From... Tower ...To Hyper

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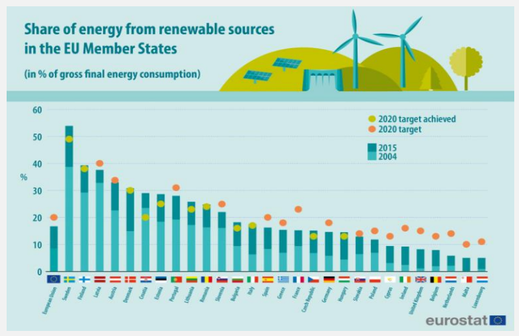
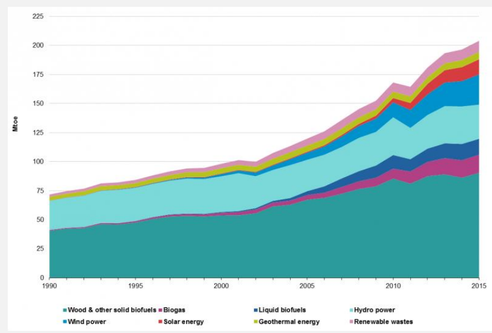
INTRODUCTION

The European Strategy 2020 is the European Union's Sustainable Development Agenda. The objectives set by the European Commission for 2020, known as the "20-20-20" targets, are binding and consist of the following three axes:

- 20% participation of RES in the European energy balance
- 20% greenhouse gas emissions reduction
- 20% energy savings

For these goals to be fulfilled, intense increase in renewable energy sources investments is imperative. The wind energy potential is greater as we move away from the earth's surface and as a consequence from urban barriers. In order to achieve the share of wind energy in the total energy produced from renewable sources, and given the availability of wind energy capacity at higher heights, wind turbines of more than 200 meters in height and 7 GWatt capacity are nowadays constructed. Even the construction of 300 meter turbine towers has been noticed. The higher the structures and the greater the weight of the mechanical equipment mounted at greater heights, which produces even higher loads due to the motion of the blades, the more imperative is the construction of more durable, economic and safe towers. As a consequence, the design of a new tower type that encompasses the above mentioned advantages is nowadays a necessity.





https://cleantechnica.com/2017/03/16/eu-share-renewables-continues-near-2020-target/

AIMS

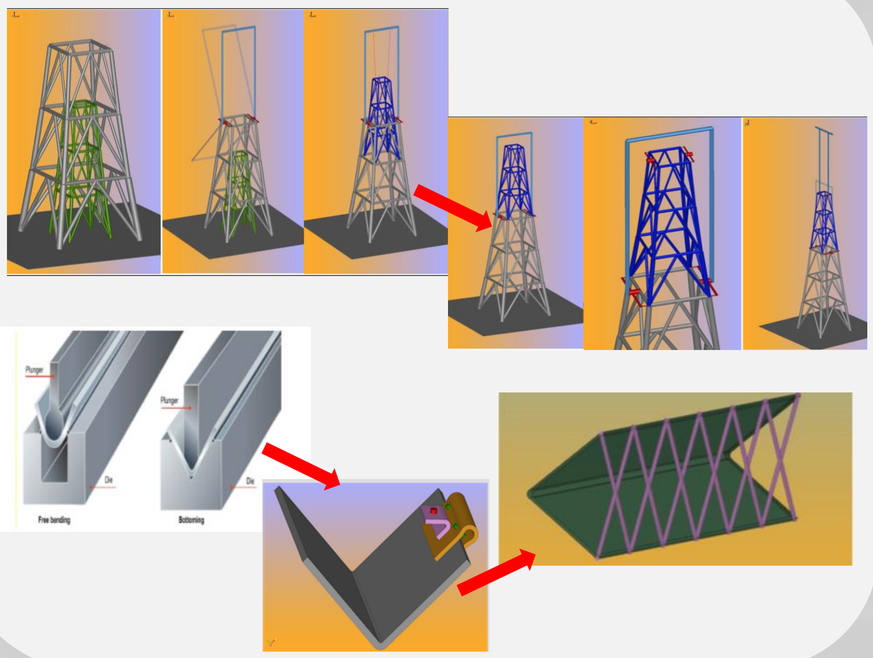
The aim of HYPERTOWER project is to provide crucial contribution to the wind energy sector and industry by proposing the design of an innovative self-risen wind turbine tower configuration assembled by trusses made up from innovative cross-sections. The subsections and the whole configuration as well are analysed under multiple loading conditions in order to reassure its safety, robustness and design life.

CHALLENGES

The construction challenges that we have to face when constructing super-high wind turbine towers are: (a) limitations to the maximum length and maximum diameter of the cylindrical tower sub-sections; (b) the transportation of the cylindrical tower subsections; and (c) their erection at heights over 200 meters. To build such high towers, diameters in excess of 4.5 meters, which are relatively impossible to transport by land, are required; while the limited availability of erection cranes and their maximum height of 230 meters make the development of a new tower morphology and a new erection and construction method for on-shore wind turbine towers imperative

RESEARCH OBJECTIVES

The objective of HYPER TOWER project is the design of an innovative self-risen wind turbine tower configuration assembled by trusses made up from innovative cross-sections. The proposed tower consists of subsequent parts, with decreasing size in greater heights. In each level the tower consists of four L-shaped "legs" with internal bracing. These L-shaped "legs" (LSL) are characterised as semi-closed polygonal cross-sections and appear to have a very high potential for hyper-tall towers as they can be easily manufactured from flat plate material and pose no diameter or size restrictions. LSL-sections fabrication simplicity and ideal capacity to weight ratio makes them an optimal candidate for the construction large-scale on-shore wind turbine towers. Their global and local buckling behavior has not, at the moment been studied and this offers a first class opportunity for high-quality original research conducted in HYPER TOWER project. The innovative idea that led to the new proposed cross-sections and configuration is the construction of super high self-risen towers without the need of heavy construction machinery. The towers consist of light weight modules with great capacity potential, every subsequent module is constructed, based on the previous and lifted afterwards to its position with the use of micro-cranes.



METHODOLOGY

The novel tower configuration and its novel cross-sectional parts are investigated analytically, numerically and experimentally, in comparison to the traditional tubular tower solution and its subparts. The capacity and structural response of the LSL cross-sections is assessed against buckling, ultimate and fatigue loading. The program consists of 5 research axes: (1) a thorough examination of the structural behavior of wind turbine towers, (2) the construction of very high wind turbine towers combined with the construction material economy, (3) the study of the critical points where experimental and numerical points do not coincide (4) resolving these discrepancies; and (5) developing methodologies to solve the problems that arise in the construction of very high wind turbine towers.

UNIVERSITY OF BIRMINGHAM
MARIE CURIE ACTIONS
Marie Skłodowska-Curie Actions

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