

WIND REPOWERING IN THE NETHERLANDS

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ABSTRACT: The Dutch government has set targets for the installed capacity of wind energy. This paper investigates the possibilities of replacing old, small wind turbines with new, larger turbines in order to reach the targets set. Two repowering strategies are discussed and it is illustrated that a considerable part of the remaining capacity to meet the national target on land can be achieved by means of a sensible repowering strategy.

Keywords: Energy Policies, Retrofitting, Stand Alone Systems, Wind farm

1 NATIONAL TARGETS WINDENERGY

The Dutch government has set targets for the installed capacity of wind energy in the country. For the year 2020 the total target is an installed generation capacity of 2750 MW, of which 1250 MW offshore and 1500 MW on land. On land, new locations for wind turbines meet increasing resistance from local inhabitants, local councils as well as environmental action groups. Assuming that all parties concerned accept current windturbines, this work evaluates whether new, modern large windturbines on existing turbine locations can contribute to the realisation of the national target.

2 REPLACEMENT OF WINDTURBINES

2.1 Goal

By replacing existing old and small wind turbines by newer, larger turbines, a larger contribution to the national target can be achieved. At the same time there will be an increased public acceptance as no new land locations are necessary and the visual impact will be improved due to less wind turbines in the landscape and a more quiet visual impression as the rotational speed of larger turbines is lower. And of course the production of electricity will increase

2.2 Approach

ECN wind energy has developed a model in which the effect of repowering existing windturbines can be simulated. The model distinguishes different sizes of turbines, windfarm sizes and age of the turbines involved. Different repowering strategies can be inputted into the model. For each strategy the effect on the total installed capacity is calculated.

3 REPOWERING STRATEGY ONE

The first of two repowering strategies discussed in this paper deals with the repowering of solitary wind turbines. In this strategy wind turbines with an age of 10 years and more, will be replaced by newer, larger turbines. Based on other research [1], it is expected that

environmental as well as technical conditions will limit repowering to 70 % of the solitary wind turbines.

Turbines with an installed capacity of 250 kW and less will be replaced by a turbine of 750 kW and a diameter of 50 meters. Turbines between 250 kW and 750 kW, will be replaced with a new turbine of 1 MW (diameter 65 m). Larger turbines will not be replaced.

Table 1 summarises the effects of this repowering strategy. In total 249 wind turbines will be replaced, resulting in a gain of 154 MW of installed wind capacity

number of new turbines	249
number of replaced turbines	249
current installed capacity (MW)	359
capacity after 10 years (MW)	513
new installed capacity (MW)	200
replaced capacity (MW)	46
installed capacity gain (MW)	154

Table I Results repowering strategy 1

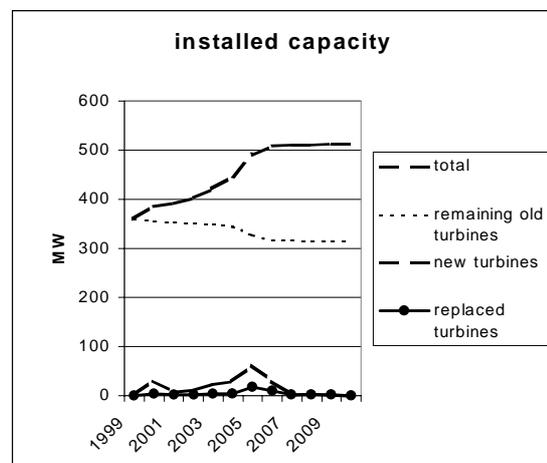


Figure 1 Development of the installed capacity under repowering strategy 1

By following this repowering strategy the increase in installed wind capacity can be achieved relatively easy, as existing locations and infrastructure will be used. The effect on the environment will be minimal.

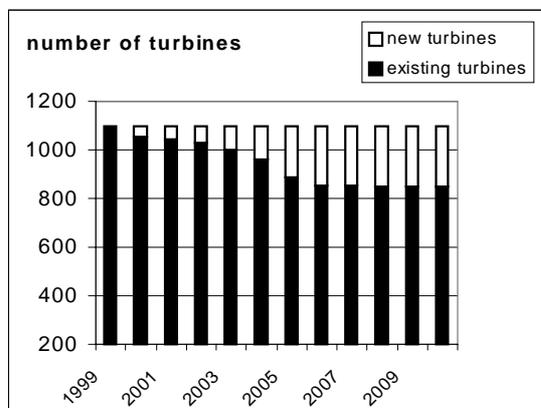


Figure 2 Number of turbines under strategy 1

4 REPOWERING STRATEGY TWO

The second repowering policy reviewed, focuses on wind farms. Wind farms are all clusters of two or more wind turbines. In this strategy all wind turbines in wind farms with an age of 10 years or older, and with an installed capacity up to 1.5 MW will be replaced with a turbine of 2 MW. These new turbines have a diameter of 72 m.

As the new wind turbines have a larger diameter than the existing turbines, the distance between the new turbines will be larger than in the old situation., hence a reduction in the number of turbines will occur. It is assumed that repowering will be feasible in 90 % of the cases.

By following this strategy a total increase of nearly 360 MW seems realistic (see table II and figures 3 and 4 for details).

number of new turbines	302
number of replaced turbines	655
current installed capacity (MW)	359
capacity after 10 years (MW)	716
new installed capacity (MW)	605
replaced capacity (MW)	247
installed capacity gain (MW)	358

Table II Results repowering strategy 2

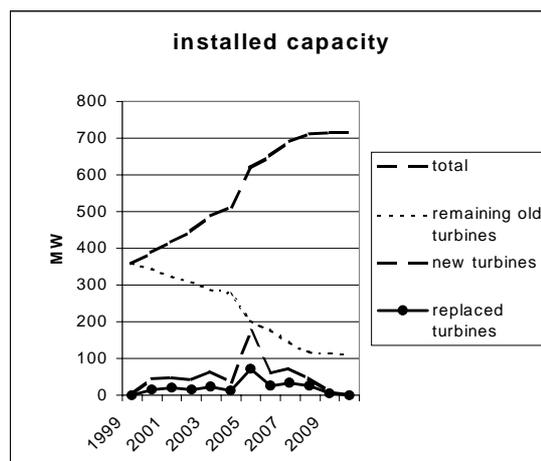


Figure 3 Installed capacity under strategy 2

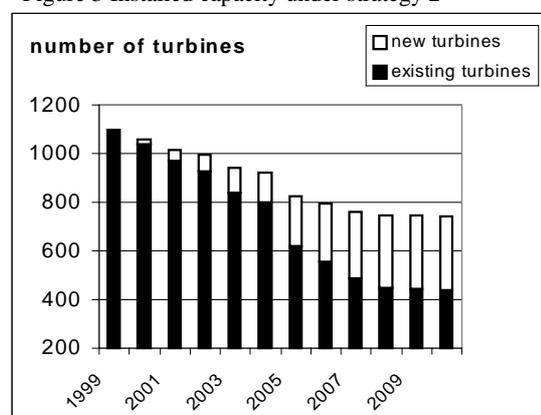


Figure 4 Number of turbines under strategy 2

5 CONCLUSIONS

In this paper two strategies are discussed to replace existing old wind turbines with modern, larger turbines. The first strategy focuses on the repowering of solitary wind turbines. If the replacement strategy as described in paragraph 3 is followed, 154 MW of additional wind capacity can be installed.

The second strategy focuses on wind farms. By replacing older wind turbines in wind farms the total number of wind turbines will decrease with approximately 350 turbines. The installed capacity will be increased with 358 MW.

Since the two repowering strategies are complementary to each other, a total increase of 512 MW of installed wind generation capacity is feasible in the Netherlands. This means that a considerable part of the remaining capacity to meet the national target on land can be achieved by means of a sensible repowering strategy. This can even lead to less visual impact and thus increased acceptance.

6 REFERENCES

- [1] Grontmij, Vervanging van bestaande windturbines, beleidsadvies. Waddinxveen, Grontmij Advies & Techniek (2000).