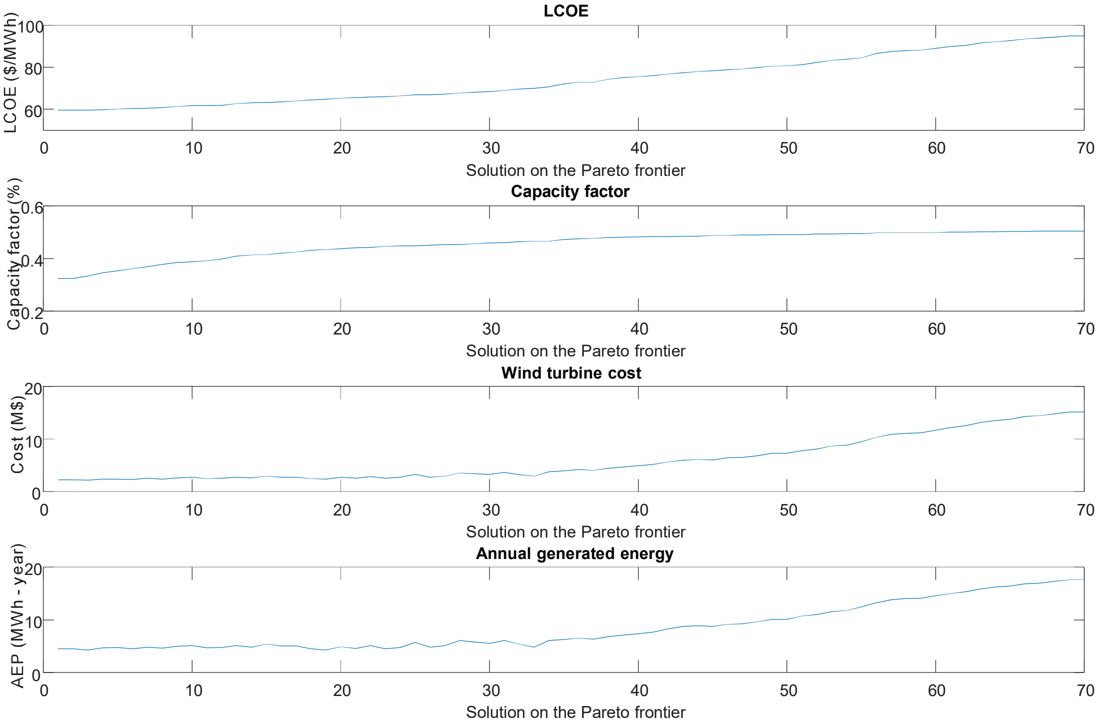

Figure 2. Evolution of main techno-economic outputs for the solutions obtained on Pareto Frontier.

provides also the lowest capacity factor 32.43%, this solution would be the obtained by the classical approach that seeks just for minimizing the LCoE. However, the proposed methodology enable to choose another different design options with higher LCoE but also with higher capacity factor along the Pareto Frontier. For example, by increasing the LCoE by around 10% (taking a solution with a LCOE of 65.85 $/MWh) a capacity factor of 44.24 % can be found, i.e., with a capacity factor around a 20% higher (with the associated benefits in terms of better plant integration). Figure 2 shows the evolution of main techno-economic outputs for the optimal Pareto solutions obtained by the proposed multi-objective approach.

5. Conclusion

This paper presents a novel approach which aims at optimizing the design of wind turbines, not only seeking for minimizing the levelised cost of energy but also by maximizing the capacity factor, which would reduce, to some extent, the intermittency of wind generation.

The proposed new approach can be of interest for current wind industry, as cost reductions is leading wind energy technology to achieve similar generation costs than conventional sources, at the same time as manufacturers are increasingly focusing their effort in offering more tailored designs of wind turbines.

Nevertheless, it is worth to mention that the work presented in this paper is a theoretical exercise and the real applicability of the proposed approach will be subject to accuracy of the cost models as well as the ability of wind turbine manufacturers to offer tailored designs of the main design variables of the wind turbine. In particular, rotor diameter and hub height are variables of design that are achieving a higher degree of customization, whilst rated power is, in practical terms, a less flexible variable, as it implies the customization of several expensive components such as electric generator, gearbox and power converter.

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