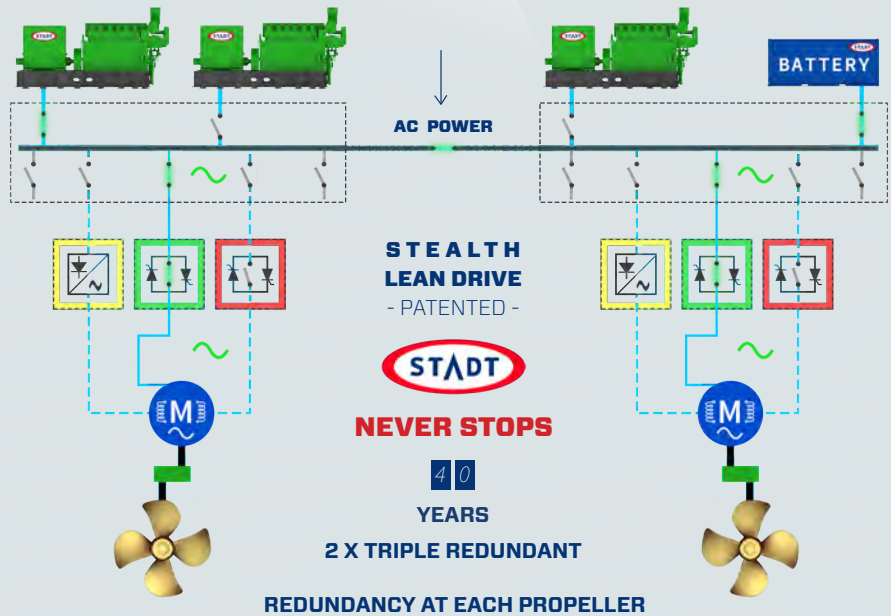
0-80 rpm  
0-12000 kW



Geared transmissions save a lot of weight and space

**STEALTH LEAN PROPULSION®**

# STADT LEAN PROPULSION® = REDUNDANCY



**STEALTH  
LEAN DRIVE**  
- PATENTED -



**NEVER STOPS**

40

YEARS

**2 X TRIPLE REDUNDANT**

**REDUNDANCY AT EACH PROPELLER**



LEAN PROPULSION

## BEST IN CLASS ELECTRIC PROPULSION

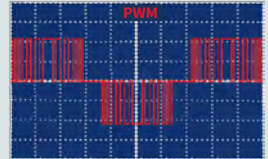
- ▲ **STEALTH SILENT** - no interference / acoustic noise
- ▲ **HIGH EFFICIENCY** - less than 0.1 % power loss
- ▲ **LOW WEIGHT** - more space for cargo
- ▲ **RELIABLE** - low maintenance cost
- ▲ Ready for **ZERO EMISSION** shipping

**INNOVATIVE PROPULSION FOR YOUR NEXT SHIP**

# PWM OR LEAN DRIVE - THE DIFFERENCE

^ **PWM (Pulse Width Modulated AC)** is an artificial chopped waveform

- ^ Created by AC to DC to AC conversion via the transistor inverter
- ^ Power-loss both in drive and transformers
- ^ Represent a variety of disturbance issues and will create :
- ^ Common mode noise, EMI, THD, URN and audible noise
- ^ Stress on El-motor bearings and windings
- ^ Hidden failures, also on other equipment on the same grid – **high failure rate**

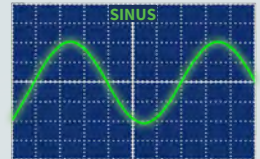


→ **PWM is a complex technology - power loss & heat - challenging installation**

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^ **STADT LEAN PROPULSION®** is based on Perfect Sinusoidal Waveform

- ^ No disturbance due to **Dynamic Ultra Low Frequency Switching Technology**
- ^ Low audible Underwater Radiated Noise (URN)
- ^ Minimum loss - no heat generation – no need for water-cooling
- ^ Represents the **perfect source for our AC induction motors**
- ^ **Lowest** failure rate



→ **Sinus is simplicity - efficiency - increased reliability - eased installation**

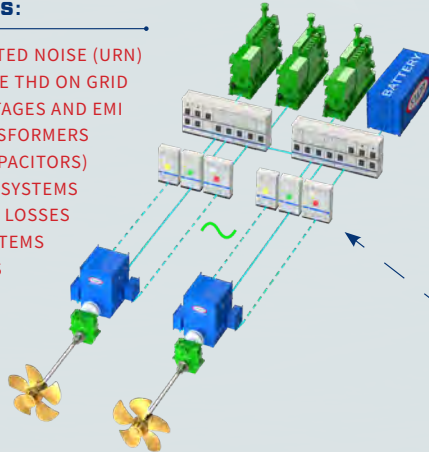
...so why disturb perfection ?

# LEAN - WHEN LESS GIVES MORE

## STADT ELIMINATES:

- UNDERWATER RADIATED NOISE (URN)
- POWER DISTURBANCE THD ON GRID
- COMMON MODE VOLTAGES AND EMI
- THE BIG DRIVE TRANSFORMERS
- EXPLOSION RISK (CAPACITORS)
- BREAKING CHOPPER SYSTEMS
- 6 % WASTED ENERGY LOSSES
- WATER COOLING SYSTEMS
- 80.000 COMPONENTS
- SCREENED CABLES
- COMPLEXITY

**= LESS DOWNTIME**



## STADT GIVES YOU MORE:

- + REDUNDANCY IN DRIVE SYSTEM
- + POWER TO PROPELLER
- + SAFETY AND RELIABILITY
- + SPACE AND LOWER WEIGHT
- + STEALTH PERFORMANCE
- + HMS AND COMFORT (SILENCE)

**= BETTER PERFORMANCE**

## HOW COME ?

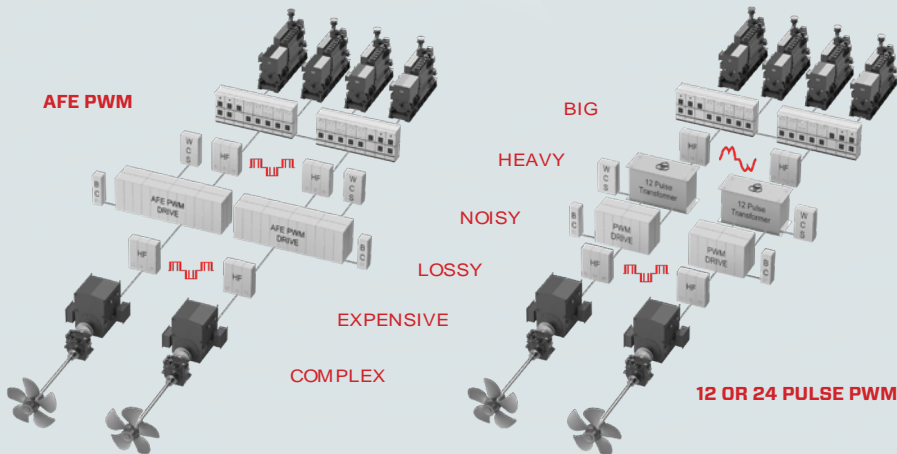
PATENTED, DYNAMIC -  
ULTRA LOW FREQUENCY  
SWITCHING TECHNOLOGY.

WHY DISTURB PERFECTION?

STADT LEAN PROPULSION®

# PWM WILL NEVER BE STEALTH OR NOISE-FREE

Complex PWM Drives (for comparison), competitor's technology



PWM = PULSE WIDTH MODULATION

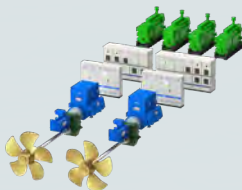


# EVALUATION OF TODAY'S DIFFERENT DRIVE SOLUTIONS

| Lean Issues To Consider                 | STADT Stealth Lean Drive | 12 Pulse or 24 Pulse | AFE (Active Front End) |
|---|--------------------------|----------------------|------------------------|
| Technology in AC drive                  | Sine Wave                | PWM                  | PWM                    |
| No. of electric energy transformations  | 0                        | 4                    | 4 or 5                 |
| Power Train Losses in Drive             | 0,1 %                    | 6 %                  | 6 - 7 %                |
| Cooling Type                            | Air is sufficient        | Water                | Water                  |
| Power Transformers Needed               | No                       | Yes                  | Sometimes • - - ,      |
| Regenerates Power to Grid               | Yes                      | No                   | Yes ▼                  |
| Weight & Size of Drive System           | 100 %                    | 500 % - 600 %        | 450 % - 700 %          |
| All Voltage Class (220V-15kV)           | Yes                      | No                   | No                     |
| Underwater Radiated Noise (URN)         | Lowest                   | High                 | High                   |
| Harmonic Distortion (THD)               | No                       | High                 | High                   |
| Common Mode Voltages and EMI            | No                       | High                 | High                   |
| Acoustic Switching Noise and URN        | No                       | Yes                  | Yes                    |
| Screened Power Cables needed            | No                       | Yes                  | Yes                    |
| Redundant Power Units                   | Standard                 | Special              | Special                |
| Designed Economic Lifetime              | 40 Years                 | 6 Years              | 6 Years                |
| Maintenance Requirement                 | Very Low                 | Frequent             | Frequent               |
| Onboard Crew Skills                     | Ordinary                 | Special              | Special                |
| MTBF (mean time between failures)       | 7 Years                  | 1 Year               | 1 Year                 |
| MTTR (mean time to repair)              | 1 Hour                   | 1 Week               | 1 Week                 |
| Spares Globally Available               | Yes                      | No                   | No                     |
| No. of Power Components in Line         | 1                        | 80 000               | 150 000                |
| Capacitors In Main Power Circuit        | No                       | Yes                  | Yes                    |
| Explosion Risk in Drive                 | No                       | Yes                  | Yes                    |
| Financial Risk (Service cost, Off-hire) | Very Low                 | High                 | High                   |

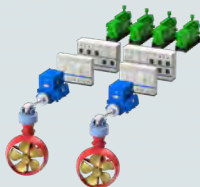
# STADT LEAN PROPULSION® ARRANGEMENTS - IEP

## SOME BASIC ARRANGEMENTS FOR FULL ELECTRIC PROPULSION



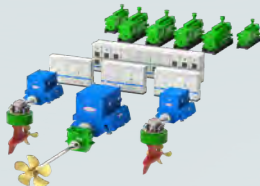
### Twin screw PTI, CP

- ▲ 4 generators
- ▲ 2 electric motors + 2 small as option
- ▲ 2 main switchboards
- ▲ Battery option



### Twin screw (Azimuth), CP

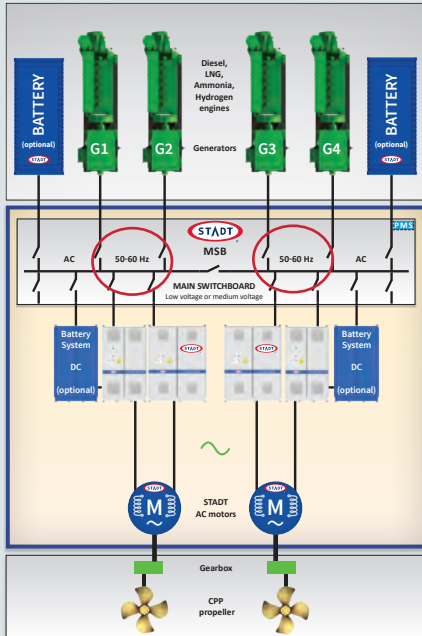
- ▲ 4 generators
- ▲ 2 electric motors
- ▲ 2 main switchboards
- ▲ Battery option



### Triple screw (2 Azipulls), CP

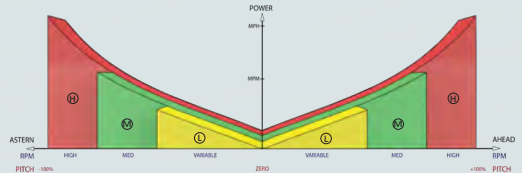
- ▲ 6 generators
- ▲ 3 electric motors
- ▲ 1 main switchboard with Bus-Tie
- ▲ Battery option

# STADT - YOUR SYSTEM INTEGRATOR



LET US DESIGN YOUR NEW  
SUSTAINABLE PROPULSION  
SOLUTION

STADT AC VARIGRID IS AN OPTION



# STADT HYBRID



HVO

Hydrogen

Ammonia

Methanol and E-fuels

Wind - Solar - Battery

LNG - BioGas - BioFuel - MDO

**ANY COMBINATION POSSIBLE:**

## REFERENCES - EXPERIENCE

*From Echo Yachts, Perth, Australia*

Echo Yachts are Australia's largest customised superyacht manufacturer.

"When we took the challenge to build the first ever diesel-electric superyacht in Australia, there were many design challenges to be solved. Such as low weight, small footprint, low noise, high efficiency, long endurance and reliability. We have found the STADT Lean Propulsion® extremely suitable for this yacht", says Mark Stothard, CEO at Echo Yachts.

The White Rabbit Golf is the largest trimaran and largest aluminium superyacht in the world at 84 meter long and 20 meter wide. Designed by Sam Sorgiovanni and One2Three Naval Architects. The STADT Lean Propulsion® is 4200 kW diesel-electric.



**Mark Stothard**

*Managing director, Echo Yachts*

## REFERENCES



### **White Rabbit**

Trimaran yacht 83x20m  
Echo Yard Australia

**WORLD'S LARGEST TRIMARAN YACHT**



**Trollfjord  
Midnatsol**  
Hurtigruten  
Fosen Yard

**CRUISE**



### **Econuri**

Incheon Port Authority  
Samsung Heavy Industries

**PASSENGER**



**Polarlys**  
Hurtigruten  
Ulstein Yard

**PASSENGER**

## REFERENCES



**OFFSHORE**

**SK Arctic, SK Atomik, SK Kinetik,  
SC Winter, SC Bongkot, SK Dynamik,  
Warami, Rawabi 324**

AHTSV NCA80E, Nam Cheong



**SAAB AB - Sweden**

**MoD and NATO**



**NAVY**



**SUPPORT VESSEL**

**THOR Magni, Modi,  
Frigg, Freyja**

SSV operated by PGS

**Sanco Star  
Sanco Spirit**

SRV operated by PGS



**RESEARCH**

# THE STADT SCOPE

Delivered to meet any typical ship classification standard.



STADT Lean Drives. Scalable in power to more than 50 MW per propeller.



STADT AC motors, asynchronous technology, a broad range.



STADT main switchboards, MCC, low voltage and medium voltage.



STADT power generators, battery systems, shore-to-ship power solutions, distribution transformers, The Cube™ certified options, etc.



Power Management System(PMS), IAS, remote access from shore, Dynamic Positioning(DP).

## SERVICES and EPC:

- ▲ Engineering of propulsion solutions
- ▲ Manufacturing and installation
- ▲ Commissioning
- ▲ Global Services

# STADT GLOBAL NETWORK

## STADT SERVICE POINTS:

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STADT NORWAY, GJERDSVIKA  
STADT ITALY, ROME  
STADT SINGAPORE, SINGAPORE  
STADT JAPAN, TOKYO  
STADT GERMANY, HAMBURG  
STADT SPAIN, VIGO  
STADT POLAND, GDYNIA  
STADT TURKEY, TUZLA  
STADT DANMARK, ESBJERG  
STADT BALTIC, KLAIPEDA  
STADT UK, ABERDEEN  
STADT MEDITERRANES, LIMASSOL  
STADT NORTH AMERICA, MIAMI  
STADT SOUTH AMERICA, RIO DE JANEIRO  
STADT KOREA, BUSAN  
STADT TAIWAN, KAOHSIUNG  
STADT INDIA, MUMBAI  
STADT AUSTRALIA, PERTH



## STADT OFFICES:

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STADT NORWAY, GJERDSVIKA  
STADT ITALY, ROME  
STADT SINGAPORE, SINGAPORE  
STADT JAPAN, TOKYO

# STADT GROUP HISTORY

## 40 YEARS IN AC DRIVES



MORE THAN 150 SHIPS AND RIGS ARE POWERED BY STADT DRIVES

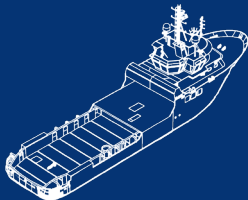
## LEAN BRINGS YOU

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- + SAFETY & RELIABILITY
- + VERY LONG LIFETIME
- + SUSTAINABILITY

- + STEALTH & HSE
- + MORE CARGO CAPACITY
- + LONGER ENDURANCE

- + LESS EMISSION AND FUEL
- + COST EFFICIENCY
- + LOWEST URN



STADT AS IS PART OF THE STADT GROUP

STADT AS

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Made in Norway

