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# Green Ammonia Project at Duslo in Slovak Republic

# 50% DECARBONISATION VIA ELECTROLYSER

**renewable electricity demand**

2 900 000 MWh/year

190 wind turbines (8.4 MWh d/MWp)

or 24 $km^2$ of photovoltaic panels (3.38 kWh d/kWp)

**electrolysers capacity demand**

effective capacity 333 MW

installed capacity 950 MW (35% use of workload)

**water demand**

1 270 tons per day

460 000 tons per year

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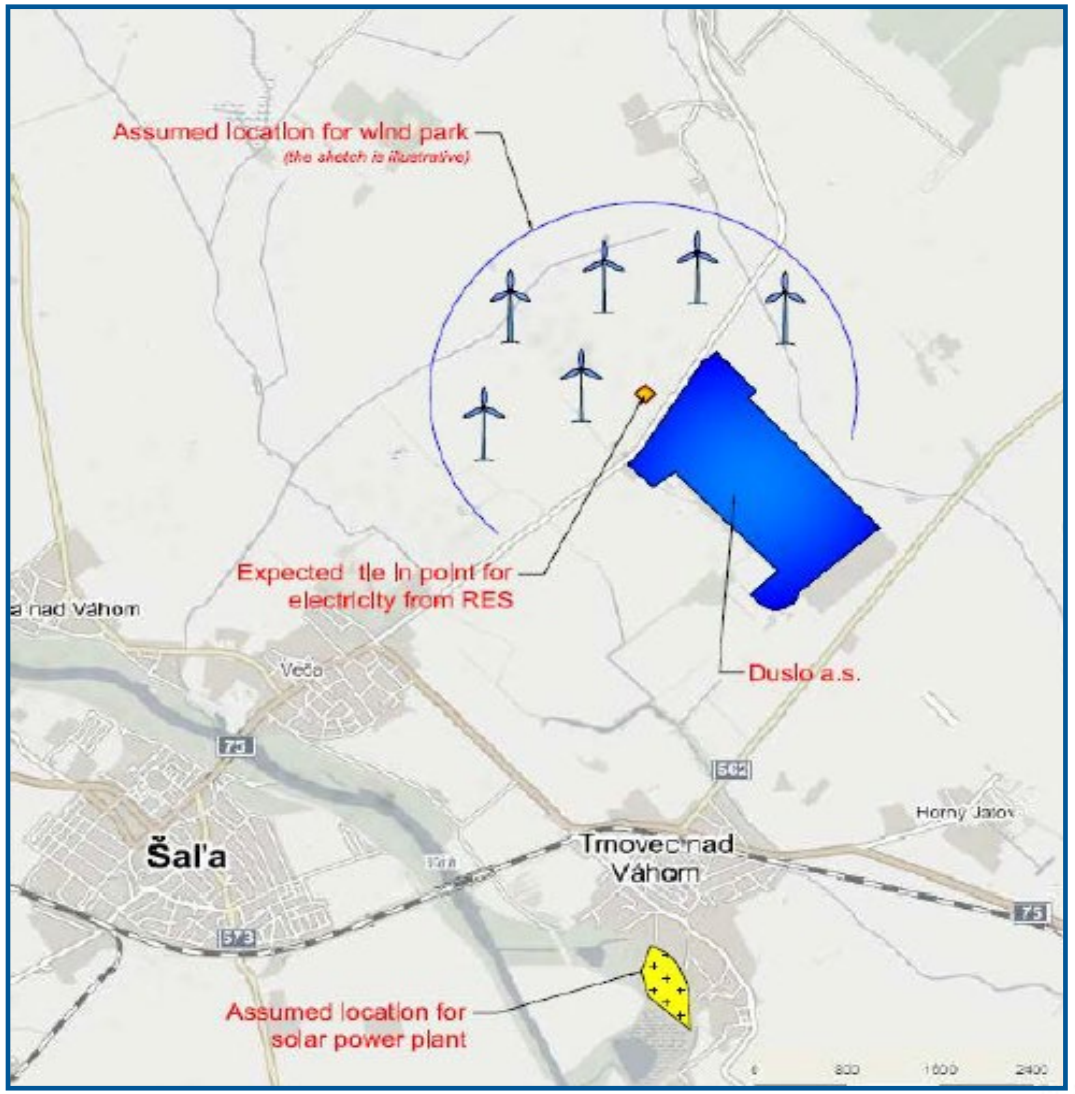
# OUR FIRST DECARBONISATION STEP

| ***Renewable energy source*** | |
|---|---|
| Wind energy | 36 MW |
| Photovoltaics | 14 MW |
| Annual production | 130 GWh/y |

| ***Green hydrogen production*** | |
|---|---|
| Electorlyser type | PEM/Alkaline |
| Installed capacity | 20 MW |
| Predicted full load hours | 4,743 h/y |
| Green hydrogen production | 2,100 t/y |
| **Expected start of operation** | **2027** |
| **Grey hydrogen replacement** | **2 - 3%** |

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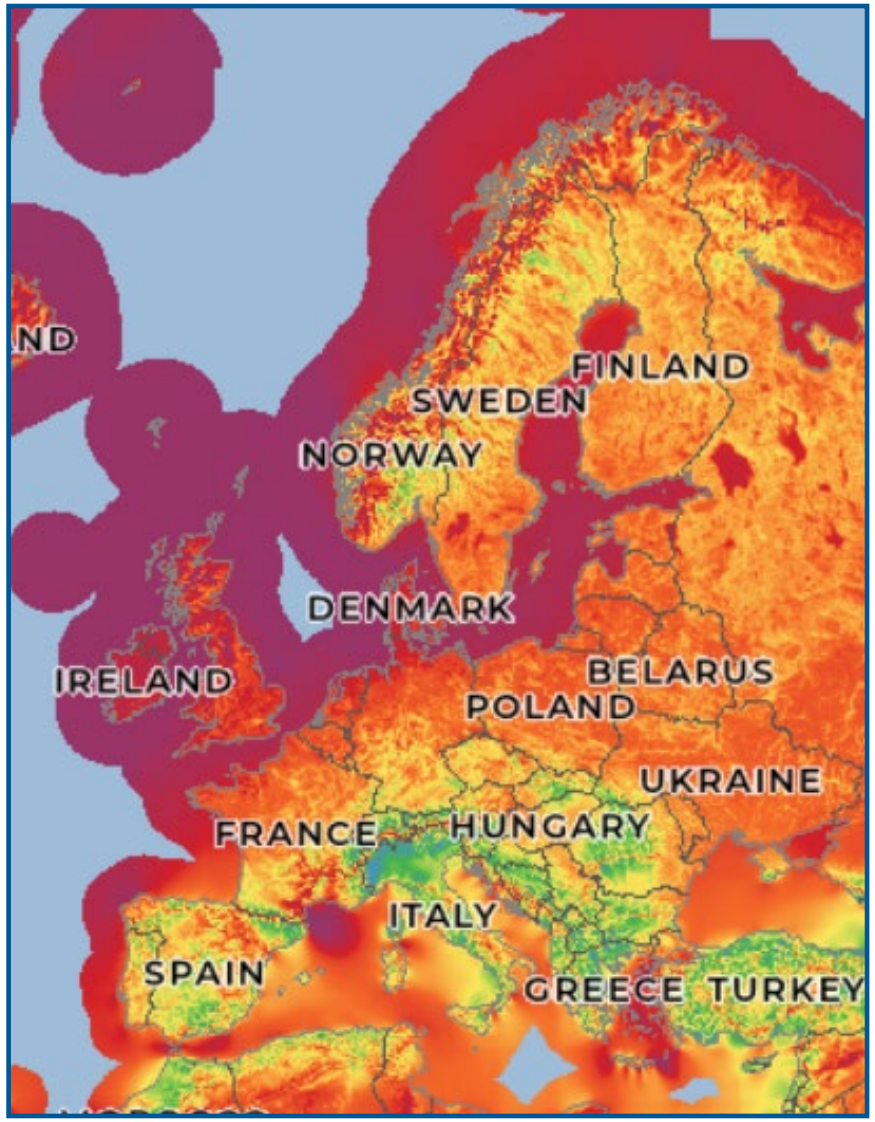
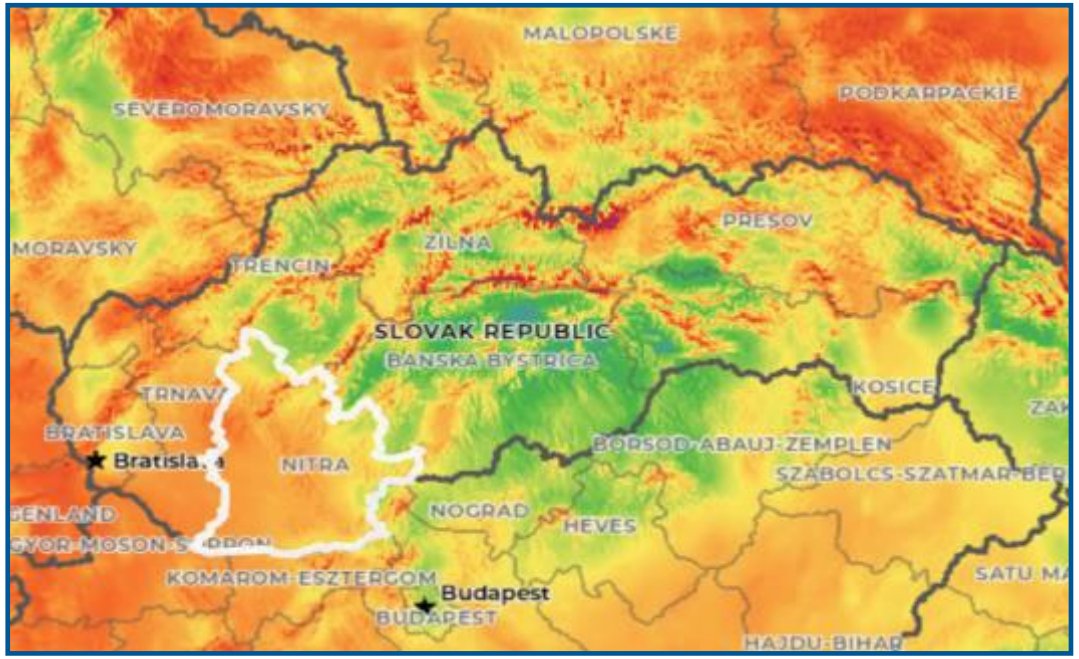
# WIND POWER AVAILABILITY




| country | mean wind power density @ height 100 m | average wind speed |
|---|---|---|
| Slovakia (Nitra) | 343 W/m$^2$ | 6.6 m/s |
| Netherlands | 692 W/m$^2$ | 8.8 m/s |
| Denmark | 799 W/m$^2$ | 9.3 m/s |

source: Global Wind Atlas

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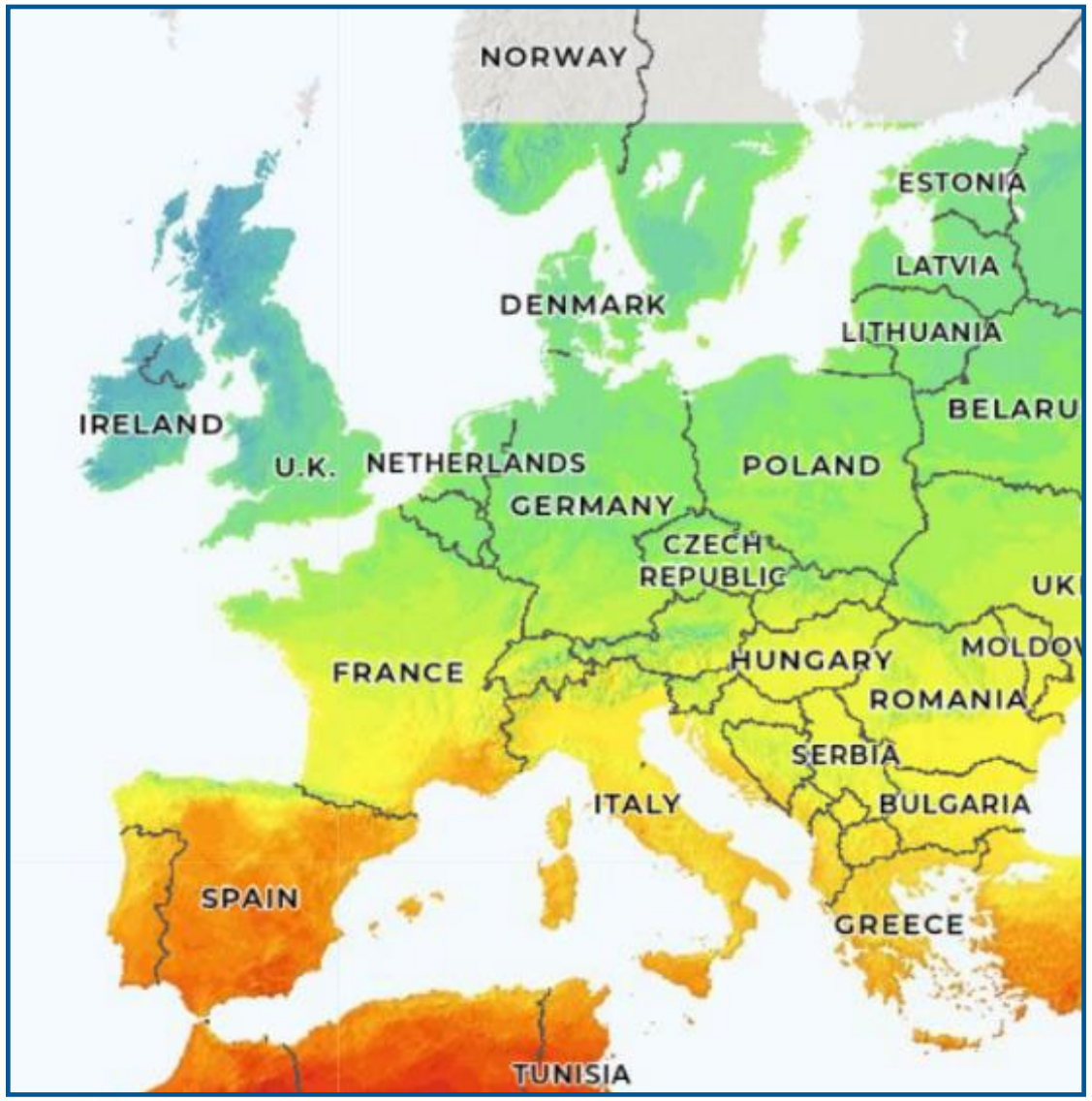
# SOLAR POWER AVAILABILITY




| country | specific photovoltaic power output<br>PVOUT average / day |
|---|---|
| Slovakia (Nitra) | 3.38 kWh/kWp |
| Spain | 4.35 kWh/kWp |
| Italy | 3.91 kWh/kWp |
| Greece | 4,11 kWh/kWp |

source: Global Solar Atlas

There are countries with good solar conditions

There are countries with good wind conditions

There are countries with bad solar & wind conditions, like Slovakia

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# CHALLENGES TOWARDS DECARBONISATION

***natural circumstances***

- limited potential for renewable energy production
- limited area for renewable energy available
- local RES cannot cover future electricity demand
- very limited possibility for CCS
- further decarbonisation needs  either:
  - competitive off-site electricity
  - competitive low-carbon off-site hydrogen
  - new low carbon use of fissile raw materials

***unclear future legal situation***

- many regulations addressing hydrogen – ETS, Taxonomy, RED III
- different conditions by different regulations for the same topic – green hydrogen / ammonia
- policies are developed on EU level at the same time the producers need to develop their projects
- financial support is crucial, but the sources look to be underestimated, at least in Slovakia

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# CHALLENGES TOWARDS DECARBONISATION

***technical problems***

- decarbonisation targets are to strict given the:
  - availability of RES
  - duration of usual project development schedule
- decarbonisation of ammonia production needs substantial changes along whole process
  - if the electrolyser capacity is added step-by-step, also whole process needs to be rebuilt in many steps
  - for big steps there is not enough RES nor financial sources
- local water balance shall be considered carefully
  - a water cycle will be much longer than in case of fuel cells
  - hydrogen atoms (future water) water will be moved with fertilizers to distant places

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# CONCLUSIONS

- yes, we can decarbonise nitrogen fertilizers production
- the low-carbon process will not be more energy efficient than conventional one
- the green transition will take time, turning 50% of hydrogen into green by 2030 is highly unlikely
- decarbonisation based on local RES or local CCS will not work for some countries
- clear and sensible regulations are needed
- all consequences of green transition shall be considered

**WE KNOW OUR CARBON FOOTPRINT, BUT DEEP AND CRITICAL CONSIDERATION OF ALL ASPECTS OF DECARBONISATION PROCESS IS ALSO A PART OF BEING RESPONSIBLE**

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# THANK YOU FOR YOUR ATTENTION !

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