LOGISTICS OF THE ENERGY REVOLUTION

THE FUTURE OF THE ENERGY SUPPLY CHAIN

POWERING OUR WORLD, TOGETHER

DELIVERING EXCELLENCE TO THE ENERGY SECTOR

DHL Energy Regional Conference Europe 2022

Driving the Supply Chain Transformation

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Five steps to safeguard the European Industry

Step 1:
Turn targets into real projects and provide market visibility

Step 2:
Stabilize supply chains and manage price risks

Step 3:
Support Innovation and foster technology competence

Step 4:
Establish a level playing field

Step 5:
Invest today into the future of an Industry of strategic importance

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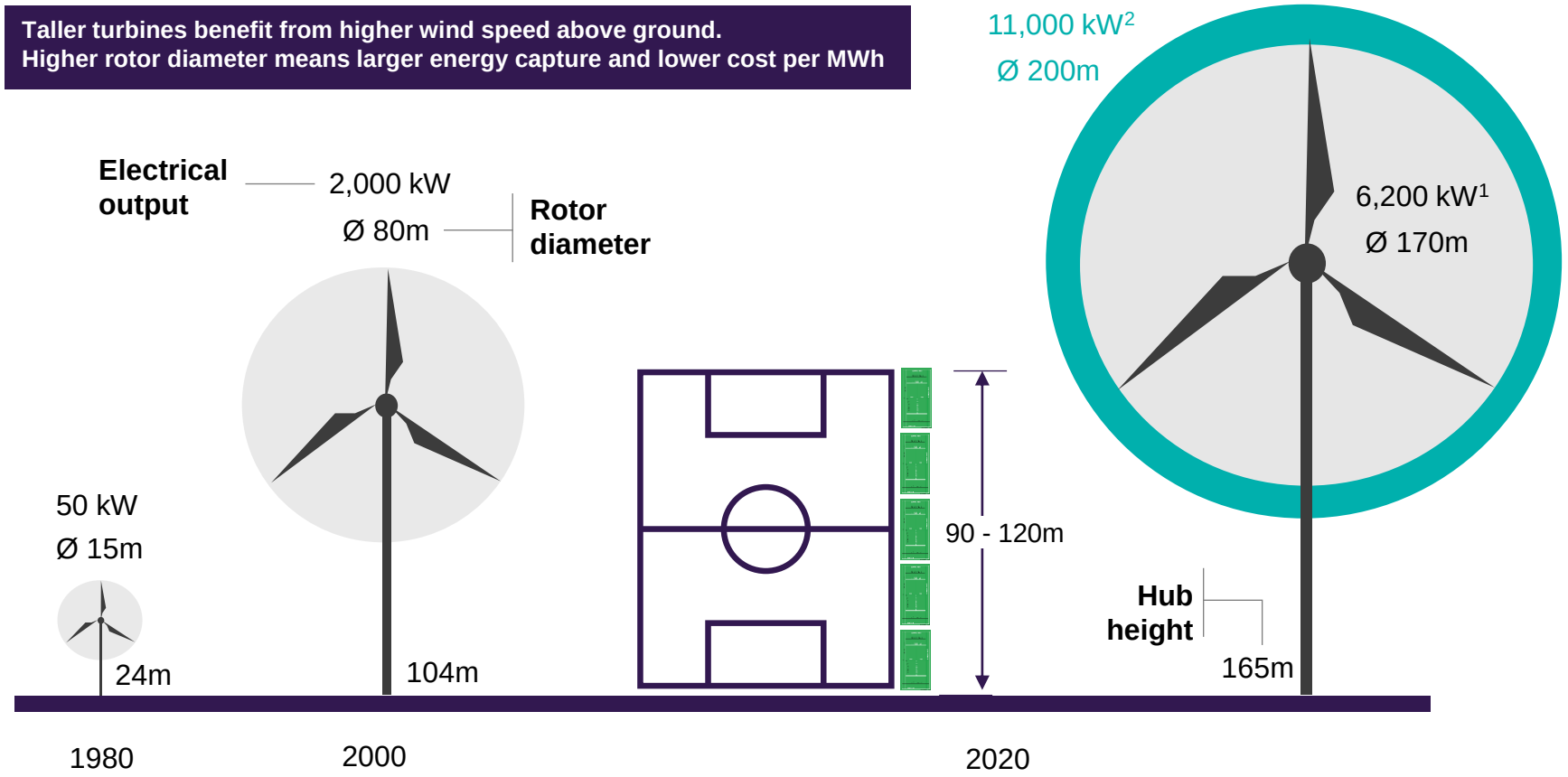
Market dynamics and trends, associated with the unprecedented growth of renewables has resulted in challenges across three areas

Area	Challenges
 **M**arket development	• **Supply Chain** with **manufacturing origins in low cost countries** and intercontinental projects **increases maritime transport**, as well as customs and other parallel complexities. • **New markets and countries** with **underdeveloped infrastructure** are subject to new challenges in the logistics activity.
 **O**perational	• **Special vehicle manufacturers** and wind turbine OEMs must be **partners** and progress together looking for new solutions (e.g., blade lifters, extendable platforms, high cranes). • **Logistics suppliers are now key partners** in wind turbine component design.
 **L**egal	• **Legal regulations compliance and evolution** is a key requirement to satisfy the market necessities.

Technological progress has resulted in challenges for Logistics and construction due to increasing weights, sizes and locations

Approximate size and power rating of wind turbines over time

Taller turbines benefit from higher wind speed above ground.
Higher rotor diameter means larger energy capture and lower cost per MWh



Wind turbine components have increased significantly in size and **weight.**

The **blade length** of current models can be **greater than the length of a football field.**

The modern wind turbine now **produces 15 times more energy** than typical turbines from 1990.

Challenges for logistics due to Technological progress.

Increased nacelle weight, blade length and hub width result in key limitations in.

- **Transport configurations** (e.g., carrying drive train inside nacelle is not feasible due to large weight; stacking multiple towers on ships is limited by maximum vessel deck pressures).

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Inland – Road transport

Trucks and vehicles

- **Transport dimensions, greater overhangs and weights.**
- **Diversity of specialized and expensive equipment** for moving just one turbine (9 to 10 specialized trailers).

Civil works

- Searching of **new routes.**
- **Significant distances** through varied and **challenging terrain.**
- **Turning areas**, elevation changes, some tunnels are too small.
- **Comprehensive route planning** and **route improvements** are required such as the removal of trees.

Transport suppliers

- **Limited number of transportation companies** with knowledge and experience.
- **Shortage** of qualified **truck drivers.**

Legal regulations

- **Transport across state lines** with different regulations.
- **Permit applications** and deposits required.
- **Escort vehicles, pilot cars**, and others needed for safe delivery.

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Continuous development of solutions working with external partners

Blade lifter to overcome inland obstacles

Schnabel de-coupled truck for tower section transport

Future developments: Airship concepts for transport of blades in reduced accessibility sites

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Maritime transport

Vessels

- **Under deck volume capacities restrictive** to accommodate certain components due their volume or weight.
- **The large weights of certain components** make it necessary to **perform more detailed studies** to distribute the weight on the deck.
- **Vessels with large carrying capacities are a limited resource and need to be optimized by stacking components.**

Stakeholders

- **Market controlled by shipowners** due to large demand and restricted supply.
- **Frame agreements** with strategic suppliers are a must**.**

Ports and facilities

- **Storage area and lifting capacity limitations** especially in new markets.
- **Larger vessels** may **limit amount of ports** where berthing is possible.
- With **larger components** it is necessary for ports to have **larger cranes, increased storage capacity and port access.**

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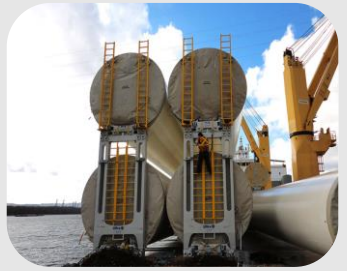
Onboard cranes for faster loading and unloading

Roll on/ roll off for faster loading and unloading



Stacking frames for space optimization

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Storage & lifting

Limited storage area capacity, which has to be **optimized taking into account planning and execution**, anticipating changes specially in ports lay down areas (i.e. Vancouver and Corpus Christi in North America region)

CAPEX investment reduction in Transport Equipment (TEQ) with **new cost-efficient solutions** for storage (e.g., disposable tooling) and increasing the TEQ reutilization ratios

Restrictions in lifting capacities in different scenarios which **requires other solutions** (e.g., new tools, longer lead times, cranes import)

Development of new logistic suppliers in new market scenarios to fulfill wind turbine industry necessities

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Blade storage using specialized tooling

Blade lifting at port

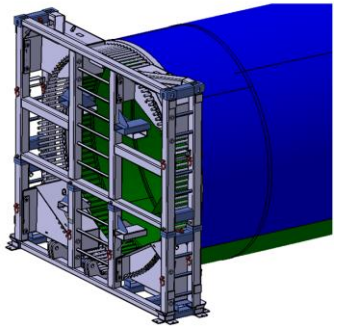
Large storage areas required during certain time periods

How do we reduce our invest in a growing market environment ?

Cost of Execution | Capital Expenditures | Cash Flow

Questions:

- What benefit can standardization bring to our industry?
- What components, technologies and processes could be standardized?
- What are potential obstacles to standardization, and could it be counterproductive?
- How can / should we collaborate and are we ready?
- Are there other, better opportunities, to cut costs?



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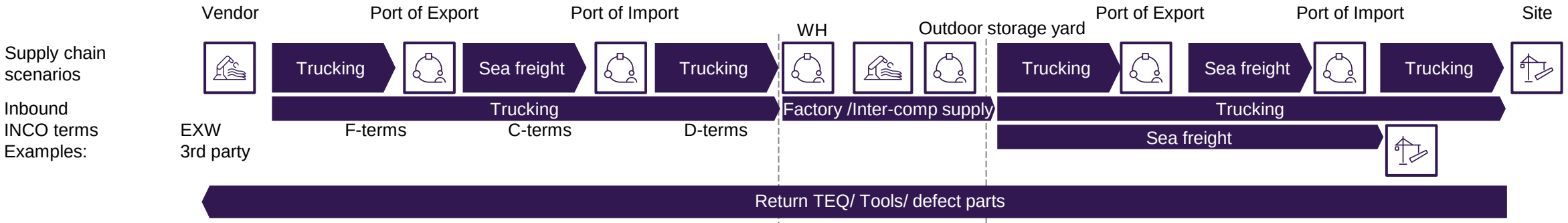
Improving our ways of working along the E2E process



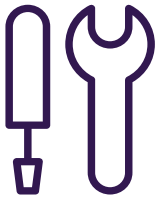
Focus topics	Inbound	Manufacturing/ Warehouse	Outbound
E2E view	Incoterm change	Smart logistics	
	Smart Packaging		Smart Yard
	Smart Labelling		Bundling opportunities
	Standardization & Modulization		
	Digitalization of Transport management process (TMS)		
	Over-dimensional cargo	Warehouse & footprint optimization (incl. 3PL)	TEQ Capex
	Consolidation		Shared service approach

Summary

Collaboration is key
(Focus on core activities)

Work end-to-end
Total Costs

Drive process standardization,
data models and digitization



Adapt best practices from
other industries

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