

On-line workshop:

# Avanzamento Delle Energie Rinnovabili Marine: Strategia Europea, Attività In Corso In Italia, e Aggiornamento Del Piano D'azione Nazionale Del Cluster-Big

24-25 Febbraio 2022



***UMBRA GROUP***

*Power Take-Off for Marine Energy Converters*

# Development roadmap of an advanced Power Take-Off for marine energy applications

Luca Castellini, UMBRAGROUP

# UMBAGROUP innovation

## Technology transfer



**1972**

FAG and GEPI found UMBRA to produce high-precision bearings

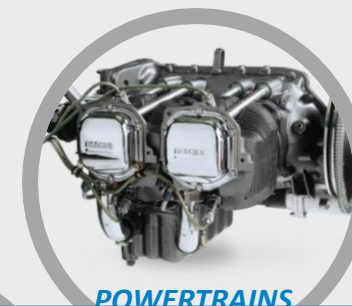


**1978**

The company starts producing ballscrews for aviation industries



**Technology transfer from other sectors to OCEAN REN. ENERGY**



POWERTRAINS



2010

AEROSPACE



ENERGY

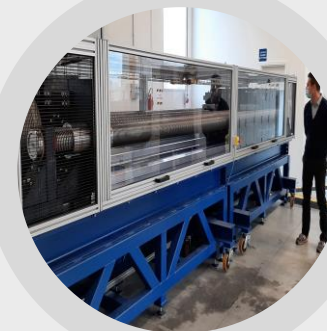
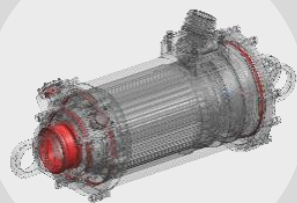




# UMBRAGROUP innovation

## ROADMAP

### ANALYSIS & SIMULATIONS



2015



2016



2017



2018



2019



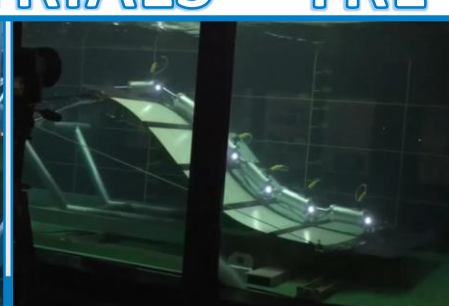
2021

### DRY TESTS

### TANK TESTS

### SCALE UP

### SEA TRIALS – TRL validation



UMBRAGROUP

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# Reciprocating Ball Screw Generator (ReBaS Generator)

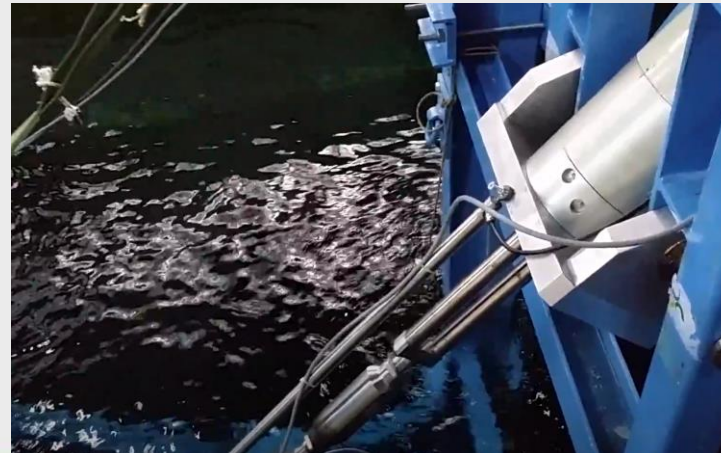
Project/ Company name	Funding source	Lead country	Start date	End date	TRL at the end of the project
ReBaS Generator/ UMBRAGROUP	Wave Energy Scotland	ITALY	2015	2016	TRL 7

COMPANIES: UMBRAGROUP, HMS, SEAPOW scr

Wave energy - PTO and oscillating point-pivoted buoy technology

Project aims PTO TRL advancement at full power scale and WEC integration.

Location: Italy



# GENerazione Elettrica Rigenerativa (GENERA)

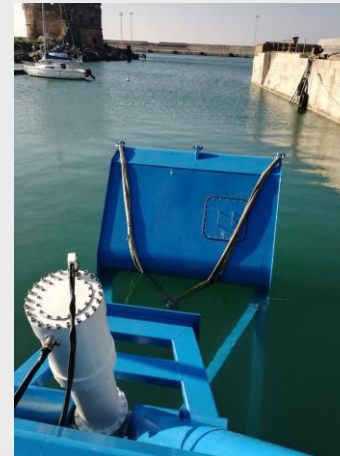
Project/ Company name	Funding source	Lead country	Start date	End date	TRL at the end of the project
GENERA/ UMBAGROUP	Italian Development Ministry	ITALY	2017	2018	TRL 7

COMPANIES: UMBAGROUP, SEAPOWER scrl, EMS

Wave energy - PTO and oscillating point-pivoted buoy technology

Project aims PTO TRL advancement and WEC development for breakwater installation.

Location: Civitavecchia Port (Italy)





# Power Take Off - Electro-MEchanical Reciprocating GEnerator (EMERGE)

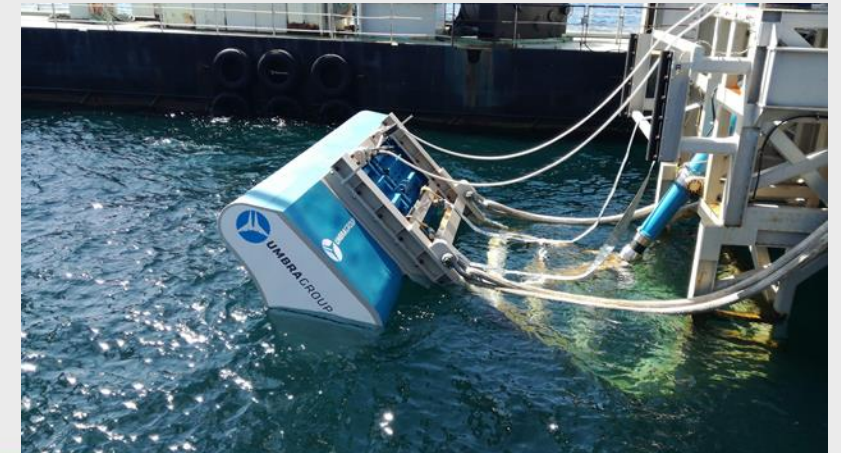
Project/ Company name	Funding source	Lead country	Start date	End date	TRL at the end of the project
EMERGE/ UMBRAGROUP	European Commission LCE-07-2016-2017	ITALY	2017	2019	TRL 7

COMPANIES: UMBRAGROUP, HMS, GREEN MARINE, Bureau Veritas, SEAPOWER scrl, Doosan Babcock, Supply Design

Wave energy - PTO and oscillating point-pivoted buoy technology

Project aims PTO TRL advancement at higher power scale and WEC development for off-shore installation.

Location: Scapa Flow, Orkney (UK)





# Innovative Method for Affordable Generation IN ocean Energy (IMAGINE)

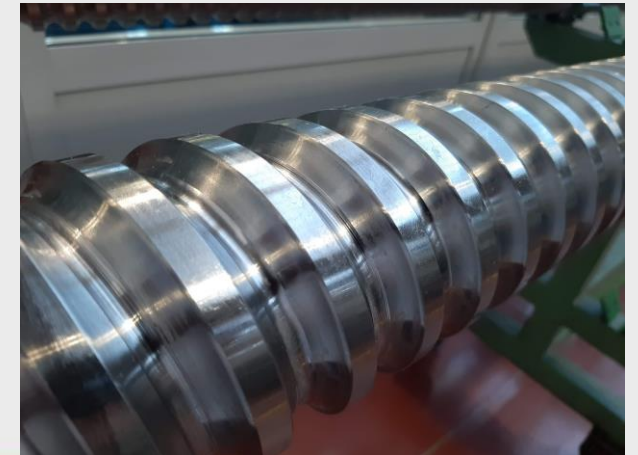
Project/ Company name	Funding source	Lead country	Start date	End date	TRL at the end of the project
IMAGINE/ UMBAGROUP	European Commission LCE-07-2016-2017	ITALY	2018	2021	TRL 5

COMPANIES: UMBAGROUP, VGA, K2M, Bureau Veritas, NTNU, University of Edinburgh

Wave energy - PTO technology

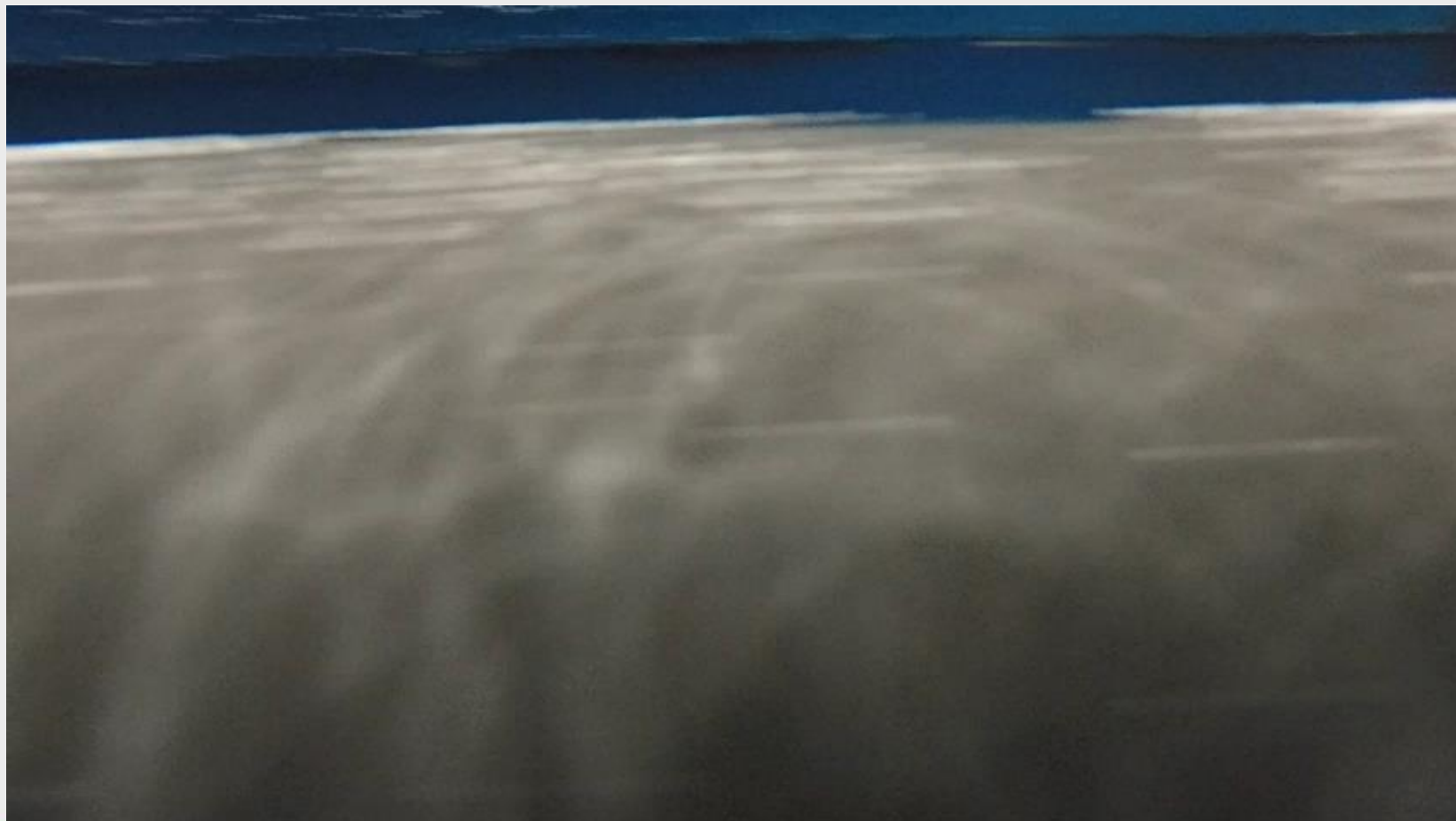
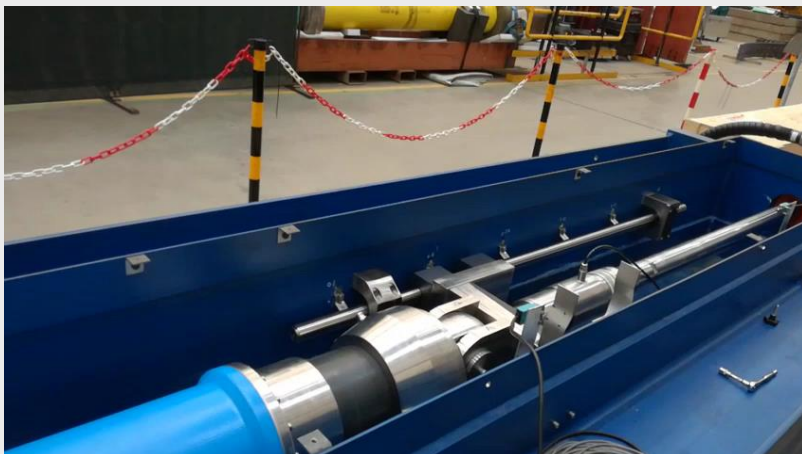
Project aims PTO TRL advancement at full power scale (modules by 250kW) and WEC integration.

Location: Italy



# *Project objectives*

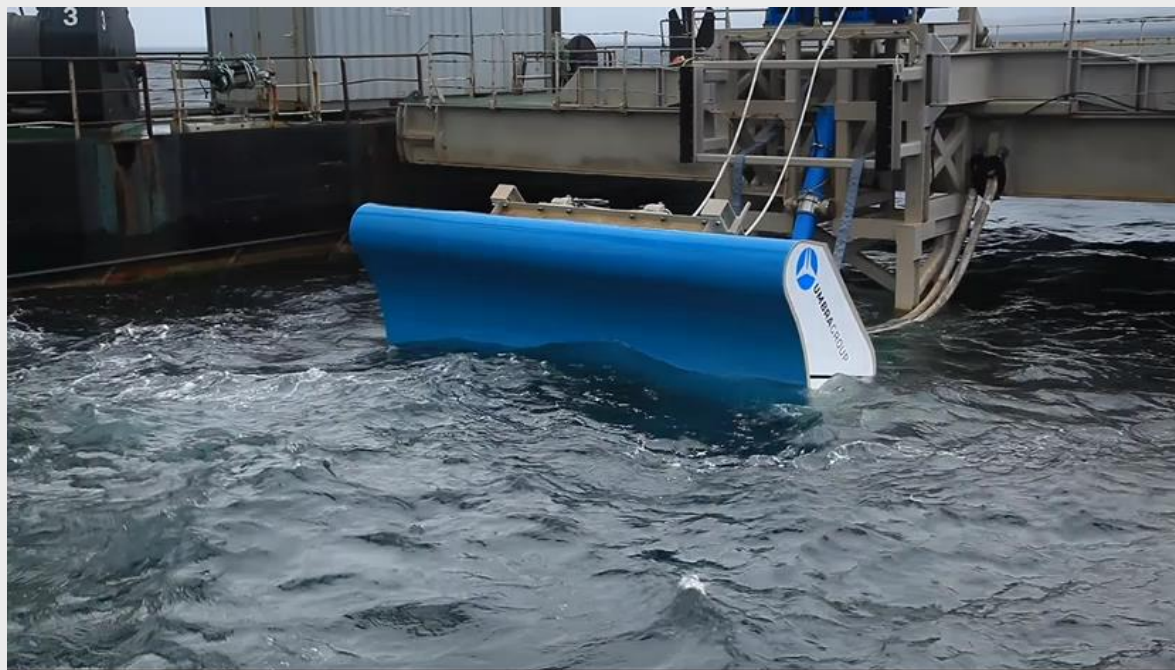
*TRL – laboratory test*





# *Project objectives*

*TRL – sea trials*



...on [LINKEDIN](#) for more video



# Project objectives

TRL

## EMG prototype

- Design for marine environment
- Manufacturing at Umbra's facilities



TRL 5

## Bench tests

- Submerged in synthetic sea water
- HardWare-In-the-Loop test bench



TRL 6

## Sea trials

- Installation on point-pivoted buoy
- Use of gantry barge for ease of access



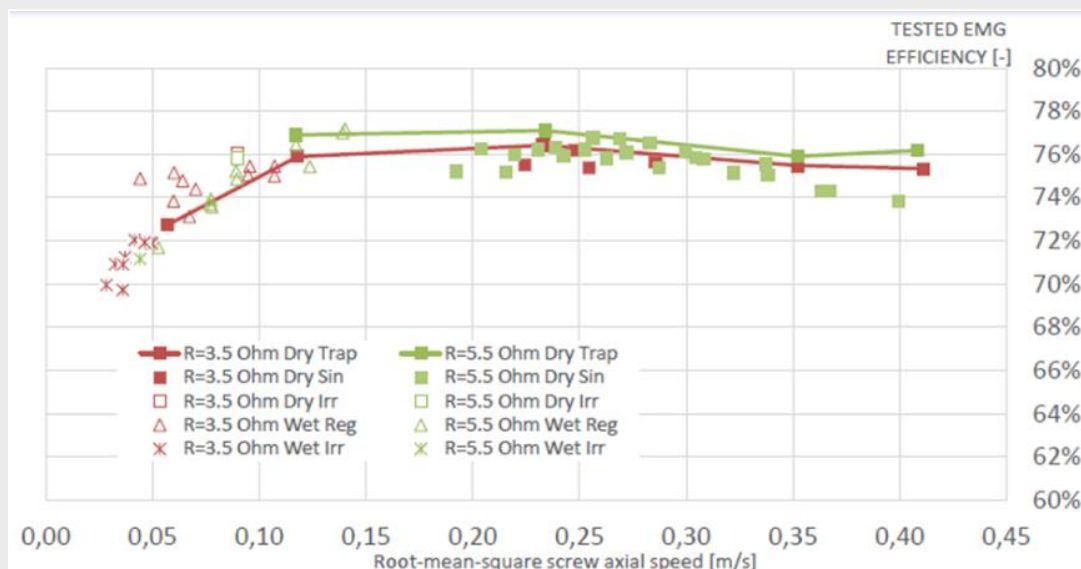
TRL 7

TRL

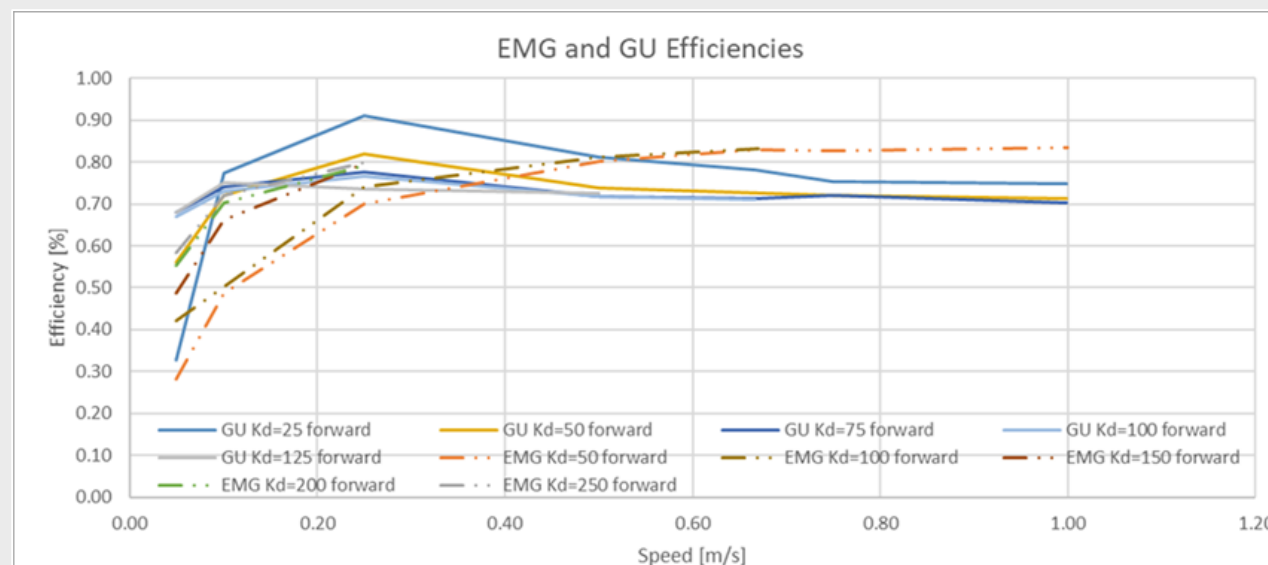
# Project objectives

## Cost reduction and commercialization

- ➔ **Average efficiency (mech input- elect output) above 70%**, expected to be in the range 70%-85%.
  - efficiency higher than 85% for some values of speed and always above 70% for a speed equal or higher than 0.100 m/s



100 kW EMG

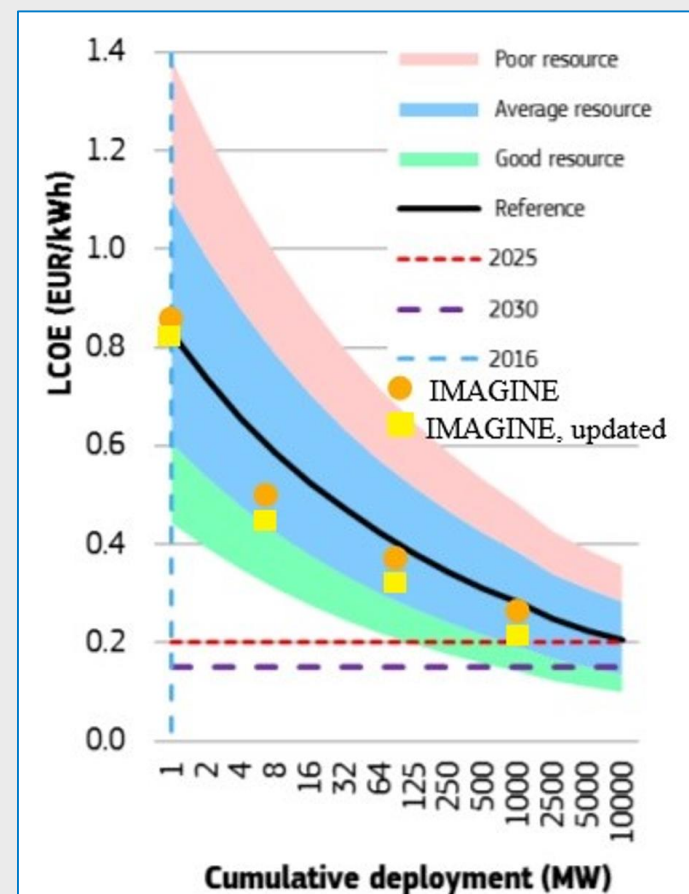


250 kW EMG

# Project objectives

## Cost reduction and commercialization

- ➔ **Decrease by over 50% the CAPEX** of current PTO technologies.
  - LCOE in the range of 850 - 200 €/kWh
  - From 100kW unit to the 250kW IMAGINE prototype we achieved a cost reduction by 72% from 5.947 €/kW to 1.650 €/kW
- ➔ **Lifetime to 20 years**, targeting an expected Mean Time Between Failures (MTBF) of 20 years:
  - no failure of the system during the test period





# CONCLUSIONS

## *Development ROADMAP results*

- ⇒ Technology transfer from other sectors to OCEAN REN. ENERGY
- ⇒ Highly reliable and efficient solution (proved by robust methodology)
- ⇒ Third-party technology validation
- ⇒ High TRL and established manufacturing capabilities





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# **GRAZIE PER L'ATTENZIONE**

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