Industry Perspectives

Desalination

Optimize your Electrical Distribution:

Thanks to better design,
better motor management,
and better maintenance.

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Life Is On Schneider Electric

Contents

1. Introduction

When humans, agriculture, and industries struggle to access scarce drinking water, desalination is often the only solution left.

Water desalination has become a vital issue, particularly in a world facing rising water demand due to climate change, growing populations, and industrial water needs. The global desalination market is poised to grow significantly, reaching $21 billion by 2030, with a compound annual growth rate (CAGR) of +8% in capital expenditure (CAPEX) from 2023.

This growth is particularly concentrated in regions such as the Middle East, Asia-Pacific, and North America, driven by increasing urbanization, rising industrial and agricultural demand, and persistent water scarcity.

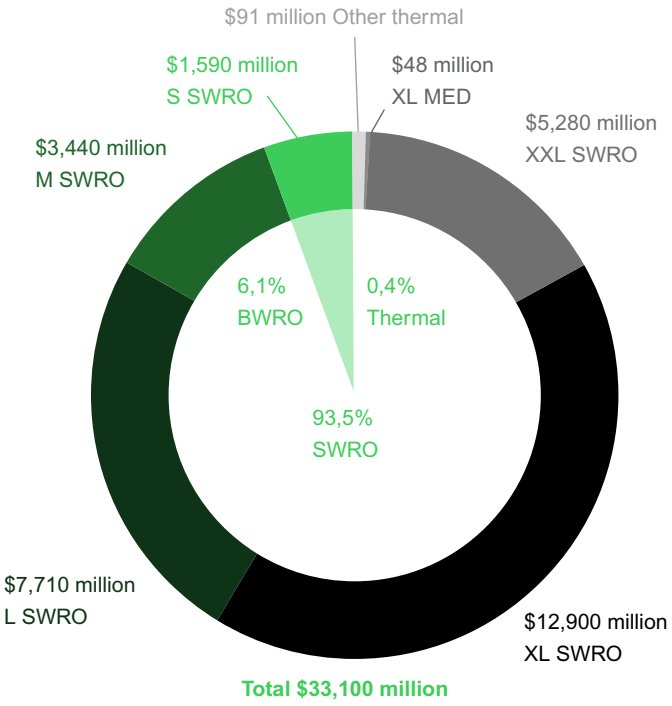
Water desalination **is a method of producing drinking water from seawater or brackish water.**

Two types of desalination technologies **lead** the market:

- **Thermal desalination,** raw water is boiled and the condensed vapor is pure water (distillate).
- **Reverse osmosis (RO),** a semi-permeable membrane is used to filter out the dissolved solids.

RO is the **dominant technology** for desalination plants and will be **the focus of Schneider Electric's efforts to address the challenges facing the water desalination industry.**

RO accounts for over **99%** of planned water desalination capacity additions during the period 2021 to 2025.



Source: "GWI, Desal data"

21,000+ desalination plants in the world producing 105M m³/day of water for 300M+ people (**4.2% of world's population**)

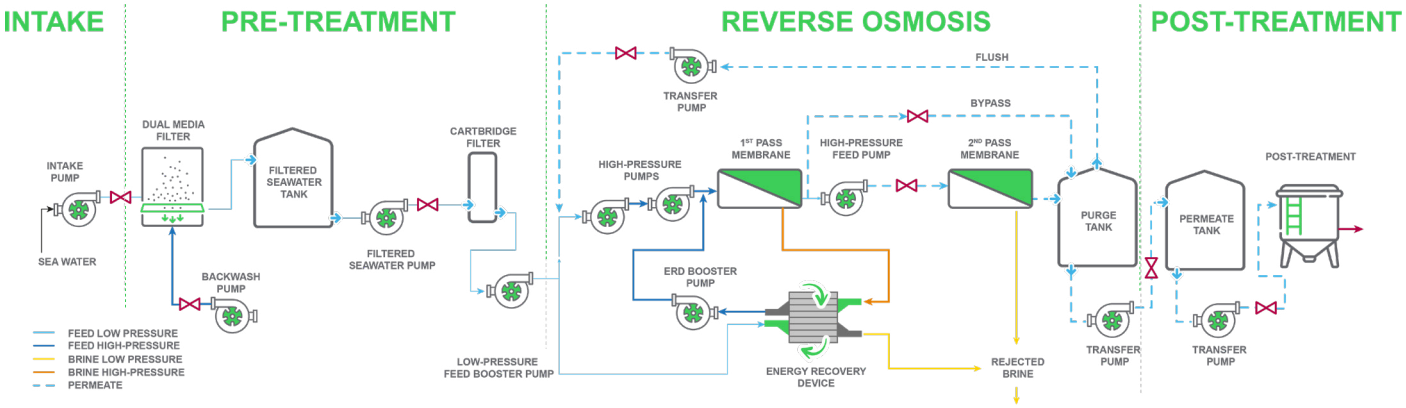
Seawater desalination represents
92% of the contracted capacity;
61% of water is produced using reverse osmosis (RO) technology.

70% of the Market is utility,
30% industrial

$4.3 billion in 2024 for Technology,
20% is Digital

Sources: "Morgan Stanley Sustainability, Report 2022" - "GWI WaterData, 2024"

1.1 Reverse Osmosis (RO) Process Overview



Several key advantages make **reverse osmosis (RO) the most widely adopted desalination technology:**

Energy Efficiency: RO is more energy-efficient compared to thermal desalination methods like multi-stage flash (MSF) and multi-effect distillation (MED). This efficiency translates to lower operational costs.

Cost-Effectiveness: The overall cost of producing freshwater using RO has decreased significantly over the years due to advancements in membrane technology and energy recovery systems.

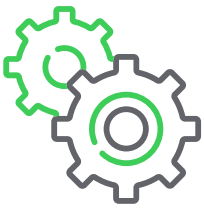
Scalability and Flexibility: RO plants can be built in various sizes, from small units for individual use to large-scale plants for municipal water supply. This scalability makes it suitable for different applications.

Environmental Impact: RO can generate fewer greenhouse gas emissions compared to thermal processes, depending on the electricity sources. Additionally, modern RO plants are designed to minimize the impact on marine environments by carefully managing the brine disposal step.

Technological Advancements: Continuous improvements in membrane technology, pre-treatment processes, and energy recovery devices have enhanced the performance and reliability of RO systems.

2. Energy Challenges of Desalination

Understanding the challenges of water desalination is the first step in solving the energy dilemma.



Energy-intensive process of desalination

+

Exponential demand for water worldwide

=

Energy-related challenges

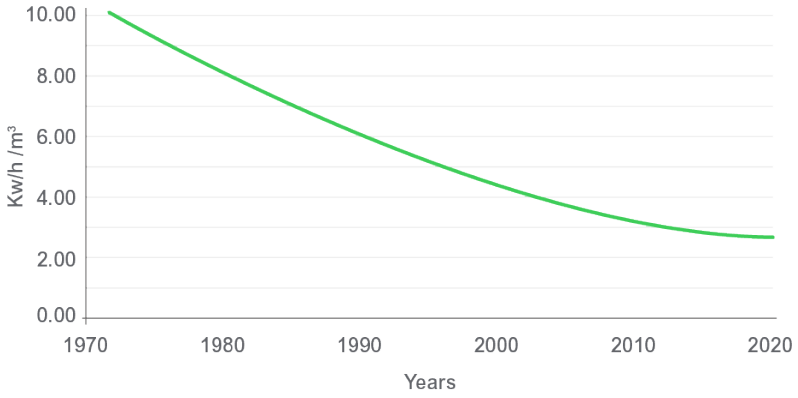
The significant improvements of Reverse Osmosis (RO) technology over the past decades have reduced desalination energy consumption to **as low as 2.5 - 3.5 kWh/m³.**

Nevertheless, desalination remains an **energy-intensive process**, with larger plants reaching power demands of hundreds MVA.

It requires substantial **electrical infrastructures** to supply the energy and results in a strong dependency on **energy sources**, both of which have a significant impact on the final **cost of water**.

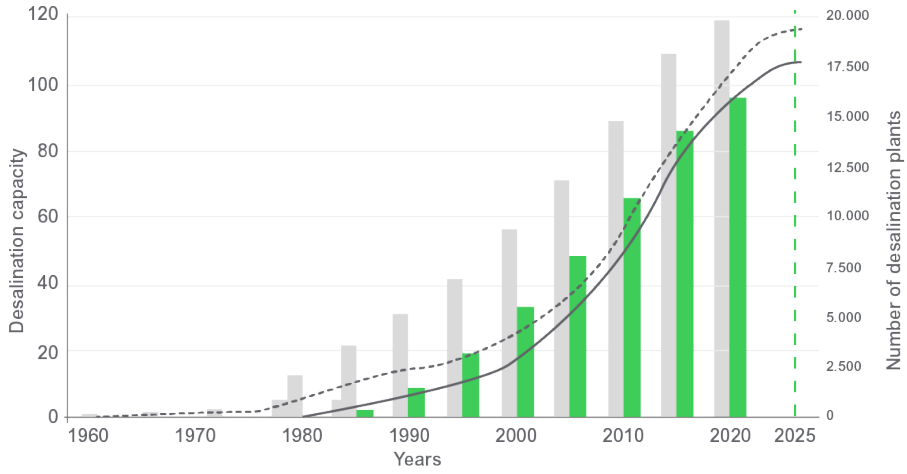
Therefore, **CAPEX, OPEX,** and **energy autonomy** become critical factors in managing overall system performance and meeting economic and operational expectations.

Historical Evolution of Energy Consumption in SWRO.



The **exponentially growing demand** for water worldwide is due to climate change, growing populations, and rising industrial and agricultural water demand. The final **cost of water** is under pressure to decrease, while production **capacity** must increase. This makes it more important than ever to meet the requirements for better process **efficiency, continuity,** and **scalability.**

Exponential Growth Observed Over the Last 60 Years.



Operational Desalination plants

Desalination plants

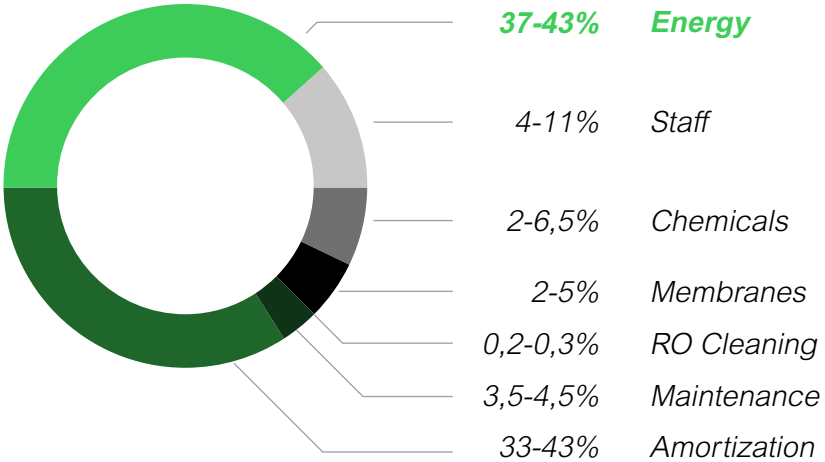
Operational Desalination capacity

Desalination capacity

- Energy supply
- Electrical infrastructure
- Energy management
- Renewable integration.

2.1 Reverse Osmosis (RO) in More Details

2.1.1 Cost Distribution of RO-Desalinated Water



37-43%	***Energy***
4-11%	*Staff*
2-6,5%	*Chemicals*
2-5%	*Membranes*
0,2-0,3%	*RO Cleaning*
3,5-4,5%	*Maintenance*
33-43%	*Amortization*

Source: "WEX 2012 Lisbon"

Energy can represent **up to two-thirds** of the operating expenditure (OPEX) and **half** of total expenditure (TOTEX).

2.1.2 RO Challenges

		Seawater supply	Pre-treatment	RO process	Post-treatment	Freshwater storage
Challenges to tackle	General	• Ensure plant performance monitoring (compliance, economic, resources, assets, maintenance, safety) • Minimize downtime • Reduce cost of Operation and Maintenance • Optimize asset performance • Increase operators efficiency				
	Specific	• Adapt to changing sea water conditions	• Reduce chemical consumption • Reduce energy consumption of the backwash process	• Improve membrane efficiency and lifespan • Improve clean-in-place (CIP) procedure efficiency • Reduce energy consumption	• Reduce chemical consumption	

Energy challenges can be addressed through **better design** of Electrical Architecture, **better management** of the motor applications and **better maintenance** of the assets.

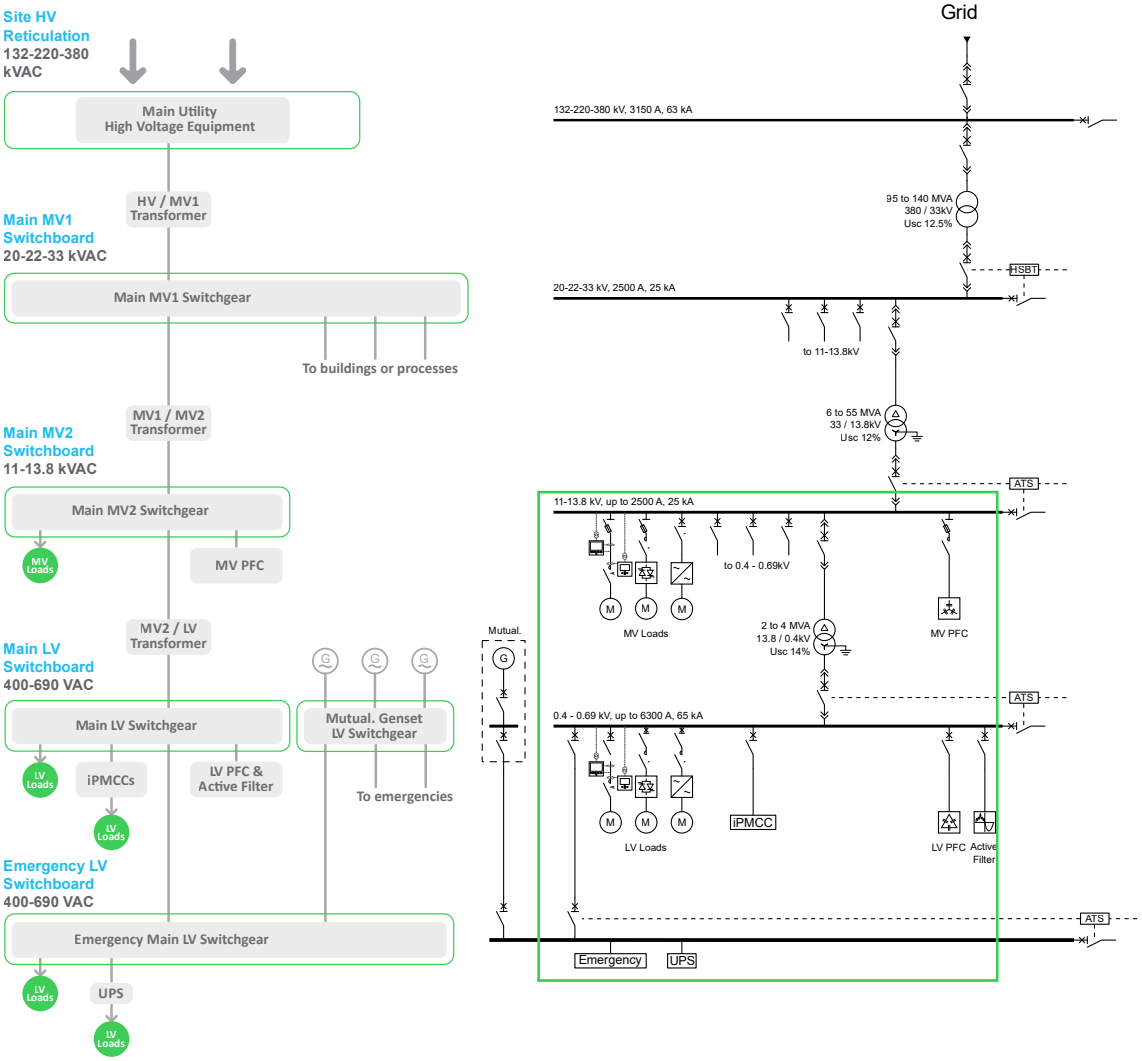
3. Design of Electrical Distribution

Optimize your electrical distribution with a better design.

A well-designed Electrical Distribution system brings significant strategic benefits. First, it helps you reduce **capital expenditure (CAPEX)** and shorten **lead times** by making smarter technical choices.
It also enhances the **safety** and **reliability** of your electrical infrastructure, minimizing the risk of failures and ensuring greater continuity of service. Moreover, by integrating photovoltaic (PV) energy, you can lower your greenhouse gas emissions and optimize your energy costs, contributing to a more **sustainable** and **cost-effective** operation.

3.1 Electrical Distribution Architectures

3.1.1 Large Plant Architecture



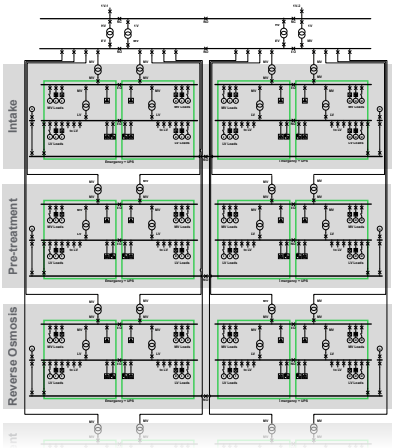
With high power demand up to several hundred MVA, large plants are connected to high-voltage (HV) supply at **132 kV**, **220 kV** or **380 kV**.

Power is distributed to processes or plant locations at **20 kV**, **22 kV** or **33 kV**.

The MV1/MV2 transformers lower the voltage to feed the high-power loads at **11 kV** or **13.8 kV**.

The MV2/LV transformers lower the voltage to feed the low-power loads at **400 V** or **690 V.**

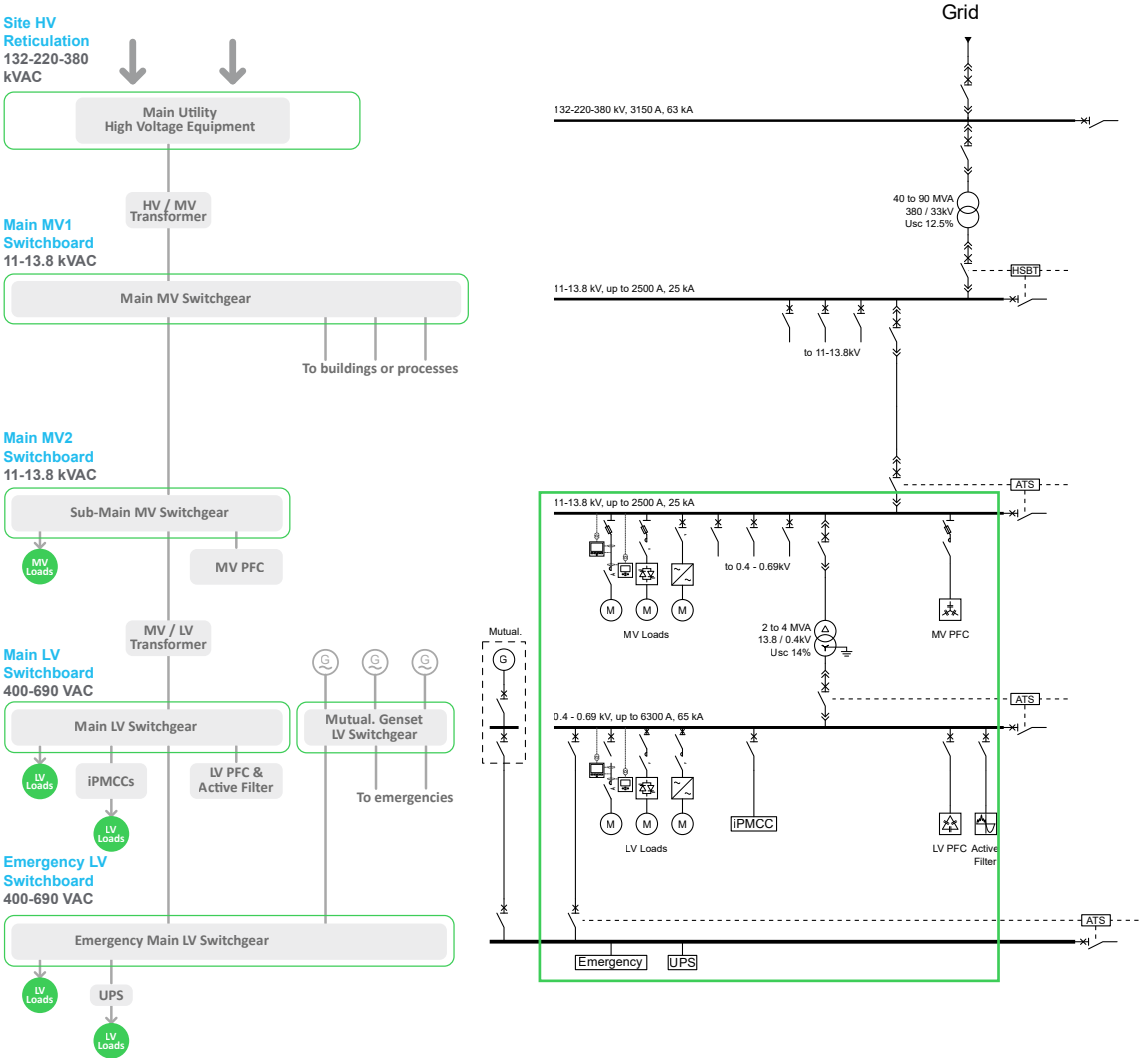
Large Plant Full Architecture Representation:



Repetitive pattern

HV: high-voltage / MV: medium-voltage / LV: low-voltage

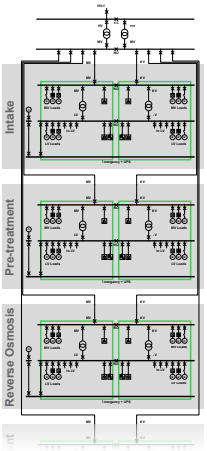
3.1.2 Small Plant Architecture



With lower power demand, small plants require only one medium voltage (MV) level at **11 kV** or **13.8 kV.**

They can remain connected in high-voltage (HV) or be connected at MV level for smaller installations. Larger loads are still supplied at MV, while smaller ones are supplied at low-voltage (LV) - **400V** or **690V.**

Small Plant Full Architecture Representation:



Repetitive pattern

3.2 Renewable Energy Integration

Even though it cannot fully meet the high and continuous energy demand of desalination, **photovoltaic (PV) energy** is playing an increasingly important role in enhancing sustainability and reducing energy costs in desalination water production.

Why is PV energy integration a key benefit for desalination?

Renewable and Sustainable
PV energy is a clean and renewable energy source that minimizes the dependency on fossil fuels and significantly reduces greenhouse gas emissions.

Cost-Effective
Although the initial capital investment for PV systems can be high, the lower operating costs they offer make them economically advantageous in the long term, providing substantial cost savings over the system's lifetime.

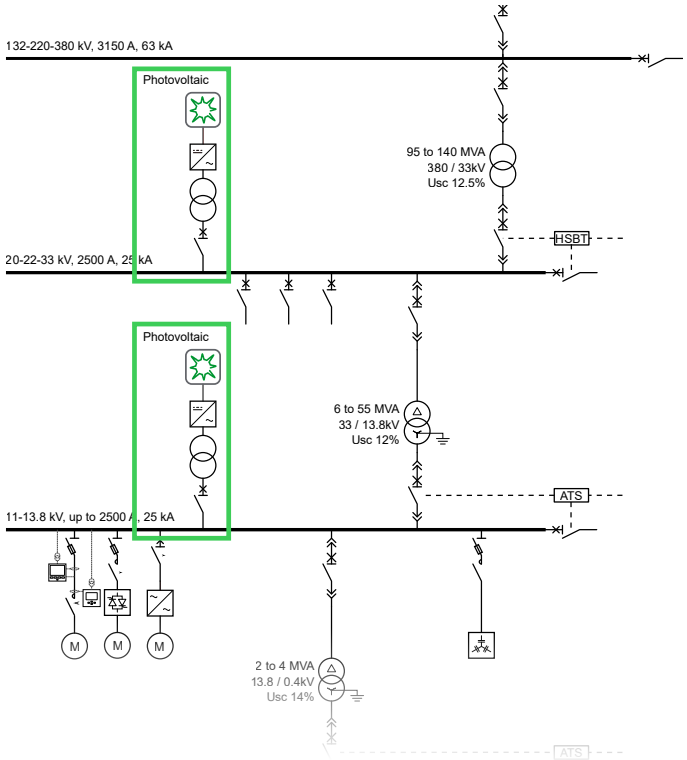
Scalability
Both PV and reverse osmosis (RO) technologies are highly scalable. Their modular design enables flexible deployment and straightforward capacity expansion on demand.

Energy Independence
Leveraging solar energy enhances energy assessment by reducing dependency on external energy sources, thereby lowering long-term energy costs.

Depending on the plant site topography, PV energy system can be:

Centralized on a single site location, installed on a large open field and connected at the medium-voltage (MV) distribution level.

Distributed over the whole site, installed on several building rooftops and connected at various MV load level locations.



3.3 Digital Layer Enhancement

Connected products enable access to advantageous digital applications that transform the way electrical systems are managed and optimized. By leveraging real-time data and smart analytics, the digital layer enhances performance across three key areas:

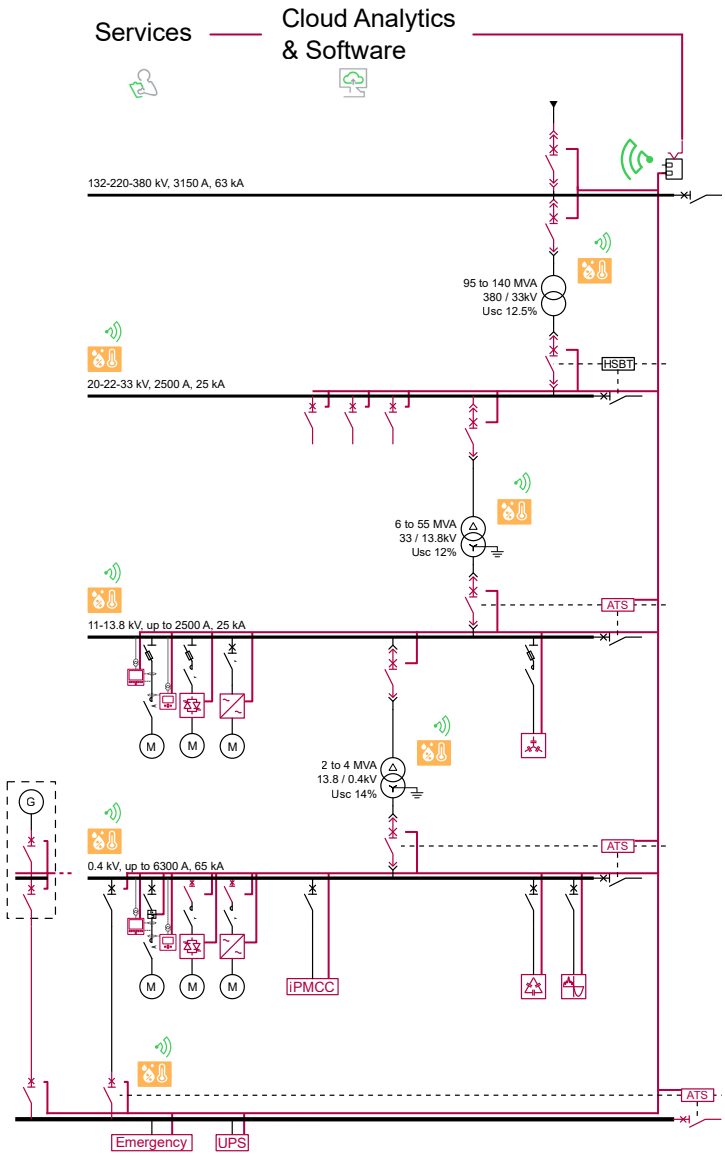
Electrical Safety
Reduces fire risks and ensures better protection for people and assets.

Power Availability
Improves electrical asset management, reduces unplanned and operational error downtimes, and strengthens energy resilience.

Sustainability
Reduces energy use, lowers CO_2 emissions, and supports your sustainability goals and regulatory compliance.

The digital layer brings **intelligence, efficiency,** and **safety** to your electrical infrastructure.

Digital Layer:
Through connected products, the digital layer can cover the entire electrical distribution system.



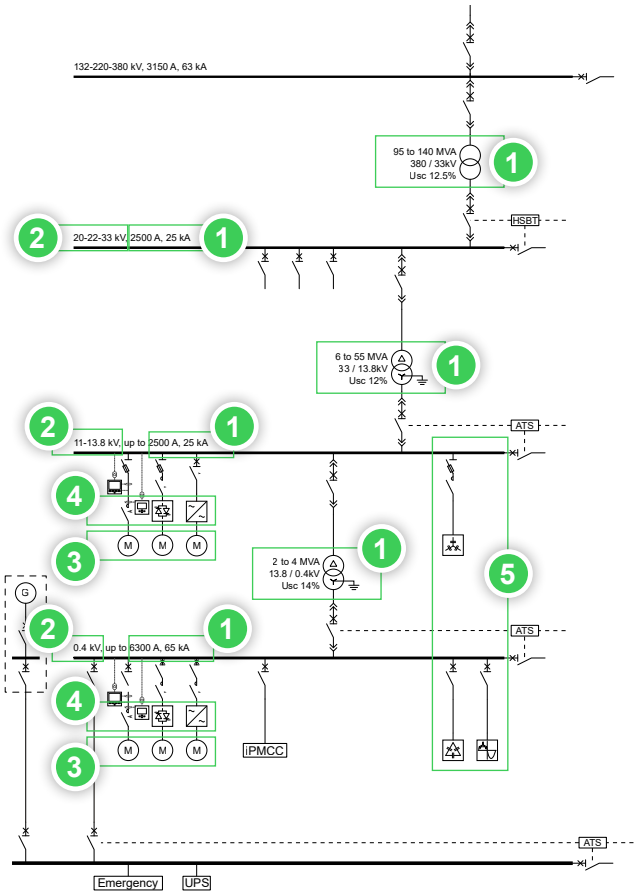
3.4 Electrical Distribution Optimization Opportunities

In today's energy-constrained landscape, optimizing electrical distribution is essential to achieve operational efficiency, reduce capital expenditures (CAPEX), and ensure high standards of safety and reliability.

By adopting a holistic approach to system design and implementation, the electrical architecture can be largely optimized.

1. **Transformer power and current sizing** (See the 3.4.1)
2. **Busbar voltage level** (See the 3.4.2)
3. **Motor voltage level** (See the 3.4.6)
4. **Motor starting and operating mode***
5. **Power quality***

**Motor Management optimizations will be addressed in Chapter 4.*



3.4.1 Transformer Power and Current Sizing

Switchboard total consumption should be calculated based on the aggregate downstream load, applying individual diversity factors (to reflect realistic operating conditions).

Transformer size should be determined according to the expected maximum power demand, rather than the theoretical maximum possible installed load power (to ensure optimized capacity and avoid unnecessary oversizing).

Busbar and feeder current ratings should be defined according to the output of the detailed load list, rather than the full rated power of the upstream transformer to align with actual load requirements.

Motor short-circuit current contribution should be excluded for motors controlled by variable speed drives (VSDs).

As a result, **both rated current and short-circuit withstand requirements can be optimized.** In line with the maximum fault clearing time given in the protection plan, the **thermal withstand duration may also be reduced** from three seconds to one second.

Transformer Power and Current Sizing

up to 10%	**up to 5%**	**up to 5%**
transformers cost saving	MV switchgear cost saving	LV panels cost saving

3.4.2 Voltage Level Choice

In **medium-voltage (MV)** installations, equipment costs rise with increasing voltage levels, rated current and short-circuit withstand capabilities.

Optimal design involves selecting the **appropriate voltage level** based on the expected **power demand**, while limiting the rated current to a maximum of **2,500 A** (or even 2,000 A) and restricting the short-circuit current to **25 kA.**

These current thresholds align with the most widely used equipment on the market, offering competitive pricing and shorter lead times due to higher standardization and products availability.

Indicative One-Transformer Ratings:

	Motor Load & Distribution Voltage			Distribution Voltage	
	6.6 kV	11 kV	13.8 kV	22 kV	33 kV
20 MVA 8%	2,000 A 25 kA*	1,250 A 25 kA*	1,250 A 12.5 kA*	630 A 12.5 kA	630 A 12.5 kA
45 MVA 11%	4,000 A 50 kA*	2,500 A 25 kA*	2,000 A 25 kA*	1,250 A 12.5 kA	800 A 12.5 kA
55 MVA 11%	5,000 A 50 kA*	3,150 A 31.5 kA*	2,500 A 25 kA*	1,600 A 25 kA	1,250 A 12.5 kA
95 MVA 12.5%	NA / NA	5,000 A 50 kA*	4,000 A 40 kA*	2,500 A 25 kA	2,000 A 25 kA
140 MVA 12.5%	NA / NA	NA / NA	NA / 63 kA	4,000 A 40 kA	2,500 A 25 kA

** Short-circuit current can be higher with DOL operation motor contribution*

Recommended / Not-recommended

Appropriate Voltage

up to 2%

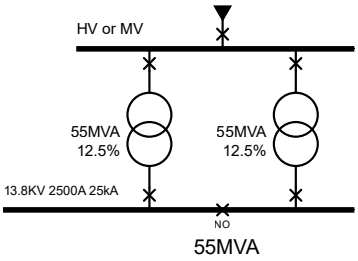
MV switchgear cost saving

Conversely, in **low-voltage (LV)** installations, increasing the voltage to **690 V** reduces overall costs by decreasing cable size and installation expenses.

3.4.3 Spare Transformer Usage

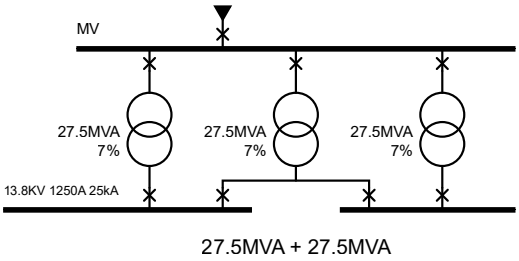
To ensure redundancy, two typical configurations can be considered:

2N Configuration: uses two half-loaded transformers in parallel, so that one transformer can feed the entire loads (**oversized**).



55MVA

N+1 Configuration: uses two fully loaded transformers, with one additional identical transformer used as spare (**load-sized**).



27.5MVA + 27.5MVA

N+1 Configuration

The N+1 configuration is **mainly beneficial in medium-voltage (MV) supply.** In high-voltage (HV) supply, the requirement for an additional feeder reduces the potential cost savings, making this configuration less advantageous.

up to 6%
transformers cost saving

up to 1%
MV switchgear cost saving

3.4.4 Transformer Windings Selection

For high-power applications, both **two-winding and three-winding transformer configurations** can be considered.

"Three-Winding Transformer" Configuration:
Each transformer consists of **two identical secondary windings** (same power/voltage), sharing one primary winding (double power).

Three-winding transformers are **more specific** than two-winding ones, which results in higher cost and longer lead time.

The mutual primary winding simplifies the upstream connection by saving one feeder, compared with two equivalent two-winding transformers that require two feeders.

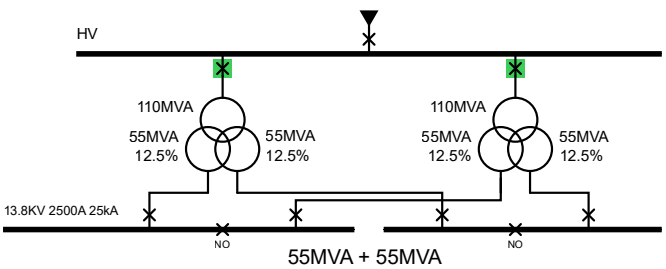
"Two-Winding Transformer" Configuration:
Each transformer consists of **one secondary and one primary winding** (same power).

These are **standard transformer types** offering the best pricing and availability.

Even though they do not optimize the number of feeders, they can still be the optimal choice.

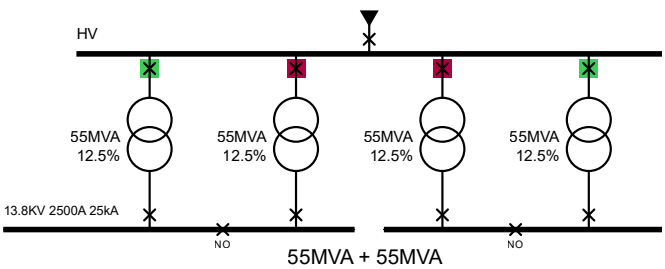
For **installations connected to the same HV busbar**, using a **three-winding transformer configuration** results in **saving two HV feeders.**

Three-Winding Transformer



55MVA + 55MVA

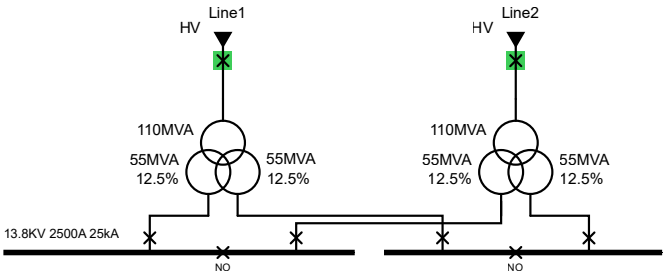
Two-Winding Transformer



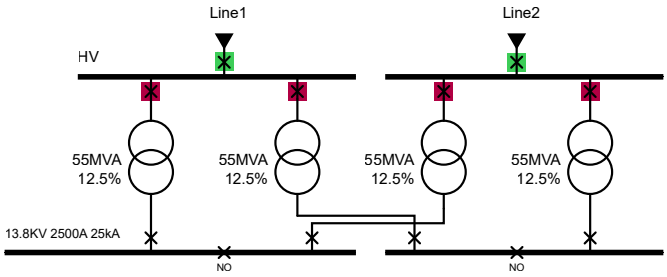
55MVA + 55MVA

For **installations with redundant high-voltage (HV) connections**, using **three-winding transformer configuration** results in **saving four HV feeders.**

Three-Winding Transformer



Two-Winding Transformer



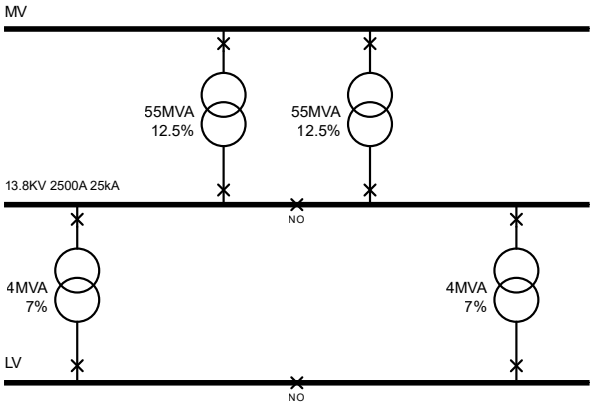
Warning! As mentioned previously, **three-winding configuration** presents higher manufacturing **specificities.** In optimization studies, it is recommended to compare transformer and feeder prices, as well as lead times, to fairly evaluate both configurations and select the most **cost-effective** solution.

3.4.5 Direct Supply for LV Loads

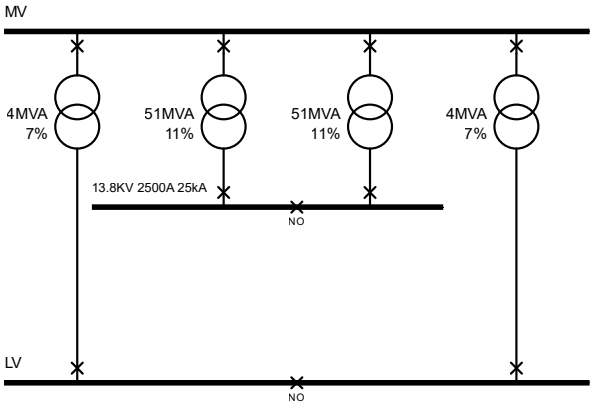
With a dedicated supply for low-voltage (LV) loads from the main busbar, overall cost savings can be achieved.

This is primarily due to the reduction in the required power rating of the medium-voltage to medium-voltage (MV/MV) transformer, which typically yields greater cost benefits than the additional expenses associated with the medium-voltage to low-voltage (MV/LV) transformer and its corresponding MV feeder.

Standard Supply



Direct Supply



Overall Savings

Direct supply of the LV loads from the main busbar provides **overall savings.**

These savings are primarily due to the reduction in MV/MV transformer power, as LV load power is no longer supplied through it. The change of the MV/LV transformers and associated cubicles will increase the respective cost, but to a lesser extent than the savings from the change of the MV/MV transformer.

up to 5%
MV/MV transformers cost saving

up to +3%
MV switchgear cost impact and MV/LV transformers

3.4.6 Motor Voltage Level Choice Between LV and MV

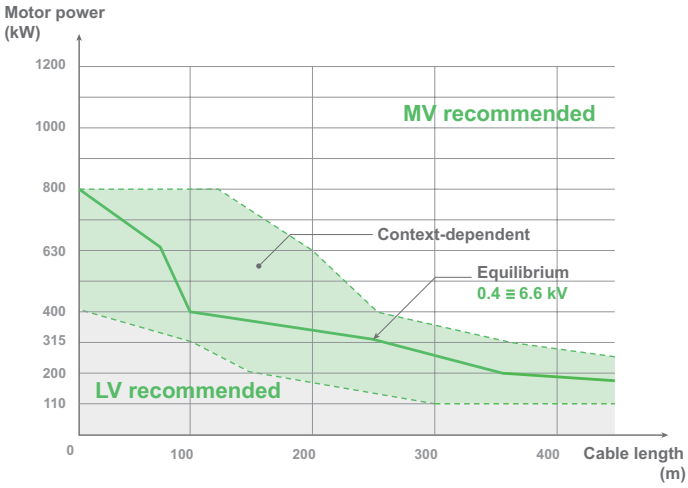
Large motors between 100 kW and 800 kW can be either low-voltage (LV) or medium-voltage (MV) versions.

The optimal motor voltage depends on several key factors, including:

- **Cable** length and associated installation costs
- **Motor** and **starter** cost (e.g. DOL, VSD, soft starter)
- Motor **power distribution**

Typical rule for motor with VSD

based on full solution cost (Feeder / VSD / Cable / Motor)



Non-technical factors *such as habits, available voltage levels, and need for personnel competency improvement can influence the choice.*
Even if more expensive, a solution can be preferred due to such contextual reasons, but also when the equipment cost between two voltage levels is negligible. A margin, noted as ***context dependent****, is considered to illustrate these variabilities.*

A comprehensive assessment of these parameters is essential to determine the most cost-effective and technically suitable voltage level for the overall motor applications.

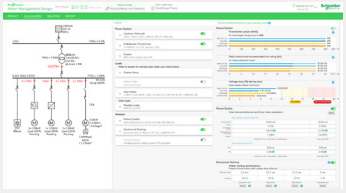
3.4.7 MV Drive Voltage Selection

6.6 kV is sometimes selected for feeder volatge to match 6.6 kV-rated MV motors, even when they are operated via a VSD.

However, **cost savings** can be achieved **by optimizing the feeder** to a higher 11 kV voltage level **with lower currents.** This can be accomplished by using VSDs with an 11 kV input and a 6.6 kV output. This allows the feeder to operate at 11 kV while still using 6.6 kV-rated motors.

Such a solution has no impact on the process and avoids the need for higher-rated 11 kV motors and the associated additional costs.

Key Tools to Support your Electrical Distribution Optimizations



Motor Management Design Web App

A combined analysis tool that enables you to easily challenge your designs in simplified contexts.

Connect to the application

Discover the tool:

ETAP Solutions

The comprehensive analysis capabilities for your entire electrical distribution design and operation.

More information

Discover the tool:

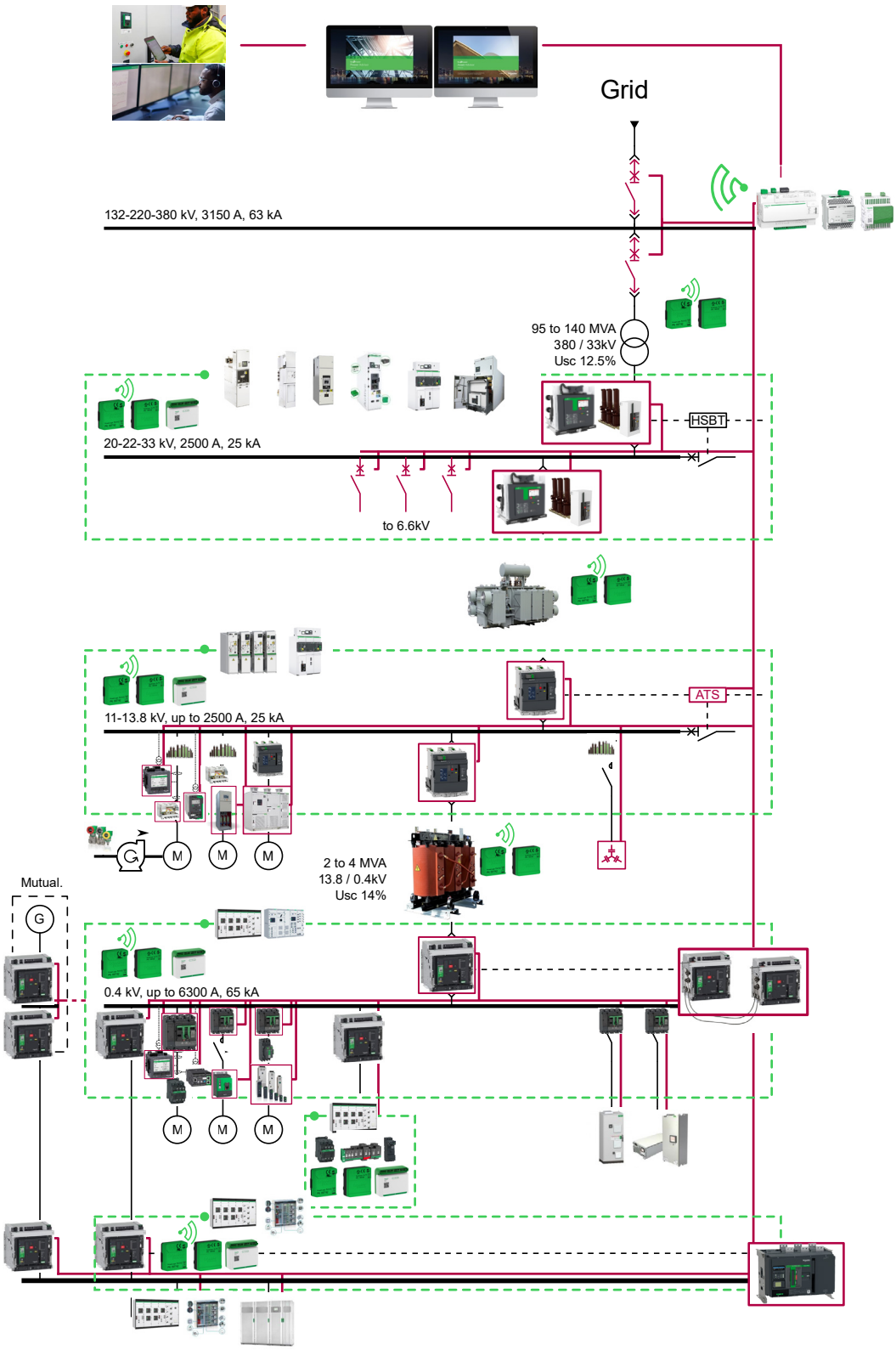
AVEVA Dynamic Simulation (DYNSIM)

A dynamic simulator that assists in process design and validation, controls checkout, operator training, and performance improvement.

More information

Discover the tool:

3.5 Offers Overview to Achieve Electrical Distribution Optimization



See "7. Appendix – Offers Portfolio" for details

Did You Know?

SF_6 Replacement Offers

A significant portion of the medium-voltage (MV) equipment currently deployed in the electrical network contains **SF_6 insulation gas,** known for its **high global warming potential** (GWP).

Our **SF_6- free AirSeT technology** offers a future-proof, green alternative by combining pure air insulation with vacuum technology, **fully eliminating the use of SF_6 greenhouse gas.**

This innovative solution provides a way to reconcile growth demands and rapidly accelerating renewable generation and electrification, with a sustainable approach to reducing greenhouse gas inventory.

Discover the *AirSeT* technology and the *SM AirSet offer*

4. Motor Management of Applications

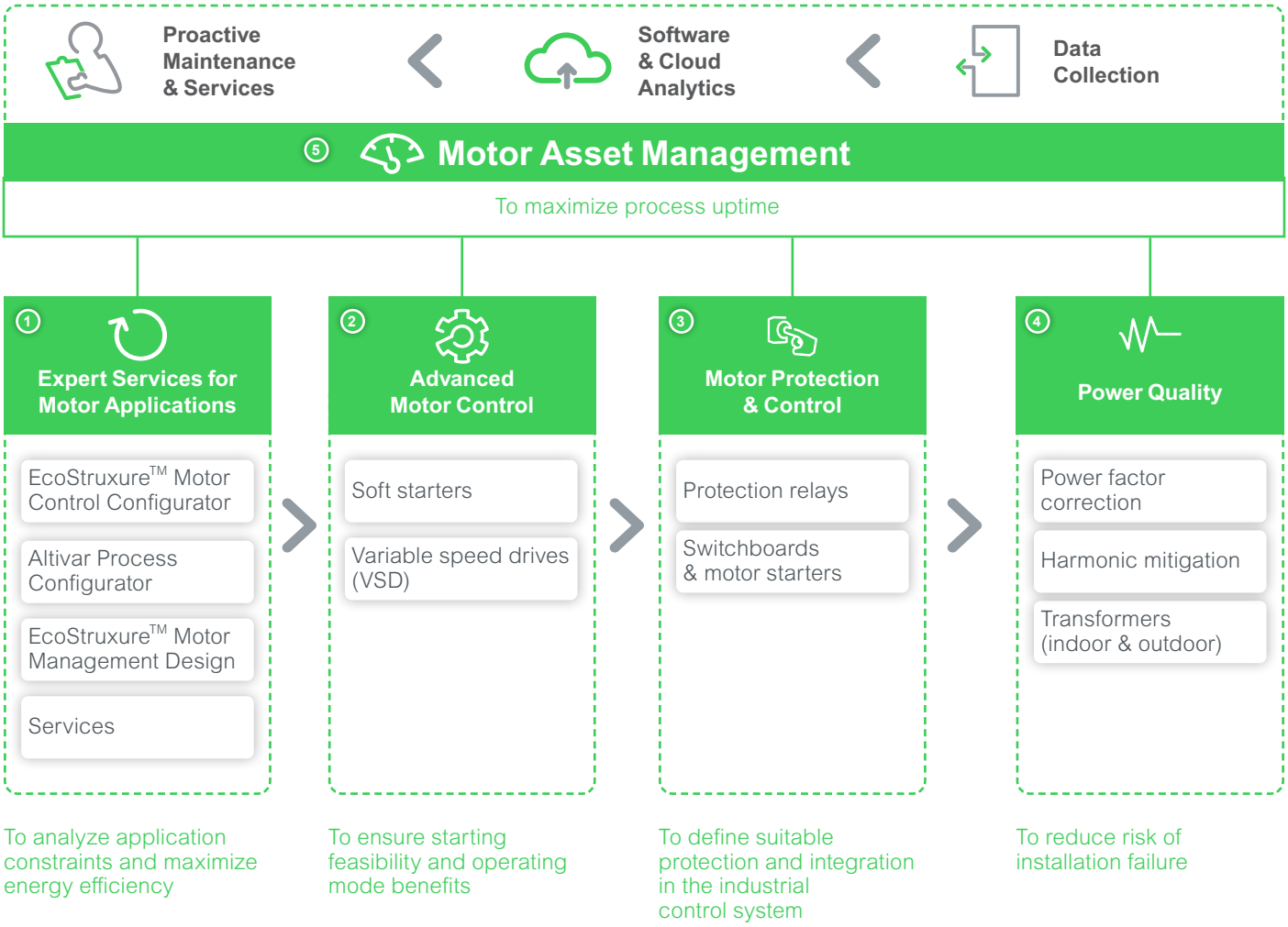
Optimize your applications' performance with better management of motor loads.

By adopting better motor management strategies, you can significantly improve the **performance** and **reliability** of your applications. With the right motor controls and harmonic mitigation solutions, you can enhance your plant's **power quality**, while reducing disturbances and ensuring **stable operation** across your electrical network. In addition, optimized motor management allows you to run your applications with greater **efficiency** and **precision**, leading to improved **productivity**, reduced **energy consumption**, and longer equipment **lifespan**.

4.1 Adopt Schneider Electric's Motor Management Approach

If your expectations prioritize **reliability, connectivity, energy efficiency,** and **performance,** Schneider Electric's Motor Management approach provides you with a comprehensive and future-ready solution.

Based on **five core domains,** Motor Management is designed to optimize motor systems, streamline maintenance, and support digital integration across your electrical infrastructure.



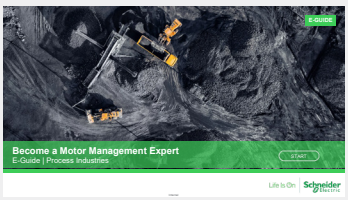
Appropriate Motor Management

up to 20%
investment savings **choosing the suitable voltage level**

up to 30%
with a **proper engineering** of Motor Management solutions

up to 30%
reduction of energy consumption for variable flow applications, with **substantial environment impact reduction**

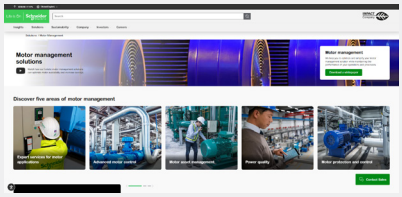
Want to Know More ?



E-guide for Motor Management in Electro-Intensive Process Industries

A step-by-step guide through the selection and design phases of our Motor Management solutions.

Download file



Dedicated Webpages

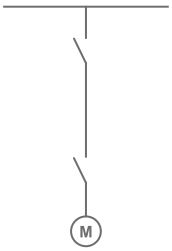
Everything you need to know about Motor Management and Schneider Electric's solutions.

Motor management solutions for business | Schneider Electric

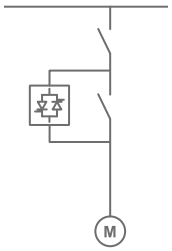
4.2 Select the Proper Motor Starting & Control Method

Selecting the appropriate motor starter is essential to ensure reliable starting performance with minimal electrical and mechanical impact, especially in applications involving frequent starts.

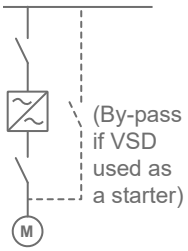
High-power motors and high-inertia loads are particularly affected, as they present greater starting challenges and must be closely evaluated to ensure compatibility with the selected starting mode.



Direct-On-Line (DOL) starting typically results in current **5 to 7 times higher than** the rated current, which can induce significant voltage drops, often exceeding acceptable limits of **10-15%.**



Soft starters can reduce the starting current to **2 to 4 times** the rated current, but with motor torque reduction that can make starting longer or even infeasible.



Variable Speed Drives (VSDs) are usually considered the ultimate starting solution when DOL and soft starters are inadequate. Although VSDs represent a higher initial investment, they offer additional benefits, including controlled ramp-up, variable speed regulation, improved energy efficiency, and enhanced monitoring and diagnostic capabilities.

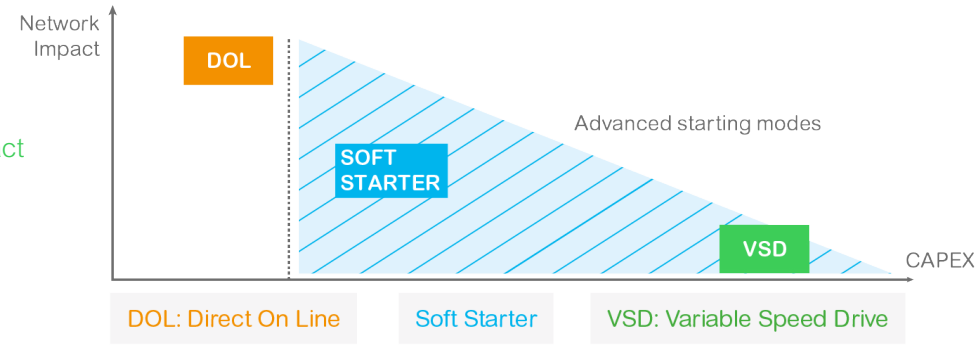
The **selection of the motor starter** directly determines whether the motor will **operate in DOL or VSD mode** after starting.

When operating in **DOL**, the motor will **contribute to the system's short-circuit current,** whereas motors operating through **VSDs will not.**

Motors operating in DOL - especially **large and numerous** ones - can impact the installation's short-circuit rating and must therefore be considered in the electrical design.

4.2.1 Starting Modes Comparison

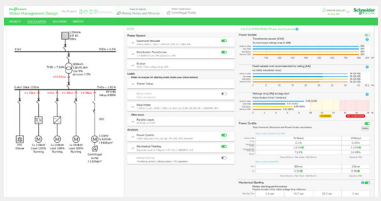
CAPEX vs Electrical Network Impact



Relevance

	Starting Equipment	Standard DOL	Soft Starter	VSD
CAPEX	Initial cost benefit	●●●	●●	●
	Footprint saving	●●●	●●	●
	Weight reduction	●●●	●●	●
	Engineering simplicity	●●●	●●	●
OPEX	Ease of equipment maintenance	●●●	●●	●
	Pump energy and maintenance savings	●	●●	●●●
	Control flexibility	●	●●	●●●
Motor	Starting current control	●	●●	●●●
	Starting torque control	●	●●	●●●
Pump adequacy	Centrifugal	●	●●	●●●
	Positive displacement	●	●	●●●

Tools to Support You in Starting Equipment Selection

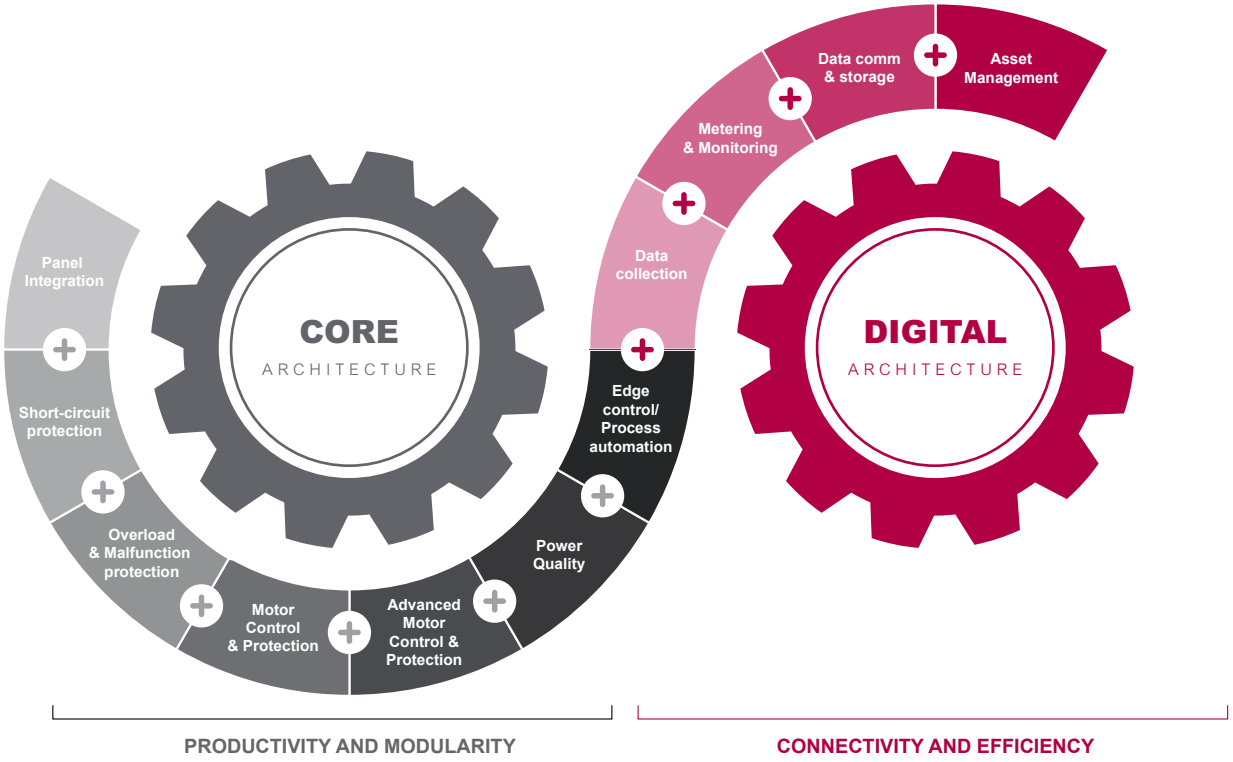


Motor Management Design Web App

For analysis of the motor starting mode feasability.

Connect to the Application

4.3 Adopt Digitalization to Fully Manage Your Applications



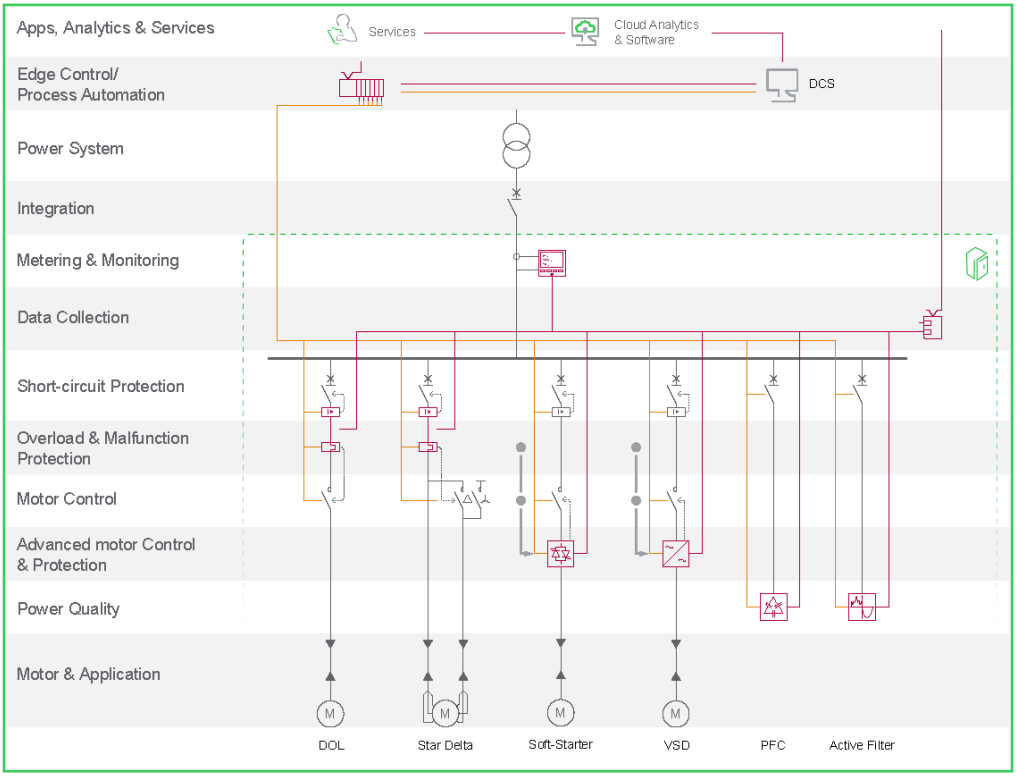
Digitalization first consists of **connected products** and **data collection**, enabling **digital services and advanced analytics.** It **enhances productivity** and **optimizes energy efficiency** across industrial applications.

Maintenance benefits
See "5. Maintenance of the Electrical and Rotating Assets"

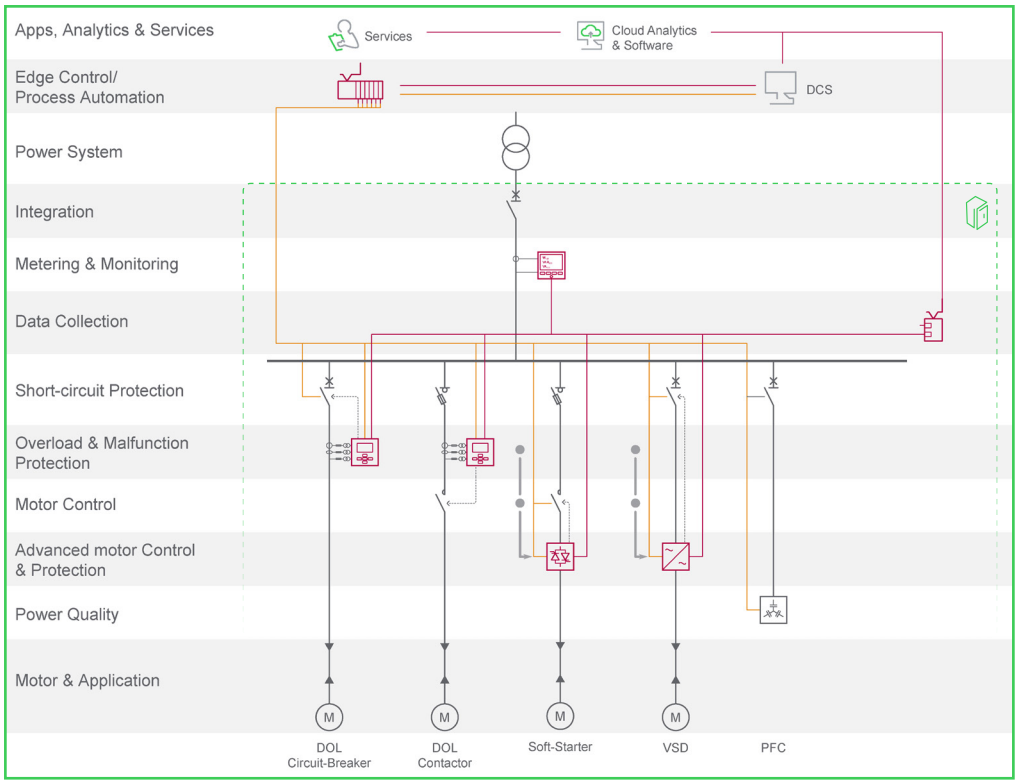
Process automation
See "6. Key takeaways"

4.3.1 Example of Digitalization Applied to Motor Feeders

Low-voltage (LV) motor feeder, depending on the starting mode:



Medium-voltage (MV) motor feeder, depending on the starting mode:



Process link Data link

4.4 Make the Most of the Variable Speed Drive with Altivar Process Solutions

4.4.1 Software-Defined Automation Enabled by Altivar Process Drives

Altivar Process Drives combined with **EcoStruxure™ Automation Expert** offer a powerful integration of software-defined automation and smart connected drives. This synergy enables the **optimization of industrial processes,** enhances **operational efficiency**, and supports **sustainability objectives.** By providing a tailored and scalable engineering solution, it addresses the challenges of **drives modernization** while streamlining business operations and **improving overall system performance.**

4.4.2 Optimize Energy Usage with Pump-Dedicated Ranges

Decarbonization efforts can be significantly accelerated through **optimized energy usage and enhanced system reliability.**

Schneider Electric's **ATV Drives** contribute to reducing energy consumption in motor-driven pumps by enabling precise control of motor speed and torque, leading to improved system efficiency and extended equipment lifespan.

Altivar Process Solutions for Pumping Application

ATV600

Low-voltage (LV) dedicated variable speed drive for pump, fan and compressor applications, up to 2,600 kW.

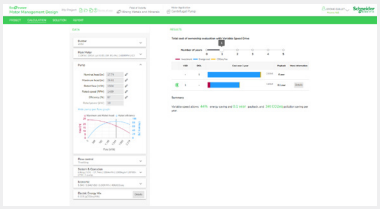
ATV6000

Medium-voltage (MV) variable speed drive from 2.3 to 13.8 kV and up to 20 MW.

Altivar Process Monitoring Interface

For a perfect monitoring of your process: integrated pump curves, monitoring of the pump efficiency, notification of critical operating points (without additional sensors)…

Tools to Support You in Energy Saving Calculation



Motor Management Design Web App

For analysis of the centrifugal pump energy saving.

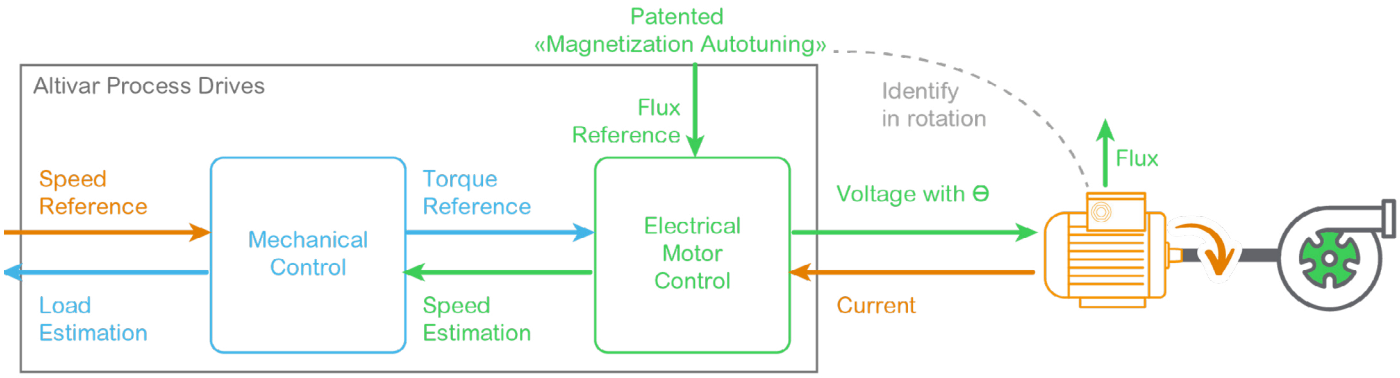
Connect to the application

4.4.3 Optimize Process Assets with Altivar Variable Speed Drives (ATV Drives)

ATV Drives leverage advanced algorithms to **dynamically adjust voltage phases**, responding precisely to **load variations** and mitigating **transient disturbances.**

Reliable motor management plays a critical role in **preventing unexpected downtime, conserving energy,** and **reducing environmental impact**. By improving energy efficiency and optimizing asset performance, these solutions directly **contribute to a more sustainable and cost-effective desalination process.**

Schneider Electric's **"Magnetization Autotuning"** technology further enhances drive performance by improving motor modeling accuracy. It enables precise estimation of rotor position and speed, ensuring that pump operation meets the demands of desalination processes.



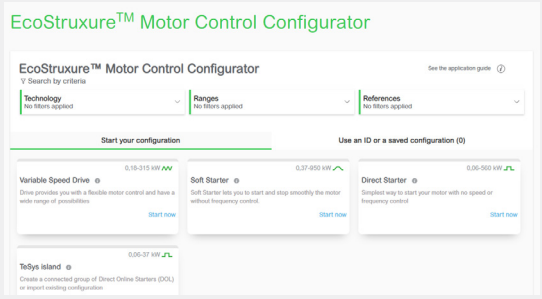
Predictive Maintenance for ATV600 Pump Applications

ATV Predict

To flexibly add predictive capabilities to your drive to increase uptime and reduce total cost of ownership.

More information

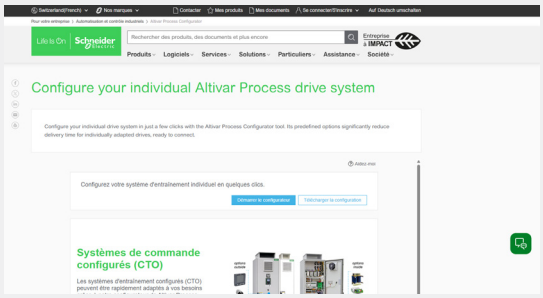
Tools to Support you in Motor Control Products Selection



EcoStruxure™ Motor Control Configurator

To select the right combination for protection and control of your motors.

Connect to the application



Altivar Process Configurator

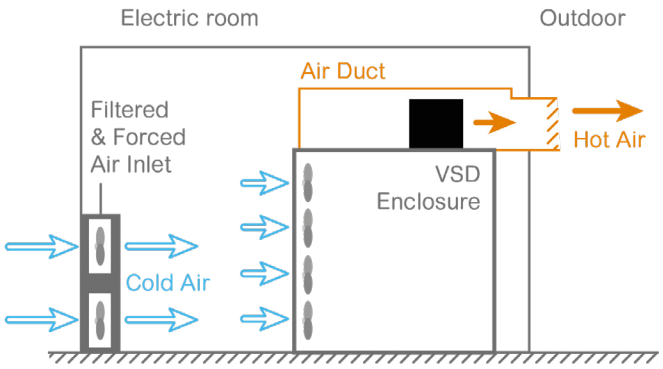
For quick quotation and configuration for typical drive applications.

Connect to the application

4.4.4 Use High-Power Variable Speed Drive Cooling

Variable Speed Drives require cooling to prevent critical semiconductor components - such as the rectifier and inverter sections - from overheating.

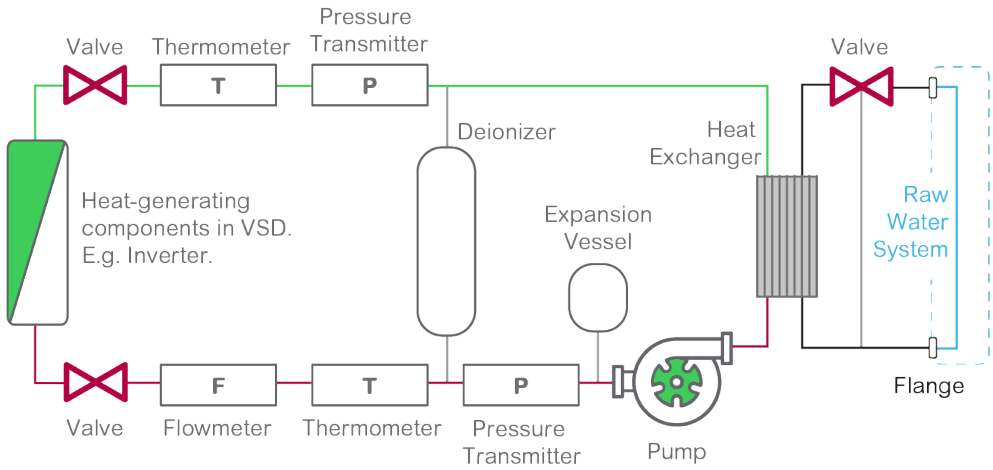
Three cooling methods are available:



Air Cooling

Air cooling uses **air as a heat carrier** to cool the components through thermal convection.

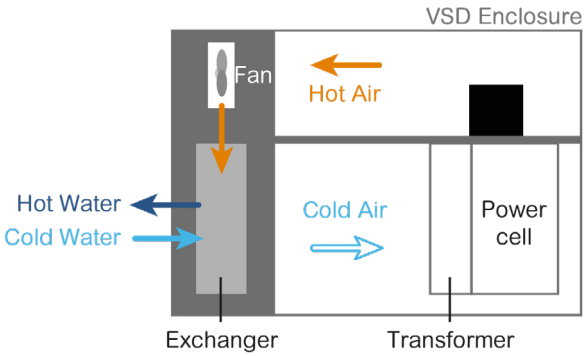
Fans force air to flow across each component inside the VSD frame. The heated air is then expelled from the enclosure either into the room or outside via an air duct.



Liquid Cooling

Liquid cooling uses **liquid as a heat carrier** to cool the components by direct thermal conduction.
The liquid circulates in a dedicated hydraulic system with pumps. A heat exchanger extracts the heat from the liquid and transfers it to a secondary raw water circuit or a chiller.

A mix of both methods, **hybrid cooling** uses **air** to cool components within the VSD and a **heat exchanger** to transfer the heat via liquid out of the VSD and the room - reducing or eliminating the need for air conditioning.



Even if thermally less efficient, **air cooling** often remains **sufficient** and the **most cost-effective solution**, suitable for **medium-power** drives and **most environments**.

When dealing with **high-power** drives or harsh environments, **liquid cooling** can provide a more efficient way to harvest and dissipate heat, all within a smaller footprint. However, liquid cooling involves a more complex system and comes with several drawbacks.

Cooling Methods Relevance

	Air-Cooling	Enhanced Air-Cooling	Liquid-Cooling
Environment			
Hot ambient	●	●● (derating)	●●●
Dust	●	●● (Filtering)	●●●
High Altitude	●	●● (derating)	●●●
Footprint (High-power)	●	●	●●●
Miscellaneous			
Thermal efficiency	●	●● (higher flow)	●●●
HVCA impact	●	●● (ducted air)	●●●
Cooling Consumption	●●●	●● (higher flow)	● (depending on secondary system)
Operation			
Easiness	●●●	●●●	●
Reactivity	●●●	●●●	●
Reliability (MTBF)	●●●	●●●	●●●
Maintenance			
Easiness	●●●	●●	●
Downtime (MTTR)	●●●	●●●	●
Spare parts availability	●●●	●●●	●

	< Medium-Power	Medium-Power	High-Power
Cost			
CAPEX	●●●	●●	●
OPEX	●●●	●●●	●●
TOTEX	●●●	●●●	●●
Typical	Up to 5 MW	Up to 10 MW	>10 MW

With proper optimization, **air cooling** remains the optimal choice for VSDs **up to 10 MW.**

5. Maintenance of Electrical and Rotating Assets

Optimize your asset maintenance with a proactive approach.

By improving the maintenance of your electrical and rotating assets, you can enhance **safety** across your facilities and operate **with peace of mind.**

Effective asset maintenance involves a **proactive approach**, reducing **unplanned downtime** and increasing **operational reliability** - all of which helps you maximize **uptime** and ensure business **continuity**.

5.1 What is Condition-Based Maintenance?

Condition-based maintenance is a **preventive maintenance** method that monitors the condition of equipment to determine which maintenance tasks need to be carried out and when. Compared to predetermined maintenance, condition-based maintenance allows greater flexibility. Based on the available data, the time interval between two interventions can be changed as necessary.

Thanks to advanced analytics leveraging **25 million data points daily**, we help **reduce costs and disruption, increase safety and reliability**, while efficiently **prioritizing on-site maintenance activities for each connected asset.** On top of that, by continuously monitoring the equipment's health status, we also help **extend the equipment lifespan** and **avoid carbon emissions.**

5.2 Our AI-Powered Advanced Analytics

At Schneider Electric, data and AI are leveraged to improve the services we deliver to our customers. As a manufacturer, we possess the **largest installed base in the industry for** condition-based services built on **proprietary AI and analytics models.** This is continuously improved by our **300+ in-house data scientists**, fed with our extensive installed-base knowledge and our expertise across many industries.

We connect sensors to the cloud and develop AI algorithms to continuously analyze data. Leveraging our **expertise in manufacturing electrical equipment**, we've created sophisticated models to assess the condition of these parts. This allows us to offer precise insights into the health of our customers' power systems, reducing the need for manual inspections and proactively enabling more efficient management and maintenance of their systems.

Our **predictive analytics** serve as a "fitness tracker" for our customers' power systems, offering early warnings to our remote experts, who proactively monitor, manage alarms, analyze, and troubleshoot if needed. This proactive approach enables businesses to maintain consistent equipment health, moving away from reactive maintenance.

However, just as a smartwatch does not eliminate the need for a doctor, our AI-driven services don't eliminate the need for on-site maintenance - but rather optimize it, so that our customers can **get the right maintenance at the right time** compared to a traditional calendar-based approach.

5.3 EcoCare Membership: A Three-Tier Offer to Cover All Your Needs

	EcoCare Essential	EcoCare Advanced	EcoCare Advanced+
Overview	**Available When You Need Us** As an EcoCare member, you have exclusive access to resources and expertise to resolve issues faster and improve the resiliency and efficiency of your business and operations.	**Fully Empowered** We empower your teams to run a resilient, safe, efficient, and sustainable operation by anticipating and remotely helping you mitigate downtime events.	**Optimized Uptime** We anticipate risks of downtime to give you the right support at the right time, and we optimize the lifecycle of your assets to maximize your business continuity.
Key features	• Priority remote access to experts • Exclusive EcoCare rates on all services • On-site intervention SLA: standard or upgraded[1] • 24/7 monitoring and alarming for connected assets • Extended warranty[2]	+ Consultancy from our experts, with advanced analytics	+ Recommendations for dynamic maintenance + Condition-based maintenance

1 Maximum zone coverage and response times might vary according to your country location.Please check with local Services sales representative.
2 Applicable for new and modernized equipment sold together with EcoCare from Day 1

5.4 EcoCare Features

		EcoCare Essential	EcoCare Advanced	EcoCare Advanced+
Support to Operations	• mySchneider portal • Premium support • Emergency support • Customer success management	●	●	●
Workforce Empowerment	• Access to online training courses	●	●	●
Exclusive Benefits	• Members rates on other services: on-site intervention, advanced trainings, spare parts and more[1]	●	●	●
Monitor and Optimize	• 24/7 monitoring and alarming	●	●	●
	• Consultancy by our experts and quarterly reports	-	●	●
	• Condition-based maintenance	-	-	●
	• Partial discharge monitoring for medium voltage switchgear	-	Option	Option
	• Advanced transformer oil monitoring	-	Option	Option
Extended Warranty		●	●	●
On-site Maintenance	• Manufacturer calendar-based maintenance visits with asset diagnostic	Option	Option	-

1 Check with your local Schneider Electric services representative

5.5 Rely on Schneider Electric Expertise to Manage Your Electrical Assets

Electrification is at the heart of our business

We provide highest-quality electrical assets, with our assets present in 1 in 3 buildings across the world

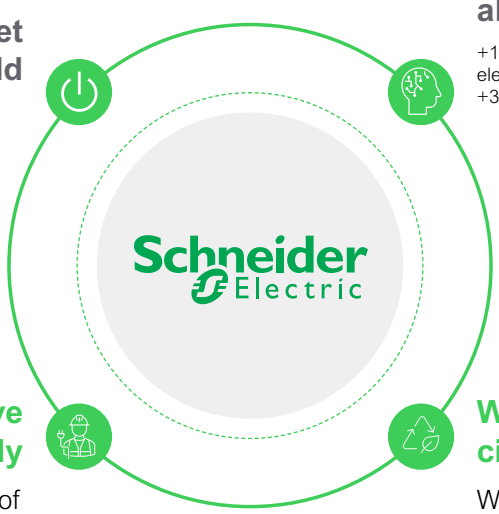
#1 largest electrical asset installed base in the world

We are pioneers in AI for electrical assets

Pioneer in connecting electrical equipment and establishing AI hubs to build most comprehensive library of analytics.

#1 most cumulative data set on electrical assets to feed our algorithms

+150 Connected Services Hubs experts monitoring electrical assets 24/7
+300 In-house Data Scientists in AI Hubs



We have the most extensive network of experts globally

We have the strongest network of experts from electrical consultants to engineers across the world

#1 largest network of electrical engineers in the world

6,000 in-house electrical experts and a large ecosystem of certified partners

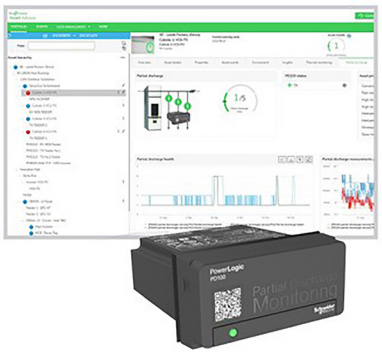
We offer the most advanced circularity services

We help companies achieve their sustainability goals with unique circularity services.

#1 most sustainable company amongst our peers

2025 World most sustainable Company (Corporate Knights)
2024 World Economic Forum Circularity Lighthouse

PowerLogic PD100



Did You Know?

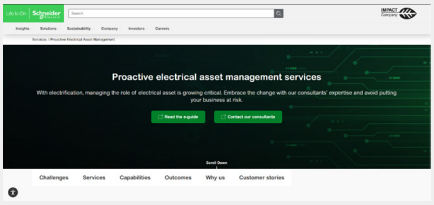
Partial Discharge Monitoring

Partial Discharge (PD) in medium-voltage (MV) systems refers to localized electrical discharges that only partially bridge the insulation between conductors. PD can lead to **insulation degradation** and **potential failure** if not detected and managed.

The **Partial Discharge sensor** (PowerLogic PD100) is installed in various **MV switchgear with Active Plus connectivity.**

Partial Discharge Monitoring solution enables the analysis of all types of partial discharge (corona, surface, internal discharge). When paired with **24/7 monitoring** and **alarms** through **EcoCare Membership**, it helps optimize **service continuity** and prevent **premature ageing** of your critical equipment.

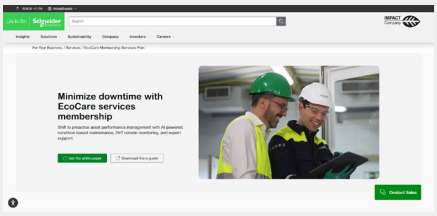
Want to Learn More ?
Discover Asset Maintenance's Proactive Approach



Proactive Electrical Asset Management

By minimizing downtime, optimizing maintenance schedules, and promoting energy efficiency and circularity, this approach improves business operations, cost efficiency, and environmental footprint.

Proactive electrical asset management | Schneider Electric



EcoCare Services Plan

Shift to proactive asset performance management with AI-powered condition-based maintenance, 24/7 remote monitoring, and expert support.

EcoCare membership services plan | Schneider Electric

6. Key Takeaways

To Optimize your Electrical Distribution

Electrical Distribution Design is key to minimizing **CAPEX** and **lead time**, while enhancing **safety** and **reliability**.

Motor Management is key to improving **plant power quality** and guaranteeing the best application **efficiency** and **precision**.

Electrical Asset Management is key to maximizing **safety**, service **continuity**, and **overall uptime**.

Then Your Process Requires More…

To ensure **full control** and **operational excellence** of your **Reverse Osmosis Desalination Plant.**

…and Schneider Electric Has the Solutions to Support You

With **EcoStruxure™ for Water and Wastewater,** we are the digital partner for **sustainability, resilience** and **efficiency** across the entire water cycle. Schneider Electric's IoT-enabled architecture and platform deliver solutions across various domains.

Applications of a Desalination Plant Supported by EcoStruxure™

Local and Central Operations

Decision Support
From unified operations to autonomous decision making.

Decarbonize Desalination
From Sustainability Consulting to Science-Based-Targets-driven operations.

Enterprise Resource Mgt
Workforce, Workflow and Asset Management.

Operational Efficiency
From specialized dashboards to remote control and co-piloted optimization.

Energy Management
From energy efficient operations to energy compliance measures.

Asset Performance
from Asset Performance Management to predictive analytics of assets.

Control & Protect the Entire Plant

Electrical Distribution
Safe & reliable Power from grid to consumers, including renewables.

Process and Consumables
Fully automated management of the reverse osmosis process and all consumables.

Want to Know More?

Please contact us

Go Further

Blog Posts:

The waters of change: The digital transformation needed in water management is a matter of people & technology

Desalination and Digital Technology: Bringing Fresh Water to More People Around the World

How digitalization drives efficiency for today's desalination plants

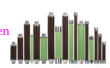
How automation and energy system digitalization reduce desalination plant operational costs

Press:

Schneider Electric Wins "Water Technology Company of the Year" in Global Water Awards 2022

7. Appendix
Offers Portfolio

Schneider Electric offers a comprehensive portfolio of solutions that cover the different types of architectures presented in **Chapter 3**, the motor control methods described in **Chapter 4**, and the services outlined in **Chapter 5**.

Function	Product Name	Technical Characteristics	
Transformers	Minera MP	Oil-Immersed Medium Power Transformer up to 100 MVA	
	Trihal	Cast Resin Distribution Transformer up to 15 MVA - 36 kV	
Switchboards	GHA	Gas-Insulated (GIS) Primary Switchboard up to 40.5 kV	
	WS	Gas-Insulated Switchgear up to 36 kV	
	PIX	The PIX range is the international and universal solution for withdrawable air insulated switchgear	
	SM AirSeT	SF6-free Modular MV Switchboard up to 24 kV	
	MCset Active	A new generation of natively connected MV switchgear up to 24 kV	
	PremSet	Shielded Solid Insulated Switchgear	
	Okken	Low-voltage switchboards for power distribution and motor control up to 7,300 A	
	iPMCC	intelligent Power and Motor Control systems	
Protection and metering	EvoPact SF	MV circuit-breakers up to 40.5 kV	
	EvoPact HVX	MV circuit-breakers up to 24 kV	
	Fusarc CF	MV Fuses from 3.6 to 36 kV	Pas lien 
	EasyPact EXE	Vacuum circuit breaker up to 17.5 kV	

Function	Product Name	Technical Characteristics	
Protection and metering	MasterPact MTZ	LV Circuit breakers to protect lines up to 6,300 A, offering advanced digital features	
	ComPacT NSX, new generation	Circuit-breakers, to protect lines carrying up to 630 amps	
	PowerLogic	Protection relay	
	Transferpact	Source-changeover devices up to 6,300 A Telemetry and Remote SCADA Systems Supervisory control and data acquisition	
	PowerLogic PM8000 Power Quality Meters	Compact, high-performance meters for cost and network management applications on feeders and critical loads	
	PowerLogic PM5000	Compact, versatile meters for energy cost and basic network management applications	
	PowerLogic PM3000	DIN rail power meters for basic metering applications	
	PowerLogic PD100	PowerLogic Partial Discharge Monitoring Solution for MV Switchgear	
	Easergy TH/CL110	Wireless Environmental Sensor for Continuous Thermal/Condition Monitoring	
	PowerLogic HeatTag	Early Detection of Overheating Cables	
	Measurement and Instrumentation	High quality measurement solutions to monitor and provide analysis of your plant	
	EcoStruxure Panel Server	Next-generation IoT gateway for an intelligent power network	
	EcoStruxure Link150	Ethernet gateway	
	Enerlin'X Com'X	Enerlin'X Com'X energy server : all-in-one-box energy management solution allowing energy consumption monitoring	

Function	Product Name	Technical Characteristics	
Protect and control	Tesys T	Advanced monitoring control and protection of electrical motors	
	TeSys Giga contactors	Contactors to control motors up to 800 A (450 kW / 400 V) or switch power up to 1,050 A	
	TeSys Deca contactors	Contactors to control motors up to 150 A (75 kW / 400 V)	
	TeSys island	Digitally powered monitoring, control and protection of electrical motors up to 80 A (37 kW / 400 V)	
	TeSys Ultra	All-in-one motor starters up to 38 A (18.5 kW / 400 V)	
Advanced control	Altivar Soft Starter ATS480	Soft starters for Process and Infrastructures from 4 to 900 kW	
	Altivar Process LV	Variable Speed Drives up to 2,600 kW	
	Altivar Process MV	Variable Speed Drive up to 20 MW	
	ATV6100 **NEW**	New Compact and Versatile MV Variable Speed Drive	
Power Quality and Continuity	VarSet LV	Smart low-voltage capacitor banks	
	PowerLogic AccuSine PCSn	Active harmonic filtering	
	Galaxy	Highly efficient 3-phase UPS power protection with flexible operating modes	
Power and asset management	EcoStruxure Power Advisor	Optimise power system performance with analytics and expertise	
	EcoStruxure Asset Advisor	Asset management software and digital services	
	EcoStruxure Maintenance Advisor	Platform for Condition Based Maintenance	

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