

# Welcome to **Danfoss Drives**



# > A better tomorrow is driven by drives

Danfoss Group

Danfoss Drives businesses

The crucial difference

Application examples

Products and services

Our commitment

# Are you ready?

Welcome to a bigger world with choices to suit you.

Get the very best out of your applications via **quality**, **sustainability** and **energy efficiency**.

Join us – we are the **AC drives partner** who shares your goals.





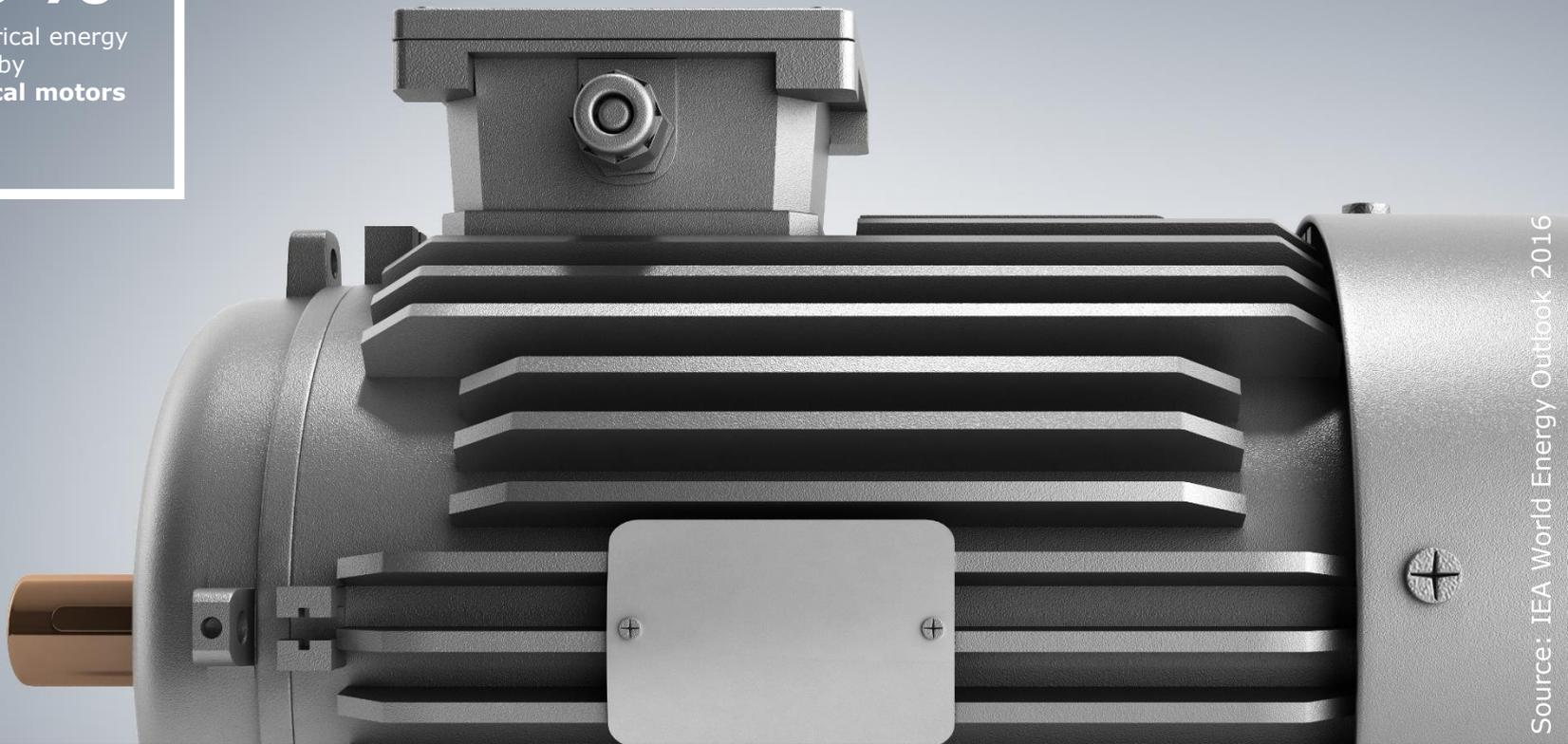
**20%**

of the world's  
energy consumption  
is **electrical  
energy**

Source: IEA World Energy Outlook 2016

**50%**

of electrical energy  
is used by  
**electrical motors**



Source: IEA World Energy Outlook 2016

**75%**

**of AC drives** are  
used on pumps,  
fans and  
compressors

*Danfoss*

10  
450V 22.0kW  
45.0 Hz  
Speed 1500

Status

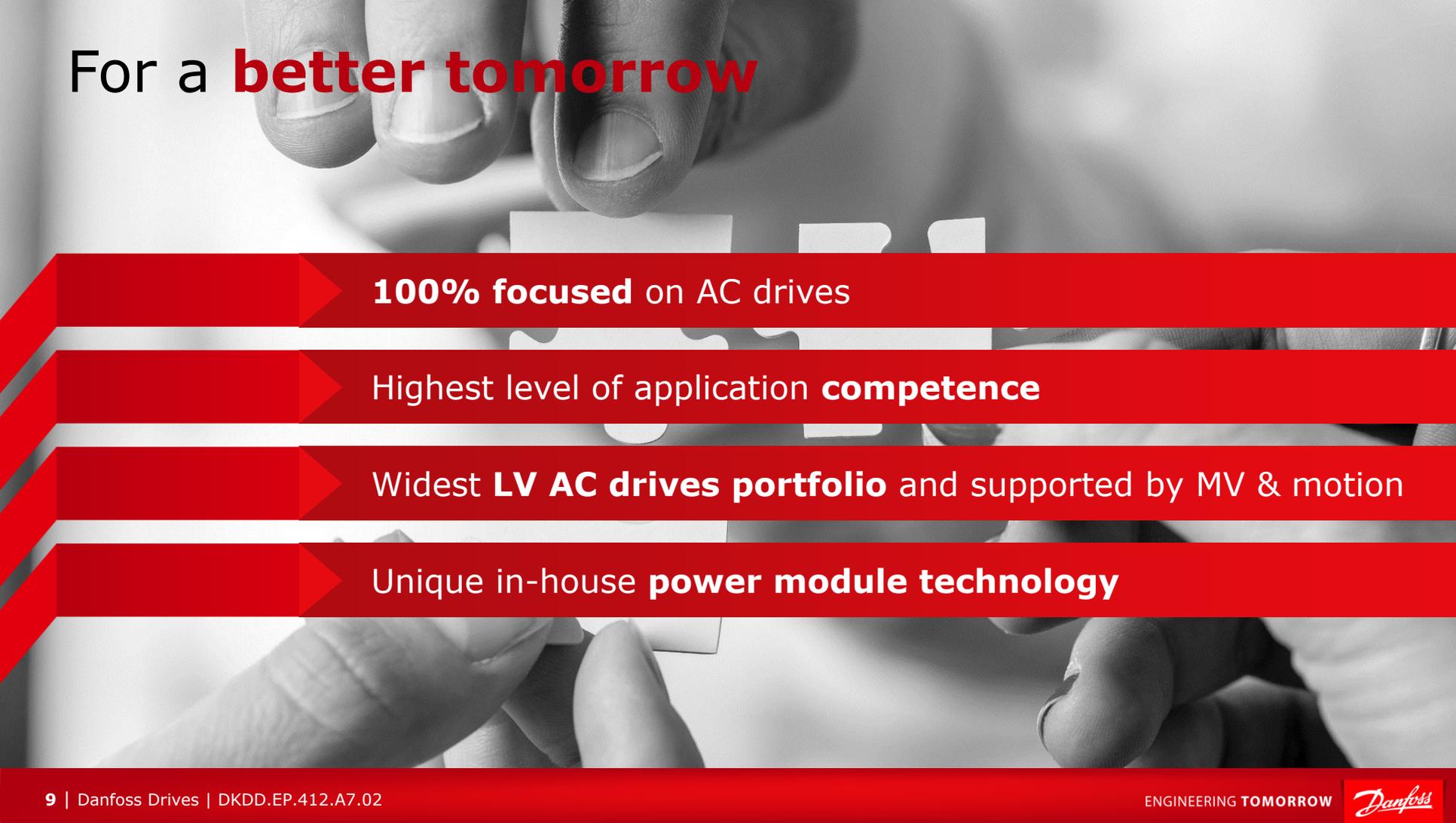
Quick  
Menu

Main  
M



AC drives have  
potential to save  
**8%**  
of global electricity  
consumption by  
2040

Source: IEA World Energy Outlook 2016



# For a **better tomorrow**

**100% focused** on AC drives

Highest level of application **competence**

Widest **LV AC drives portfolio** and supported by MV & motion

Unique in-house **power module technology**

# Driven **by drives**

**Pursuing sustainability makes good business sense**

Boost your business by



Increasing efficiency by

**30%**

**Peroni Brewery  
Italy**

Find out more >



Reducing CO<sub>2</sub> + NO<sub>x</sub> emissions by

**4500  
tonnes annually**

**CCB Bergen  
Norway**

Find out more >



Saving energy by

**40%**

**Aarhus Water  
Denmark**

Find out more >

**Draw upon our unparalleled expertise in applications – always “part of the package”**

A better tomorrow is driven by drives

## > **Danfoss Group**

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**DIGITALIZATION**



**ELECTRIFICATION**



**URBANIZATION**

# GLOBAL MEGA-TRENDS

transforming our world



**CLIMATE CHANGE**



**FOOD SUPPLY**

# 2017 at a glance

## Results

Sales EURbn

**5.8**

Growth in local currency

**12%**

EBIT margin

**11.1%**

EBIT EURm

**645**

Net profit EURm

**445**

## Regions

Western Europe



Eastern Europe



North America



Asia-Pacific



Latin America



Africa-Middle East



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# Danfoss Drives business

## AC DRIVES

**1.2**BN EUR  
NET SALES

**88%**  
SHARE OF  
DANFOSS DRIVES  
BUSINESS



## SILICON POWER

**0.1**BN EUR  
NET SALES

**9%**  
SHARE OF  
DANFOSS DRIVES  
BUSINESS



2017 numbers

**SOLAR INVERTERS (SMA): 38.2M** EUR net sales; **3%** share of Danfoss Drives business

# AC drives business in numbers

Annual  
revenue

**1.4bn**

EUR



**22.5m**

drives  
delivered



**30m**

cars equipped  
with power  
modules



**1000**

partner  
companies



Global presence  
**100/50/9**

Countries  
Sales & service offices  
Factories



First mover since

**1968**



# Local presence, global reach



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Danfoss Drives businesses

## > **The crucial difference**

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# 100% focused on **developing, manufacturing and supplying** AC drives

We focus on AC drives. It's what we do best, and it helps you to focus on what you do best.

**We put you in the driving seat** by giving you the freedom to

- **optimize** your systems
- **equip** your drives
- **collaborate** with your drives partner to ensure the best possible AC-drive solutions without compromises

**You decide** the best equipment for your application. You are not tied to a single technology or choice of component, such as motors, fieldbuses or PLCs.

**We'll make sure** the AC drive fits that choice and support you every step along the way.

# Optimize differently

## How?

Take advantage of our support and software to tailor your drive so that its form, fit and function are exactly how you need them to be throughout its entire life cycle.

To ensure you find the optimum solution, we offer:

- The widest portfolio of AC drives
- Fast, simple tools for customization
- Programmable drives and special software
- DrivePro® service and maintenance support



# Equip differently

## How?

**Configure, monitor and combine your drive with any motor type, PLC and fieldbus to match it to your specific application and get the best mix of efficiency, speed and torque.**

**To ensure you find the optimum solution, we offer:**

- Compliance with the motor you need
- Compliance with the fieldbus you need
- Outstanding harmonic solutions expertise
- Innovation in energy storage projects

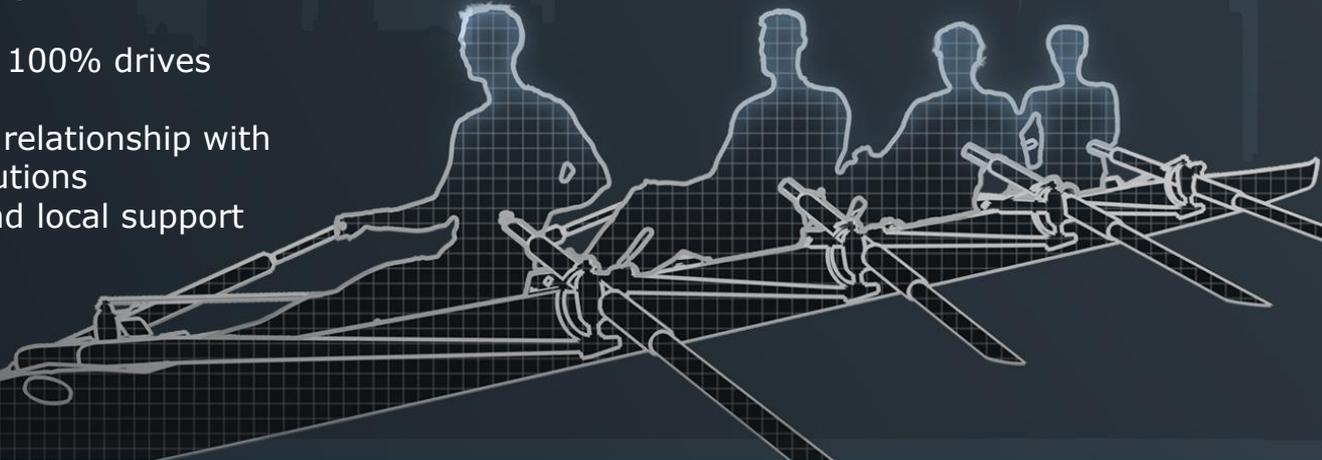
# Collaborate differently

## How?

Choosing a Danfoss AC drive means selecting a vendor who goes the extra mile, who truly values your success and who works with you on your terms.

To ensure you succeed and meet your business goals, we offer:

- Independence and 100% drives expertise
- A non-competitive relationship with you on system solutions
- Global presence and local support



# Our commitment to **Quality**

Helps us achieve continuous improvements



Prevents defects



**TS 16949** is the foundation for all our efforts to stay ahead on quality.



Reduces variation



Minimizes waste



Transitioning to  
**IATF 16949**



# Strategic supply to sharpen competitive edge

## Danfoss Silicon Power In-house power modules and stacks

**Sharing  
Knowledge**

**Internalizing  
Knowledge**

**Quality, reliability and performance.** Customized solutions that exceed your expectations.



**Trust  
Competence  
Support**

**Commitment and dedication.** Application of first-hand knowledge to advance innovation and business.

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## > **Application examples**

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**MARINE AND OFFSHORE**



**WATER AND WASTEWATER**



**HVAC/BUILDING  
AUTOMATION**



**FOOD AND  
BEVERAGE**



**REFRIGERATION**



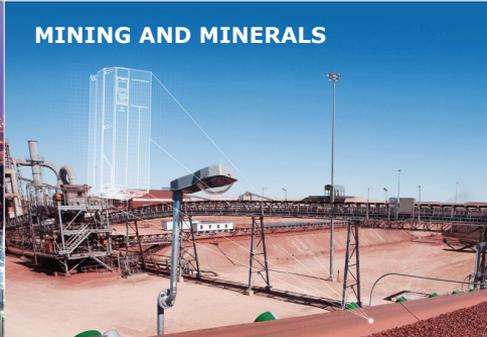
# Examples

Application-optimized  
solutions and services  
for your industry

**ELEVATORS AND  
ESCALATORS**



**MINING AND MINERALS**



**CRANES AND HOISTS**



**HEAVY INDUSTRY/  
OIL AND GAS**



**CHEMICAL**



# Marine and Offshore

Expand your efficiency horizons with powerful drive and grid systems



**Total**

range for  
Marine and  
Offshore needs

**Enjoy full flexibility to create tomorrow's outstanding clean power systems, today:**

- Ruggedize your drive-grid systems
- Manage heat loss intelligently
- Reduce emissions and fuel consumption, and save space
- Optimize vessel-wide applications
- Utilize power conversion and shore supply

**Draw on our global network:**

- Extensive lifecycle services
- Know-how that is second to none
- No matter which platform or port of call, we are there to help

**Benefit from application-optimized products with global marine certifications**

**Top performers:**

- VACON® NXP Liquid Cooled Drive
- VACON® NXP,  
VACON® NXP Grid Converter

# Marine and Offshore

High sustainability for hybrid RORO passenger ferry

**38%**

less fuel  
consumption



## CMAL Ferries Scotland

Diesel-electric battery propulsion



**38%** fuel savings



**30%** more traffic capacity

Higher reliability



Meets 2020 air pollution limits



Reduced noise

Batteries charge via  
renewable-energy-based shore  
power supply

# Marine and Offshore

Battery-powered propulsion for hybrid pedestrian ferries

24/7

continuous  
operation

## IJ Ferries Netherlands

Diesel-electric battery propulsion



24/7 continuous operation

Reduced generator size due to  
peak shaving

2 minutes battery charging time



Better air quality,  
fulfils the 2020 air pollution rules



Bumpless changeover to  
redundant DC grid

Low noise level

# Marine and Offshore

Shore supply to rigs ensures fuel savings and cleaner air

**4500 t**

Reduction in  
emissions  
annually

## CCB Bergen Norway

Shore power supply



**5000** liters  
less diesel consumption daily

**4500** t less CO<sub>2</sub> and NO<sub>x</sub>  
emission annually



Easy connectivity



Prepared for future legal  
requirements



Optimal user interface for easy  
operation

Optimal cooling

# Marine and Offshore

Energy-efficient shaft generator for 7 GT RoFlex<sup>®</sup> vessel

**10%**

fuel cost  
reduction

## M/V Bore Sea Finland

Propulsion machinery



**10%**  
fuel cost savings

**2000** t pa less CO<sub>2</sub> emission



**30%** variable frequency  
on shaft generator

Auxiliary generators eliminated



Main propulsion boost capability

Ship Energy Efficiency  
Management Plan



Power balancing with frequency  
drooping

# Marine and Offshore

Everywhere on the ship – improving efficiency, safety and reliability

**80%**  
energy savings

**DS Norden, sea water cooling pumps**  
Denmark

Pumps



**80%**  
energy savings



Payback time  
**< 14** months



**30,000 USD**  
p.a. saving per vessel



Nine marine type approvals



Safety requirements met via engineering support

# Food and Beverage

Unsurpassed fit and variant reduction improve line productivity

**90%**  
overall system  
efficiency

**Feeding a growing population demands innovation in hygiene, traceability and cutting-edge control**

**Reinvent system efficiency**

- 30% energy savings is typical
- Most competitive total cost of ownership, TCO
- Innovative motors, efficiency class > IE4

**We champion your cause with intelligent product lifecycle services**

**Globally-compatible AC drives, optimized for food and beverage:**

- Unique synchronization and positioning with Integrated Motion Controller. No servo drive required.
- Leaner warehousing thanks to variant reduction
- European Hygienic Engineering & Design Group (EHEDG) certification

**Top performers:**

- VLT® AutomationDrive FC 302
- VLT® OneGearDrive
- VLT® Decentral Drive FCD 302
- VLT® Integrated Servo Drive ISD 510

# Food and Beverage

Fine-tuning and variant reduction improve line productivity

**90%**  
overall system  
efficiency

## Cantine Riunite wine bottling line Italy

Conveyors



**30%** energy savings



Payback time **~1** year



**40%**  
less cleaning time



EHEDG certified hygienic design  
for food safety

Efficiency class > IE4



Variant reduction for leaner  
warehousing

# Food and Beverage

Precision process control of quark production line

## Valio dairy Finland

CoHeat pumps, pumps, mixers, separators,  
fans, conveyors, packaging & palletizing



**19** GWh annual energy  
recovery via heat pumps



**500,000 €**  
annual savings

Pump energy consumption data  
collection

Improved process control, work  
safety and reliability



Uniform drives throughout plant  
simplify installation, monitoring,  
preventive maintenance & spare  
parts logistics



Safe Torque Off (STO) functionality  
PROFIBUS communication

# Water and Wastewater

Get the ultimate in cost-efficient system optimization from the market leader

**190%**

power  
generation,  
for water  
management that  
powers itself

**Achieve energy neutrality in your water and wastewater systems**

**Eliminate one of the largest drains on the municipal electricity budget**

**Preserve precious drinking water, and let waste be a thing of the past.**

**World-class expert services**

**Achieve more with less:**

- Use the most cost- and energy-efficient application-optimized AC drives on the planet
- Enjoy uniform water-dedicated technology for compatibility, ease of training and service
- Unsurpassed fit to your system, with universal adaptability and connectivity

**Top performer:**

- VLT® AQUA Drive FC 202

# Water and Wastewater

Generating 90% surplus power from wastewater treatment

**190%**

power generation results in 90% annual net surplus

## Aarhus Water WWTP Denmark

Blowers, pumps, mixers and dewatering pumps



**35%** carbon footprint reduction



**40%** annual electricity surplus

**2.5** GWh annual heat surplus

**0.32** kWh/m<sup>3</sup> treated wastewater



Uniform water-dedicated technology for flexibility, compatibility, ease of training & service

# Water and Wastewater

AC-drive-controlled pool pumps deliver cool savings

Energy savings  
of up to

**70%**

## Davey Water Products Australia

Pool pumps



Up to **70%** energy savings

**290-500 €**  
annual savings



Heat losses from motor & drive  
transferred to pool water heating

Quieter pump operation



Domestic earth leakage  
compliance due to low-leakage  
RFI filter

Can be integrated into pool pump  
housing



Operable up to 60°C ambient  
temperature

# HVAC/Building Automation

Maximizing comfort and building efficiency



**2.5M**

global installed  
base of  
dedicated HVAC  
drives

**Achieve world-class asset protection, control and energy savings, whilst creating comfort**

**Look no further for high-quality, application-optimized AC-drives answers you can trust:**

- Most competitive total cost of ownership, TCO
- Seamless BMS integration including BACnet IP
- Draw upon expert services to reach your goals

**World leader in HVAC since 1986**

- Unique HVAC-dedicated features, which are integrated as standard
- Global installed base of 2.5 million dedicated HVAC drives

**Top performers:**

- VLT® HVAC Drive FC 102
- VLT® DriveMotor FCP 106

# HVAC/Building Automation

Totally reliable server room cooling

**IE4**

motor  
compatibility

## Equinix Netherlands

Data center ventilation



Significant energy savings



< **1** year payback



Maximum uptime

Fast commissioning

Remote monitoring and analysis



IE4 motor compatibility

Preventive maintenance service

# HVAC/Building Automation

Improved passenger comfort with significant energy savings

**500**

tonnes less  
CO<sub>2</sub> emission  
annually

## Belfast International Airport Ireland

AHU ventilation fans



**500 t** less CO<sub>2</sub> emission  
annually

**112,000 €**  
energy savings annually

Payback time < **1** year



No disruption to staff or passengers  
during installation

Air quality improved via CO<sub>2</sub>  
sensors linked to the drive BACnet  
and Modbus communications



First-class EMC compliance:  
IEC/EN 61000-3 parts 1 and 2



Built-in features for fire and seismic  
safety

# HVAC/Building Automation

The right amount of air at the right time

**<1 year**

best case  
payback time

## Friends Arena Sweden

Pumps and fans



Significant energy savings



**<1** year best case payback



Delivers the right volume of air at the right time



Complies with harmonics standard  
**IEC/EN 61000-3-12**



Space-saving cabinet-free  
side-by-side installation

Built-in RFI filters and DC chokes  
ensure interference-free operation  
even in sensitive environments

# Refrigeration

Accelerate system payback with best-practice speed control

**<1** year

best case  
payback time

Drive down total cost of ownership for reefers, cold rooms and all kinds of compressors

Win full traceability, seamless system integration and full motor compatibility

We champion your cause in optimizing refrigeration applications

- Experts at your service
- Specialized range of refrigeration - optimized AC drives

**Top performer:**

- VLT® Refrigeration Drive FC 103

# Chemical

Enhanced reliability in a harsh environment



## Freedom

of choice in control  
system and motor  
type

**Surpass the competition with world-class precision, quality technology**

**Draw upon the know-how of our experts:**

- On-site project engineering
- Extensive lifecycle support services

**Do more with less:**

- Superior energy efficiency
- Application-optimized AC drives give you leaner machines and processes

**Top performers:**

- VACON® NXC
- VACON® 100 INDUSTRIAL

# Chemical

Enhanced reliability in a harsh environment

**200+**

VLT® drives  
rated  
1.5 kW - 500 kW

## Calcium carbide plant, China

Lime kilns, exhaust fans, blowers,  
compressors, hoists



**Significant** energy savings

Plant reliability guaranteed



No additional cooling fans needed

3C3 coated PCBs make for  
durability and reliability



Back-channel cooling system  
minimizes heat loss and improves  
energy efficiency

Built-in RFI filters and DC chokes  
ensure interference-free operation  
in severe environments

Ability to operate with

**300 m** long motor cables

# Mining and Minerals

Save on CAPEX and OPEX with robust, reliable drives



**Intelligent**  
heat management  
drives down  
substation costs

**Boost productivity and extend equipment lifetime**

**Win high asset availability:**

- Heavy-duty, application-optimized AC drives
- Rugged high performance in the harshest of conditions
- Intelligent heat management

**Reap surprising savings in both CAPEX and OPEX:**

- World-class AC drive dedicated engineering
- Expert lifecycle support services
- On-site support to back you up

**Top performers:**

- VACON® 100 INDUSTRIAL
- VACON® NXP
- VACON® NXC

# Mining and Minerals

Save on CAPEX and OPEX with robust, reliable drives

**85%**

less substation  
heat load is typical  
due to high  
efficiency and  
innovative back  
channel cooling

## Kolomela Mine South Africa

Dewatering pumps, feeders, stockpile conveyors,  
train load out conveyor, stackers, reclaimers



**80kW** power savings due to lower  
substation heat load enabling smaller air-  
conditioning systems

**20%** more power savings due to  
smaller air-conditioning systems than  
from converting to high efficiency motors  
across the whole mine site



Payback is **instant**

**10 %** of the VSD investment can  
typically be saved in project costs due to  
the significantly lower substation heat  
load enabling the use of smaller, lower  
cost air-conditioning systems



**50°C** outside air temperature,  
without derating

Innovative, maintenance-free spin filter  
system in substation design

# Cranes and Hoists

The sky is the limit for safe and efficient performance

**Global**  
service network

**Meet the challenges of safety and efficiency demands, using our:**

- Extensive lifecycle services
- World-class application-optimized AC drives
- Heavy-duty reliability when it counts

**Achieve high availability and powerful efficiency:**

- Hoisting and other crane movements
- Innovative hybrid energy storage

**Top performers:**

- VACON® NXP Air Cooled
- VACON® NXP Common DC Bus
- VACON® 20 Cold Plate

# Elevators and Escalators

World-class buildings demand cutting-edge convenience

## Intuitive

set-up, with  
graphical  
interface

**Enjoy the ultimate in travel comfort, with no compromises**

**Full range of market-leading AC drives with integrated elevator control:**

- Tailored solutions for large OEMs
- Extensive lifecycle services
- Versatile, seamless system integration

**Second life for hydraulic elevators via modernization with an AC drive:**

- Fast retrofit
- More rides per day
- High availability

**Top performer:**

- VACON® NXP Air Cooled

# Heavy industry

Supreme process availability and performance when it counts

Current ratings  
up to  
**5000A**

Ensure best-practice process control and optimal efficiency to meet your performance targets, no matter how demanding the task is.

We offer heavy-duty expertise in both single-drive and system-drive applications encompassing the entire power range.

Win competitive edge using tomorrow's technology today:

- Expert services
- Broad range of air- and liquid-cooled AC drives
- Seamless system integration
- Rapid connectivity

**Top Performers:**

- VACON® 100
- VACON® NXP Liquid Cooled
- VACON® NXC
- VACON® NXP System Drive

# Oil and gas

Save energy and drive down operating costs

**Long**

lifetime, top  
performance,  
and full-throttle  
process  
throughput

## Gain even more competitiveness via variable speed control

- Improve the productivity of your existing systems
- Save energy and drive down operating costs, thanks to extended product lifetime

## Combine the newest intelligent functionalities and high durability to win more sustainability

- Innovate better equipment with application-optimized AC drives

## Get fast response from the global service network:

- World-class AC-drive-dedicated engineering
- Extensive lifecycle services

## Top Performers:

- VACON® NXC
- VACON® NXP Liquid Cooled
- VACON® NXP System Drive
- VACON® 100

# Application focus to boost your business

		INDUSTRIES														
		HVAC	Food & Beverage, Packaging	Water & Wastewater	Refrigeration	Marine & Offshore	Mining & Minerals	Metals	Chemical	Cranes & Hoists	Energy	Elevators & Escalators	Material handling	Oil & Gas	Pulp & Paper	Textile
APPLICATION EXAMPLES	Pumps	■	■	■	■	■	■	■	■		■			■	■	■
	Fans	■	■	■	■	■	■	■	■		■		■	■	■	■
	Compressors	■	■	■	■	■	■	■	■		■			■	■	
	Conveyors		■			■	■	■	■		■		■			
	Process, Material Treatment		■	■			■	■	■		■			■	■	■
	Mills, Drums, Kilns						■	■							■	
	Winding, Unwinding						■								■	■
	Drilling						■							■		
	Propulsion, thrusters					■										
	Winches					■										
	Vertical & horizontal movement		■	■		■	■	■	■	■	■	■		■	■	■
	Power conversion Generation, smart grids			■		■				■	■	■				
	Positioning, Synchronization		■					■	■				■		■	■

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Application examples

## > **Products and services**

Our commitment

# Breadth and depth in **expert products**

**VLT®**

VLT® drives position you at the forefront of the energy-efficiency race.

Outmaneuvering other precision drives, they excel, with remarkable fit, functionality and diverse connectivity.

VLT® drives play a key role in rapid urbanization through an uninterrupted cold chain, fresh food supply, building comfort, clean water and environmental protection.



# Breadth and depth in **expert products**

**VLT®**

- **AC drives**  
(0.18 – 1,400 kW)
- **Decentral drives**
- **Integrated servo drives**
- **Soft starters**
- **Power options**  
(filters)
- **Software tools**



# Breadth and depth in **VLT®** products

Low-voltage drives up to 1.4 MW

				
<b>VLT® Micro Drive FC 51</b>	<b>VLT® Midi Drive FC 280</b>	<b>VLT® HVAC Basic Drive FC 101 Limited markets</b>	<b>VLT® Automation Drive FC 360 Limited markets</b>	<b>VLT® Lift Drive LD 302</b>
				
<b>VLT® Refrigeration FC 103</b>	<b>VLT® Automation Drive FC 301/FC302</b>	<b>VLT® AQUA Drive FC 202</b>	<b>VLT® HVAC Drive FC 102</b>	<b>VLT® Low Harmonic Drive</b>
<b>Motor protection</b>		<b>Brake resistors</b>		<b>Decentral drives up to 7.5 kW</b>
				
<b>VLT® Advanced Harmonic Filter AHF 005 and AHF 010</b>	<b>VLT® Advanced Active Filter AAF</b>	<b>VLT® Sine-wave Filter MCC 101 VLT® dU/dt Filter MCC 102 VLT® Common Mode Filter MCC 105</b>	<b>VLT® Brake Resistor MCE 101</b>	<b>VLT® Decentral Drive FCD 302</b>
<b>Motion drives and gear motors up to 7.5 kW</b>			<b>Soft starters</b>	<b>Software</b>
				
<b>VLT® DriveMotor FCP 106</b>	<b>VLT® OneGearDrive®</b>	<b>VLT® Integrated Servo Drive ISD® 510 System</b>	<b>VLT® Soft Starters</b>	<b>VLT® Software</b>

# Breadth and depth in **expert products**

## VACON®

Combine innovation and high durability for the sustainable industries of tomorrow.

For long lifetime, top performance, and full-throttle process throughput, equip your demanding process industries and marine applications with VACON® single or system drives.



# Breadth and depth in **expert products**

## VACON®

- **Air and liquid cooled drives**  
(0.25 – 6,000 kW)
- **Decentral drives**
- **Active Front-End drives**
- **Industrial system drives**
- **Grid converters**
- **DC/DC converters**
- **Hybrid and energy storage solutions**
- **Customer-specific solutions**
- **Software tools**



# Breadth and depth in **VACON®** products

Low-voltage drives up to 6.0 MW

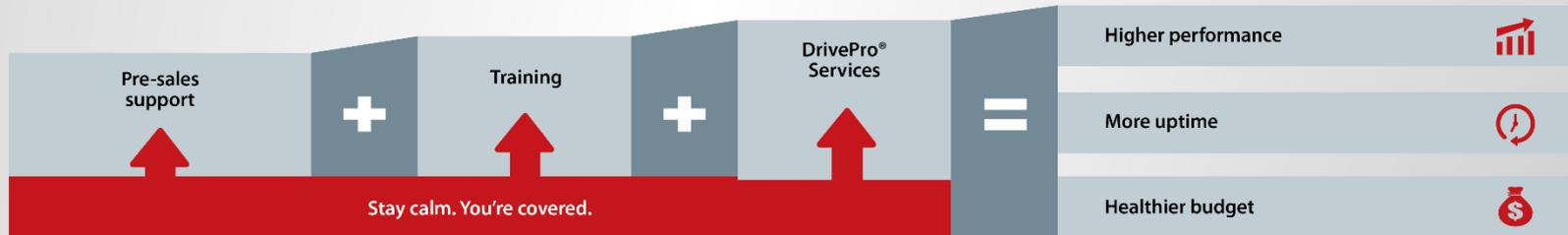
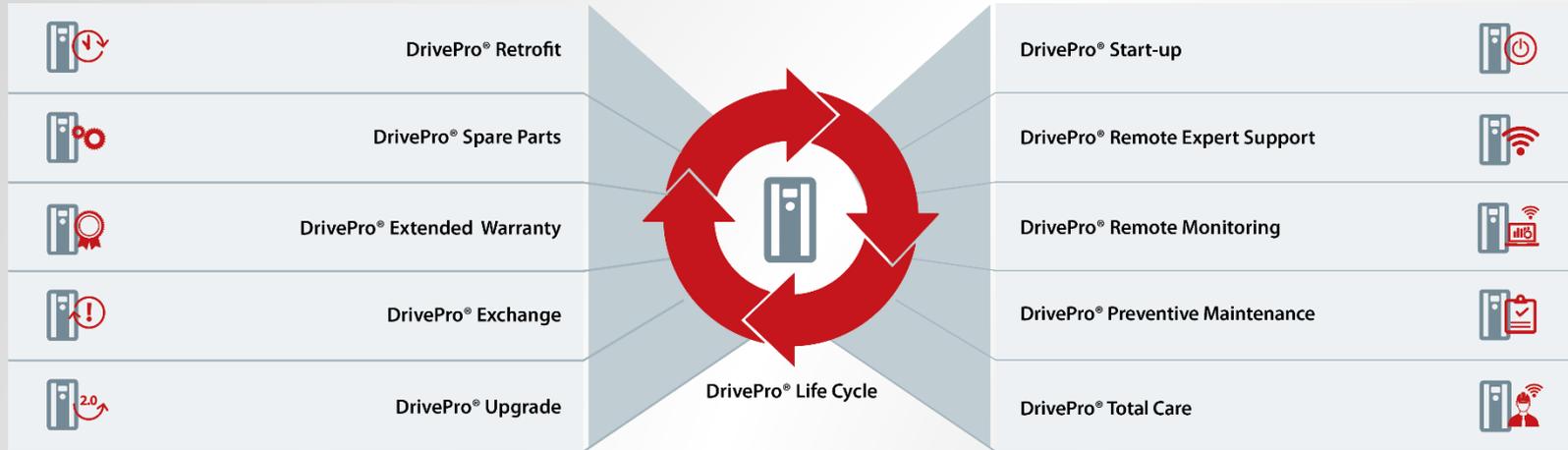
				
<b>VACON® 20</b>	<b>VACON® 20 Cold Plate</b>	<b>VACON® 100 INDUSTRIAL</b>	<b>VACON® 100 FLOW</b>	<b>VACON® NXP Air Cooled</b>
				
<b>VACON® NXC Air Cooled Enclosed Drives</b>	<b>VACON® NXP Liquid Cooled Drive</b>	<b>VACON® NXP Liquid Cooled Enclosed Drive</b>	<b>VACON® NXP System Drive</b>	<b>VACON® NXP Common DC Bus</b>
<b>Harmonic products</b>			<b>Decentral drives up to 37 kW</b>	
				
<b>VACON® NXP Liquid Cooled Common DC Bus</b>	<b>VACON® NXP Grid Converter</b>	<b>VACON® NXP DC/DC Converter</b>	<b>VACON® NXC Low Harmonic</b>	<b>VACON® 20 X</b>

**Medium-voltage drives**

**Software**

		
<b>VACON® 100 X</b>	<b>VACON® 3000 Drive Kit</b>	<b>VACON® Software</b>

# World-class expert services - DrivePro®



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Products and services

> **Our commitment**

# Your **best supplier**

THE AC DRIVES PARTNER WHO SHARES YOUR GOALS

**First mover**

in mass production of drives



**Financially robust**



**Global presence**



**World leader**

for installed base

**#1**

**Equip differently**

with the motor and fieldbus of your choice



**Simplified purchasing**



A better tomorrow is  
**driven by drives**



**ENGINEERING  
TOMORROW**