



Siemens Gamesa Service Partial repowering

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Pablo Montori – Head of Onshore Platforms

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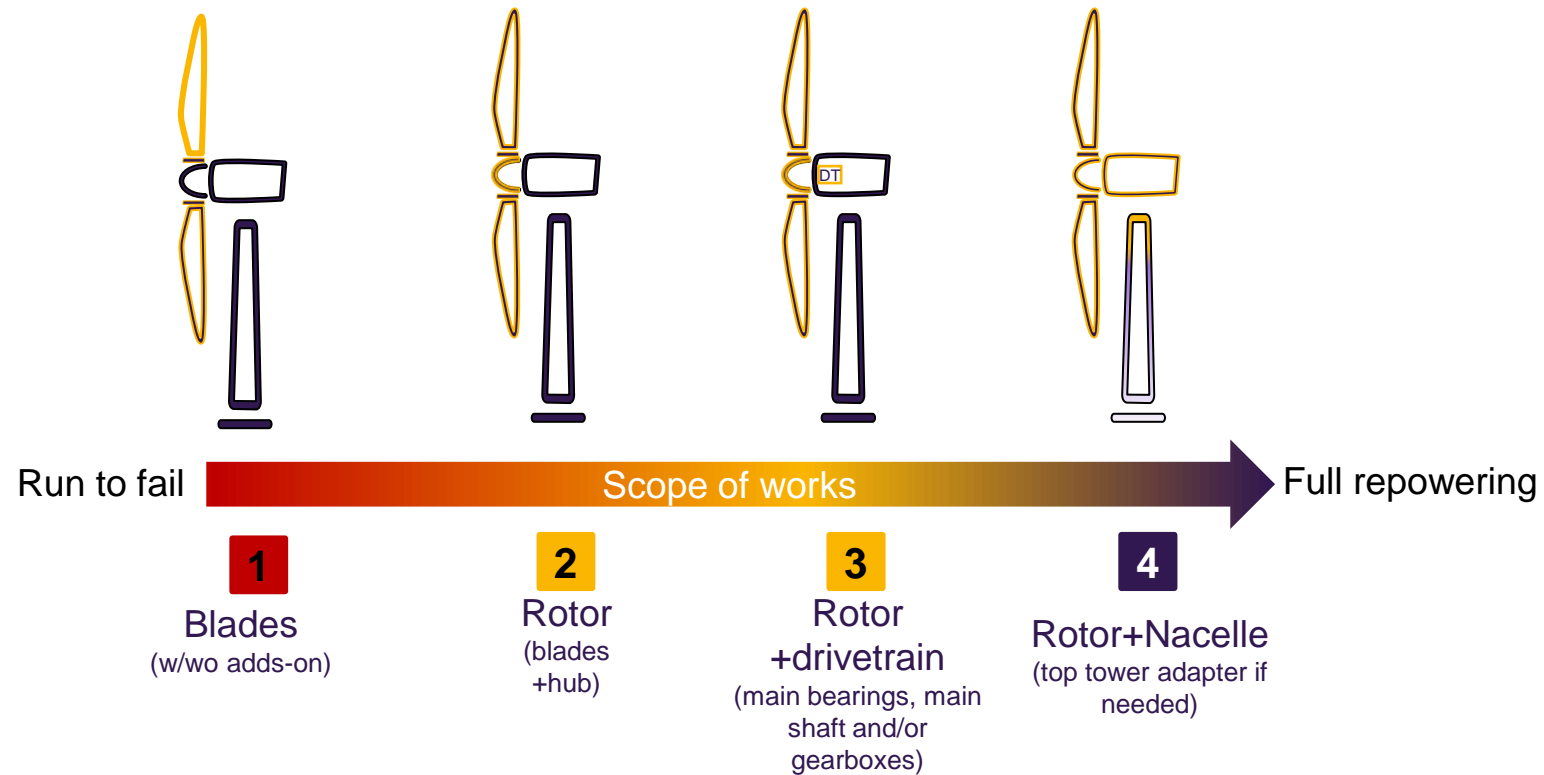
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4. Success stories

Definitions

The optimum scope is market specific.



Business rationale

Wind Farm end of life

- 30 years O&M being deployed by SGRE on several platforms.
- AEP improvements + design modifications to boost performance.

Regulatory Framework

- No specific regulation yet for partial repowering. Significant constraints for existing windfarms to go for full repowering.
- Is relevant to identify al environmental or urbanistic impact along with H&S technical restrictions

Circular Economy

- Reconditioned components available for ESG ranking and access to sustainable financing.

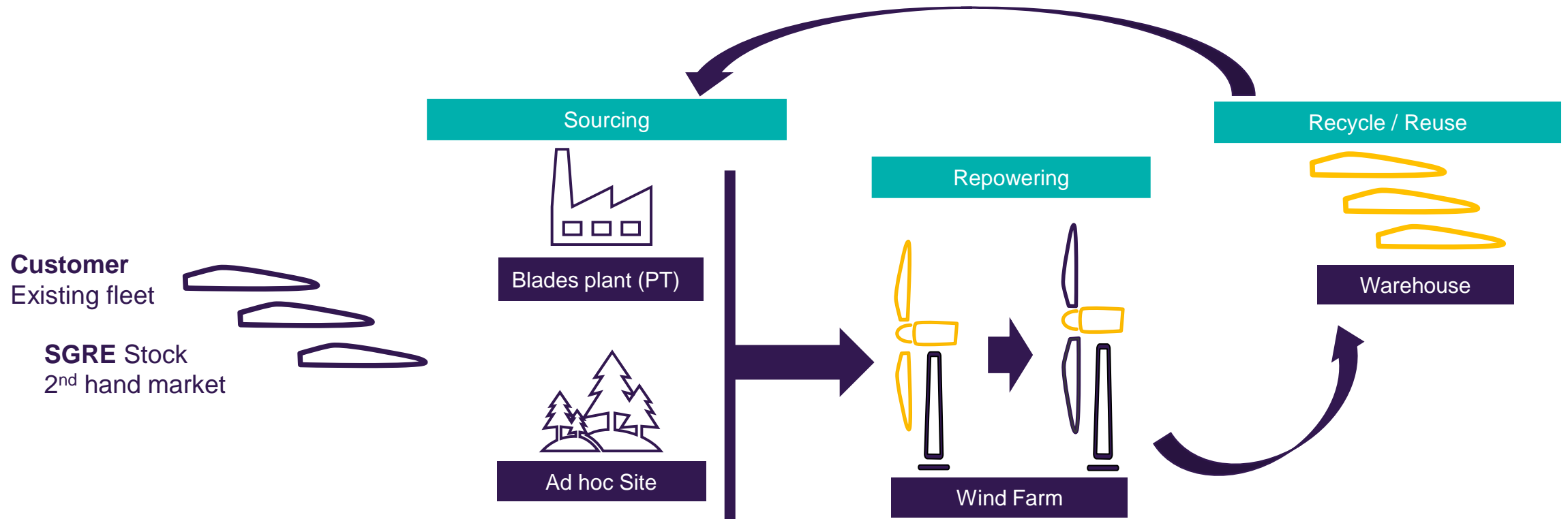
PERTE's in Spain related with Next Generation funds would foster the development of partial repowering.



Legislation evolving fast to:

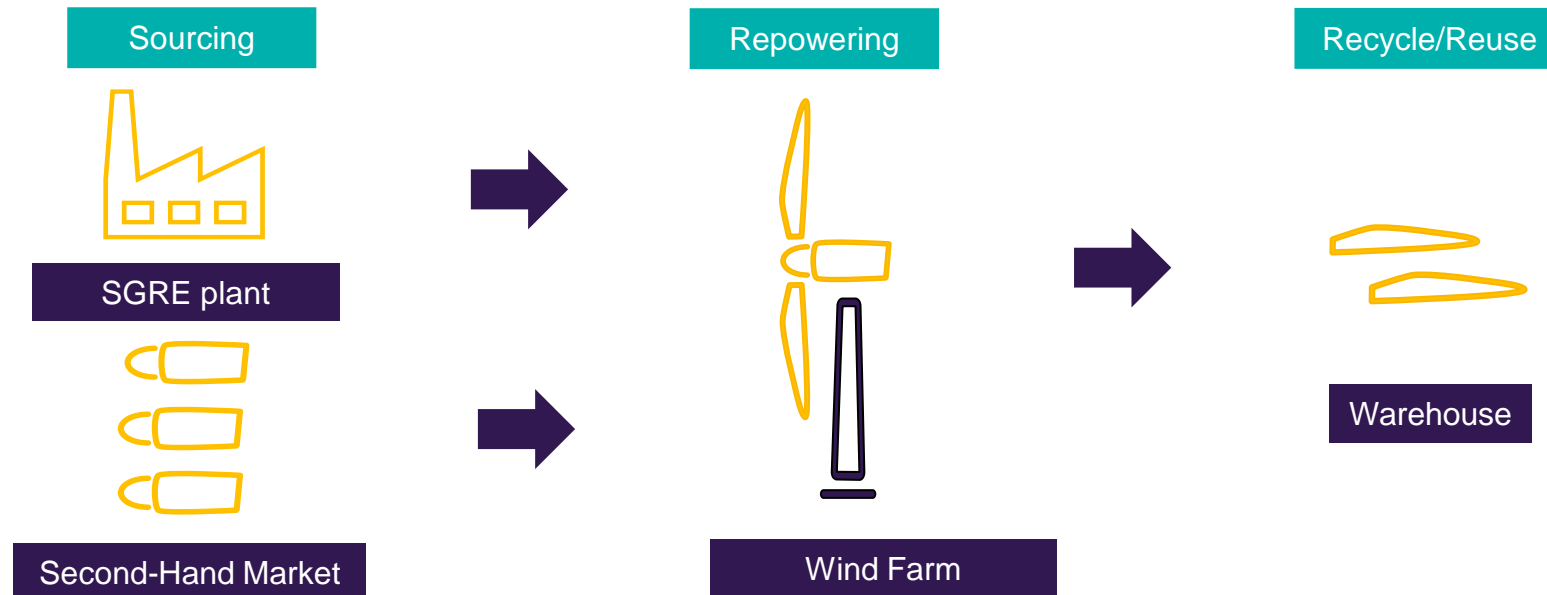
1. Introduce a structural approach for end of life WFs
2. Make best use of EU funds

Business Model (1) – Full nacelle compatibility



- 1) SGRE to manage all steps of the project including reusing of blades on a project basis and full scope O&M till year 30.
- 2) Sourced components new or reconditioned.







Business Model (2) – Different nacelle families



- 1) SG114 supply chain partially reactivated for service volumes.
- 2) Sourced components new or reconditioned.
- 3) Reuse of components on a project by project basis.

Partial repowering: Proof of Concepts

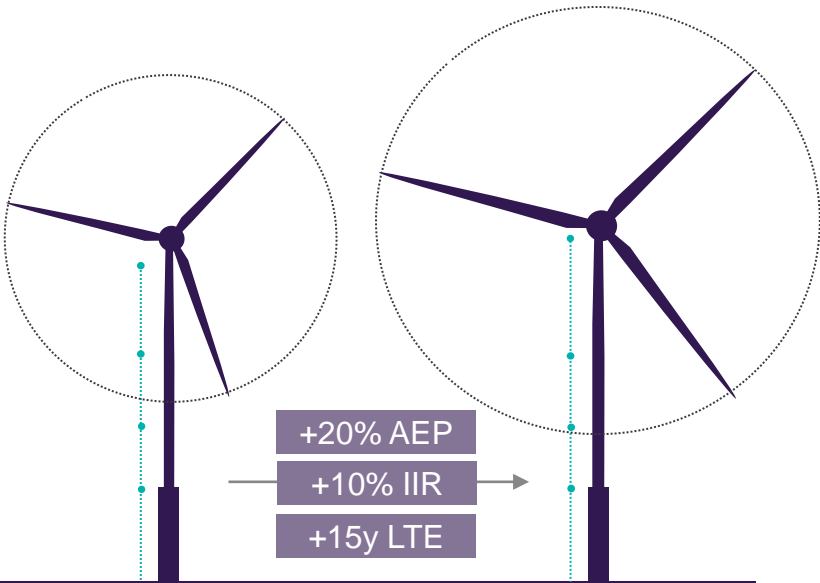
Concepts to validate

-  AEP Assessment
-  Loads Assessment (along LTE)
-  Nacelle Exchange
-  Re-blading
-  Tower Extension
-  Overhaul

Platforms

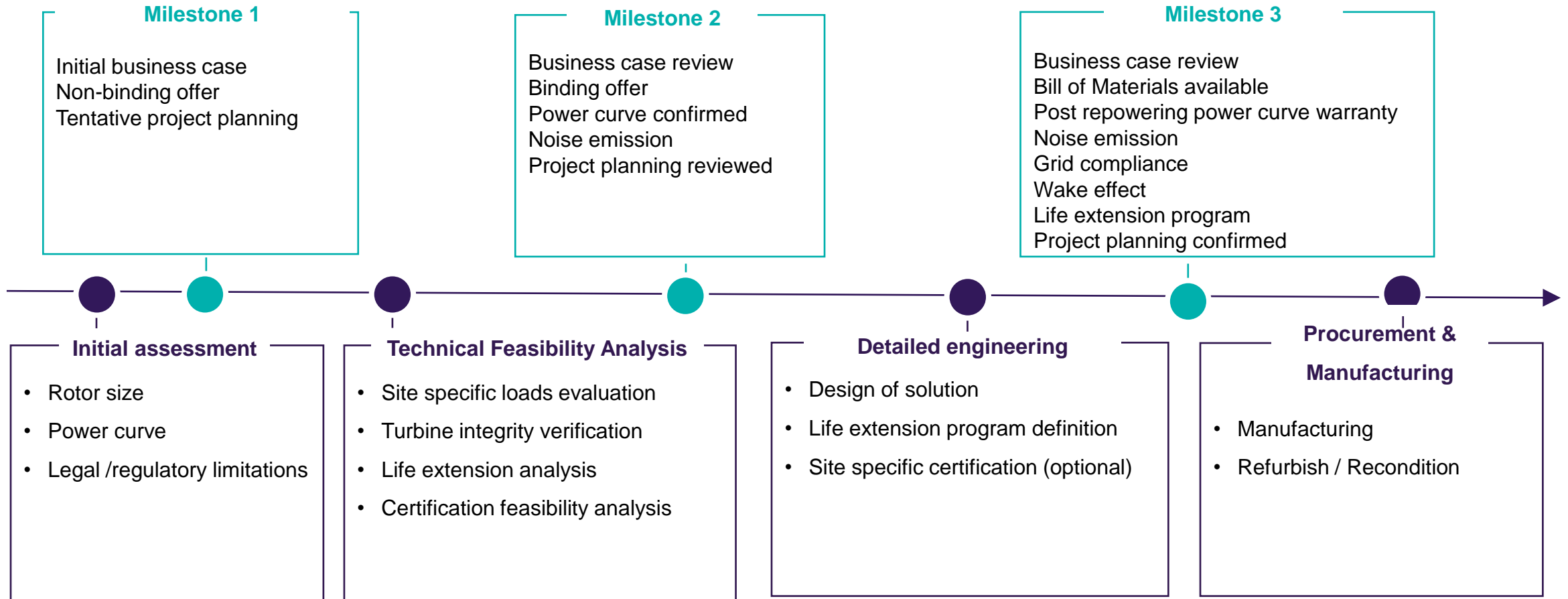
FROM	To Reblading	To Partial Repowering
MM82 / 92	MM 92 / 100	SG 114
SWT 2.3 – 93		SWT 2.3 -101/ 108 (50/60Hz)
SWT 2.3 - 93		SG 114 / 128
G90		G97 / SG 114
G80/83	G90	G97 / SG 114
G52	G58	G58 (Reinf.)

BC Feasibility

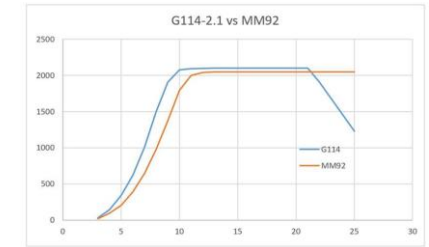


Full repowering refers to the complete dismantling and replacement of wind turbine equipment (included foundations) at an existing site. **Partial repowering** is defined as installing/refurbish a new nacelle or drivetrain and/or rotor on an existing tower and foundation.

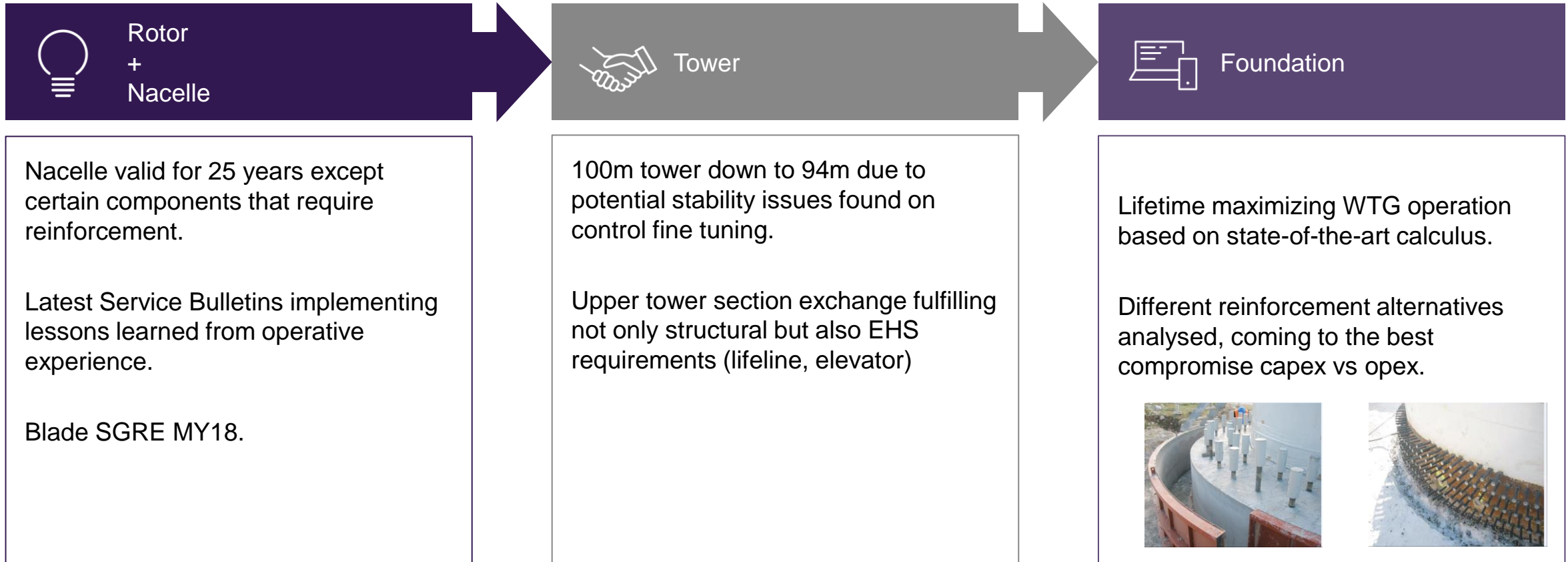
SGRE's approach for Partial Repowering



Senvion MM92 (2.05MW) => SG2.1-114 (2.1MW)



Components summary



Senvion MM92 (2.05MW) => SG2.1-114 (2.1MW)



Proven technical advantages

- Senvion detailed information available
- Aeroelastic model updated, loads and stability checked.
- Components to be exchanged:

Nacelle

Hub

Blades

Tower top section

Ground cabinet

HV cables

Control & Signal Cables
- Certifiability reviewed



AEP enhanced

95 WTGs

3 different WTG configurations analyzed.

Improved AEP, specially at low wind speeds
(**average 25% improvement**, depending on Weibull)

Delta AEP (G114vsMM92)								
Air density 1.225 kg/m³								
<div>m/s</div> <div>k</div>	6	6.5	7	7.5	8	8.5	9	9.5
1.5	24.2%	21.9%	19.9%	18.1%	16.5%	15.1%	13.8%	12.6%
2	30.9%	27.6%	24.8%	22.3%	20.1%	18.2%	16.4%	14.8%
2.5	37.0%	32.9%	29.1%	25.8%	22.9%	20.4%	18.3%	16.4%



Optimum LCoE

Existing life of 10 years.

Additional 20 years or 25 years (depending on CAPEX vs OPEX optimization)

SWT-2.3-101/108 into SG129

Components upgrade



SWT2.3-101/108 upgraded into SG 129

- 3m tower adapter needed
- Blade
- Hub
- Drive train
- Gearbox

6 sites and 403 turbines to be completed in 2022, with more planned in future.



SWT-2.3-101/108 into SG129



Proven technical advantages

- Equipment upgrade:
 - ✓ Replacement full nacelle
 - ✓ hub
 - ✓ blades
 - ✓ and 3m top tower adapter section
- SCADA compatibility upgrade
- Foundation sufficient.



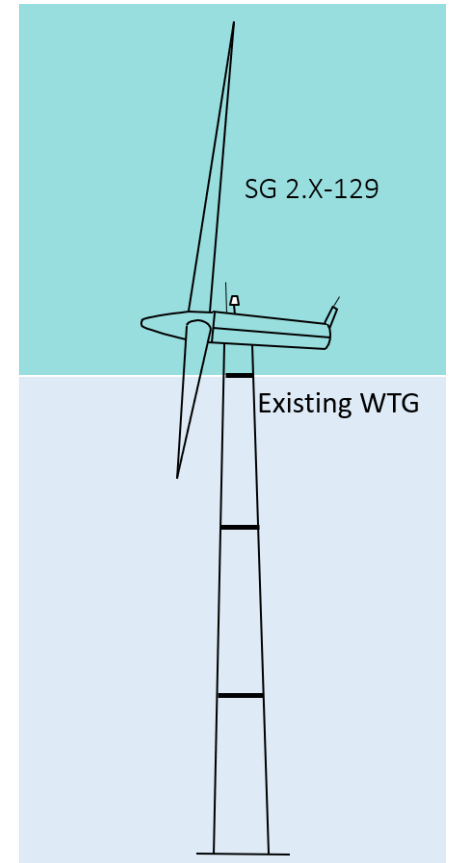
AEP enhanced

- 23% AEP improvement at low wind speed
- Options up to 2.9 MW (NP or PowerBoost)



WindFarm LifeTime

- Lifetime inspection program of the tower: 10 years old + additional 20 years
- PTC qualified 5%





Thank you!