Silent, elegant and efficient:  
The intelligent response to increasing demands,  
the ELFA® Marine Hybrid System

Presentation Colombia Mar 2013

Cartagena, Colombia

Marzo 14, 2013
Contents

- Perspective and competence
  - Marine hybrid concept and advantages
  - The ELFA product range
  - ELFA packages for the boating industry
  - Operation experience
  - ELFA components in detail
Perspective and competence in hybrid applications

- Over 100 years of experience in drive technology
- Competence in marine, industrial, train, mining and road applications
- Years of experience incorporated directly in the ELFA System
- Close to our customers
- Over 50 hybrid bus projects in Europe, North and South America and Asia
- Various installations of ELFA into yachts prove the system capabilities
- Over 10 mio hours recorded on ELFA system
Contents

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Market trends and increasing governmental requirements

- Global trend toward greener propulsion systems also in the marine industry
- Increased global and local pressure for CO\textsubscript{2} reduction
- Increased requirements for noise reduction
- Increased requirements for maneuverability and control
- Increase requirements for innovations in drive control

Siemens ELFA offers a reliable solution to these requirements with a proven technology, today!

*Examples of green logos and activities*
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## Boat types and compatibility with Siemens hybrid systems

### Commercial boats

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<th>Harbor craft Inland vessels</th>
<th>Fishing boats</th>
<th>Ocean-going vessels</th>
<th>Military</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Tug boats</td>
<td>- Offshore</td>
<td>- Research</td>
<td>Under 38m</td>
</tr>
<tr>
<td>- Ferries</td>
<td>- Long Liners</td>
<td>- Survey</td>
<td>- Patrol</td>
</tr>
<tr>
<td>- Public</td>
<td>- Netters</td>
<td>- Utility</td>
<td>- Coast guard</td>
</tr>
<tr>
<td>- Crew</td>
<td>- Seine</td>
<td>- Cruise Ship</td>
<td>- Surveillance</td>
</tr>
<tr>
<td>- Police</td>
<td>- Purse</td>
<td>- Container ship</td>
<td>- Tender</td>
</tr>
<tr>
<td>- Excursion</td>
<td>- Gill</td>
<td>- RORO</td>
<td>- Gig</td>
</tr>
<tr>
<td>- Pilot boats</td>
<td>- Shrimp</td>
<td>- Large tugs</td>
<td>- War ships</td>
</tr>
<tr>
<td>- Fire boats</td>
<td>- Lobster</td>
<td>- Ice breaker</td>
<td></td>
</tr>
<tr>
<td>- Light cargo</td>
<td>- Crab</td>
<td>- Exploration</td>
<td></td>
</tr>
<tr>
<td>- Lighters</td>
<td>- Drift fishing</td>
<td>- Tanker</td>
<td></td>
</tr>
<tr>
<td>- Supply</td>
<td>- Bait boats</td>
<td>- Freighter</td>
<td></td>
</tr>
<tr>
<td>- Tow Boats</td>
<td>- Dive boats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Fire boats</td>
<td>- Processing ship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Dredger</td>
<td>- Mother ships</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Canal boats</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Moored passenger vessels

- Pilot boats
- Fire boats
- Tow Boats
- Fire boats
- Dredger
- Canal boats

### Offshore

- Offshore
  - Long Liners
  - Netters
    - Seine
    - Purse
    - Gill
  - Shrimp
  - Lobster
  - Crab
  - Drift fishing
  - Bait boats
  - Dive boats
  - Processing ship
  - Mother ships

### Ocean-going vessels

- Research
  - Survey
  - Utility
  - Cruise Ship
  - Container ship
  - RORO
  - Large tugs
  - Ice breaker
  - Exploration
  - Tanker
  - Freighter

### Legend:

- Suited for SIEMENS hybrid drive technology (ELFA)
- Not suited for SIEMENS hybrid drive technology (ELFA)
Boat types and compatibility with Siemens hybrid systems

Legend:
- Suited for SIEMENS hybrid drive technology (ELFA)
- Not suited for SIEMENS hybrid drive technology (ELFA)
Basic ELFA product overview

**Drives and Generators**
- Synchronous drives
  - 100kW, 140kW, 180kW
- PEM drive
  - 160kW, 260kW

**Converters**
- Mono Inverter
  - ELFA 2nd generation IP 69k

**Controls and Software**
- DICO
- Control software
The ELFA hybrid system – Drive- and power-packs, controls, batteries

Power packs
- Engine
- ELFA II inverter
- Battery packs
  - e.g. Zebotec, Saft, Voltaic

Drive packs
- Siemens drive as motor
- Gearbox
- ELFA II inverter
- Controls
  - e.g. Rexroth, Bosch Group

Integrators
- Siemens I DT LD MS Hamburg
- EPD Energytech
- Henkelhausen
- ECA EN France
- Zebotec
- Ixelec
- Siemens Turkey
- Siemens Spain
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Standard ELFA packages

Serial hybrid

Parallel hybrid

Hotel load management

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Industry Sector, I DT LD TD HD SPP
Serial hybrid drive
Ideal for boats with average usage of all power segments

Serial hybrid drive packages

Serial Hybrid fits into boats with average usage of all power segments of the drive system.

Packages fit in all boats < 360 kW, especially displacement boats such as trawlers, passenger ferries, smaller cruisers and large sailboats.
Serial Hybrid

- Hotel load Max 180kVA
- Optional 2nd and 3rd SMART generator
- Gearbox 180 kW or 140 kW
- Battery
- Max 180kVA

Optional 2nd and 3rd SMART generator

Max 3 diesels

Integ. Control

SMART generator

Gearbox 180 kW or 140 kW

M/G

180 kW or 140 kW

Gearbox

M/G

180 kW or 140 kW

G

180 kW or 140 kW

G

Optional 2nd and 3rd SMART generator

Max 3 diesels

Integ. Control

SMART generator

Gearbox 180 kW or 140 kW

M/G

180 kW or 140 kW

G

180 kW or 140 kW

G

Optional 2nd and 3rd SMART generator

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Max 3 diesels

Integ. Control

SMART generator

Gearbox 180 kW or 140 kW

M/G

180 kW or 140 kW

G

180 kW or 140 kW

G
Serial Hybrid

Diagram showing a serial hybrid system with components labeled as follows:

- Hotel load
- Battery
- SMART generator
- Optional 2nd SMART generator
- Integ. Control
- DICO
- M/G
- Gearbox

Specifications include:
- 180 kW or 140 kW
- 180 kW or 140 kW
- 180 kW or 140 kW
- 180 kW or 140 kW
Serial Hybrid

SMART Generator

Hotel Load

Battery

2x 140 kW
2x 180 kW

180 kW or 140 kW

90 kW or 70 kW

140 kW
180 kW

M/G

Gearbox

Integ. Control

DICO

180 kW

90 kW or 70 kW

M/G

Gearbox

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Standard hybrid drive product packages (Detailed)

Sail/Powerboat – One prop
1x80-180 kW - 2x135-180kW
Standard ELFA packages
Parallel hybrid for boats with 230-2000kW per propeller

Parallel hybrid
Ideal for patrol and trawler boats that run 80% of the time at low loads

Parallel hybrid drive packages
Electric drive with 10-20% power of ICE

Parallel Hybrid fits into boats with long trolling and cruising speed intervals

Packages fit in boats > 230 kW
Parallel Hybrid

PTI – parallel hybrid
Using for example ZF 5000 or 9000 PTI gearbox

PTI – parallel hybrid
Using for example ZF 5000 or 9000 PTI gearbox

ICE as generator
Optional 2nd ICE as generator

Hotel load
Battery

180 kW or 140 kW
180 kW or 140 kW

Integ. Control

DICO

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Industry Sector, I DT LD TD HD SPP
Parallel Hybrid

SMART generator

Integ. Control

Hotel load

Battery

2x 140 kW
2x 180 kW

180 kW or 140 kW

2x 140 kW
2x 180 kW

90 kW or 70 kW

180 kW or 140 kW

90 kW or 70 kW
Parallel Hybrid

PTI – parallel hybrid

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The ELFA hybrid drive advantages

<table>
<thead>
<tr>
<th><strong>Boat owner / operator</strong></th>
<th><strong>Boat builder</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Green propulsion</td>
<td>Design freedom - more space</td>
</tr>
<tr>
<td>Noticeably more quite propulsion</td>
<td>Weight distribution freedom</td>
</tr>
<tr>
<td>Lower running costs</td>
<td>Improved propulsion system</td>
</tr>
<tr>
<td>Lower maintenance costs</td>
<td>High power hotel supply</td>
</tr>
<tr>
<td>Better maneuverability</td>
<td>Possible access to governmental support – Green funding</td>
</tr>
<tr>
<td>Better performance</td>
<td>Future safe</td>
</tr>
<tr>
<td>Plenty of load for hotel appliances</td>
<td></td>
</tr>
<tr>
<td>Proven technology</td>
<td></td>
</tr>
<tr>
<td>Future safe</td>
<td></td>
</tr>
</tbody>
</table>

**Integrator**

| Access to marine hybrid technology |
| Pretested system with defined functions |
| Access to partners for hybrid systems |
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- ELFA components in detail

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Hybrid drive configuration example – Spain – In operation since 2011
Hybrid drive configuration example – Megaride – Launch 2013
Hybrid drive configuration example – Columbus Yachts – Launch 2013
Hybrid drive configuration example – Abeking & Rasmussen SWASH Launched 02 / 2013
Hybrid drive configuration example – Ferry Grave in operation since 2009
Hybrid drive configuration example – Saphir – In operation since 03/2012
Hybrid drive configuration example – O-foil – Holland – Launched 02/2013
Hybrid drive configuration example – Wally project – Launched 05/2012
Hybrid drive configuration example – Energytech Marine – Launch 2013
Hybrid drive configuration example – Zebotec – Cobalt boats – In operation since 2011

Cobalt 233 ZET

powered by zebotec Drive Systems

eMobility ist stark!

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Hybrid drive configuration example –
Long island boats – Launched 02 / 2013
LNG-electric drive configuration – River transport boats – acquisition ongoing
Electric vessel in Norway

2x500 kW Propulsion
5.5 MWh battery bank
Siemens Experience Globally with Hybrid Bus Technology
How can we support the waterborne segment?

<table>
<thead>
<tr>
<th>Turnkey Solutions</th>
<th>Pretested and preconfigured systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Project specific solutions via our Siemens internal integrator in Hamburg</td>
<td>▪ The Siemens marine hybrid system allows for various types of applications in the marine environment</td>
</tr>
<tr>
<td>▪ System access is also possible via an external integrator</td>
<td>▪ Standard systems are pretested in our systems test lab in Nürnberg</td>
</tr>
<tr>
<td>▪ Simple to multiply system. Just a one time set up fee for series production</td>
<td>▪ Configuration adaptation possible to meet different propulsion needs.</td>
</tr>
</tbody>
</table>

Components and functionalities

▪ Very compact, water cooled inverters and motors
▪ Standardized controls
▪ Drive and generator capabilities
▪ Provision of on board network (0-500V 56/60 Hz)
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ELFA drives and generators
ELFA drives and generators
ELFA Inverter
ELFA Inverter
Stiebel Stepup gearbox for 1FV5139 140kW and 1FV5168 200kW

For 1FV5139 140kW - 6 and 12 o’clock

For 1FV5168 200kW – 6 o’clock
ZF Parallel hybrid gearboxes - Series 5000, 9000 and 23000 – Launch of 2000 and 3000 expected
Servogear Hybrid CPP Propulsor
Thank you for your attention!

Felipe Santander
Phone: +49 (0) 911 4337977
E-Mail: philip.santander@siemens.com