

WIND TURBINE SCALING: NABRAWIND SOLUTIONS

New Delhi
April 26th, 2017
PPT-0425 Rev. /



NAWIND

ENEKO SANZ / *General Manager*

+34 609 040515

esanz@nabrawind.com

CONTENTS

1. Company Introduction

- Background
- Innovation Key Drivers

2. NABRALIFT®: a Craneless Self-erecting Tower

- Tower Market Trends
- Nabralift Description
- Alternatives Comparison
- Conclusions

3. NABRAJOINT®: a First-class Modular Blade Joint

- Blade Logistic Challenges
- Nabrajoint Description
- Alternatives Comparison
- Conclusions



Self Erected
Tower



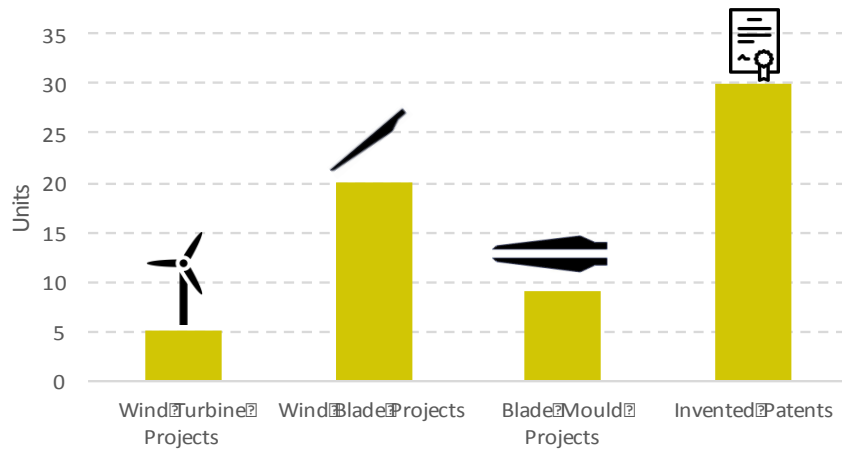
Modular Blade
Joint

1 COMPANY INTRODUCTION

Background

NABRAWIND

Advanced Wind Technologies



Pamplona (Spain) HEADQUARTER



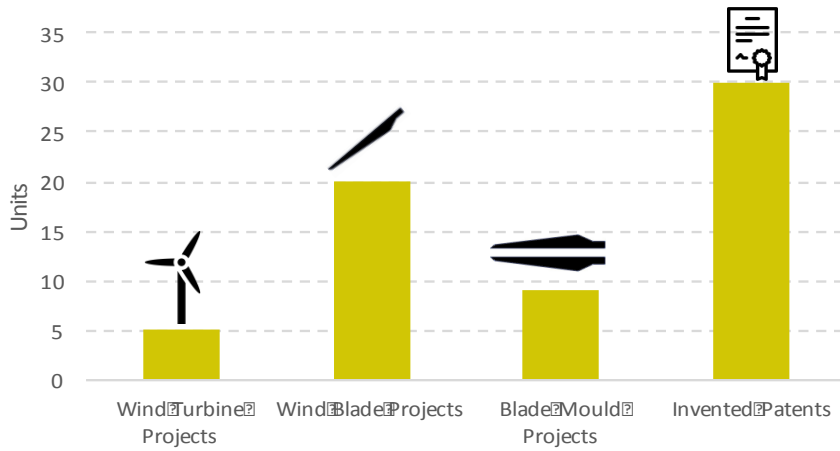
NAWIND

1 COMPANY INTRODUCTION

Innovation Key Drivers

NABRAWIND

Advanced Wind Technologies



Pamplona (Spain) HEADQUARTER



Drastic Cost Reduction



Modularity



Proven Technologies

CONTENTS

1. Company Introduction

- Background
- Innovation Key Drivers

2. NABRALIFT®: a Craneless Self-erecting Tower

- Tower Market Trends
- Nabralift Description
- Alternatives Comparison
- Conclusions

3. NABRAJOINT®: a First-class Modular Blade Joint

- Blade Logistic Challenges
- Nabrajoint Description
- Alternatives Comparison
- Conclusions



Self Erected
Tower



Modular Blade
Joint

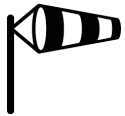
2 NABRALIFT®: A CRANELESS SELF-ERECTING TOWER

Tower Market Trends



WTG Rotor Increase

Power Density Decrease

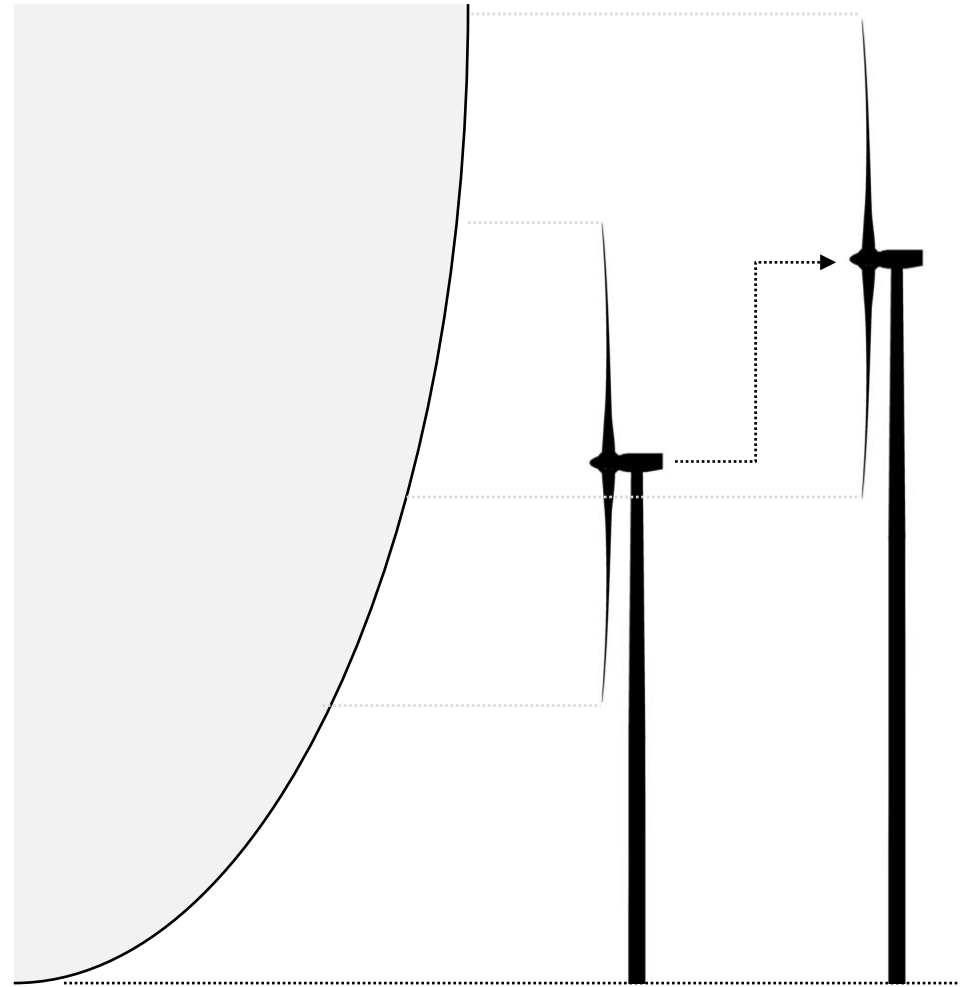
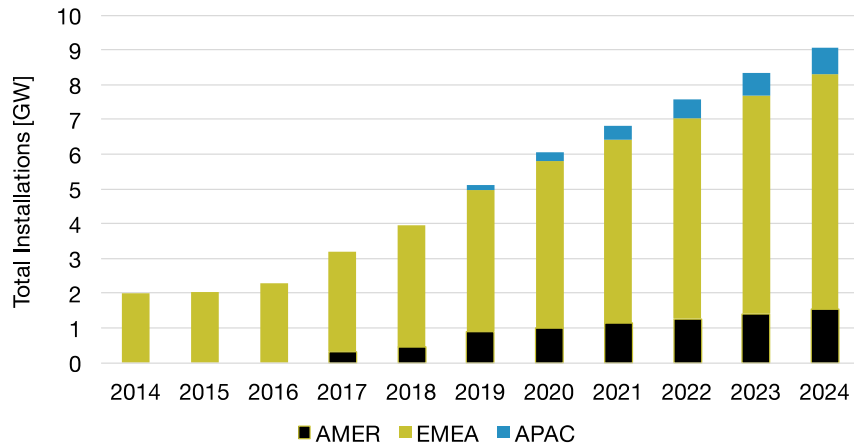


Market Maturity

Class III / IV Wind Farms

Significant Wind Shear

TOWER >120m MARKET



2 NABRALIFT®: A CRANELESS SELF-ERECTING TOWER

Tower Market Trends



Cost Increase

$$\epsilon_{HH140} = 1.6 \cdot \epsilon_{HH100}$$

Most Expensive Component HH > 120



Logistics

Roads / Bridges Limiting Concepts



Assembly Cranes

Lack of Availability

Large Mobilization and Rental Costs

Required for Large Correctives



Installation Rate

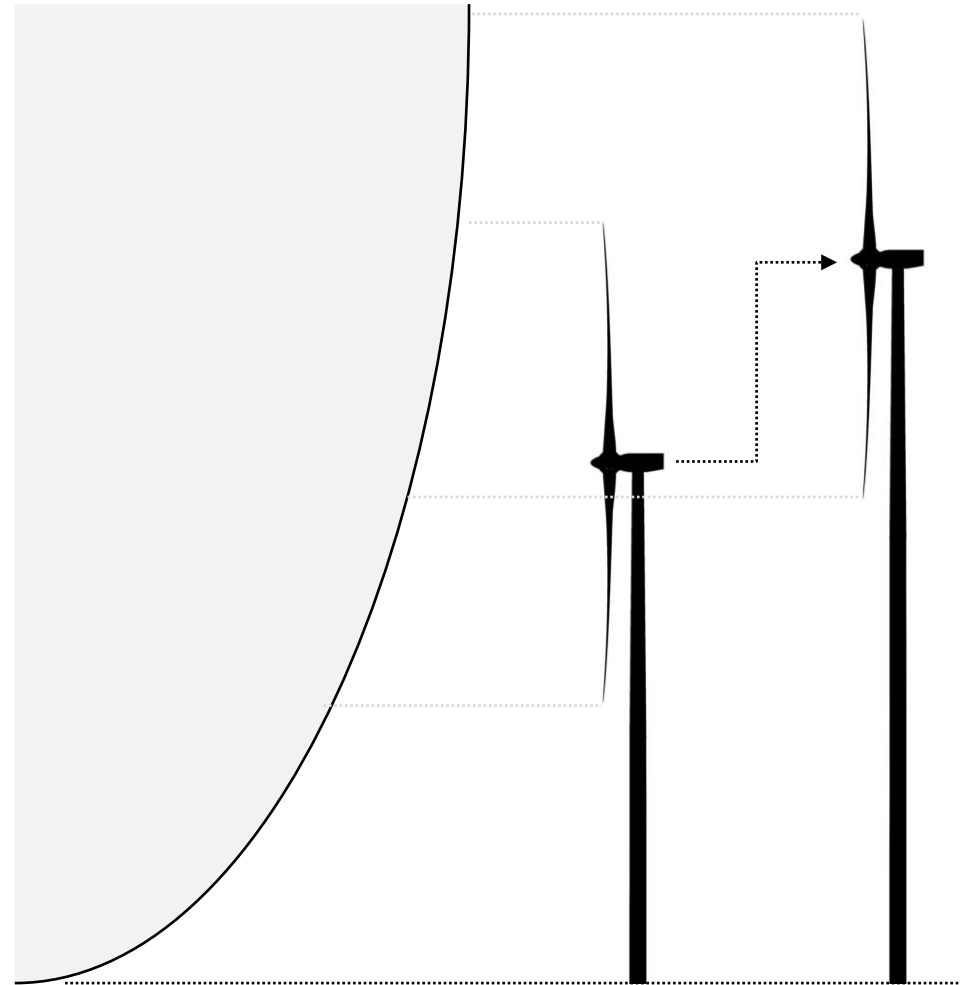
Slow Wind Farm Installation Rates



WTG Integration

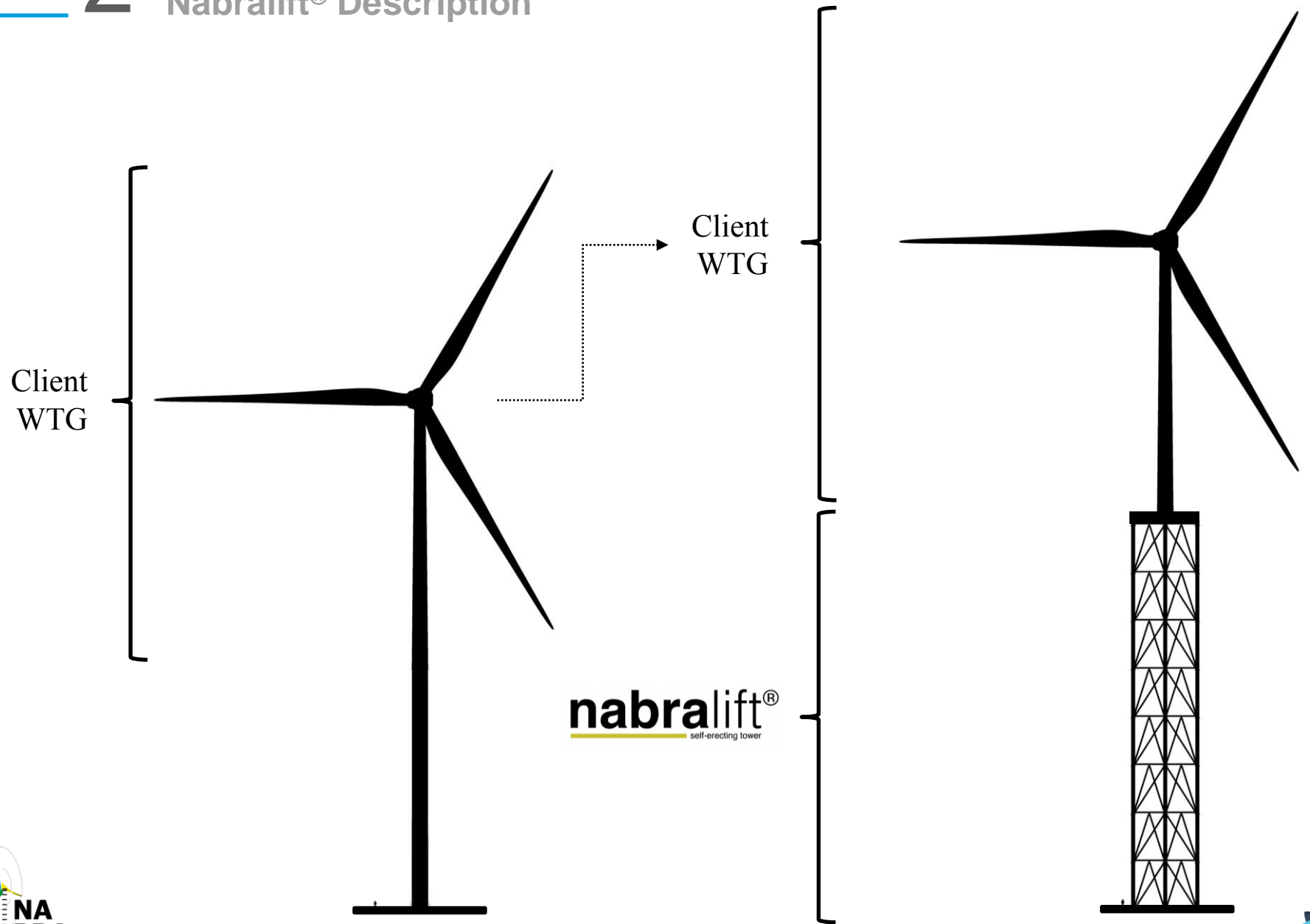
Control Challenges in Soft-Soft Towers

Soft-Stiff Unfeasible for XXL Steel Towers



2 NABRALIFT®: A CRANELESS SELF-ERECTING TOWER

Nabralift® Description



2

NABRALIFT®: A CRANELESS SELF-ERECTING TOWER

Nabralift® Description



Ultra Low Cost

Foundation / Tower Components

Logistics / Assembly

HH > 160m



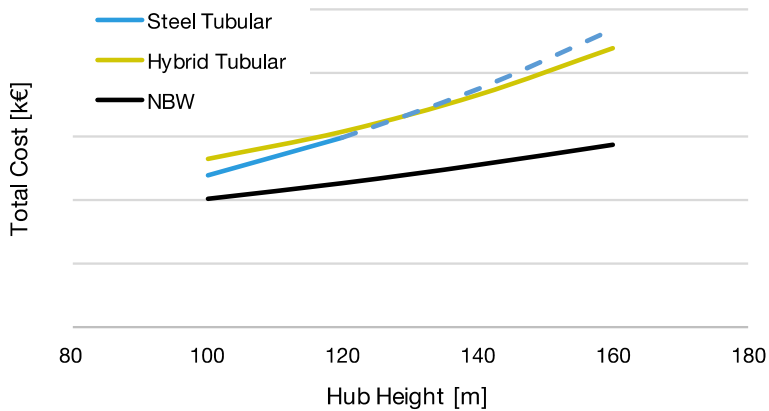
Self Erection

No Large Cranes

Fast Assembly – 3 days erection

Crane < 80m

Tower + Installation Cost



2 NABRALIFT®: A CRANELESS SELF-ERECTING TOWER

Alternatives Comparison

● Good ○ Poor

XXL Tower Alternatives



Tubular Steel



Segmented Steel



Precast Concrete or Hybrid



Lattice



nabralift®

Tower Cost	○	○	○	○	○
Logistics	○	○	○	●	○
Assembly & Erection	○	○	○	○	○
Modal Coupling	○	○	●	○	●
Specialized large crane	○	○	●	○	○

Source: MAKE

2 NABRALIFT®: A CRANELESS SELF-ERECTING TOWER

Conclusions



Ultra Low Cost

Foundation / Tower Components

Logistics / Assembly



Self Erection

No Large Cranes

Fast Assembly – 3 days erection



Weather Insensitivity

Prefab Foundation

Higher Wind Speeds for Erection



Simple Logistics & Operation

Packable in 5-7 Standard Containers

Maintenance Free



Easy WTG Integration

Soft—Stiff Tower HH > 180 m

No Functional Affection



CONTENTS

1. Company Introduction

- Background
- Innovation Key Drivers

2. NABRALIFT®: a Craneless Self-erecting Tower

- Tower Market Trends
- Nabralift Description
- Alternatives Comparison
- Conclusions

3. NABRAJOINT®: a First-class Modular Blade Joint

- Blade Logistic Challenges
- Nabrajoint Description
- Alternatives Comparison
- Conclusions



Self Erected
Tower

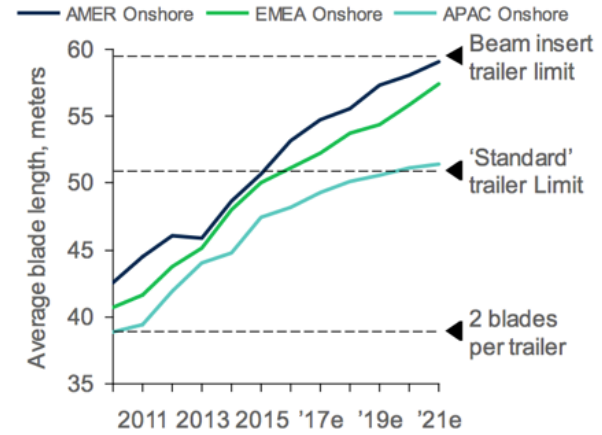
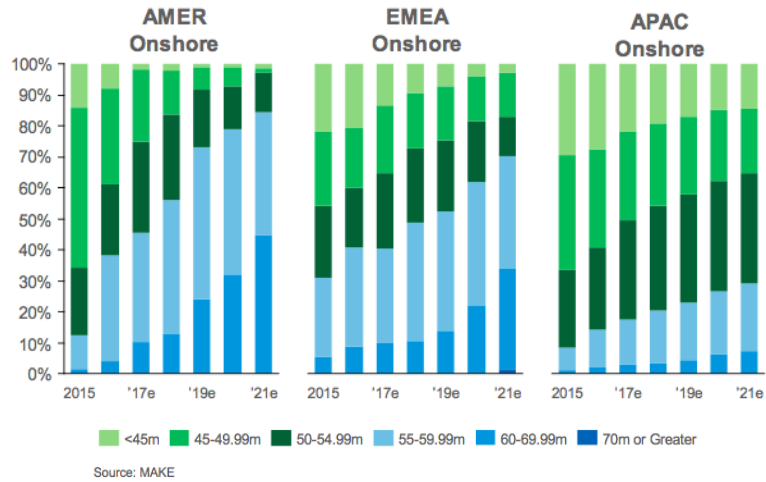


Modular Blade
Joint

3

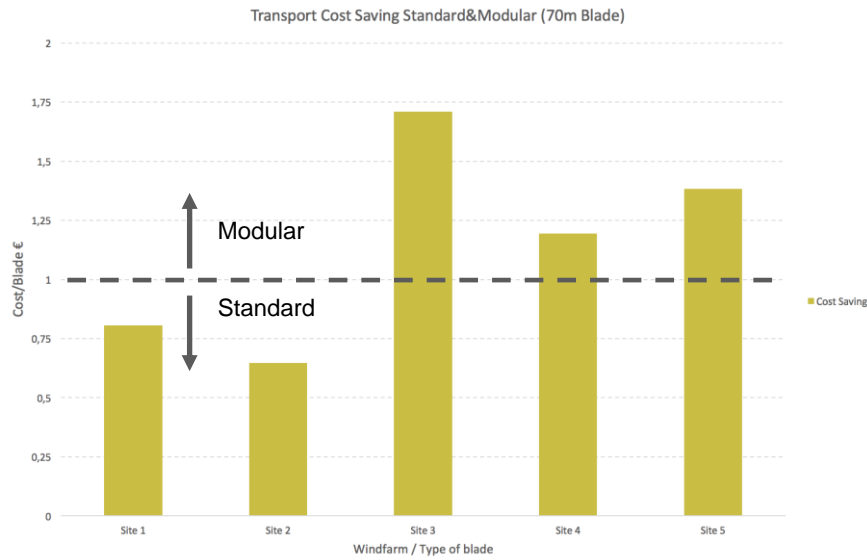
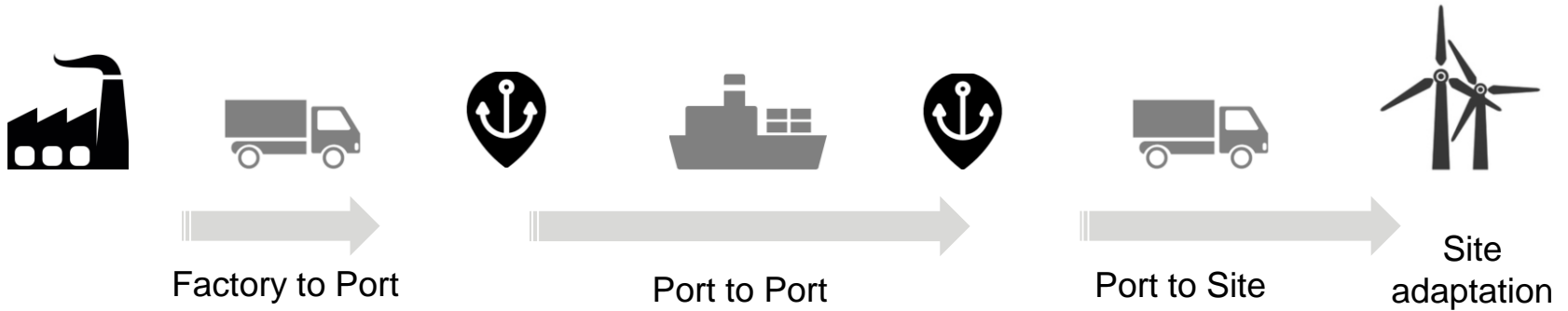
NABRAJOINT®: A FIRST-CLASS MODULAR BLADE JOINT

Blade Logistic Challenges



3 NABRAJOINT®: A FIRST-CLASS MODULAR BLADE JOINT

Blade Logistic Challenges

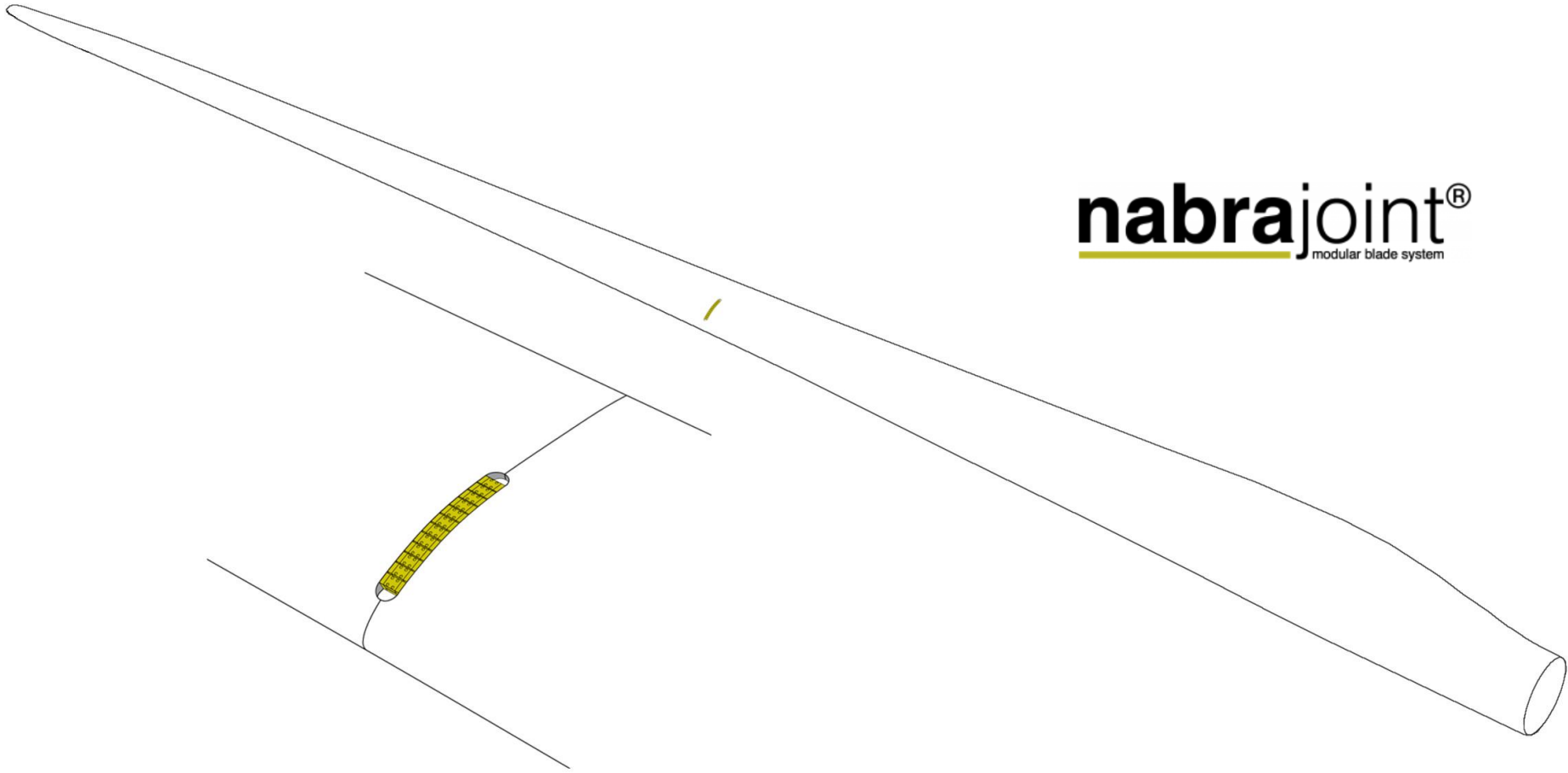




3

NABRAJOINT®: A FIRST-CLASS MODULAR BLADE JOINT

Nabrajoint® Description

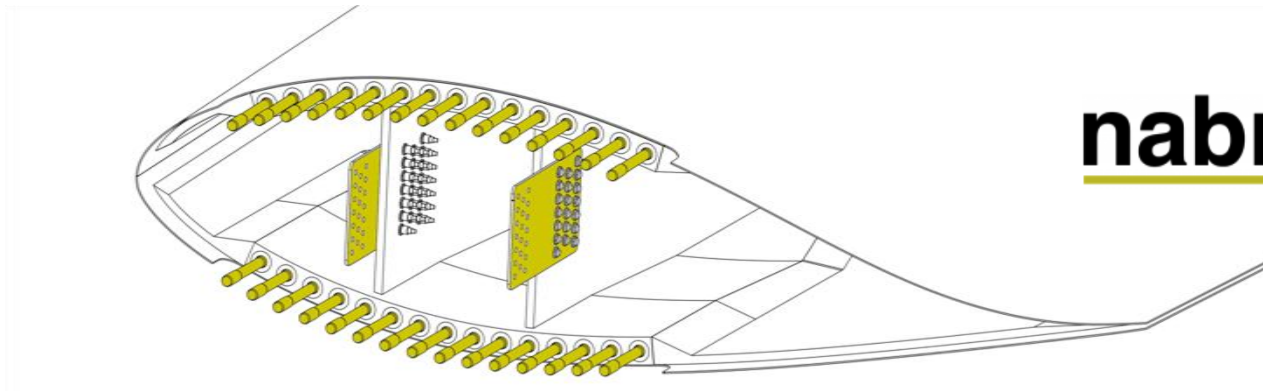


nabrajoint®
modular blade system

3 NABRAJOINT®: A FIRST-CLASS MODULAR BLADE JOINT

Nabrajoint® Description

- MBJ Details. General view

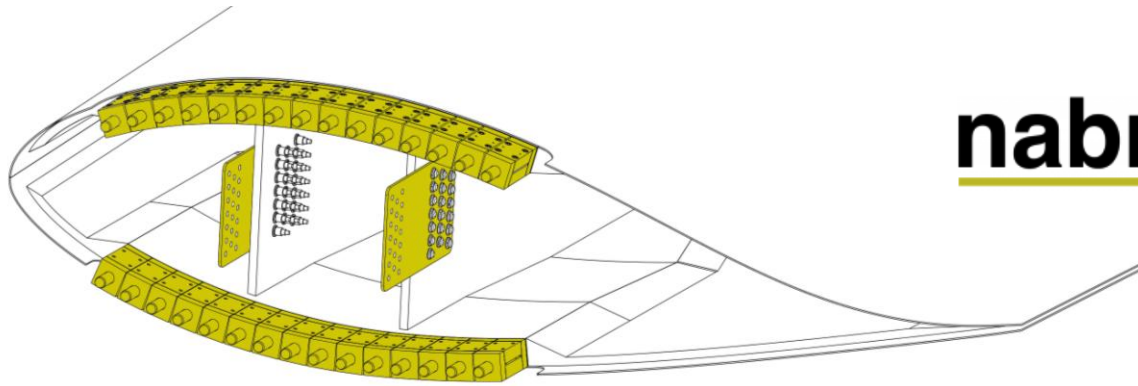


nabrajoint®
modular blade system

3 NABRAJOINT®: A FIRST-CLASS MODULAR BLADE JOINT

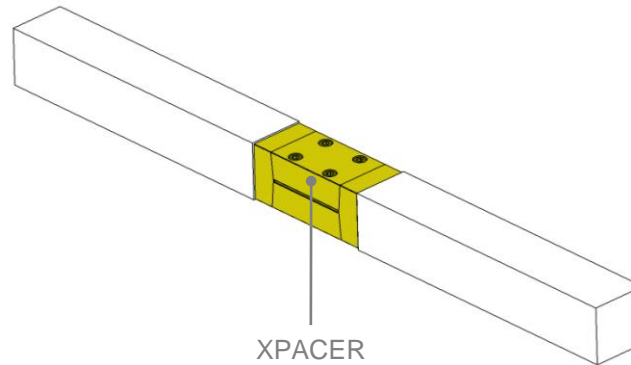
Nabrajoint® Description

- MBJ Details. General view



nabrajoint®
modular blade system

- Single element detail



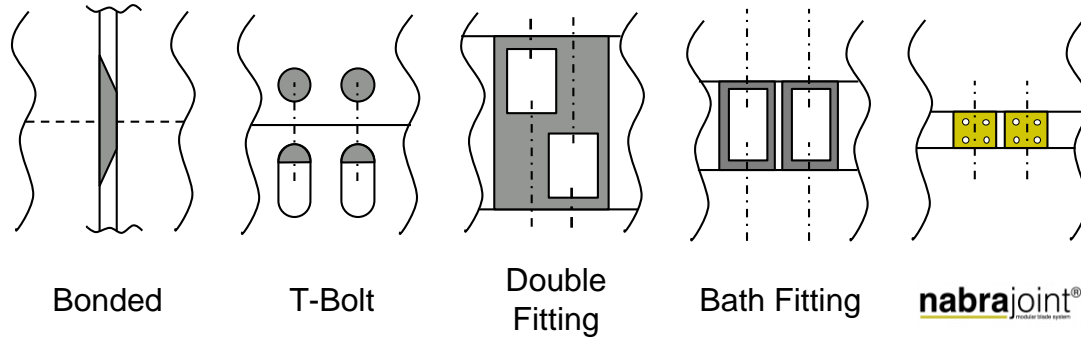
XPACER

3

NABRAJOINT®: A FIRST-CLASS MODULAR BLADE JOINT Alternatives Comparison

● Good ○ Poor

Modular Blade Joints Alternatives



	Bonded	T-Bolt	Double Fitting	Bath Fitting	nabrajoint®
Strength / bolt sizing	●	○	◐	◑	◑
Mass & Cost	●	◑	◐	◑	◑
Assembly on Site	○	◑	◑	◑	◑
Maintenance	●	◐	◑	●	●
Reliability	○	◑	◑	◑	●

Source: MAKE

3 NABRAJOINT®: A FIRST-CLASS MODULAR BLADE JOINT

Conclusions



Cost-Effective Solution

Single Bolt per Joint Element

Smart Intermediate Spacer



Minimum Weight

Ultra High Load Carrying Capacity

Hybrid Carbon-Glass Fiber Module



Fast Assembly

Simple Segments Coordination

Automatic Pretension Tooling



Reliable Solution

Robust Assembly Process

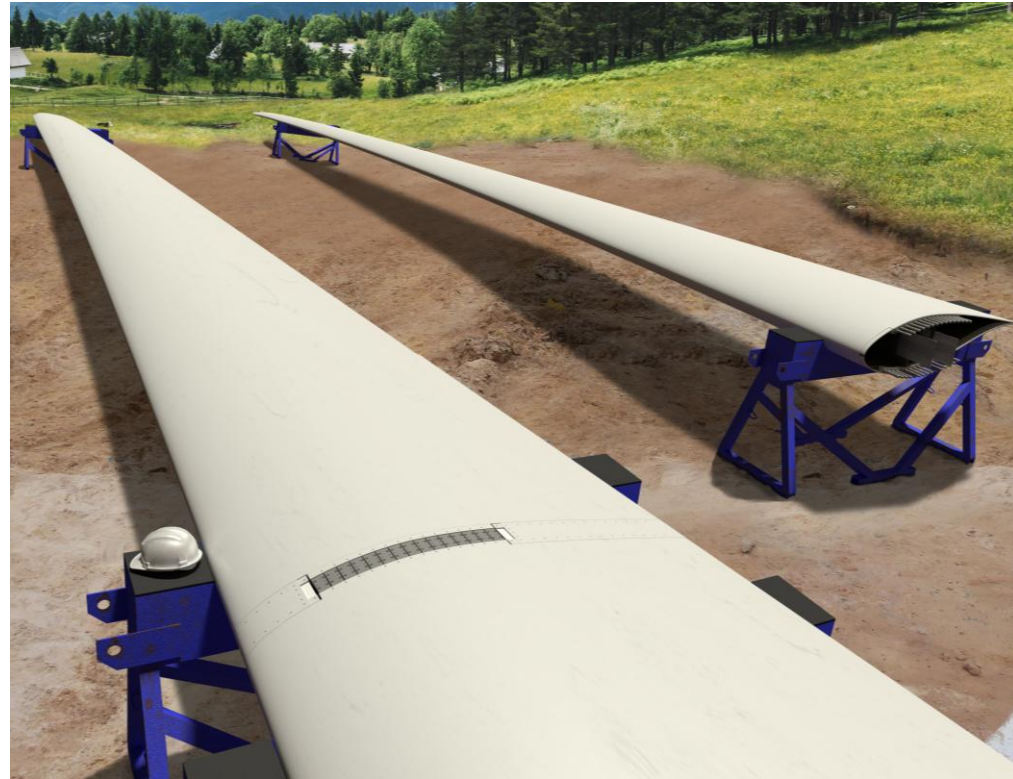
Maintenance Free

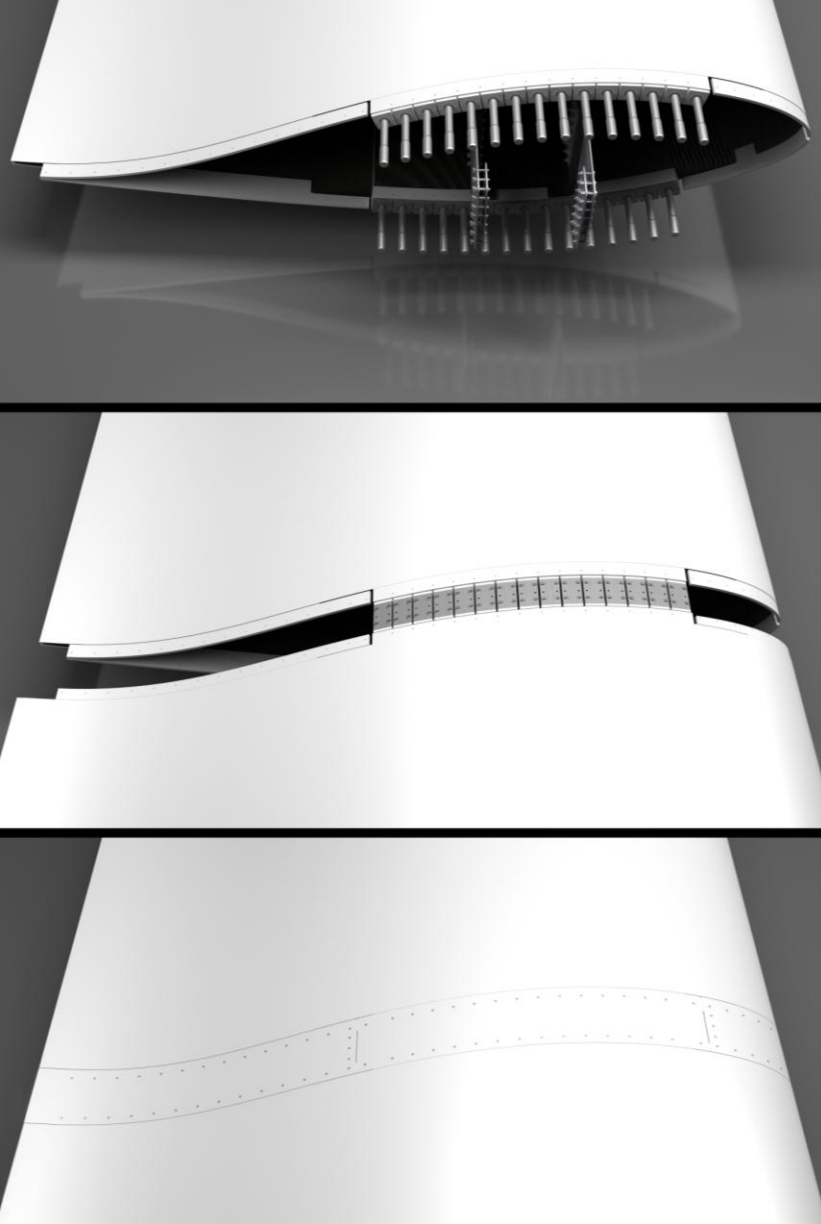


First Class Technology




DNV-GL Certification Process

Long Track Record Team








nabrajoint[®]
modular blade system
MODULAR BLADE SYSTEM

-  **COST-EFFECTIVE** Our segmented blade reduces by about 10% the final on-site cost of the blade.
-  **LIGHT** Metallic parts are minimized to reduce the joint mass.
-  **RELIABLE** Our patented bolted joint is extremely simple and robust.

nabralift[®]
self-erecting tower
SELF-ERECTING TOWER

-  **COST-EFFECTIVE** Nabralift reduces the total tower cost by about 30%.
-  **CRANE-FREE** Our self-erection system avoids large cranes even for 160-180 m hub heights.
-  **FAST** Self erection process reduces by 50% the WTG assembly time.

www.nabrawind.com



Thanks for your Attention / Námaste