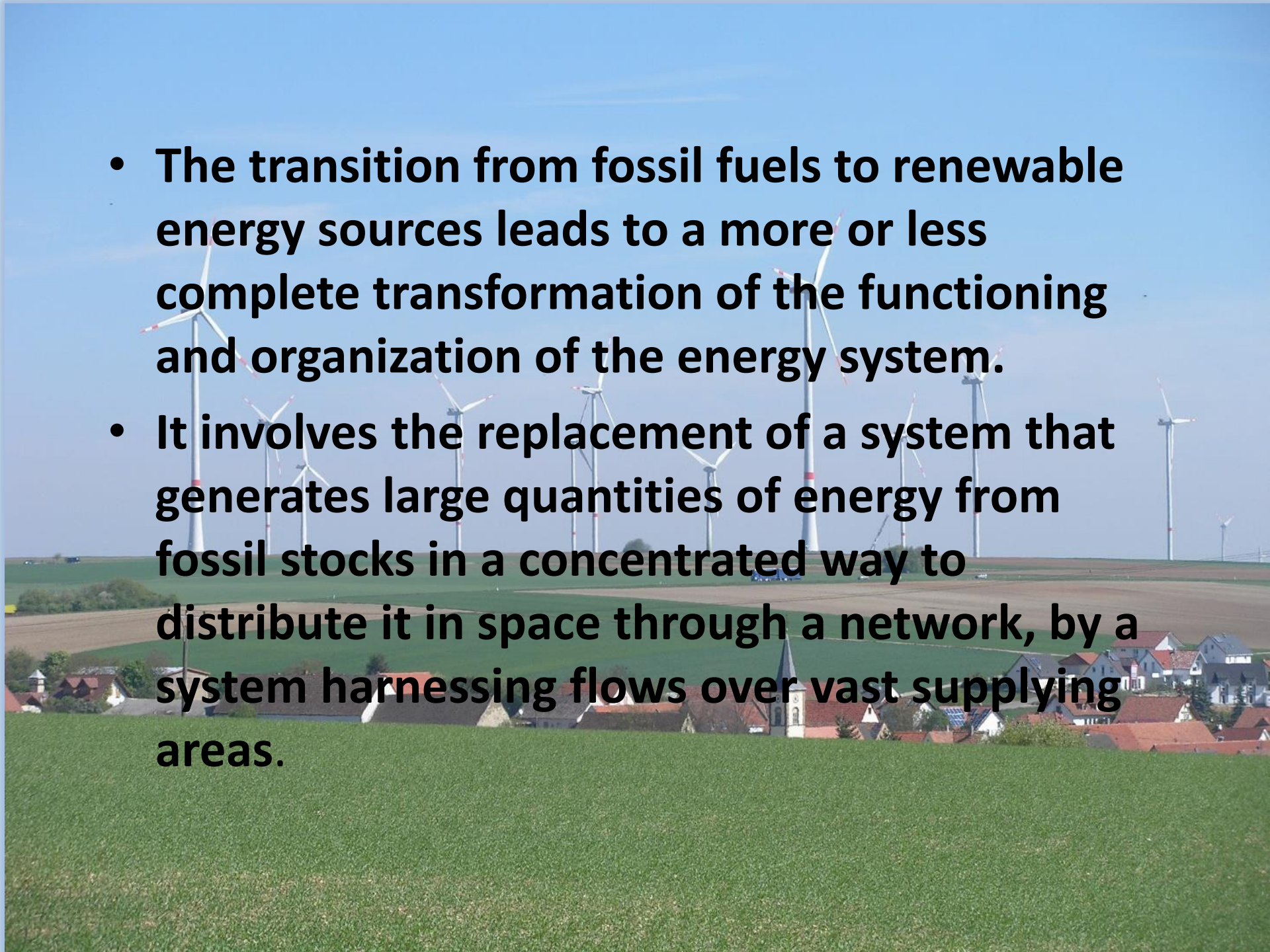
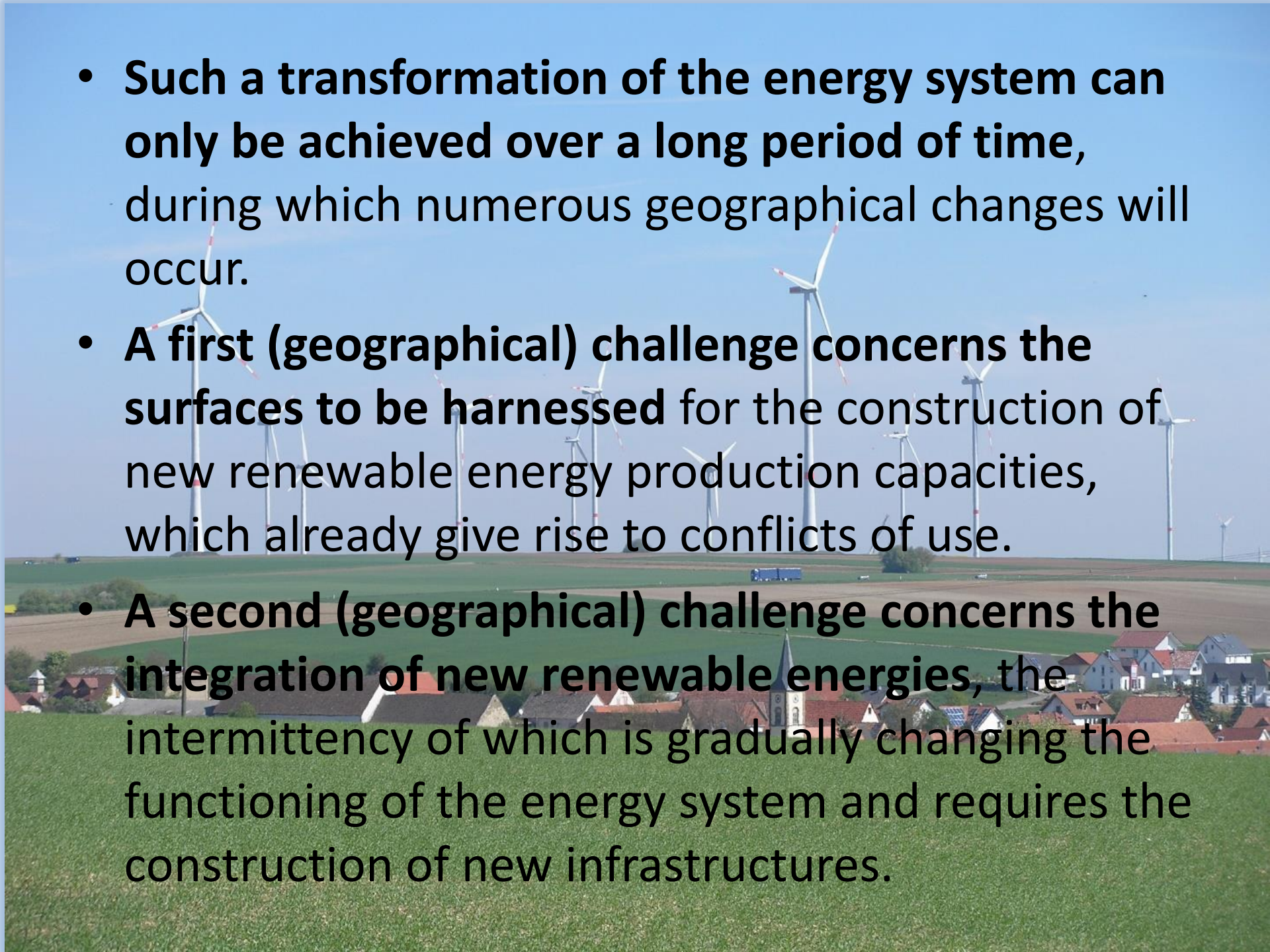


A large white wind turbine stands prominently in the center of a lush green field. In the background, several other smaller wind turbines are visible, along with a small mound of earth. The sky is a vibrant blue, filled with scattered white clouds.

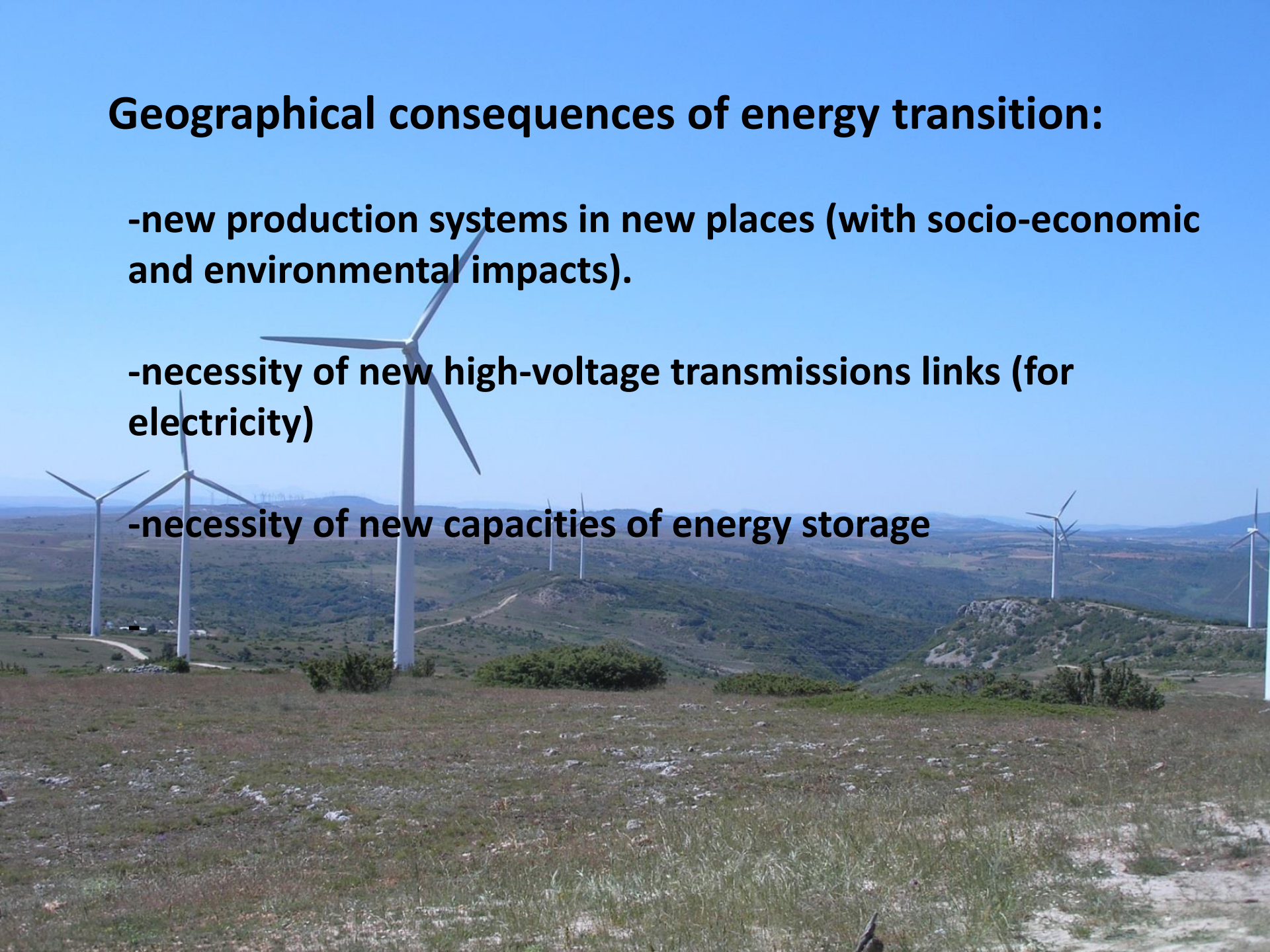
Integration of new production systems from renewable energy in the territory: A geographical approach

- 
- The transition from fossil fuels to renewable energy sources leads to a more or less complete transformation of the functioning and organization of the energy system.
 - It involves the replacement of a system that generates large quantities of energy from fossil stocks in a concentrated way to distribute it in space through a network, by a system harnessing flows over vast supplying areas.

- 
- **Such a transformation of the energy system can only be achieved over a long period of time, during which numerous geographical changes will occur.**
 - **A first (geographical) challenge concerns the surfaces to be harnessed for the construction of new renewable energy production capacities, which already give rise to conflicts of use.**
 - **A second (geographical) challenge concerns the integration of new renewable energies, the intermittency of which is gradually changing the functioning of the energy system and requires the construction of new infrastructures.**

Geographical consequences of energy transition:

- new production systems in new places (with socio-economic and environmental impacts).**
- necessity of new high-voltage transmissions links (for electricity)**
- necessity of new capacities of energy storage**



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.....and also: Which fossil power plants should be closed first, and which power plants should instead be conserved or built as renewable energies develop?

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.....and also: Which fossil power plants should be closed first, and on the contrary which power plants should instead be conserved or built as renewable energies develop?

Where is it better to build these new production, transmission and energy storage capacities to ensure the best integration in the territory?

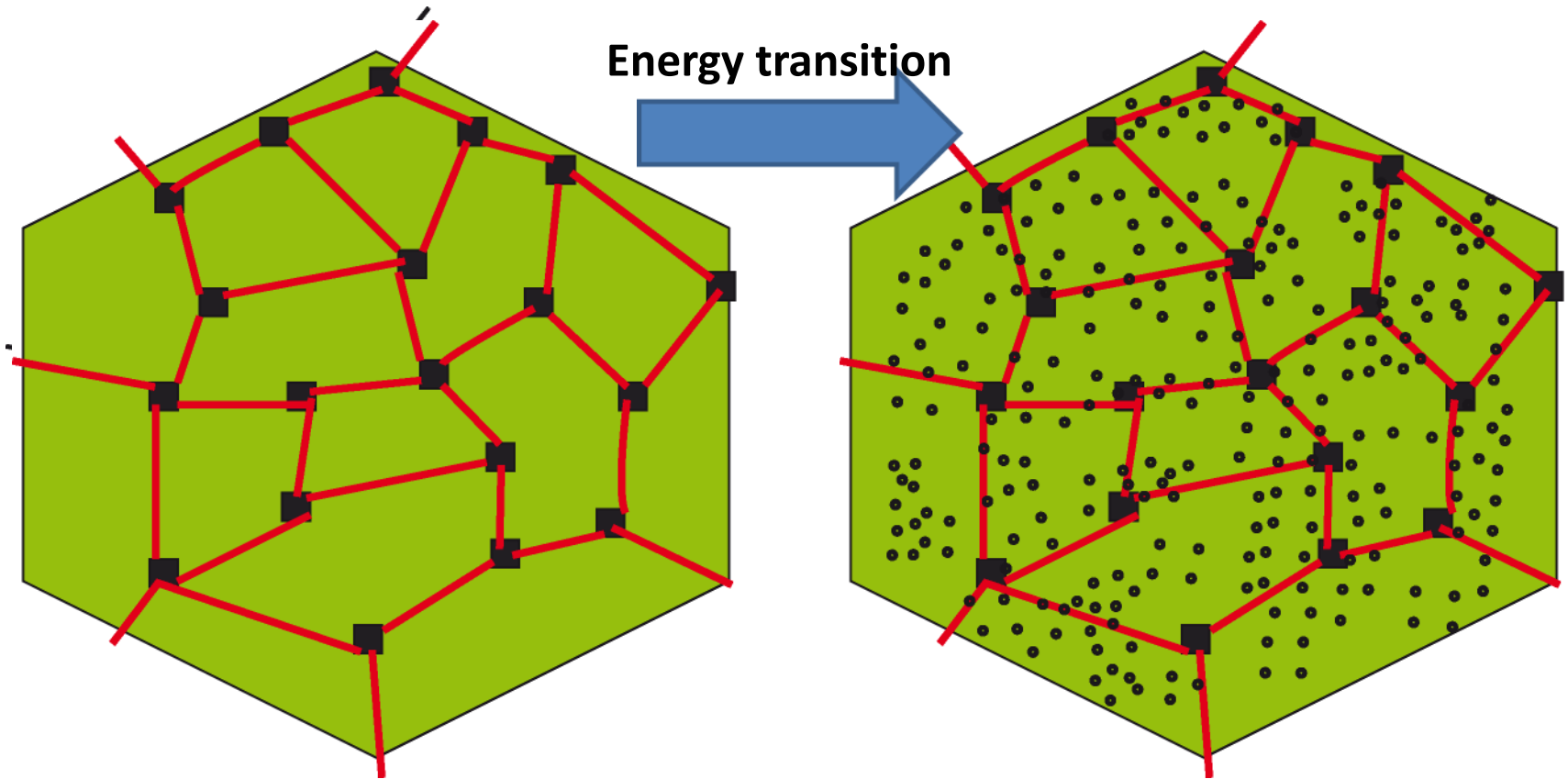
Problems of developing renewable energy sources for electricity production

- Since 20 years, the development of renewable energy sources has been anarchic without real planning, with a real difficulty in controlling the development of production systems that are in essence even diffuse.
- However, this anarchic spatial diffusion poses many problems: integrating several thousands new production systems into a network designed to distribute electricity produced in large power plants (thermal or nuclear plants); modification of the existing production system due to the intermittency of a large part of the new sources of energy; the need to look for ever more new sites of implantation which is proving already more and more complicated and poses environmental and social acceptability problems.

Imagine the future: geographical consequences of energy transition: the example of electricity production

Today: « Energy for space »

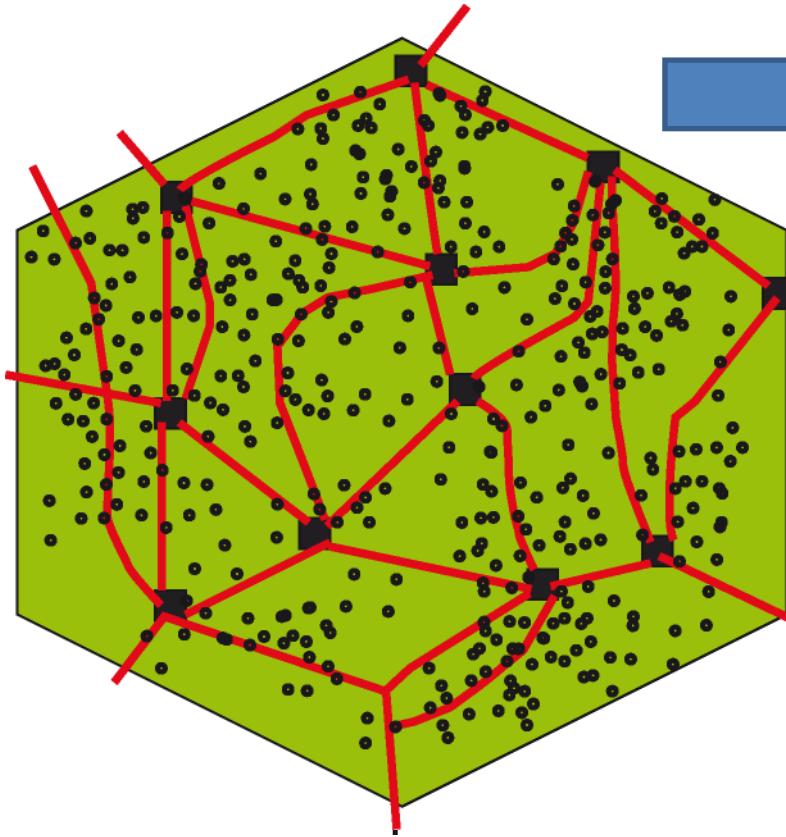
Tomorrow: «Energy from space »



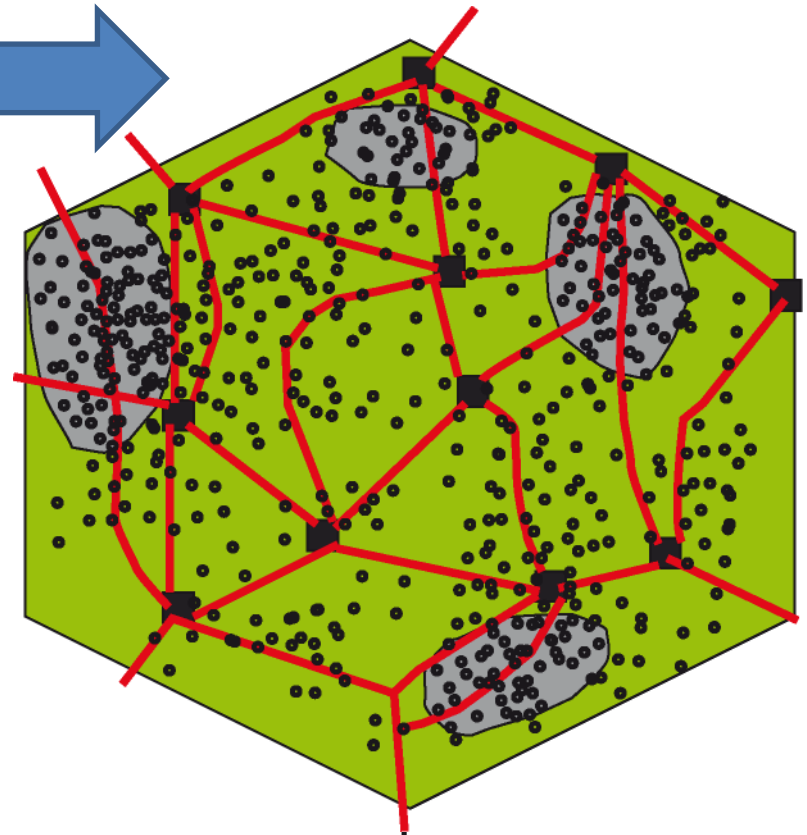
In the future, a new geography of energy production

Challenges around new production areas and new high-voltage transmissions lines

In 2040??

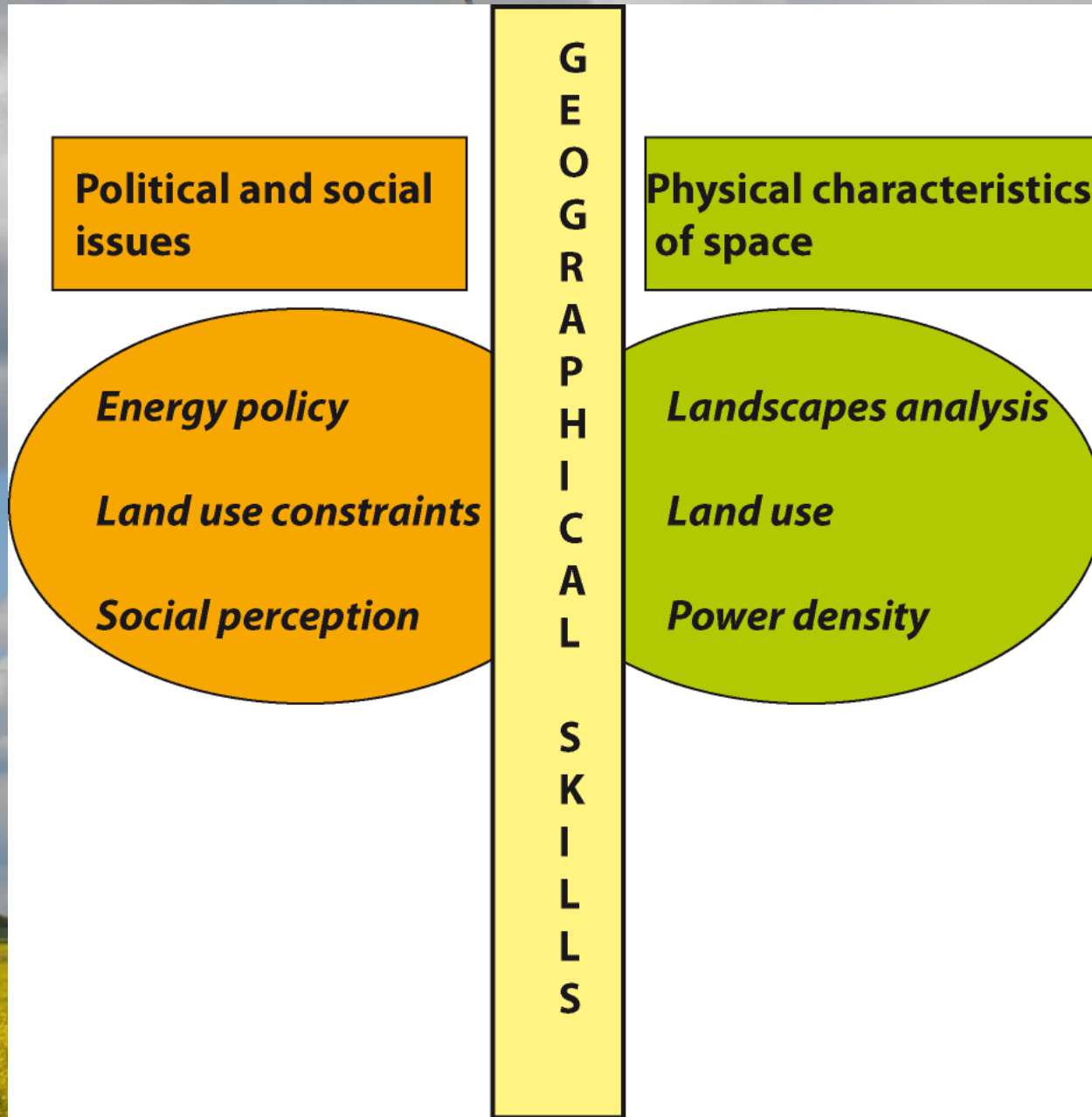


in 2050????



Energy transition is a spatial challenge

Geographical approach of energy transition



The example of densification areas of wind farms in the Grand Est Region



Where is it possible to build new wind farms?



A photograph of three white wind turbines with red accents on their towers, situated in a field of bright yellow wildflowers. The sky is blue with scattered white clouds. The text is overlaid on the image.

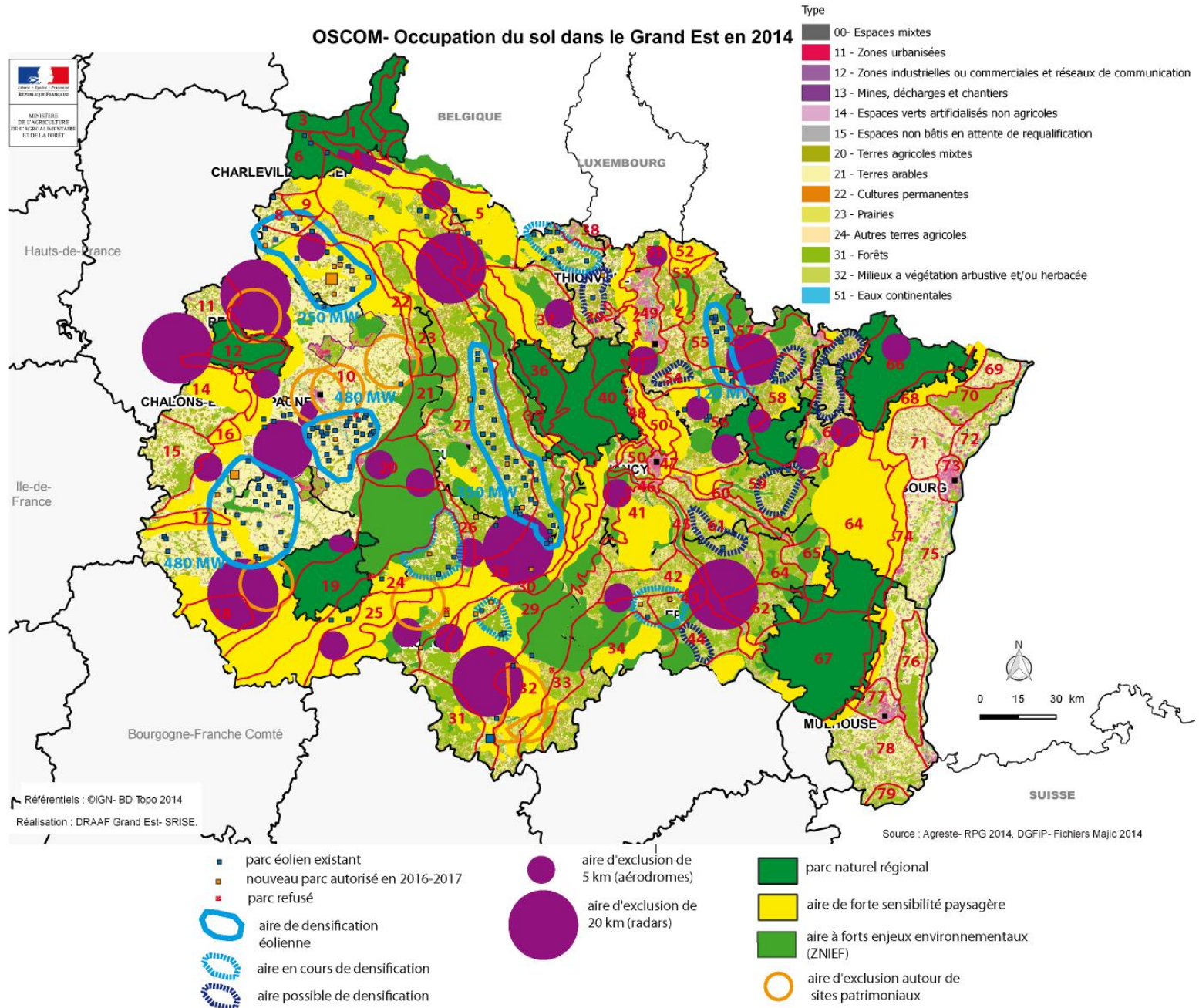
public inquiries highlight the following problems of wind farms development:

-Importance of landscape issues, particular sensitivity of the co-visibility of wind farms with certain emblematic sites; or near areas with strong landscape and environmental issues.

Wind farms over-densification in some areas where many projects are being developed simultaneously.

Insufficient studies on the cumulative effects of wind farms

Environmental, landscape and technical constraints

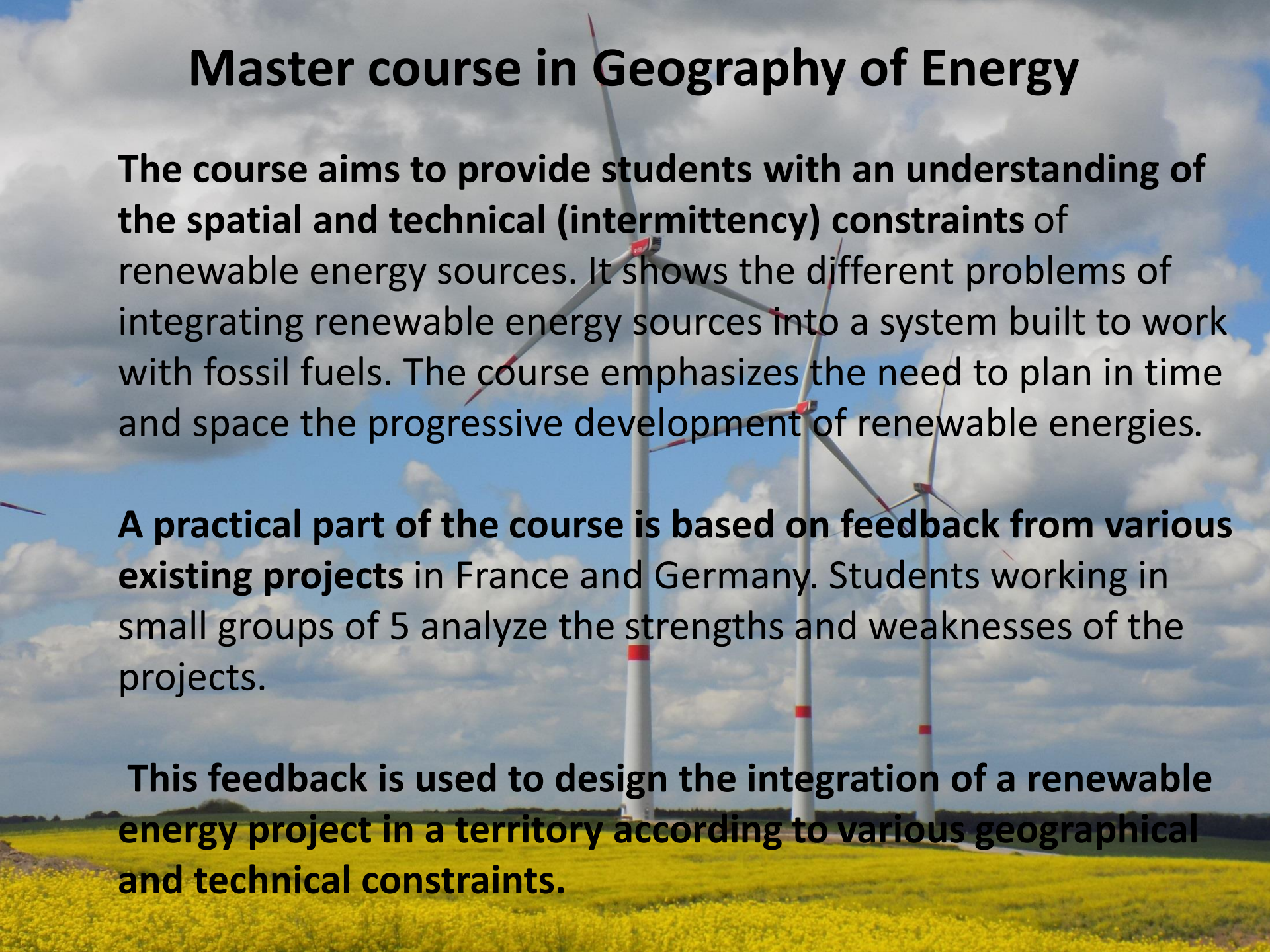


Master course in Geography of Energy

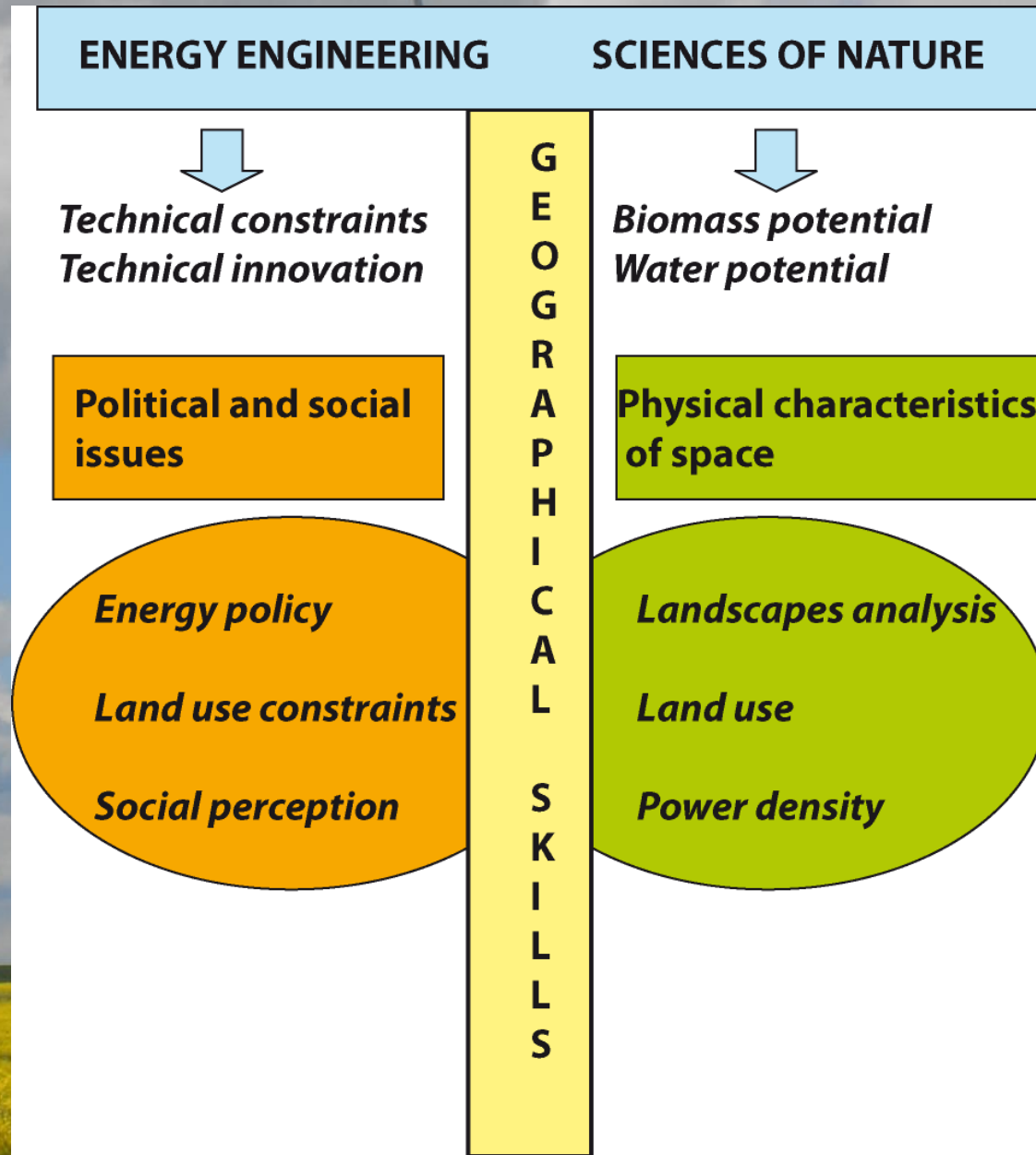
The course aims to provide students with an understanding of the spatial and technical (intermittency) constraints of renewable energy sources. It shows the different problems of integrating renewable energy sources into a system built to work with fossil fuels. The course emphasizes the need to plan in time and space the progressive development of renewable energies.

A practical part of the course is based on feedback from various existing projects in France and Germany. Students working in small groups of 5 analyze the strengths and weaknesses of the projects.

This feedback is used to design the integration of a renewable energy project in a territory according to various geographical and technical constraints.



combine geographical approach with natural sciences and engineering



A photograph of three white wind turbines with red-tipped blades standing in a field of bright yellow flowers. The sky is filled with large, white, fluffy clouds. The text "Thank you very much for the attention!" is overlaid in the center of the image.

Thank you very much for the attention!