ENERGIAKLUB
CLIMATE POLICY INSTITUTE
APPLIED COMMUNICATIONS

SHORT STUDY

What can we achieve with 3 GW of new wind power capacity in Hungary?

We looked at the impact of different amounts of new wind power capacity entering the Hungarian electricity system: what would happen if 500, 1000 or 2000 MW of new wind power capacity were installed in 2025, and 500, 1000, 2000 or 3000 MW in 2030?

The scenarios evaluated

The analysis focuses on 2025 and 2030. For both years, we determine the future power mix and electricity demand for the entire European system (exogenously) - the baseline includes the current installed capacity of Hungarian wind power plants. Against this baseline, we consider what would happen if 500, 1000 or 2000 MW of new wind capacity were installed in 2025 and 500, 1000, 2000 or 3000 MW in 2030. For the latter year, we also perform the analysis with two different PV capacities (8 GW and 12 GW) due to the higher uncertainty.

For the analysis, we used the European Power Market Model (EPMM) of the Regional Energy Economy Research Centre, a scheduling and load balancing market model covering the countries of the ENTSO-E region. The model tries to find the system state in which the assumed future electricity demand of the European system can be met at the lowest cost for all hours of 12 reference weeks each year. It does this by simultaneously optimising the wholesale electricity and reserve markets.

Key results:

The primary impact of the new wind farms would be to replace imported electricity (largely fossil), which would exceed 4.5 TWh by 2030.

Rather than increasing the cost of the services needed to keep the system stable, increasing wind capacity has the potential to actively participate in regulation and thus reduce the overall cost of the system; by 2025, with +2000 MW of new wind capacity, the total cost of reserve maintenance would be reduced by 30%.

If significant domestic wind power capacity is installed in Europe in 2030, this could avoid emissions equivalent to the carbon dioxide emissions of the coal - fired Hungarian Mátra power plant.

Changes in the domestic electricity mix

Figure 1 shows the change in the electricity mix in Hungary compared to the case where no new wind power is built at all. For example, in 2025, 500 MW of new wind capacity (column 1) will add 792 GWh to domestic wind generation, which will largely be net imports (650 GWh).

Wind power generation will reshape the domestic electricity mix slightly differently in 2025 than in 2030. In both cases, the primary effect is to replace imported electricity. While in the former year we also see a significant reduction in domestic gas-fired generation (with 2 GW of wind power installed, gas-fired generation is reduced by 730 GWh and imports by nearly 2.5 TWh), in 2030, in both cases under consideration, the change in fossil-based domestic generation dwarfs the total amount of imports replaced, exceeding 4.5 TWh if 3 GW of new wind capacity is assumed.

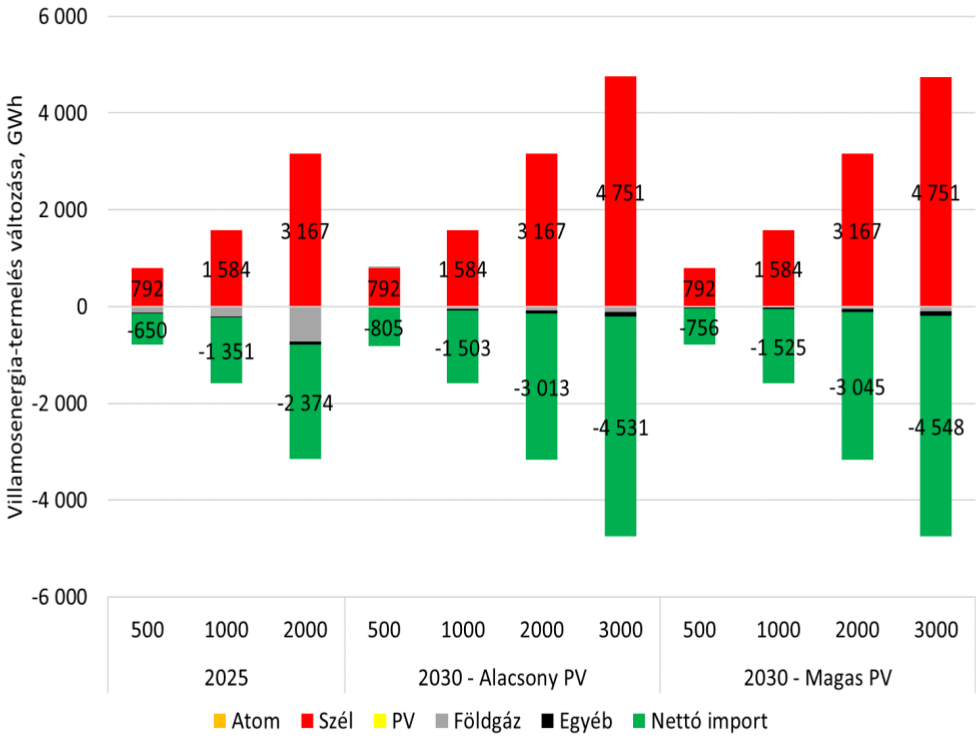

Figure 1: Change in electricity mix in Hungary compared to the 0 MW wind power scenario (nuclear is shown in ochre, wind in red, solar in yellow, gas in grey, other resources in black and net import in green)

Impact on electricity prices

Like all plants (virtually) without variable costs, wind power plants reduce wholesale electricity prices. The extent of the change depends, among other things, on overall consumption and on the characteristics of other players on the supply side. Figure 2 illustrates the change in wholesale electricity prices compared to the situation when no new wind capacity is built. It can be seen that the price impact is larger in 2025 - as we have seen, in this year wind power is replacing imports and domestic gas-fired power generation, and gas-fired generation will still be quite expensive. Thus in 2025, the addition of 2 GW of new wind capacity will reduce the wholesale electricity price by almost 0.8 €/MWh. In 2030, we would see somewhat lower impacts, with a likely price reduction of 0.4-0.5 €/MWh for different PV penetrations. However, this still represents a significant saving of around €11.7 billion due to higher consumption.

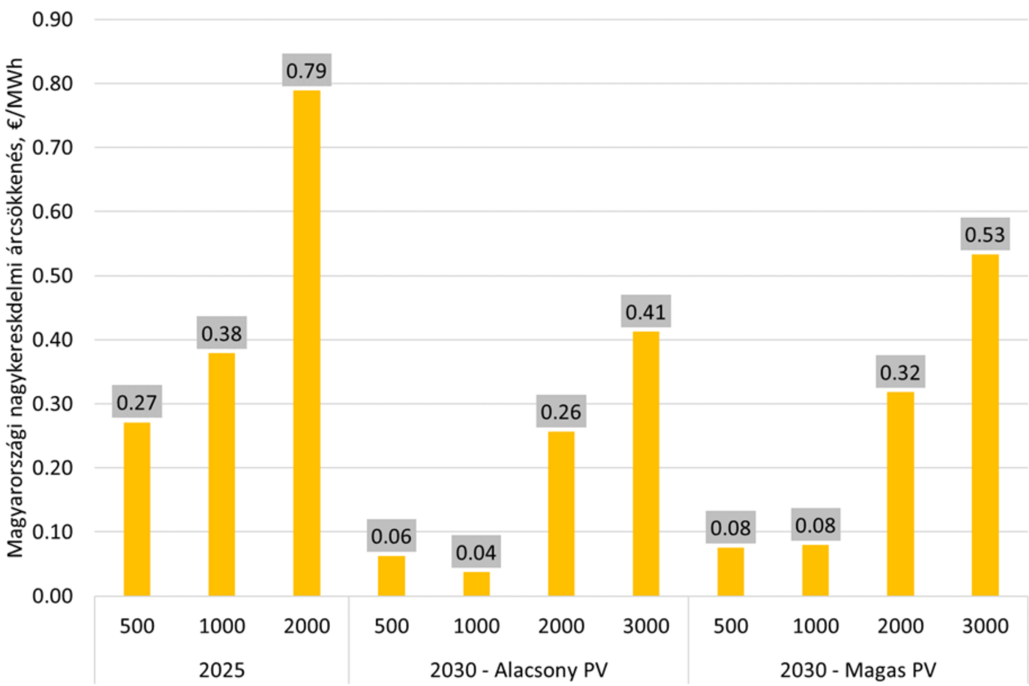

Figure 2: Wholesale electricity price change in Hungary compared to 0 MW new wind capacity scenario, €/MWh, at 2022 real prices (2030 – low PV, 2030 – high PV)

Impact on regulatory markets

Recently, the reserves for balancing weather-dependent renewables (and also for balancing power) have become significantly more expensive, mainly due to rising natural gas prices.
Modelling allows us to estimate how much the cost of reserve maintenance would increase as a result of increased wind power capacity. Wind power has two important impacts on the reserve market. First, they actually increase the amount of reserves required. At the same time, they can participate in this market. In other words, they can provide dispatching services when they are generating, i.e. they can reduce their generation to maintain system stability. Based on our modelling calculations, **assuming 2,000 MW of new wind capacity in 2025, the total cost of reserve maintenance will be reduced by 30%, which represents a saving of nearly 20 billion HUF in this year alone.** If we break this down to total domestic consumption, we find that the cost to consumers could fall by around 0.5 HUF/kWh as wind power comes on stream. In 2030, these savings are much smaller, as we assume that by then the price of natural gas will have fallen significantly (1-1.5 bn HUF savings), so the cost of these services will also be significantly lower. At the same time, a very important modelling result is that increasing wind power capacity, far from increasing the cost of the services needed to keep the system stable, is able to actively participate in regulation and thus reduce the overall cost of the system.

The European picture

As described above, increasing domestic wind power generation will be replacing imports in Hungary. However, it is important to examine the sources of these net imports. Figure 3 shows the impact on the European electricity mix of a steady increase in domestic installed wind capacity. This is similar to Figure 1, except that while that figure illustrated the domestic situation, the figure below illustrates the pan-European electricity mix.

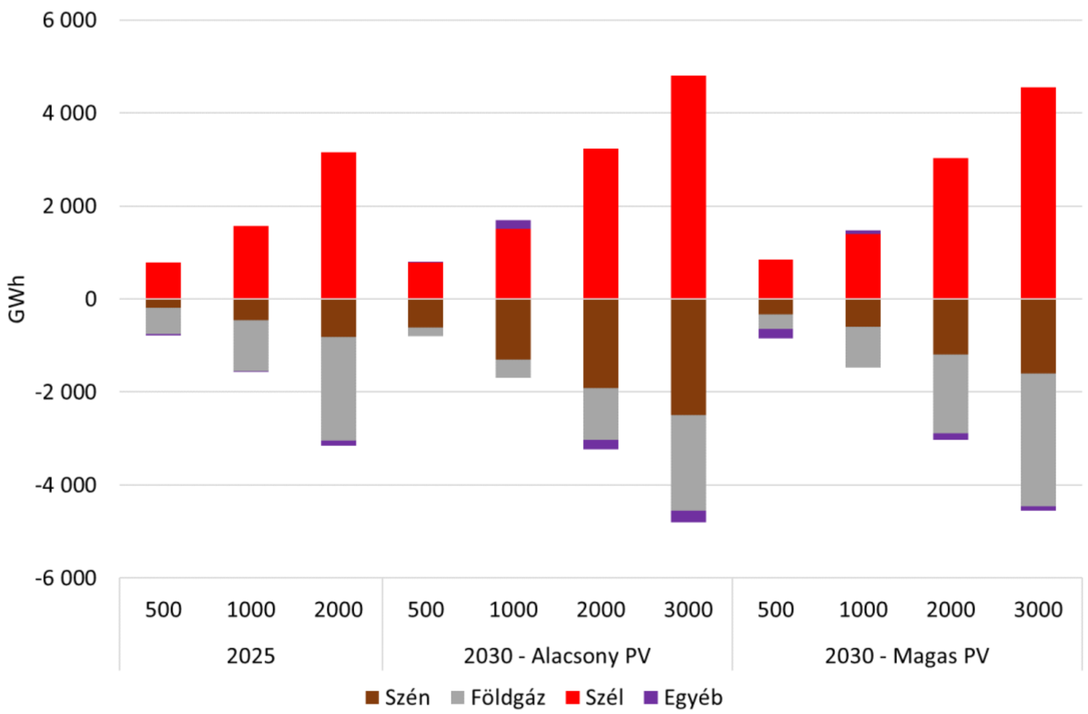

Figure 3: European electricity generation change compared to a 0 MW new wind capacity scenario in 2025 and 2030, GWh (brown=coal, grey=natural gas, red=wind, purple=others) (2030 – low PV, 2030 – high PV)

Figureshows the change in the European electricity mix in all scenarios compared to a scenario with zero new wind capacity. It reveals that an increasing wind capacity replaces mainly gas and to some extent coal-fired electricity generation in 2025. In 2030, the situation changes slightly, as natural gas firing becomes cheaper than coal-based generation due to assumed lower natural gas prices and high carbon dioxide quota prices, and therefore, at lower installed solar capacity, new wind-based generation replaces natural gas and coal-based generation in approximately 50/50 shares. If more solar is expected in Hungary, the substitution will again shift towards natural gas. The **amount of natural gas replaced by wind power is very significant: in 2025, assuming 2000 MW of new wind power capacity, natural gas replacement will amount to 5 TWh (0.5 bn m^3)**, equivalent to 5% of total domestic gas consumption. In 2030, 3000 MW of new wind power capacity and 12 GW of installed solar capacity would result in 6.5 TWh.

It can therefore be seen that the increased wind power generation is largely replacing fossil power generation and thus has a positive impact on European GHG emissions.

Figureshows how GHG emissions from the power sector would evolve compared to a situation with zero new wind capacity. The figure shows separately the domestic change (orange bars) and the emissions of European countries outside Hungary.

Significant carbon savings can be achieved as early as in 2025 if new wind power capacity is built in our country. If 2,000 MW of new capacity were to be built, more than 1.5 mt CO_2 emissions would be avoided per year. This could result in carbon emission reductions of up to 3 Mt by 2030, which is of the same order of magnitude as the emissions of the Hungarian coal-fired Mátra Power Plant.

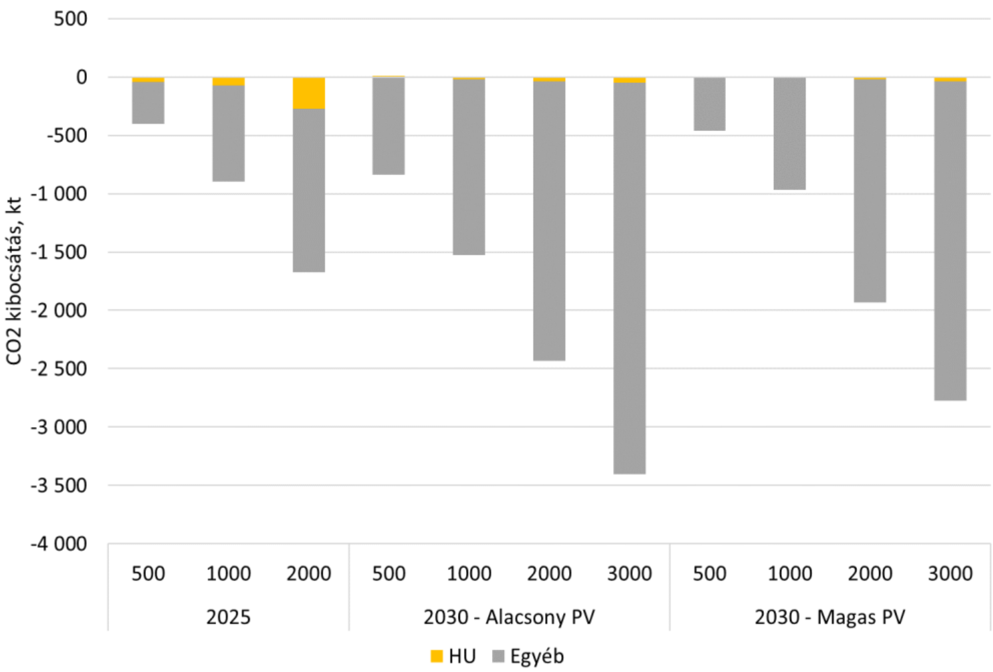

Figure 4: Change in carbon emissions compared to a 0 MW new wind power capacity scenario in Europe, Hungary shown in yellow and other European countries shown in grey (2030 – low PV, 2030 – high PV)