We power freedom.

RENK

VARIABLE SPEED SYSTEMS

RECOVAR®-E: The variable speed drive system.

/ Drivetrain efficiency 95%

Best in class for variable speed solutions

/ Maximum availability

Mean time between critical failure is over 30 years

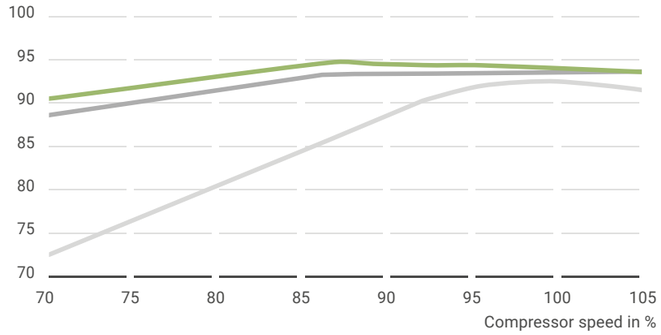
RENK. We are the world's leading specialists for pioneering drivetrain solutions – in industrial applications, energy production and beyond. Our innovative products and solutions set standards when it comes to quality, precision, and reliability. At the same time, they represent cutting-edge technology across global markets.

Through RECOVAR®-E engineering, we are at the vanguard of redefining superimposition (SI) for mechanical drives up to 25 MW and 15,000 rpm. As such, the RECOVAR®-E delivers unparalleled efficiency, unmatched simplicity and a low part count. Beyond this, it boasts an unrivaled inspection and maintenance concept for epicyclic drives. The variability the RECOVAR®-E achieves through superimposed drives is thus: AN ECONOMICAL MUST-HAVE.

RECOVAR®-E superimposition drive: The cutting edge of efficiency and availability for variable speed drives.

The RECOVAR®-E provides an unparalleled overall system efficiency of 95% throughout the entire drive system – including the main motor.

Savings compared to conventional solutions through RECOVAR®-E: Increasing the efficiency of a 10 MW application by 5% represents energy cost savings of at least € 200,000 per year.



RECOVAR®-E in your train:

- Coaxial shaft arrangement
- Very low moment of inertia for direct on-line (DOL) starting
- RENK helps to select/ provides the main motor

Over the past twenty years, the industry has developed solutions to operate compressors and pumps at variable speeds in order to preserve energy.

Prior to this, using the throttle was the only way to vary the output of these machines. In many cases, however, this resulted in a loss of more than half the input power.

With the RECOVAR®-E, RENK now offers the latest development for variable speed drive systems. As a hybrid mechanical and electrical solution, it offers the best of both worlds.

By redefining SI for mechanical drives, the RECOVAR®-E delivers the following:

- Unparalleled efficiency
- An unrivaled inspection and maintenance concept for epicyclic drives (similar to that for parallel shaft gears)
- An unmatched low part count via direct drive SI
- All rotating parts are supported by slide bearings
- No scheduled mean time between overhauls (MTBO)
- Reduced total harmonic grid distortion (THD)
- Possible as an option: a redundant converter for the superimposition (SI) motor.

/ On-site maintenance

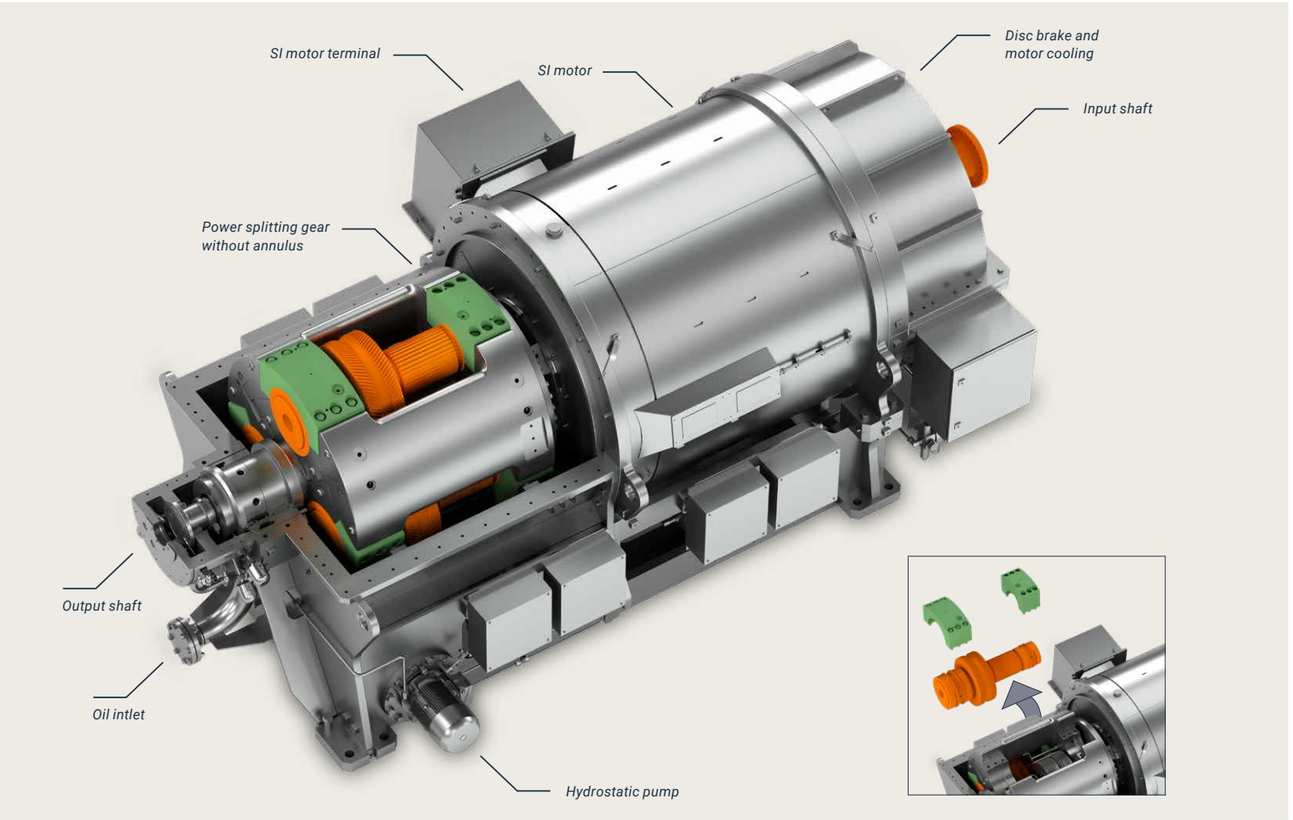
Spare part exchange possible on-site: gear rotor set, bearings, SI motor

/ Low inertia

Allows for easy direct on-line starting of motor

/ Low total harmonic grid distortion

Ideal for local grids



Made for Oil & Gas industry

- Ideal for compressor operation with variable speed
- Long MTBF
- Long intervals between maintenance/overhaul

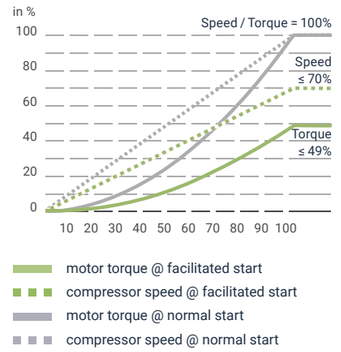
Engineered for in situ maintenance.

Most RECOVAR®-E components can be inspected / disassembled with the unit still installed in the shaft train.

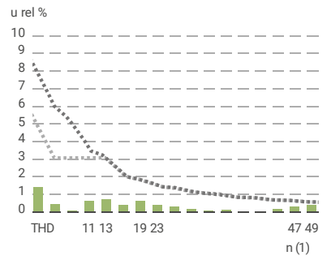
Thanks to its featured horizontal split line, the RECOVAR®-E overcomes the typical maintenance disadvantages associated with epicyclic gears (e.g. those associated with existing SI gear concepts with an annulus). Since there is no ring gear, the planet shafts are accessible (as is the case in a parallel shaft gear with bearing caps). The planets can be disassembled together with their bearings. Output and input sun gears can also be maintained without any disruption of the casing alignment. This work requires only very limited crane capacity in the shaft axis line.

RECOVAR®-E lowers the inertia and the impact on the grid.

RECOVAR®-E supports DOL start of main motor (Example: based on a 10 MW application)



Harmonics and THD



Benefits of the RECOVAR®-E for the DOL start of the main motor:

- Facilitated start of main motor / drivetrain
- Reduced thermal stress for motor
- In many cases, no additional measures required (such as low inrush current motor/additional motor-starting devices)
- Reduced costs for main motor
- Improved motor efficiency (compared to low inrush current motor)

RECOVAR®-E supports the direct on-line start of the main motor.

Since the main motors of compressors or pumps usually operate directly on the grid, the requirements for DOL start-up have to be considered.

Thanks to the absence of an annulus, the RECOVAR®-E features very low inertia. In fact, it has by far the lowest inertia of the known solutions for compressor drives. This reduces the torque during start-up. By using the SI motor to adjust the speed ramp-up during the starting procedure, the start can be further facilitated, reducing the requirements for the main motor even more.

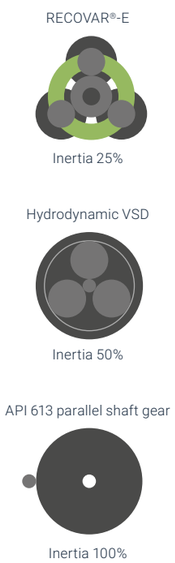
RENK can provide you with a counter-torque curve of the main motor to be purchased. RENK can also quote the main motor.

Low harmonic distortions.

Particularly in decentralized grids, such as those on offshore oil platforms, harmonic distortion must be prevented. RECOVAR®-E produces very low THD on the electrical grid, well below IEC acceptance criteria.

The SI drive requires only limited power to adjust the speed. This allows a small frequency converter to be used. Compared to a full variable frequency dive (VFD), the RECOVAR®-E frequency converter handles just a fraction of the power. As a result, harmonic distortion is minimized.

A systems comparison for inertia at the motor shaft:

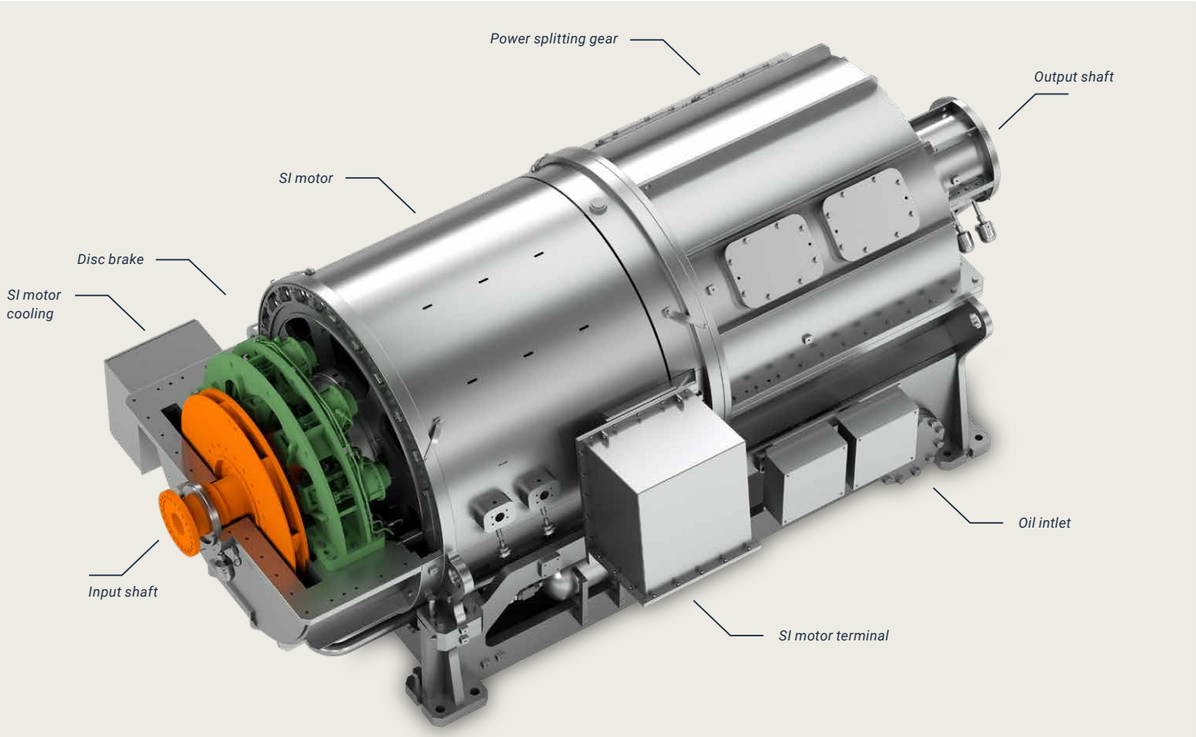


/ Unparalleled simplicity

Engineered for maximum modularity

/ Water or oil cooling

SI motor cooling is adapted to site requirements



The SI motor is an induction motor which is water jacket or oil jacket cooled. In the event of a power outage in the SI-motor supply, a disc brake safely brings the SI drive to standstill. The RECOVAR®-E is designed to continue operation at fix speed.

Induction machines are known for their robustness when it comes to operation in harsh environments. Due to their simplicity this technology is a key factor in maintenance, service and safety.

Slide bearings for all shafts in the RECOVAR®-E are essential for continuous operation.

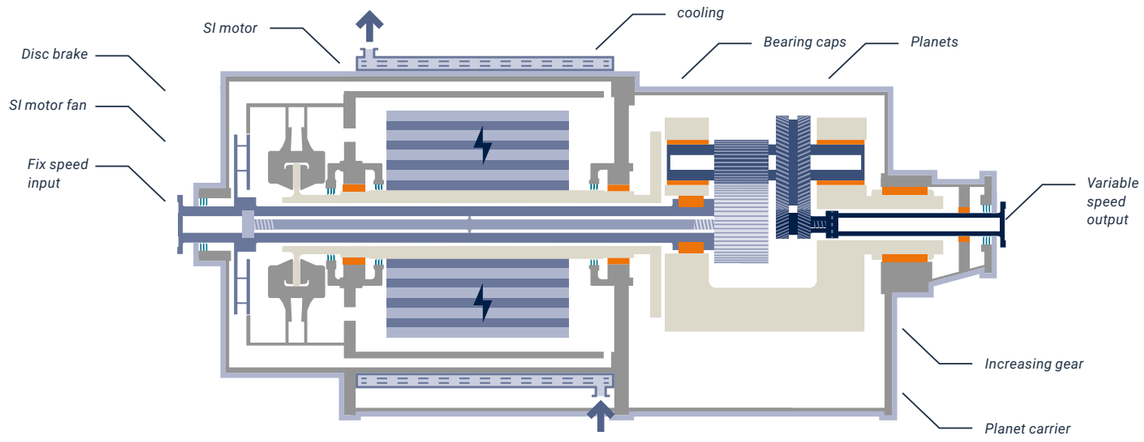
The RECOVAR®-E design features planet bearing temperature monitoring by radio-frequency identification (RFID). Data are transmitted wirelessly from the revolving planet.

The SI motor is a state-of-the-art induction motor.

It unites top efficiency, simplicity and robustness. The high torque of this motor allows direct coupling to the planet carrier.

RECOVAR®-E: Engineering excellence. Maximum Simplicity. Maximum Resilience.

RECOVAR®-E for variable speed applications: Innovative. Intelligent. Low maintenance.



Superimposition transmission reinvented.

RECOVAR®-E is a cost efficient solution whenever a high speed drive system above 3 MW requires speed control. This is the case for roughly 50% of compression and pumping systems. A RENK field reference, which has been in operation since 2017, demonstrates that power of 100 MW can be transmitted.

When variable speed is required, many applications are equipped with large frequency controlled motors. Others are equipped with fix speed motors and hydrodynamic superimposition drives. The RECOVAR®-E is the drive solution for all of these applications.

The principle of SI is used in the RECOVAR®-E's specific differential gear design to control the output speed in a defined range below and above the gear ratio of the speed increaser.

In conventional SI layouts, the SI drives transmit their torque through complex gearing mechanism on the drivetrain. In the RECOVAR®-E design, by contrast, the SI motor is directly coupled with the planet carrier.

The entire RECOVAR®-E is engineered with RENK proven slide bearing design for maximum efficiency and availability.

/ Smaller footprint

Same output while taking up much less space in the electrical room

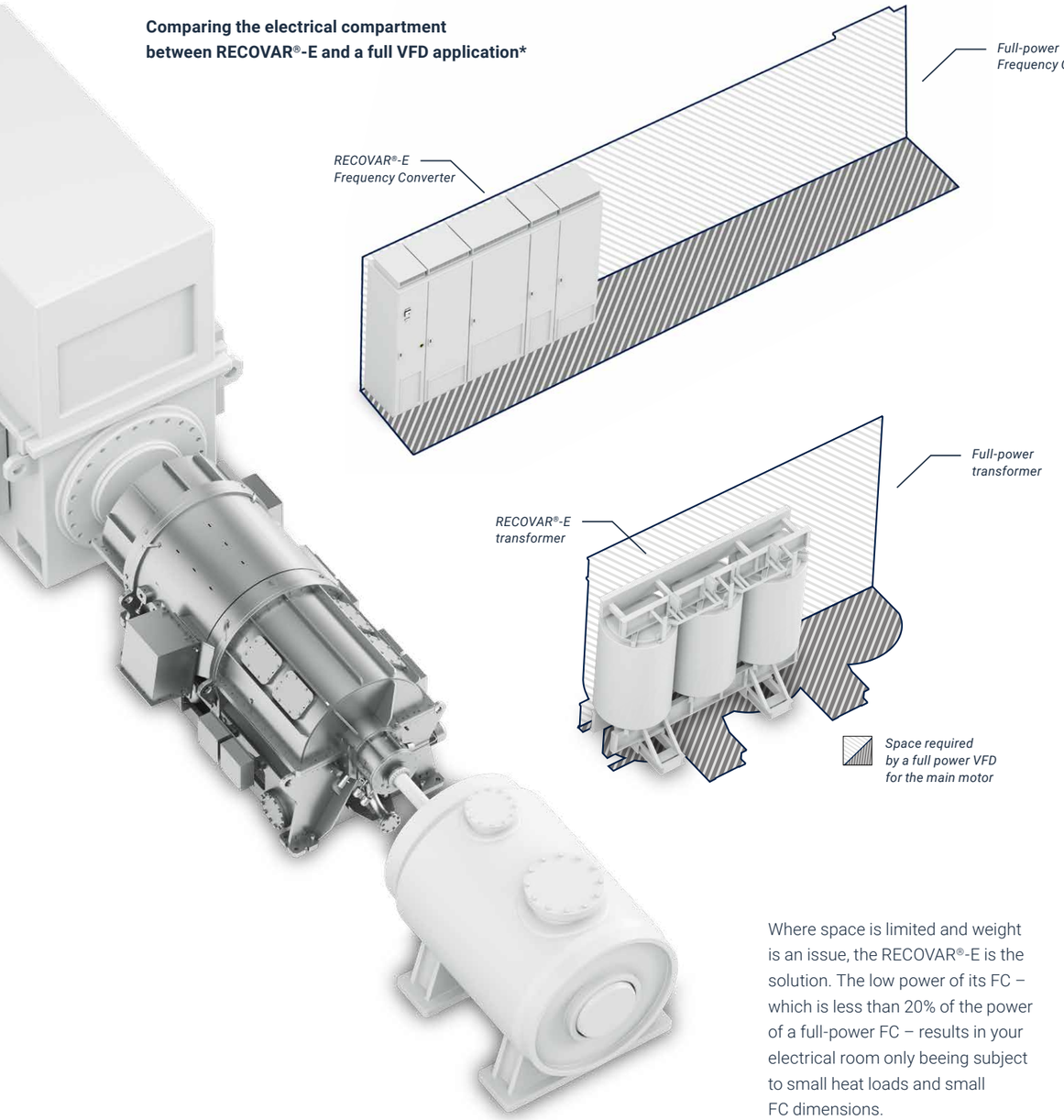
/ Less weight

than a full-power FC and transformer

/ Less heat load

in the electrical room

Comparing the electrical compartment between RECOVAR®-E and a full VFD application*



Where space is limited and weight is an issue, the RECOVAR®-E is the solution. The low power of its FC – which is less than 20% of the power of a full-power FC – results in your electrical room only beeing subject to small heat loads and small FC dimensions.

** based on an example of a 10 MW application*

Innovative monitoring for the RECOVAR®-E.

The optional condition monitoring RVM (RENK Vibration Monitor) allows for remote diagnosis.

The RVM analyzes all relevant parameters of drives, couplings and gear units. The system logs key data and transmits it to any digital device at any location via high-quality cryptographic encryption standards.

If desired, information concerning equipment conditions as well as maintenance recommendations can also be delivered as individual reports. This recording of cross-system conditions is the foundation for the efficient maintenance of the entire system.

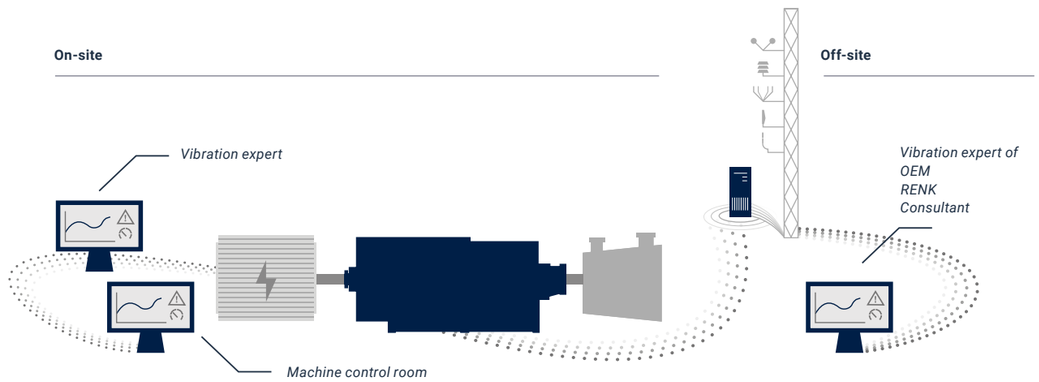
The data is either stored locally or directly in a certified RENK data center through a VPN data line. As a result, highly qualified service personnel can check the system status at any time.

The RECOVAR®-E is equipped with API 670 based instrumentation to monitor the following:

- Shaft vibration for output shaft and SI shaft line
- Casing vibration
- Temperature for all bearings
- Brake status
- SI motor winding temperatures
- Lube oil data
- Output torque

All components in view.

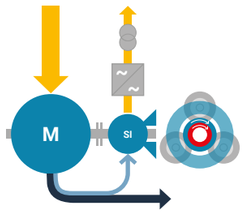
With the RVM, manufacturers and operators have online access to the condition of rotating machinery. Maintenance can be scheduled based on comprehensive historic data collected by the RVM instead of inspections.



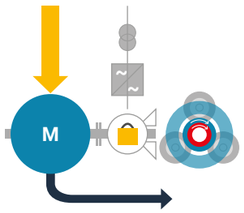
RECOVAR®-E provides 95% or more total system effciency over a wide range of output speeds – thanks to electric superimposition.

RECOVAR®-E – Electrical and mechanical power flow

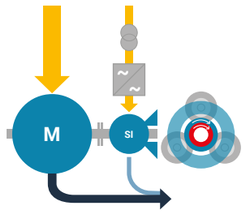
SI Generator Mode



Back-up Mode



SI Motor Mode



Unique design for ultimate performance.

SI in the RECOVAR®-E uses an induction motor fed through an active-front-end FC to rotate the planet carrier.

With the superimposition motor at standstill, the output speed is defined by the input speed and gear ratio (central part of image).
Operating the SI as a generator results in lower speeds (left side of the image). Electrical power gets recuperated.
Operating the SI in motor mode results in increased speeds (right side of the image).

The SI motor is rated according to the required torque and speed range of your application. The low power and high efficiency of the SI motor and its frequency converter boost the efficiency of the RECOVAR®-E to a level beyond that of all other available solutions for variable speed drives.

Application range

The RECOVAR®-E is available for a variety of input speeds. The 100% output speed can range from 4,000 to 20,000 rpm.

The speed control range is typically 70% to 105%. Lower control ranges result in even greater efficiencies and lower costs. Higher control ranges are also possible. The efficiencies given here do include the main motor. With the RECOVAR®-E, the drive power is the total of the main motor power and the SI motor power. As a result, part of the drive power comes from the SI motor. RENK is more than happy to quote the main motor which normally is not part of the scope of the RECOVAR®-E.

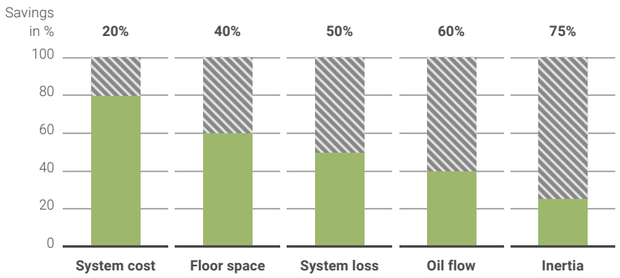
RECOVAR®-E

is based on an electric SI drive (with a fraction of the main motor power). This results in high efficiency, a small FC and a lube oil system similar to a parallel shaft gear.

The electrical SI provides the RECOVAR®-E with its good system efficiency, superior to the efficiency of hydrodynamic solutions. In solutions up to 25 MW, the SI motor directly drives the planet carrier. Solutions for up to 100 MW are available with geared SI.

Please contact our sales team for further details.

When compared to conventional solutions



One system, one partner.

As your system partner for RECOVAR®-E variable speed drives

- **RENK's scope comprises all mechanical and electrical components from shaft end to shaft end.**
- **RENK provides torsional shaft train analysis for your entire drivetrain.**
- **RENK can, upon provision of the grid data, provide you the THD calculation of your grid or sub-grid.**
- **RENK can provide you with a counter-torque curve of the main motor to be purchased. RENK can also quote the main motor.**
- **RENK can provide automated and online diagnosis of the RECOVAR®-E through the condition monitoring RENK RVM.**

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freedom.

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Edition: 2026-10-01