



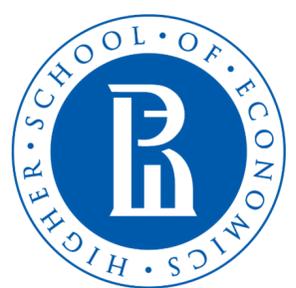
Modeling and Economic Assessment of the Effectiveness of Renewable Energy Utilization: Experience of Italy and Regional Aspects

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 Introduction

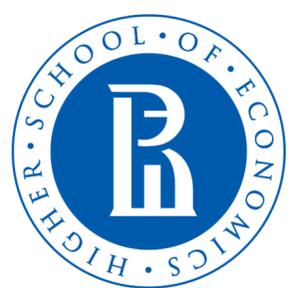
 The role of renewable energy in the global green agenda

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Relevance: having introduced the European New Green Deal Plan, the European Commission required a significant **increase of renewable energy generation efficiency** from the EU countries

Purpose: **detection of misbalances** in the Italian renewable energy generation system and **development of recommendations** for its mitigation

Hypotheses:

- ❓ the regions of Italy are heterogeneous in terms of the degree of renewable energy sources development
- ❓ the Italian renewable energy generating system has misbalances which lead to losses of efficiency

The role of renewable energy in the global green agenda

After the 2015 United Nations Climate Conference 106 out of 162 national plans gave priority to renewable energy development



RES play a key role in:

- 1) Combating climate change and CO2 emissions reduction
- 2) Combating local atmospheric pollutions
- 3) Creation of new opportunities for oil importers and exporters
- 4) Providing energy for remote areas
- 5) Employment creation



The level of RES development:

- 1) New types of RES cover 2% of world energy consumption
- 2) 21% of the EU energy consumption was covered at the expense of RES in 2018
- 3) 17,7% of the Italian energy consumption was covered at the expense of RES in 2018



Solar energy effectiveness modeling

Two principal components were formed for the solar energy model (2018) :



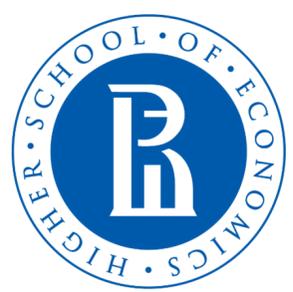
Predisposition to solar energy generation:

- 1) Direct normal irradiation (kWh/m^2)
- 2) Global tilted irradiation at optimum angle (kWh/m^2)
- 3) Average photovoltaic power output of plants with capacity up to 1 kWp per year (MWh)
- 4) Average photovoltaic power output of plants with capacity up to 1000 kWp per year (MWh)

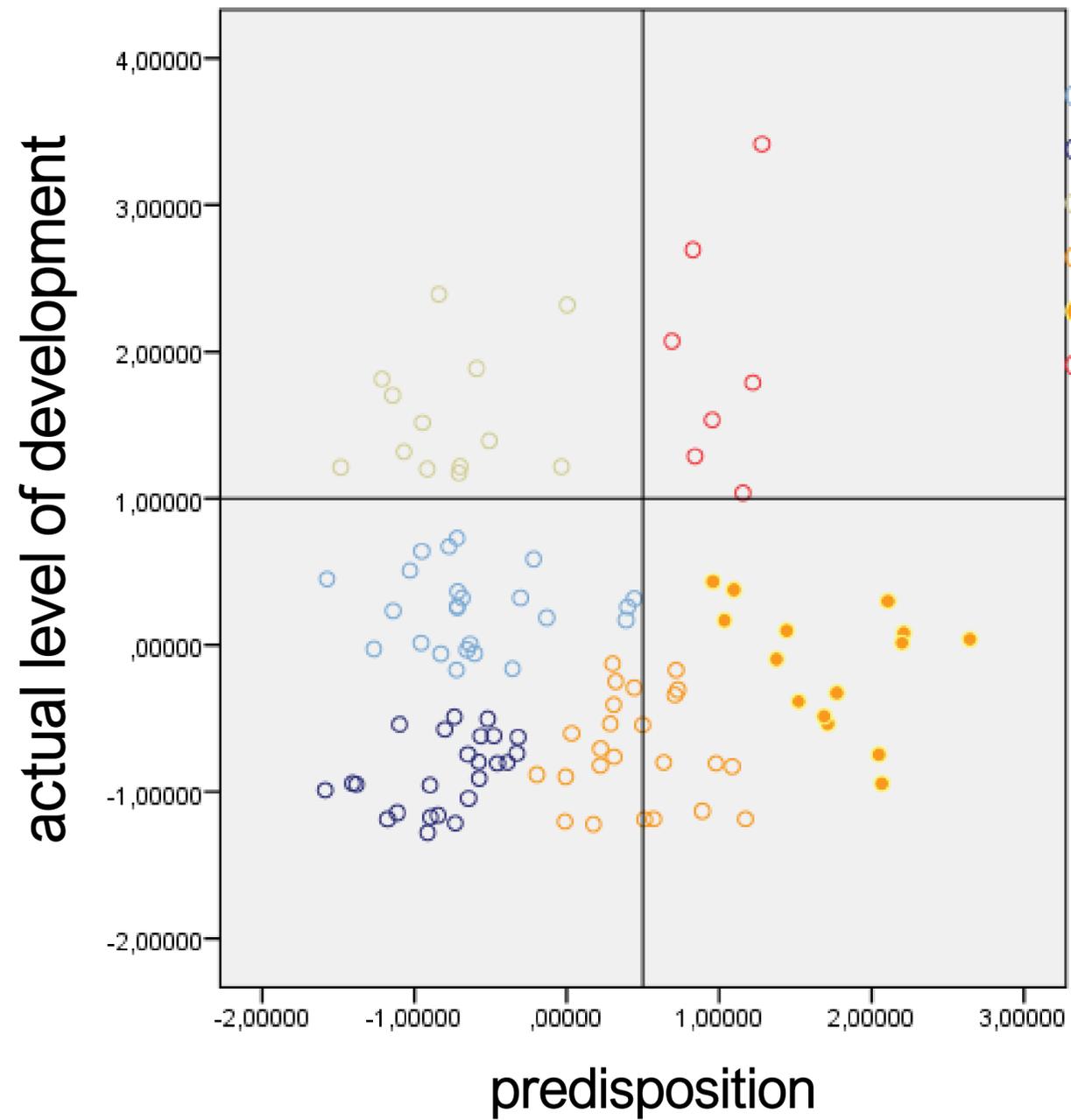


The actual level of development:

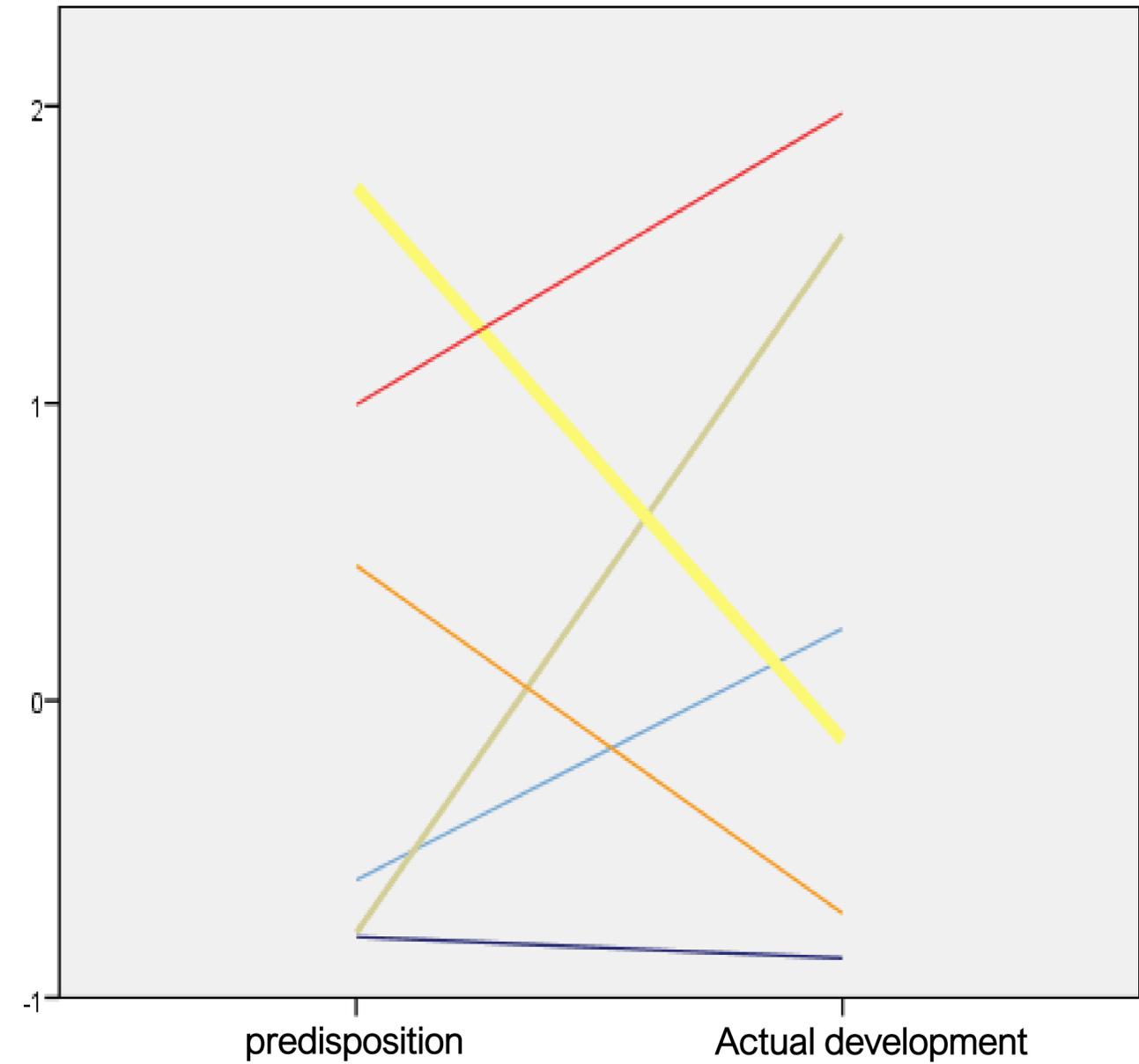
- 1) Number of plants (%)
- 2) Installed capacities (%)
- 3) Produced energy (%)

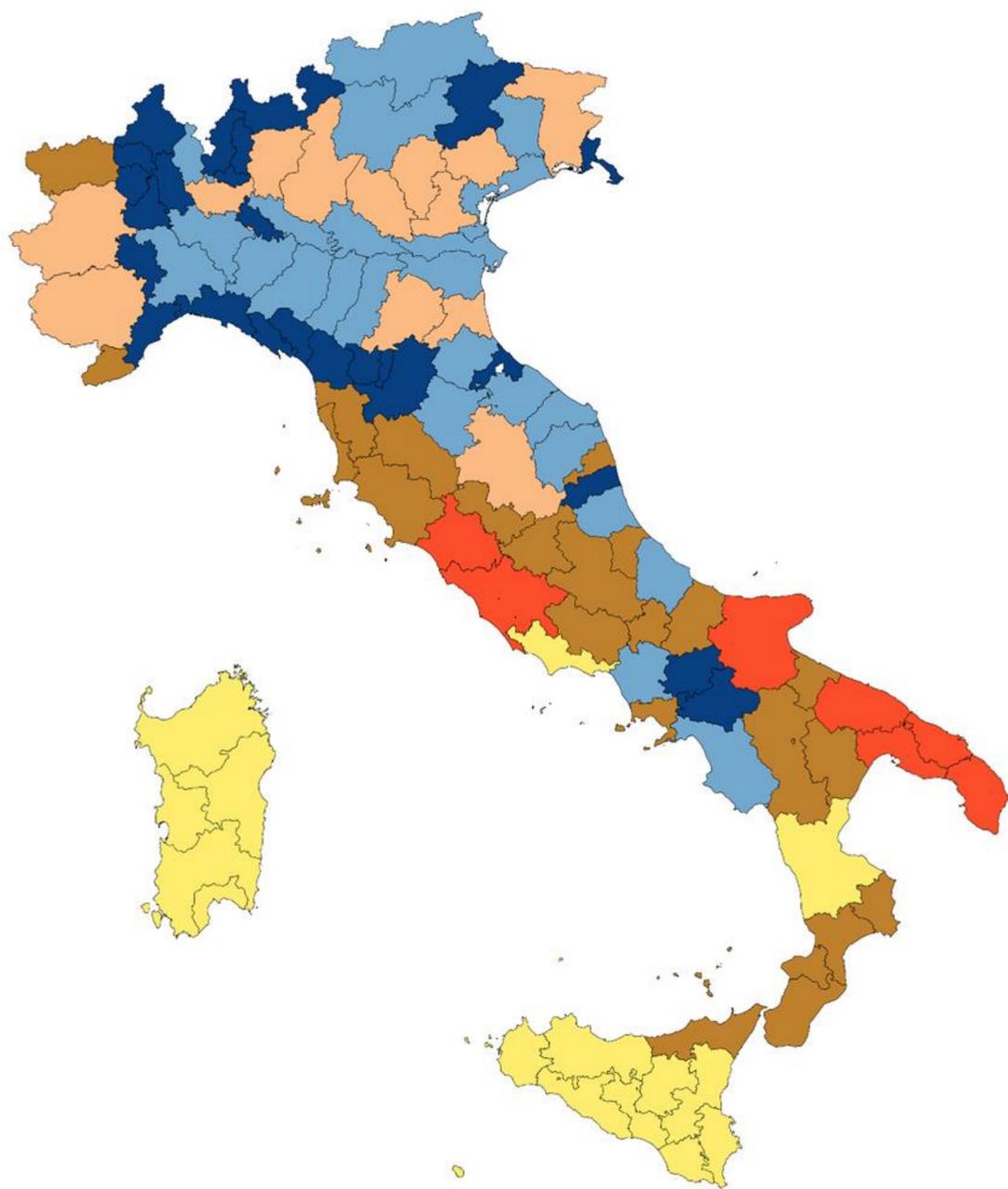


Scatter diagram



Mean values by clusters





In the northern part: provinces with low predisposition and generation(3),(1) and provinces with low predisposition and unexpectedly high generation(2)

In the central part: provinces with moderate predisposition and generation(4)

In the southern part: provinces with high predisposition and low generation(5)

Lazio and Puglia: high predisposition and generation (6)



Reasons for misbalances existence and recommendations for its mitigation

Lazio and Puglia (high predisposition and generation):

- 1) High level of income
- 2) The PAN project

The northern provinces (low predisposition and high generation):

- 1) High level of income
- 2) Concentration of productions
- 3) High level of investments

The southern provinces (high predisposition and low generation):

- 1) Low level of income
- 2) Ecomafia
- 3) Public mistrust
- 4) Insufficient level of investments

Recommendations:

- 1) Further proliferation of the PAN project technologies
- 2) Combating ecomafia
- 3) Awareness-raising work in the South
- 4) Creation of more incentives for households to obtain photovoltaic panels
- 5) Creation of supporting mechanisms for companies willing to integrate solar energy in production processes



Wind energy effectiveness modeling

Two principal components were formed for the wind energy model (2018):



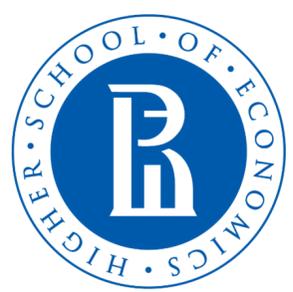
Predisposition to wind energy generation:

- 1) Mean power density (W/m^2)
- 2) Mean wind speed (m/s)



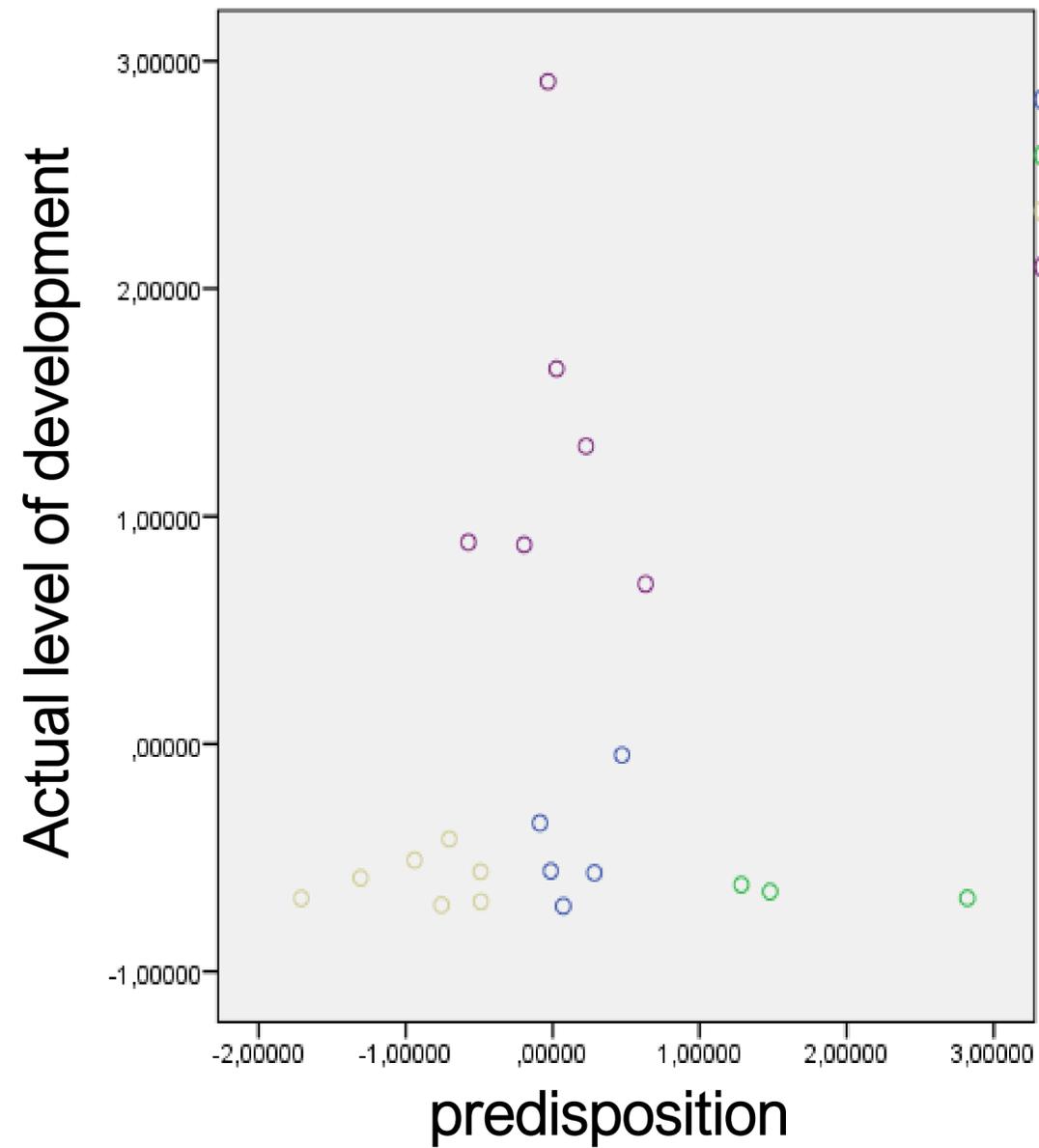
The actual level of development

- 1) Number of plants (%)
- 2) Installed capacities (%)
- 3) Produced energy (%)

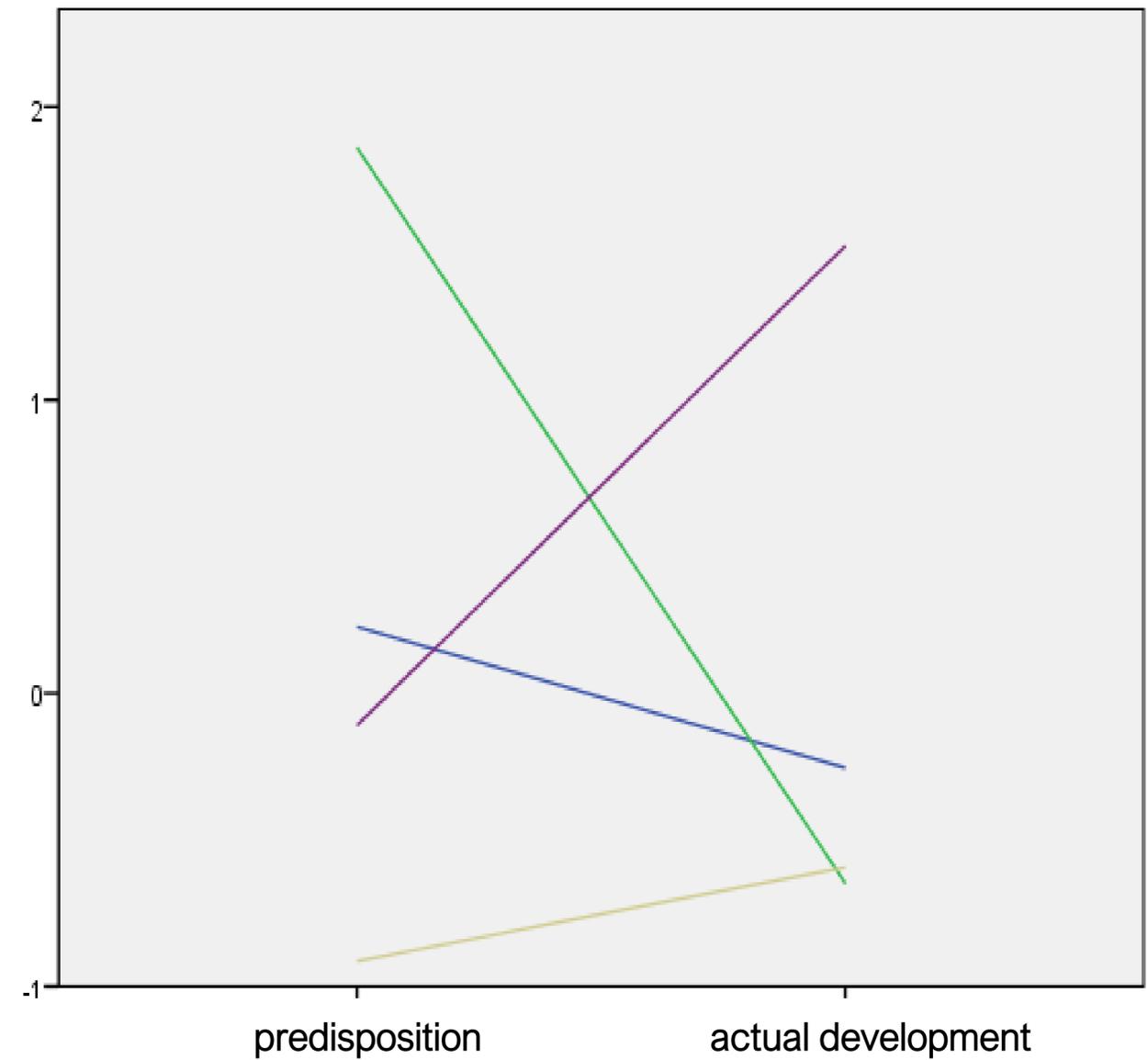


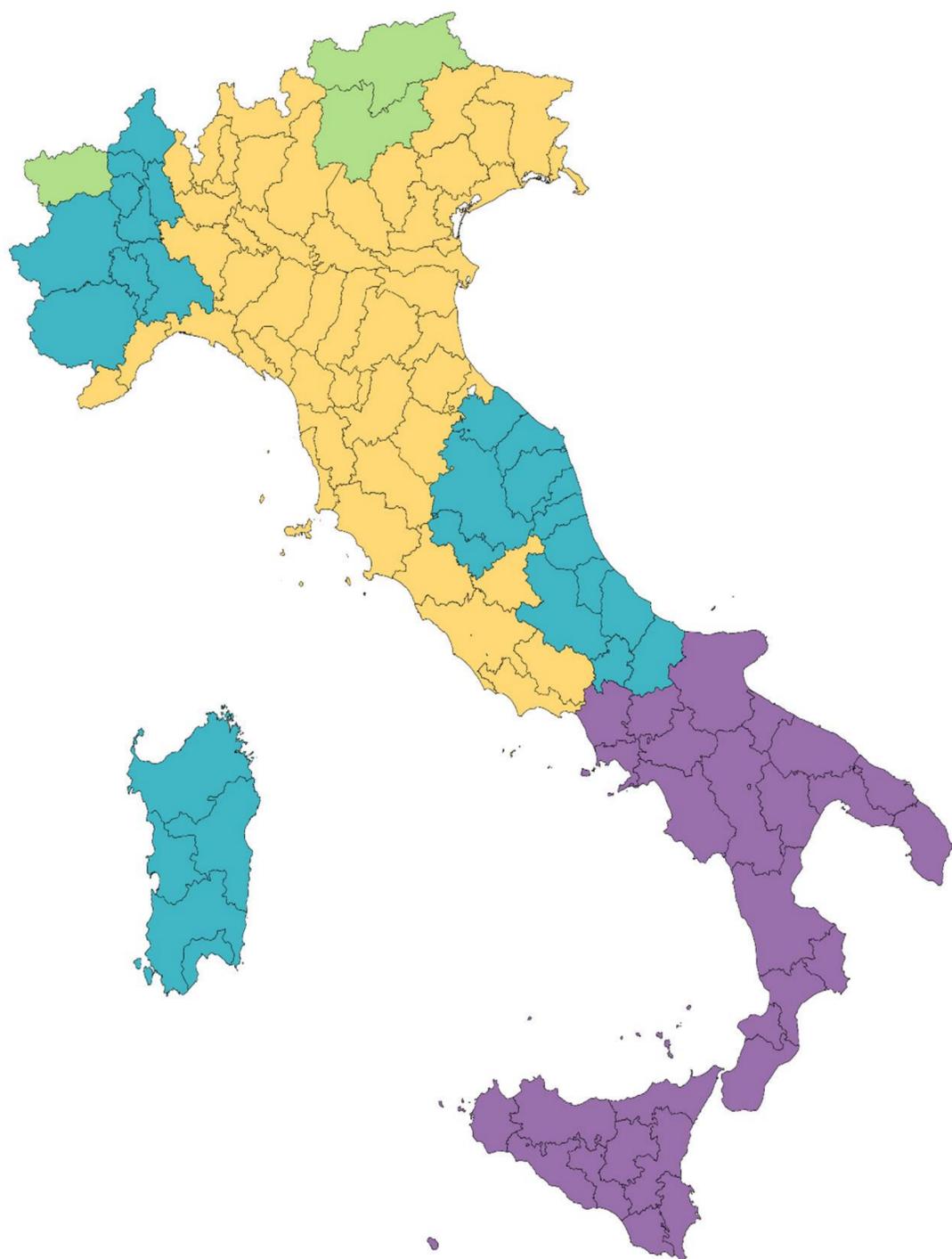
Wind energy effectiveness modeling

Scatter diagram



Mean values by clusters

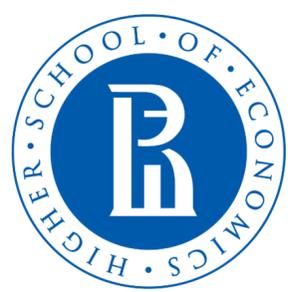




In the northern part: regions with low predisposition and generation (3) and regions with high/moderate predisposition and low generation (1), (2)

In the central part: low predisposition and generation (3)

In the southern part: moderate predisposition and high generation (4)



Reasons for misbalances and recommendations for its mitigation

Regions with moderate predisposition and high generation:

- 1) PAN project technologies
- 2) Governmental support

Regions with moderate/high predisposition and low generation:

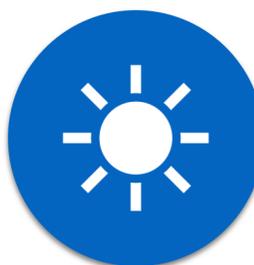
- 1) Insufficient level of investments
- 2) Absence of effective mechanisms for solving typical problems

Recommendations:

- 1) Further proliferation of the PAN project technologies
- 2) Integration of central regions with high potential in developed southern infrastructure
- 3) Off-shore generation development



The European New Green Deal Plan fixed RES as a key instrument for climate change combating and improvement of ecological situation. The EU countries will have to raise the RES share in energy consumption using available resources more effectively



In the Italian solar energy generation system there are significant imbalances that cause losses of efficiency



In the Italian wind energy generation system there are some imbalances and areas which productivity can be increased

Thank you for attention!