



**ORDINE DEGLI
INGEGNERI**
DELLA PROVINCIA
DI CASERTA

Bladeworks
a Cartflow company

Cartflow
ONE SHOT BLADE®

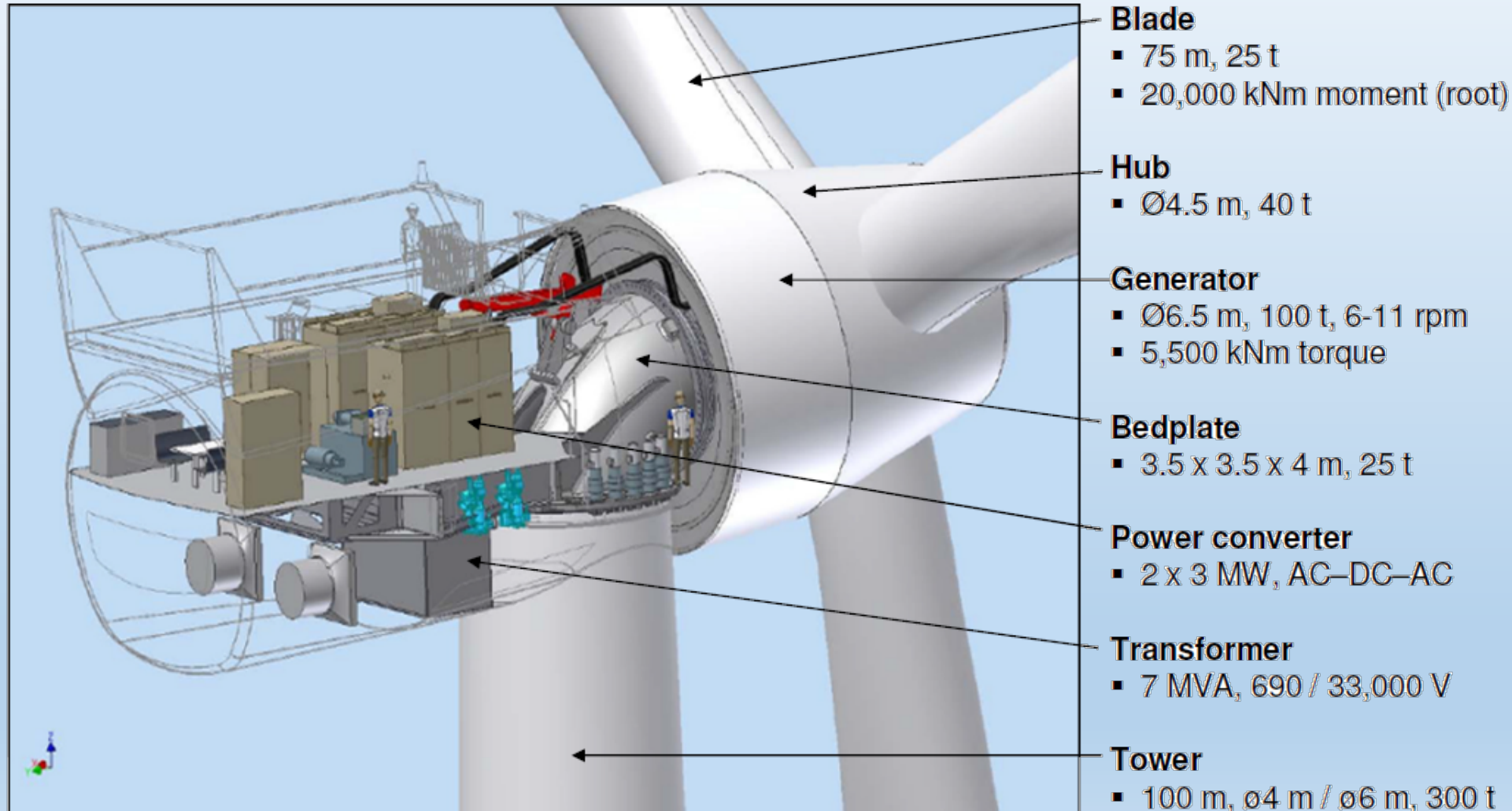
La Progettazione Meccanica e le nuove Tecnologie Abilitanti

Applicazioni nel settore Eolico

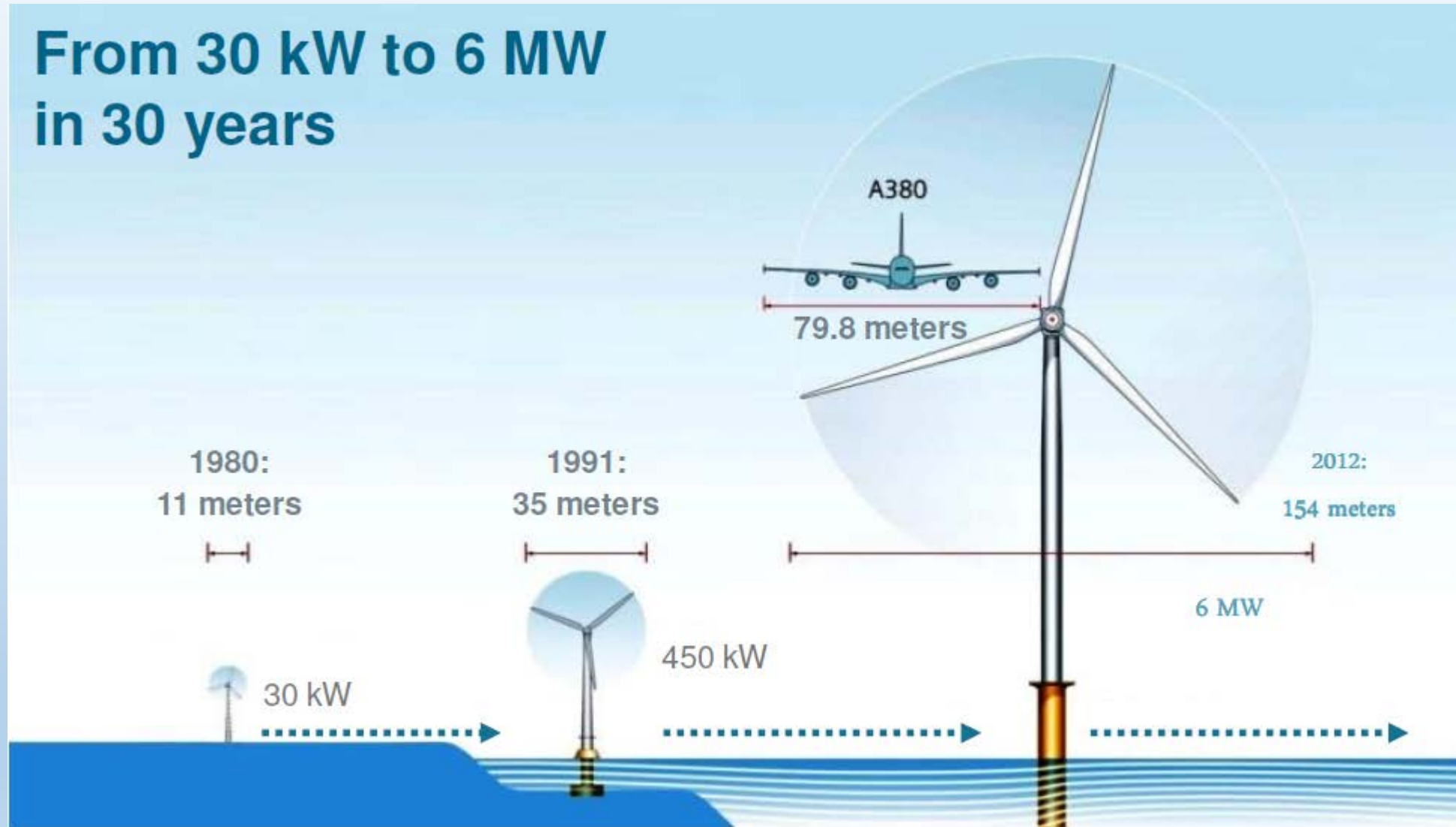
MARIO LONGO
Bladeworks s.r.l.

Martedì 16 febbraio 2021 – dalle 15.00 alle 18.30
Ordine degli Ingegneri della Provincia di Caserta

SIEMENS 6MW DD OFFSHORE TURBINE



From 30 kW to 6 MW in 30 years



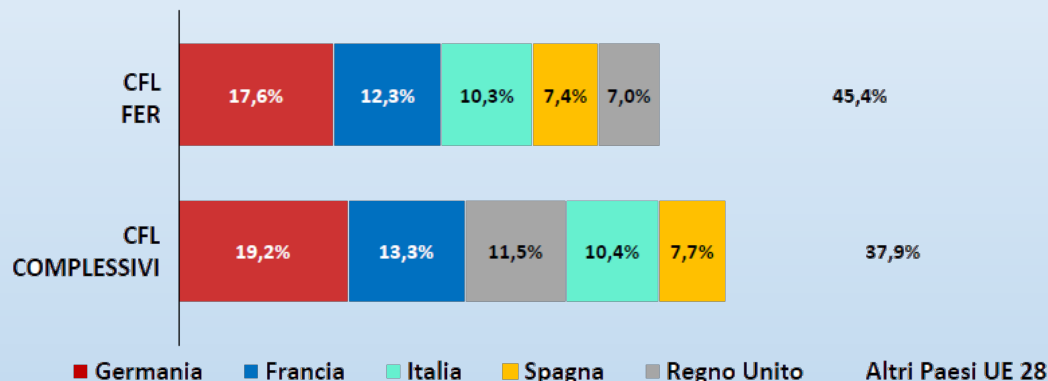
Vestas ha appena annunciato la realizzazione (prototipo 2022, produzione di serie 2024) della **V236-15.0 MW**

GSE – FER DATI DI SINTESI 2018

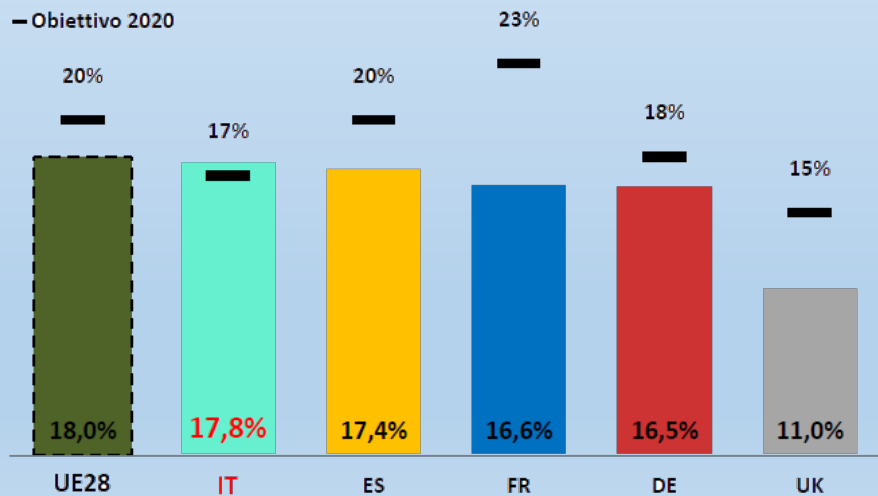
	Italia	Europa (UE28)
Quota FER sui consumi energetici totali	17,8%	18,0%
Quota FER nel settore trasporti	7,7%	8,1%
Quota FER nel settore elettrico	33,9%	32,1%
Quota FER nel settore termico	19,2%	19,7%

Tra i Paesi UE, nel 2018 l'Italia si posiziona al 3° posto per contributo ai consumi di energia da FER e al 4° posto per contributo ai consumi di energia complessivi.

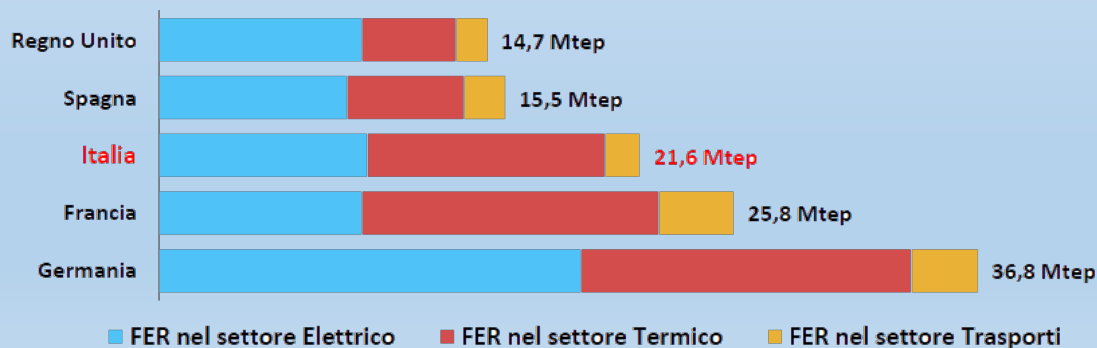
Peso percentuale dei singoli Paesi sul totale dei consumi dell'UE28



Nel 2018 l'Italia è l'unico tra i principali Paesi UE nel quale si osserva una quota FER sui Consumi finali lordi superiore all'obiettivo fissato dalla Direttiva 2009/28/CE per il 2020



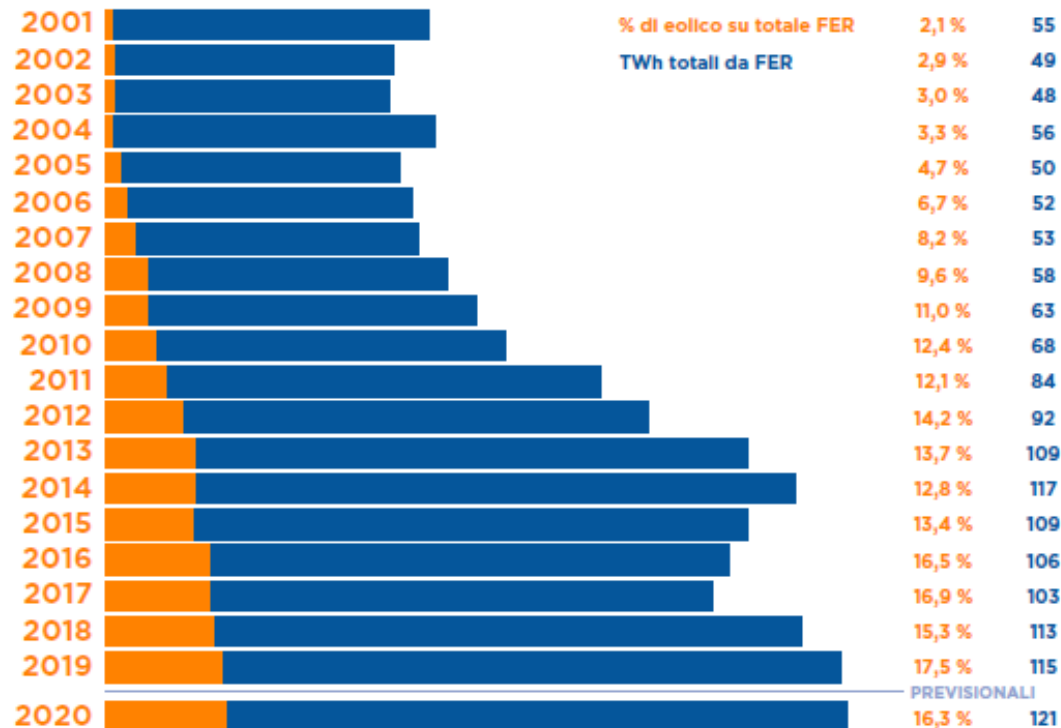
In Italia nel 2018 sono stati consumati 21,6 Mtep di energia da FER



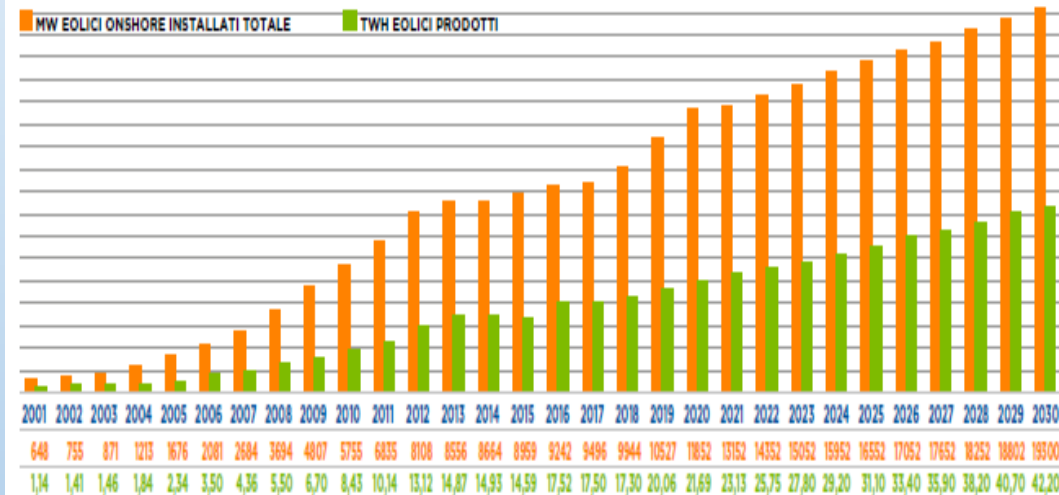
ANEV – PRODUZIONE E PROSPETTIVE DI CRESCITA AL 2030

PRODUZIONE DA FONTE EOLICA IN RAPPORTO AL TOTALE DELLE FONTI RINNOVABILI

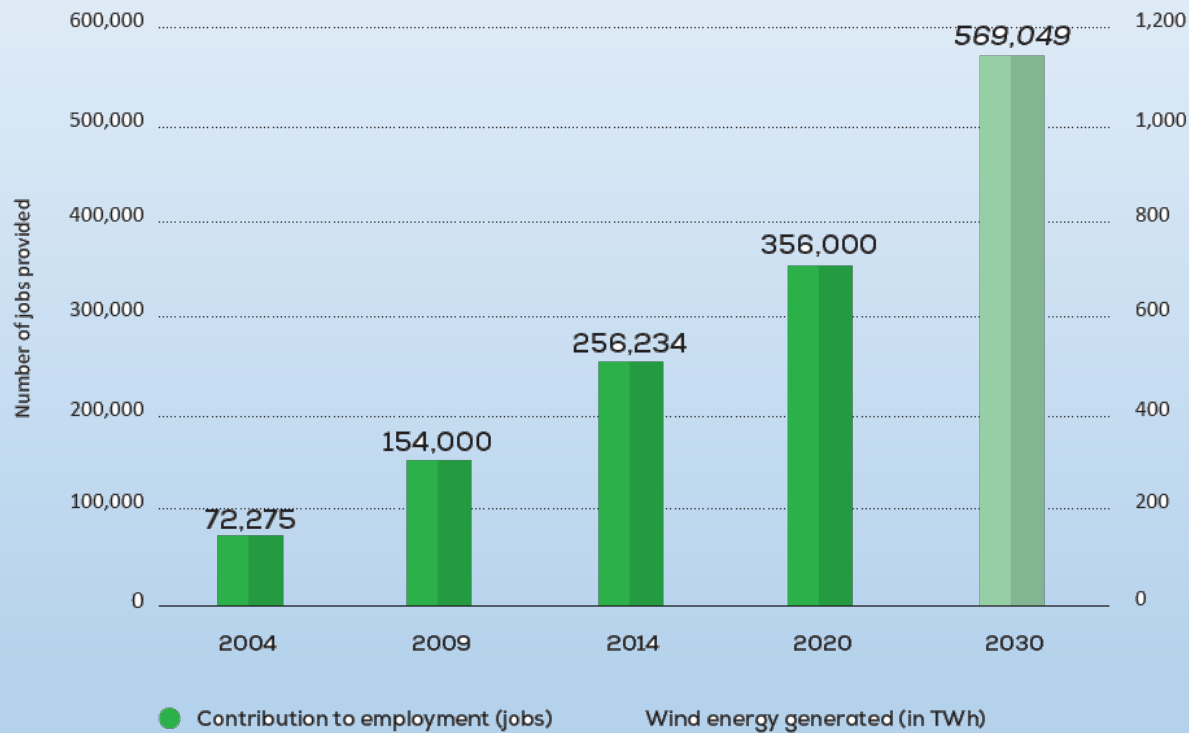
(dato storico e previsionale)



PROSPETTIVE DI CRESCITA DELL'EOLICO SULLA BASE DEGLI IMPEGNI DELL'ITALIA IN SEDE COMUNITARIA



ETIPWIND/ANEV – CRESCITA OCCUPAZIONALE AL 2030



Every GWh produced supports almost 1 full-time job

	SERVIZI E SVILUPPO	INDUSTRIA	GESTIONE E MANUTENZIONE	TOTALE	DIRETTI	INDIRETTI
PUGLIA	3.500	4.271	3.843	11.614	2.463	9.151
CAMPANIA	3.192	1.873	3.573	8.638	2.246	6.392
SICILIA	2.987	1.764	2.049	6.800	2.228	4.572
SARDEGNA	3.241	1.234	2.290	6.765	2.111	4.654
MARCHE	987	425	1.263	2.675	965	1.710
CALABRIA	2.125	740	1.721	4.586	1.495	3.091
UMBRIA	987	321	806	2.114	874	1.240
ABRUZZO	1.758	732	1.251	3.741	1.056	2.685
LAZIO	2.487	1.097	1.964	5.548	3.145	2.403
BASILICATA	1.784	874	1.697	4.355	2.658	1.697
MOLISE	1.274	496	1.396	3.166	1.248	1.918
TOSCANA	1.142	349	798	2.289	704	1.585
LIGURIA	500	174	387	1.061	352	709
EMILIA ROMAGNA	367	128	276	771	258	513
ALTRE	300	1.253	324	1.877	211	1.666
OFFSHORE	529	203	468	1.200	548	652
TOTALE	27.417	16.205	23.388	67.200	22.562	44.638

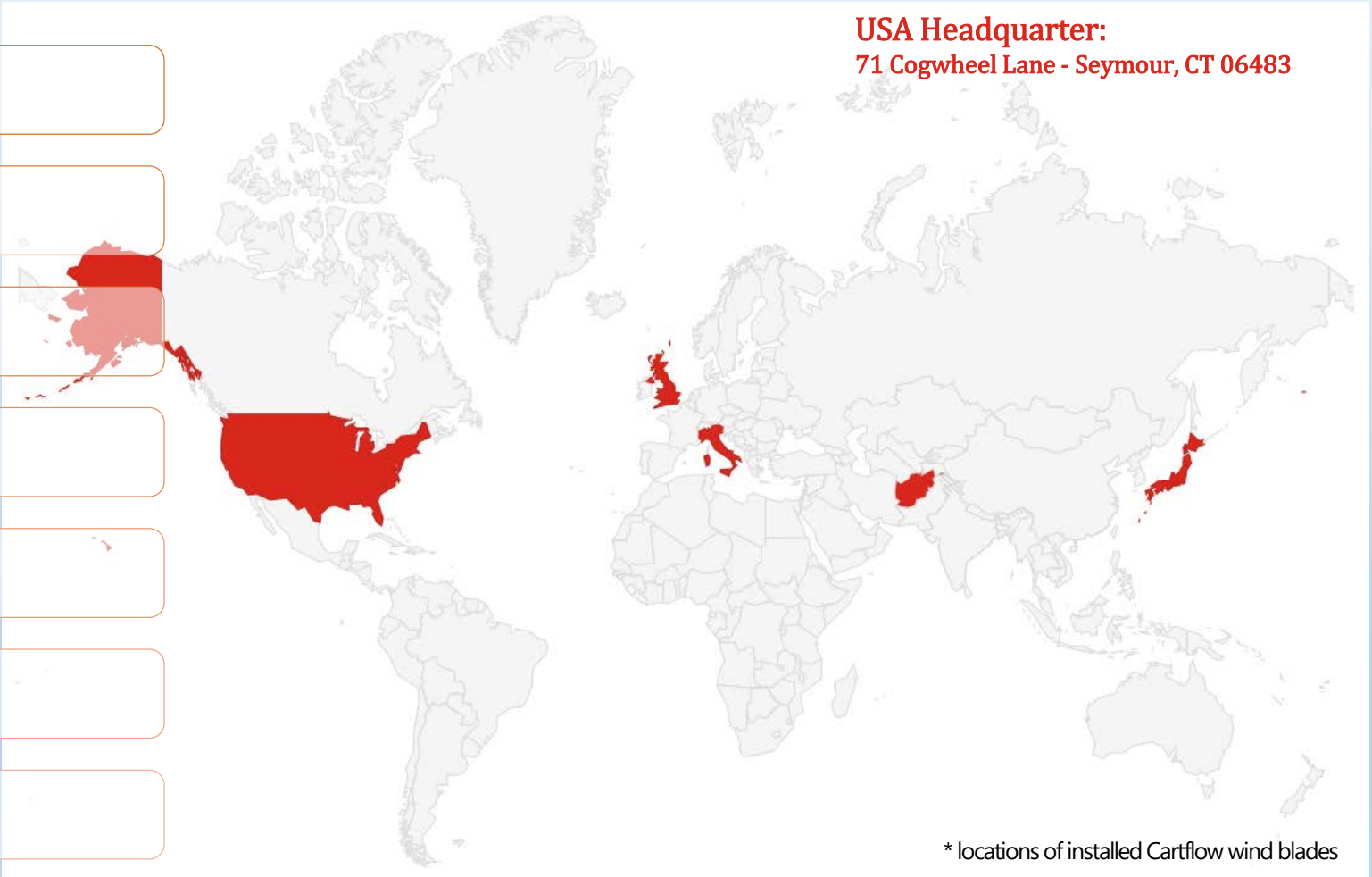
Attuali occupati nel settore: 16.000

CARTFLOW KEY NUMBERS

Europe Headquarters:
Via Nuova Marina, 20 - 80133 Napoli
Via Centauro, 1 - 81030 Castel Volturno

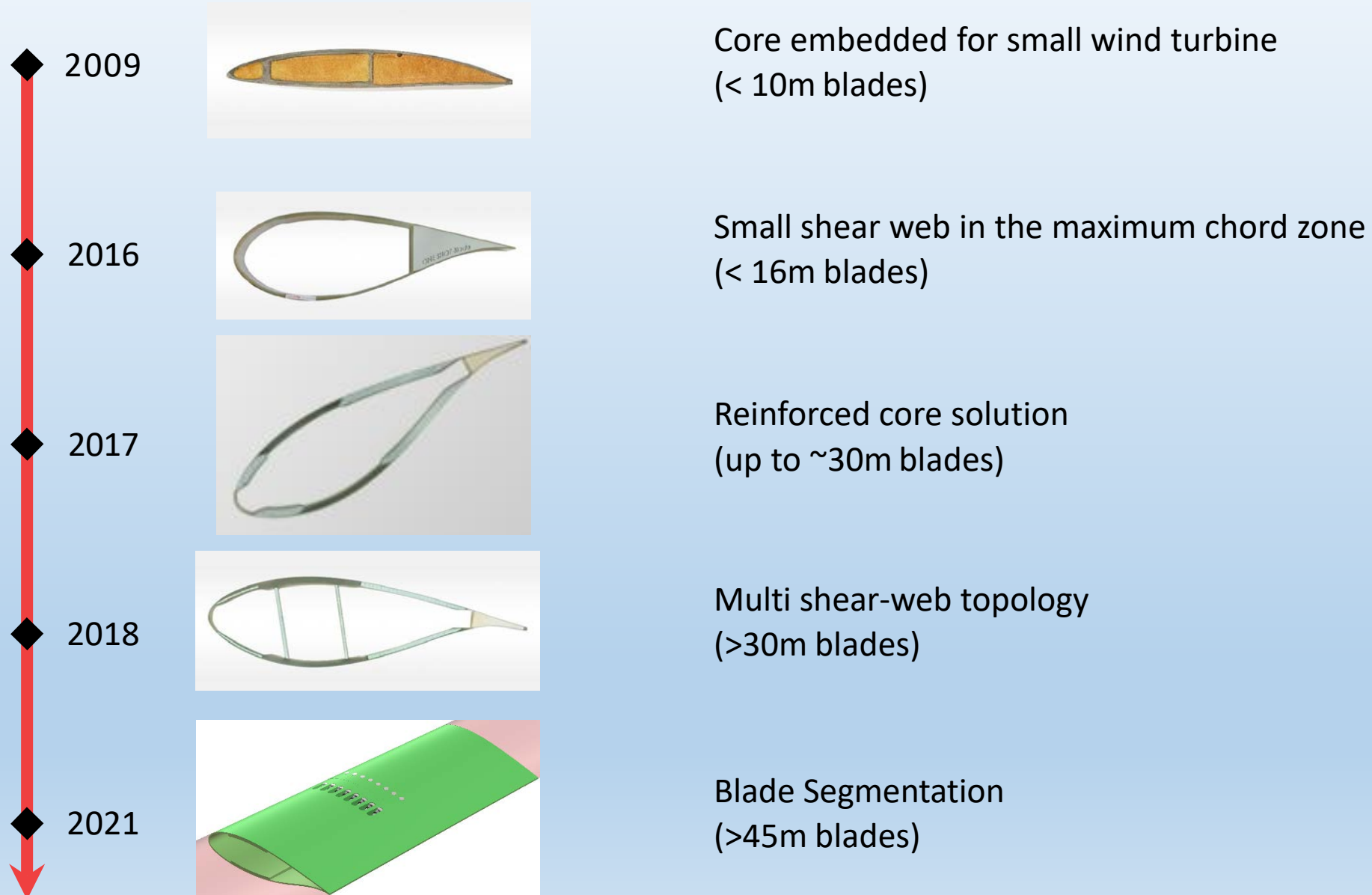
USA Headquarter:
71 Cogwheel Lane - Seymour, CT 06483

- 2008 • development of the One Shot Blade® technology
- 2009 • first One Shot Blade® produced
- 2011 • leader in Italy of small wind blade
- 2017 • business unit in US
- 2018 • more than 2000 blades produced
• Multi shear-web solution
- 2019 • ten years of activity
- 2020 • certification of One Shot Blade®



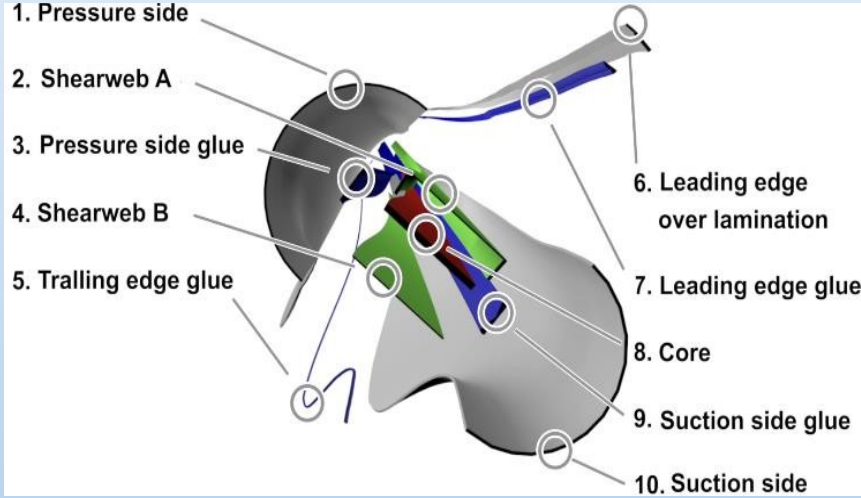
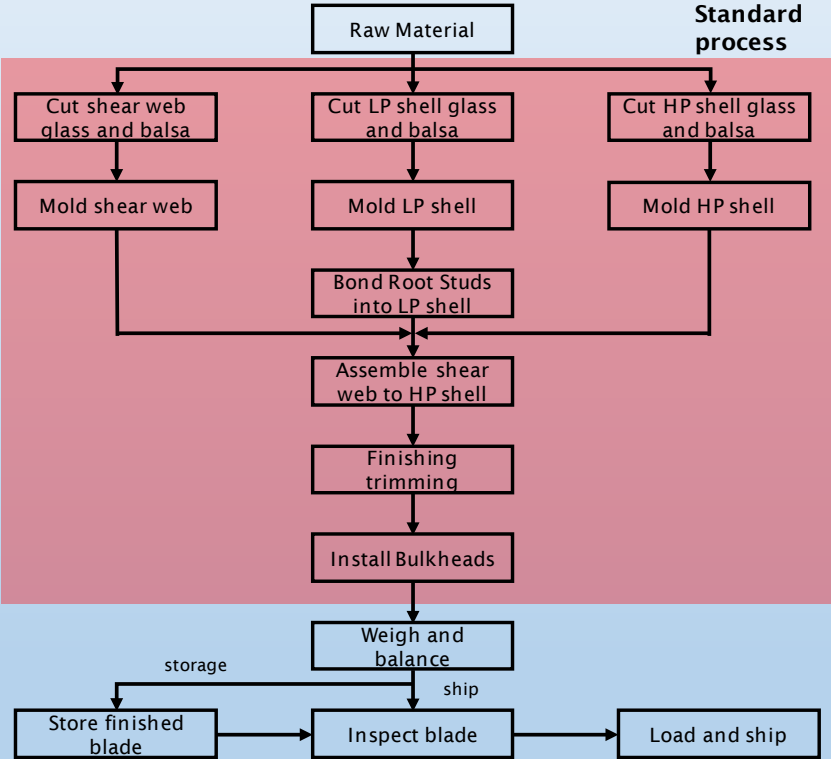
* locations of installed Cartflow wind blades

MILESTONES



STATE OF ART

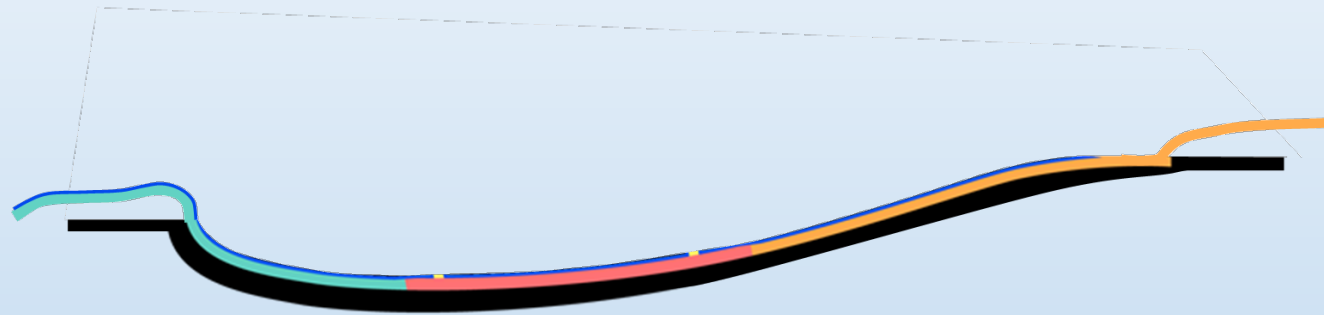
The conventional manufacturing process is based on the bonding of many parts by means of structural adhesives



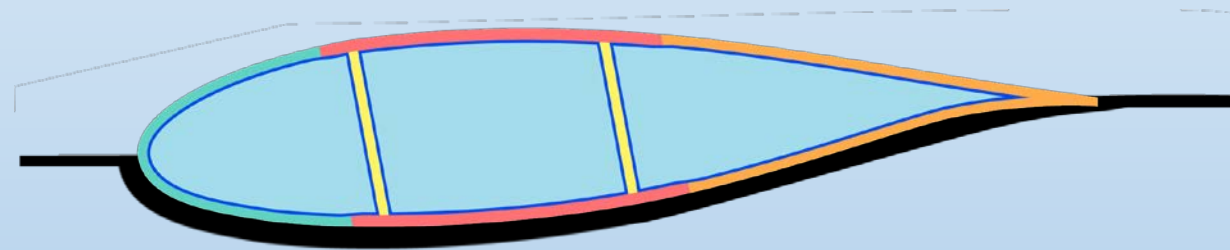
HOW IT'S MADE

Internal rigid mould allows to obtain closed boxed allowing an improved **structural reliability**

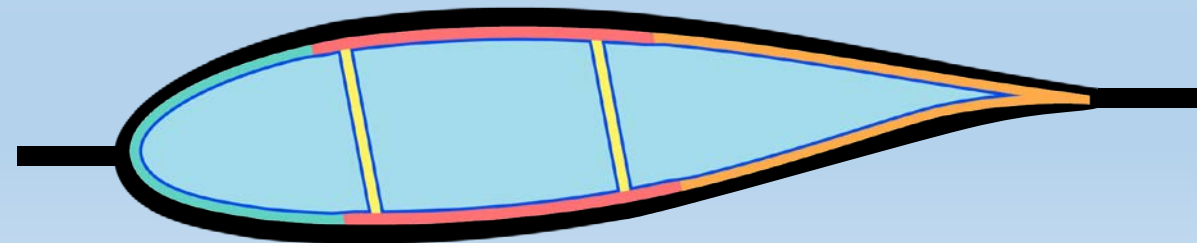
Step 1
Layup of one side of the blade (PS or SS)



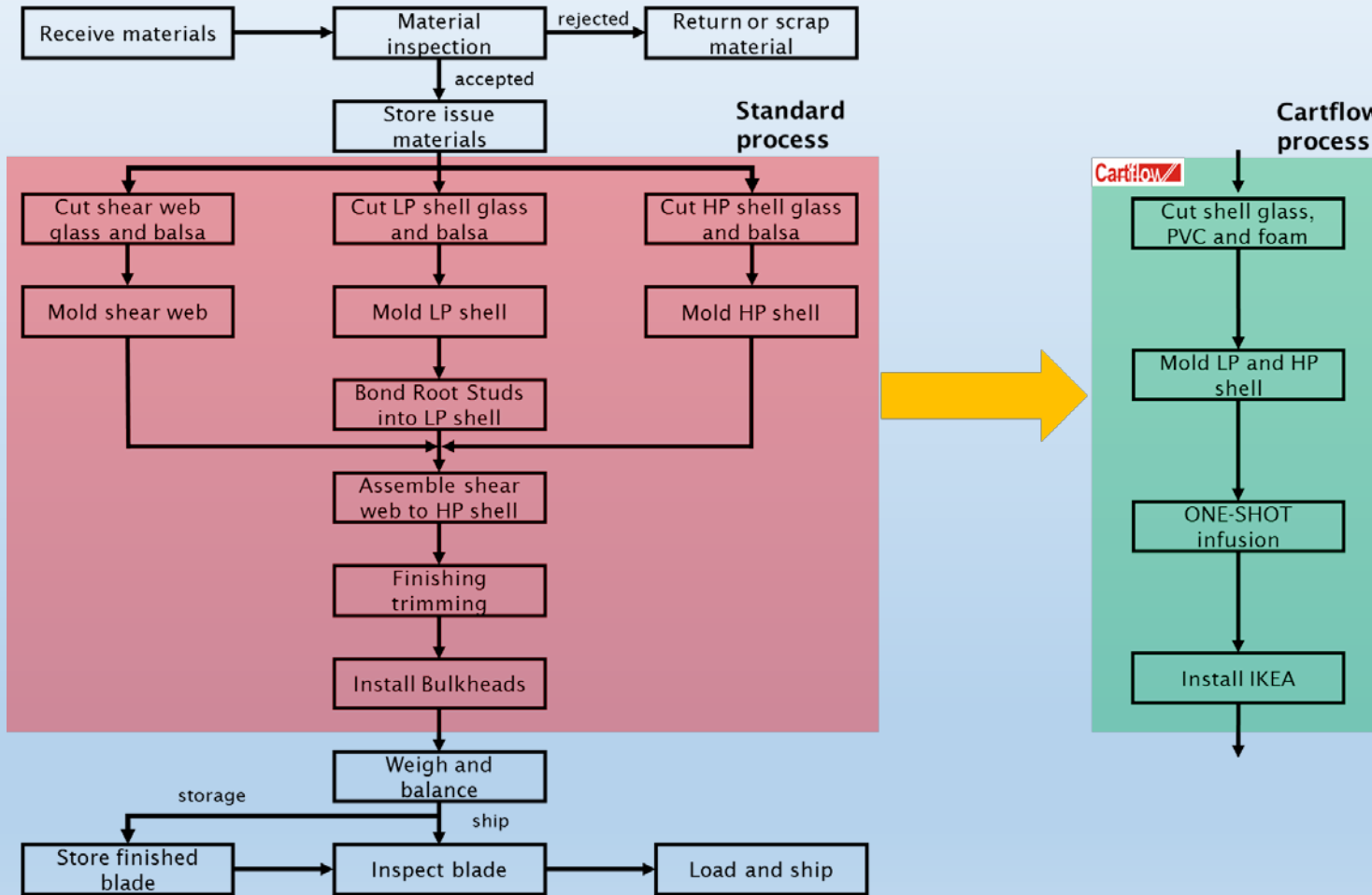
Step 2
Placing internal rigid mould
Layup of other side of the blade



Step 3
Closing mould
Starting infusion process



COMPARISON OF THE PROCESSES



COMMON TASKS IN THE BONDING PROCESS

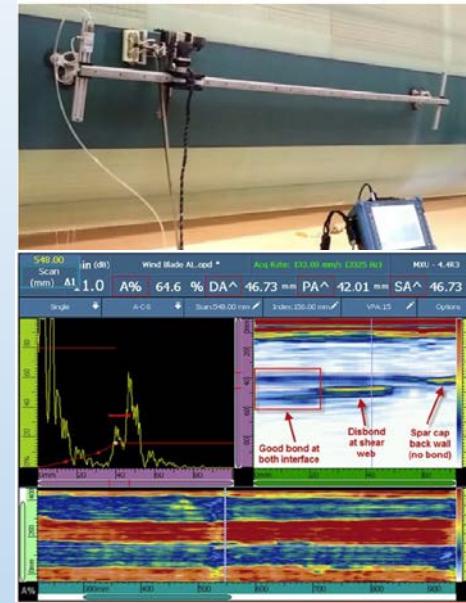
Bonding placement

- *repeatability*
- *variable mass*
- *Manual/automated placement*



Quality inspection control

- *expensive tool*
- *experienced / competent staff*



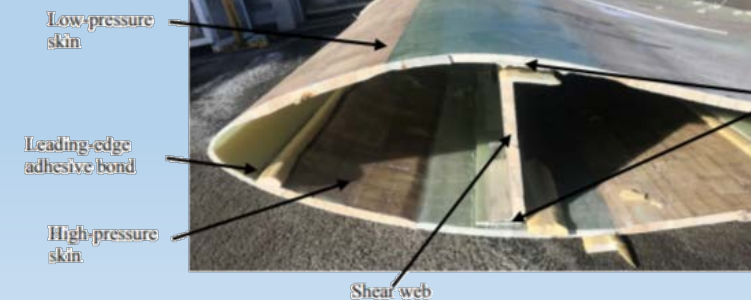
Alignment of the shear webs

- *crucial operation*



R.E. Murray et al. / Renewable Energy 140 (2019) 501–512

Possible debonding



- *quality issues*
- *fatigue stress*

COMPARISON OF THE PROCESSES

Conventional process



reduction of disposable materials

reduction of cycle time



improved reliability



reduction of BoM

no re-work time



ease of manufacturing



high cost-effective



One Shot Blade® process



PLUG AND MOLD MANUFACTURING PROCESS

Polystyrene stock



Rough milling



Smooth milling



PLUG AND MOLD MANUFACTURING PROCESS

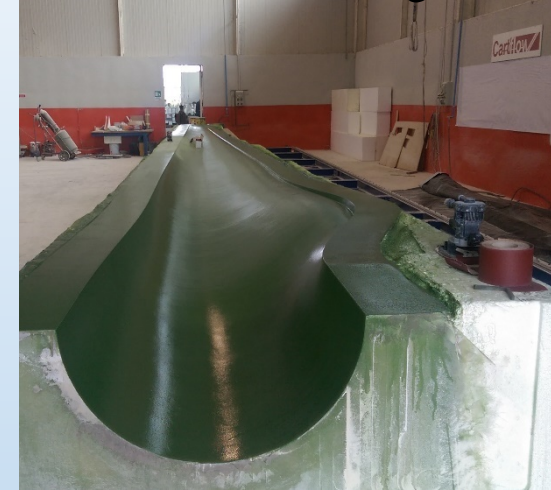
Mold lamination



Diamond tool mill mold



Mold finishing



Plug forming



Spray polyurethane plug

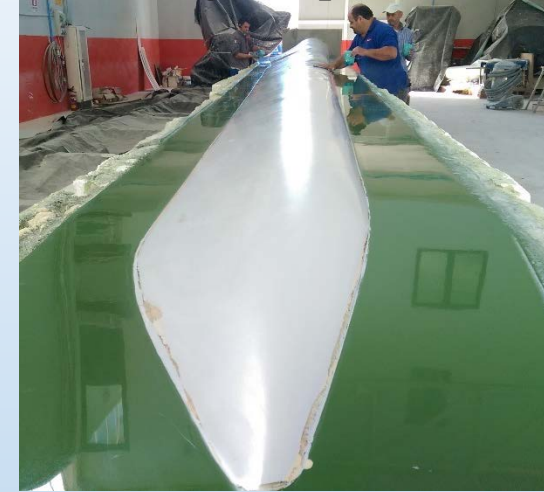


PLUG AND MOLD MANUFACTURING PROCESS

Finishing plug



Plug completed



Lamination and metal frame mold



Onshore



Main Data

- Power rating: 2-4MW
- Rotor: 100-150 m
- Hub heights: 100-200 m

Technologies

- Blades with structural-aerodynamic coupling for passive load reduction
- High-stiffness fibers in blades (carbon, new fiber types)
- Direct drive transmission
- Commoditized design, standard components
- Ancillary services, fault robust with short-term storage

Offshore

Main Data

- Power rating: 6-10MW
- Rotor: 150-210 m
- Hub heights: 80-140 m

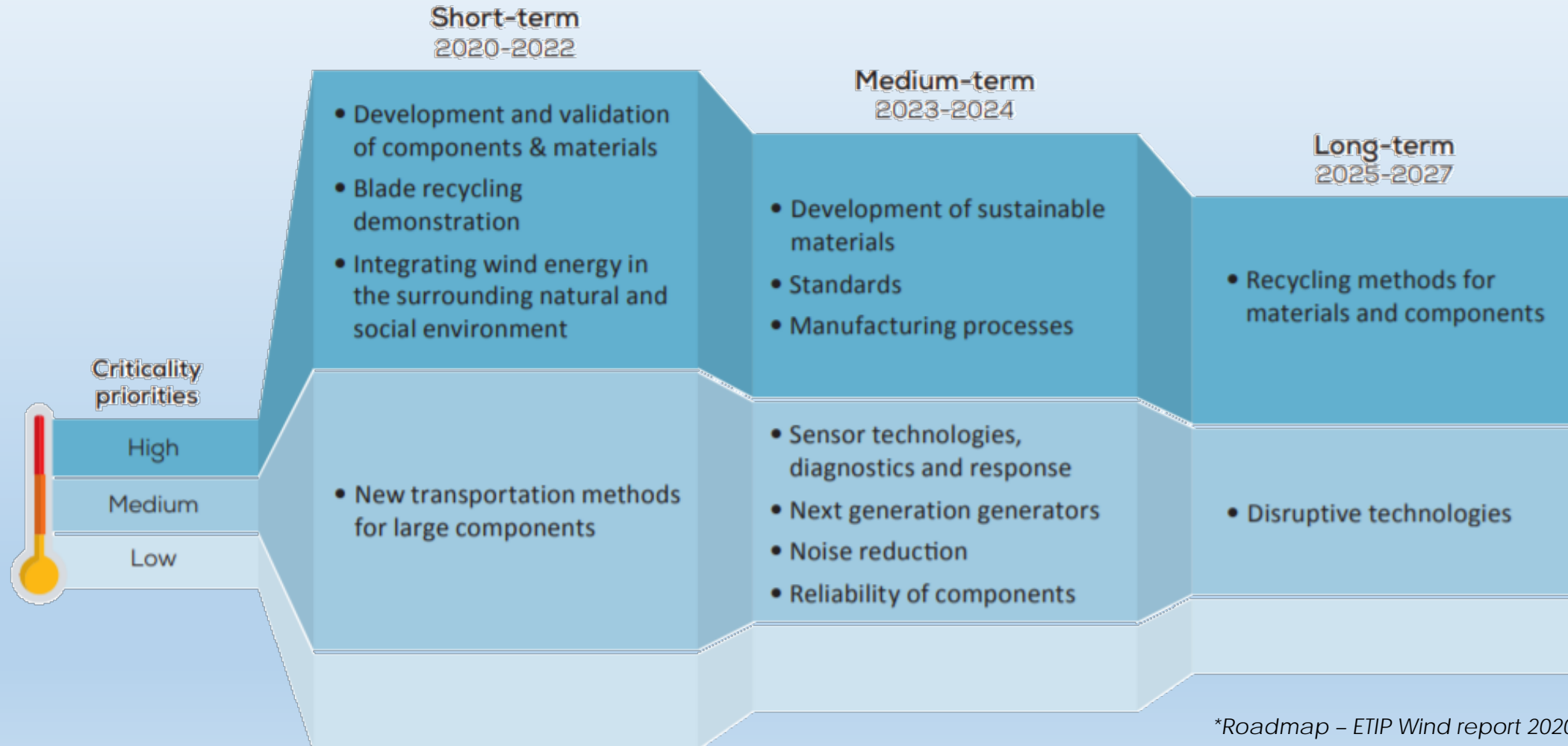
Technologies

- Basics same as onshore technologies
- Tailored redundancy concepts for increased robustness
- Two-year service intervals
- Electrical and civil infrastructure at 40% of today's cost
- Simplified installation w/o piling



RESEARCH & INNOVATION: ACTION AREAS

A common challenge for the next future toward a 100% recyclable wind blade



*Roadmap – ETIP Wind report 2020

THANK YOU !

Cartflow
ONE SHOT BLADE®

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Europe Headquarters

Via Nuova Marina, 20 – 80133 Naples, Italy
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USA Headquarters

71 Cogwheel Lane – Seymour, CT 06483



*NPS wind turbine in Necker Island,
Virgin Islands*