transforming a fixed speed
into a variable speed **wind turbine**

with the new

INGECON WIND FIX2VAR SPEED
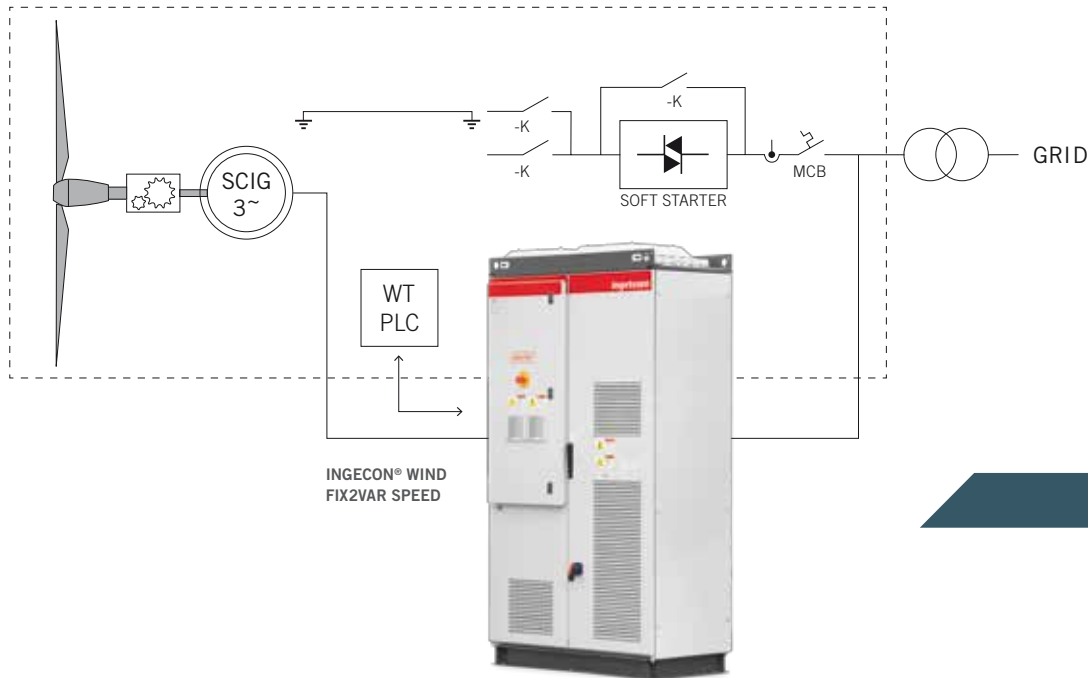
maximize your ROI

Ingeteam

transforming a fixed speed
into a variable speed **wind turbine**

Fixed Speed Technology

SCIG 3~

-K

-K

SOFT STARTER

-K

MCB

GRID

WT PLC

INGECON® WIND
FIX2VAR SPEED

BENEFITS
AT A GLANCE:

INGECON WIND FIX2VAR SPEED

maximize
your ROI by:

- Minimizing the investment, maintaining generator and PLC

- Minimizing the Levelized Cost of Energy (LCoE) with optimum case by case power curve, increasing Annual Energy Production (AEP) and Lifetime Extension (LTE)

- Complying with the strictest grid codes

WHAT IS
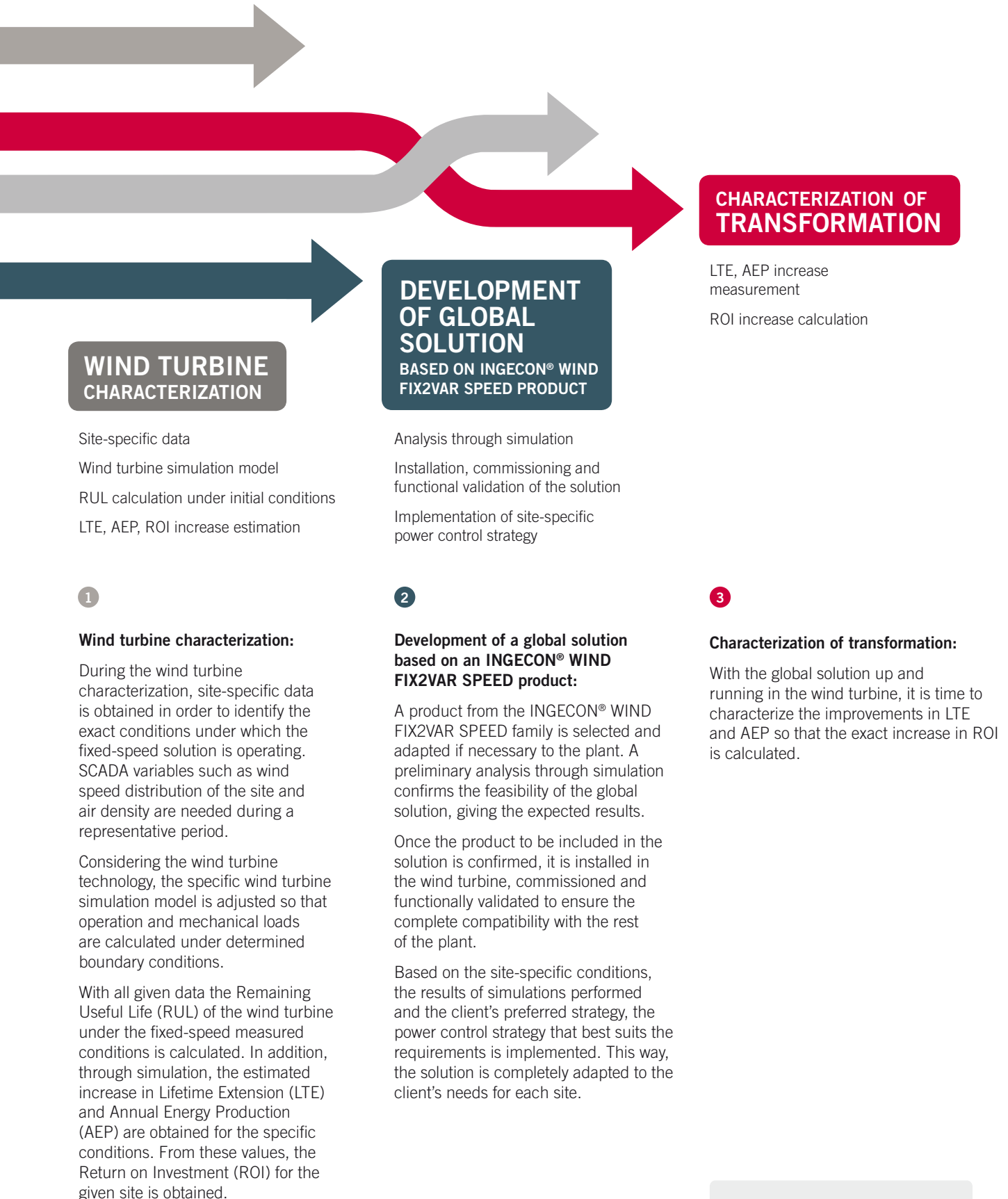## INGECON® WIND FIX2VAR SPEED?

The INGECON® WIND FIX2VAR SPEED solution is a ground-breaking autonomous power conversion system that increases the Annual Energy Production (AEP), lifetime and grid-performance of fixed-speed wind turbines by enabling them to transform to variable-speed machines to best match wind conditions.

The transformation to a variable speed topology will enable fixed-speed asset operators to obtain the optimum power curve for their fleet, in a wide range of wind speeds, leading to increased AEP.

INGECON® WIND FIX2VAR SPEED extends asset lifetime by smoothing speed changes, reducing mechanical torque steps caused by wind gusts, as well as by minimizing transients due to start-ups, emergency stops and grid variations. What is more, the system ensures grid compliance by removing flicker effects and low frequency harmonics generated by the capacitor banks and enabling power factor regulation.

This new innovation in power conversion can turn fixed speed drivetrains to variable speed without the need to recondition both the original generator and wind turbine programmable logic controller (PLC).

SCOPE OF THE SOLUTION:

CHARACTERIZATION OF TRANSFORMATION

LTE, AEP increase measurement

ROI increase calculation

WIND TURBINE CHARACTERIZATION

DEVELOPMENT OF GLOBAL SOLUTION
BASED ON INGECON® WIND FIX2VAR SPEED PRODUCT

Site-specific data

Wind turbine simulation model

RUL calculation under initial conditions

LTE, AEP, ROI increase estimation

Analysis through simulation

Installation, commissioning and functional validation of the solution

Implementation of site-specific power control strategy

1

Wind turbine characterization:

During the wind turbine characterization, site-specific data is obtained in order to identify the exact conditions under which the fixed-speed solution is operating. SCADA variables such as wind speed distribution of the site and air density are needed during a representative period.

Considering the wind turbine technology, the specific wind turbine simulation model is adjusted so that operation and mechanical loads are calculated under determined boundary conditions.

With all given data the Remaining Useful Life (RUL) of the wind turbine under the fixed-speed measured conditions is calculated. In addition, through simulation, the estimated increase in Lifetime Extension (LTE) and Annual Energy Production (AEP) are obtained for the specific conditions. From these values, the Return on Investment (ROI) for the given site is obtained.

2

Development of a global solution based on an INGECON® WIND FIX2VAR SPEED product:

A product from the INGECON® WIND FIX2VAR SPEED family is selected and adapted if necessary to the plant. A preliminary analysis through simulation confirms the feasibility of the global solution, giving the expected results.

Once the product to be included in the solution is confirmed, it is installed in the wind turbine, commissioned and functionally validated to ensure the complete compatibility with the rest of the plant.
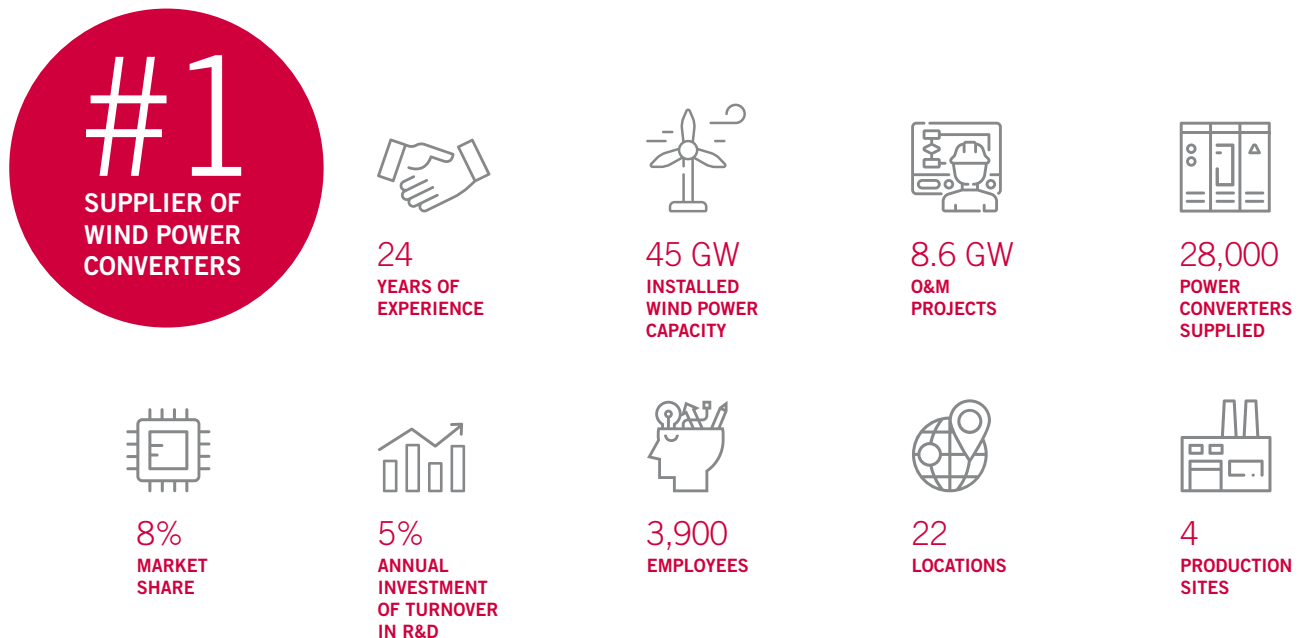
Based on the site-specific conditions, the results of simulations performed and the client's preferred strategy, the power control strategy that best suits the requirements is implemented. This way, the solution is completely adapted to the client's needs for each site.

3

Characterization of transformation:

With the global solution up and running in the wind turbine, it is time to characterize the improvements in LTE and AEP so that the exact increase in ROI is calculated.

ABOUT US

#1
SUPPLIER OF WIND POWER CONVERTERS

24
YEARS OF
EXPERIENCE

45 GW
INSTALLED
WIND POWER
CAPACITY

8.6 GW
O&M
PROJECTS

28,000
POWER
CONVERTERS
SUPPLIED

8%
MARKET
SHARE

5%
ANNUAL
INVESTMENT
OF TURNOVER
IN R&D

3,900
EMPLOYEES

22
LOCATIONS

4
PRODUCTION
SITES

OUR VALUE PROPOSITION IS BASED ON **R&D, FLEXIBILITY, GLOBAL PRESENCE, EXPERIENCE AND PARTNERSHIP**

Ingeteam, an independent supplier of electrical conversion equipment, offers power converters, turbine controllers, CMS, Smart SCADA management systems and O&M services for wind turbines up to 15 MW for onshore and offshore applications.

Ingeteam provides ongoing support throughout the entire product lifecycle, from research and design to production and testing, commissioning and after-sales services, technical training and support.

We are committed to innovation and development of full in-house technology. Our Policy of Continuous Improvement is focused on reliability and cost effectiveness from a global point of view, optimizing the whole solution in terms of Levelized Cost of Energy. In 2018, 5% of net sales was invested in R&D, the backbone of our business activity.

We are flexible in designs and R&D solutions, operations, different business models or additional value-added services. We work very closely with our clients, listening to them and anticipating their needs to be ready to satisfy their demands and requirements.

We can supply equipment from any of our production facilities in Europe, Asia, North and South America, applying the same standards and know-how. We can also deliver the most efficient and specialized support and service to you from our sales and service centers strategically located all over the world.

Since 1995, we have commissioned over 28,000 wind power converters, accounting for more than 45 GW of installed wind power capacity worldwide and an 8% market share. The company is the world's number one independent supplier of wind power converters and a leading O&M services provider with more than 8.6 GW maintained in the world.

Ingeteam Power Technology, S.A.
Energy