

# HOW DIFFERENT ARE POLISH REGIONS WITH REGARD TO THE UTILISATION OF BIOGAS PLANT TECHNOLOGY APPLICATION POTENTIAL?

Grzegorz Ginda and Marta Szyba  
Faculty of Management, AGH UST, Cracow, Poland

## The background

The full exploitation of renewable energy potential is of great importance for Poland due to international obligations and attempt to diversify energy sources, and thus to strengthen the safety and independence of Polish energy sector. Permanent strong performance of Polish agricultural sector as well as living and professional activities of citizens result in a lot of agricultural and sewage waste, as well as a need for more landfill areas. The vastness of waste which has to be processed makes an evident opportunity to being utilised for energy production. Biogas plants represent complex technology, and are thus costly. Their effective application depends on different factors. Therefore, deployment of biogas technology is not a common and straightforward task. The deployment of biogas technology for energy production has been developed for several years. The actual results of the development seem not to be satisfactory in Poland. Moreover, there seem to appear evident disparities in the development of biogas technology application for energy production between Polish regions. This is why the an effort is made in the paper to provide the methodology for effective assessment of actual progress in biogas technology adoption for energy production in different Polish regions - 16 voivodships.

## The proposal

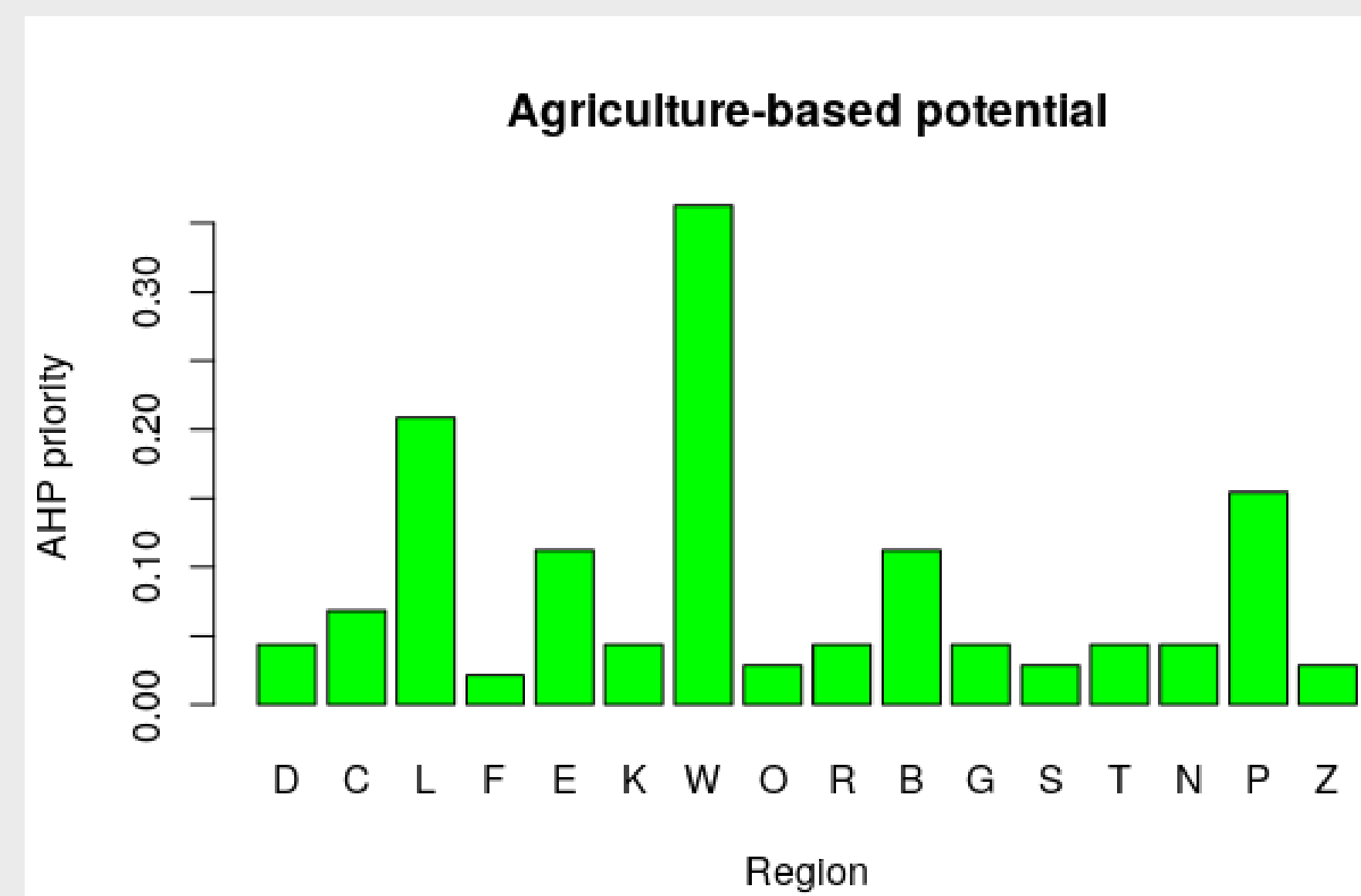
The effects of actual deployment of a complex technology may depend on numerous factors. Moreover, many of such factors may be of intangible nature due to imperfect and scarce information. AHP/ANP methodology is capable of dealing with information of such a kind. This is why the proposed approach for the assessment of actual regional potential of biogas technology is based upon AHP/ANP. A way for the improvement of the process of interpreting AHP/ANP methodology application results is also proposed in the paper. The results are often treated thoughtlessly as perfectly exact numbers. In reality, however, the methodology is based on the application of ordinal input data. The interpretation of AHP/ANP application results as perfectly exact numbers brings a kind of a contradiction with regard to ordinal nature of input. A kind of classification approach is proposed in the paper to adequately deal with the contradiction. A rule used in another MCDA technique, namely well known Opricovic's VIKOR, is adopted to interpret AHP/ANP application results in a way compatible with the methodology.

## Data

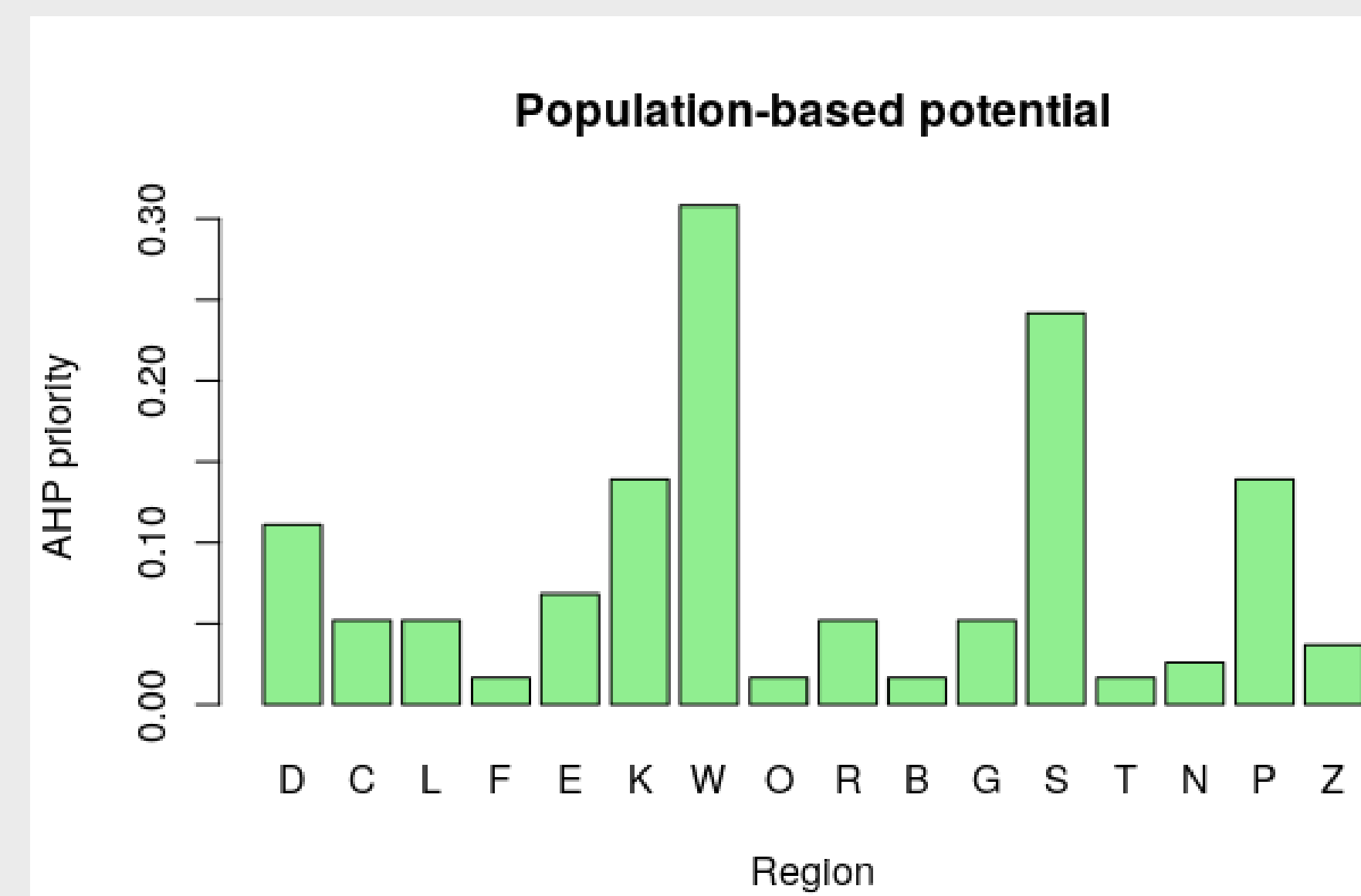
A thorough analysis of available information about actual state of biogas technology application and Polish regions was made. The newest complete information with this regard was finally used which pertains to year **2016**. The auxiliary application of well known DEcision MAKing Trial and Evaluation Laboratory (DEMATEL) technique was applied to identify the key factors for the assessment of actual biogas technology potential. Finally, three factors proved to be decisive with this regard:

1. Agricultural regional potential (organic waste production).
2. Population (domestic and professional waste production).
3. Population density (inhibitor of the dissemination of biogas technology application).

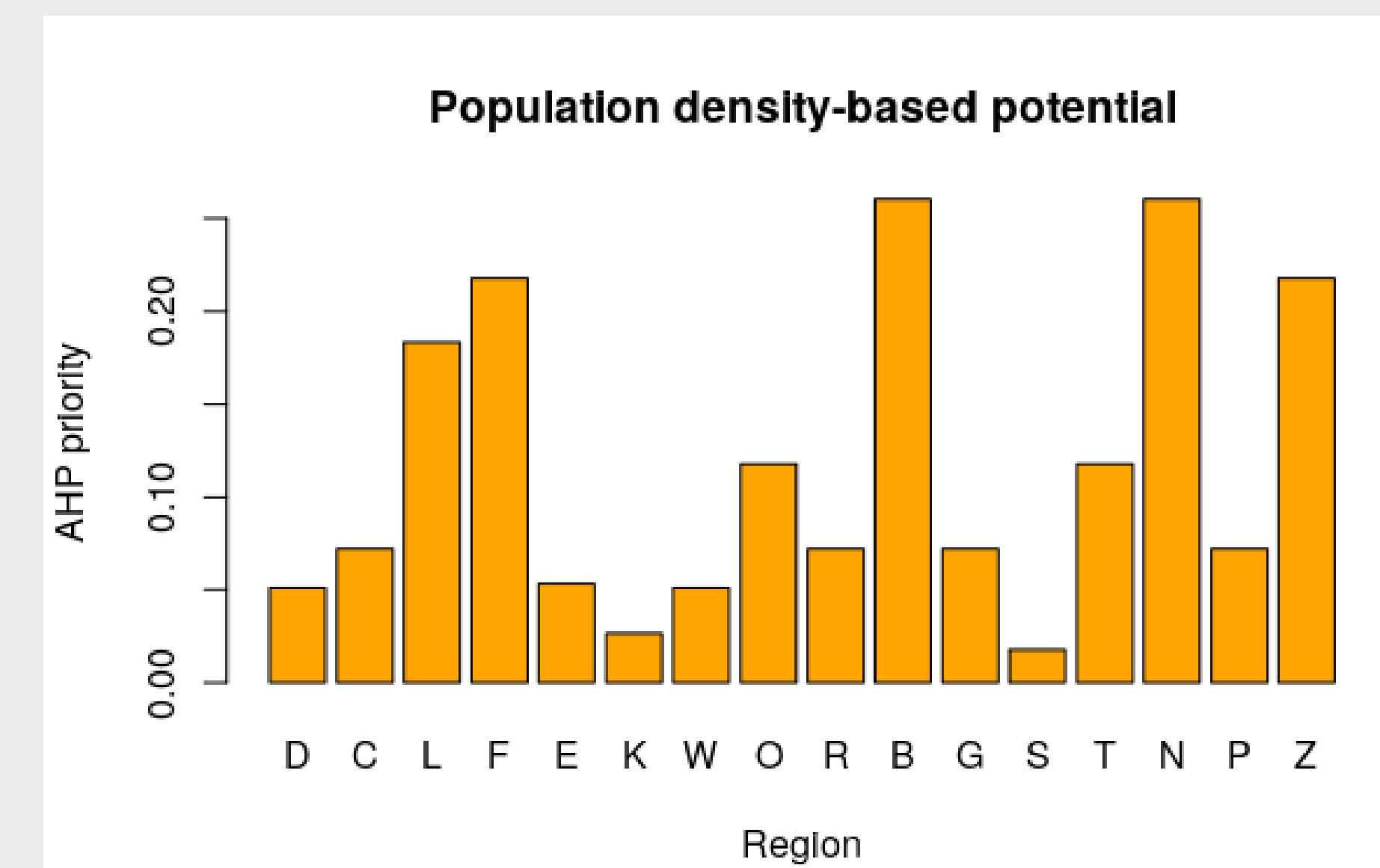
## Agricultural potential assessment



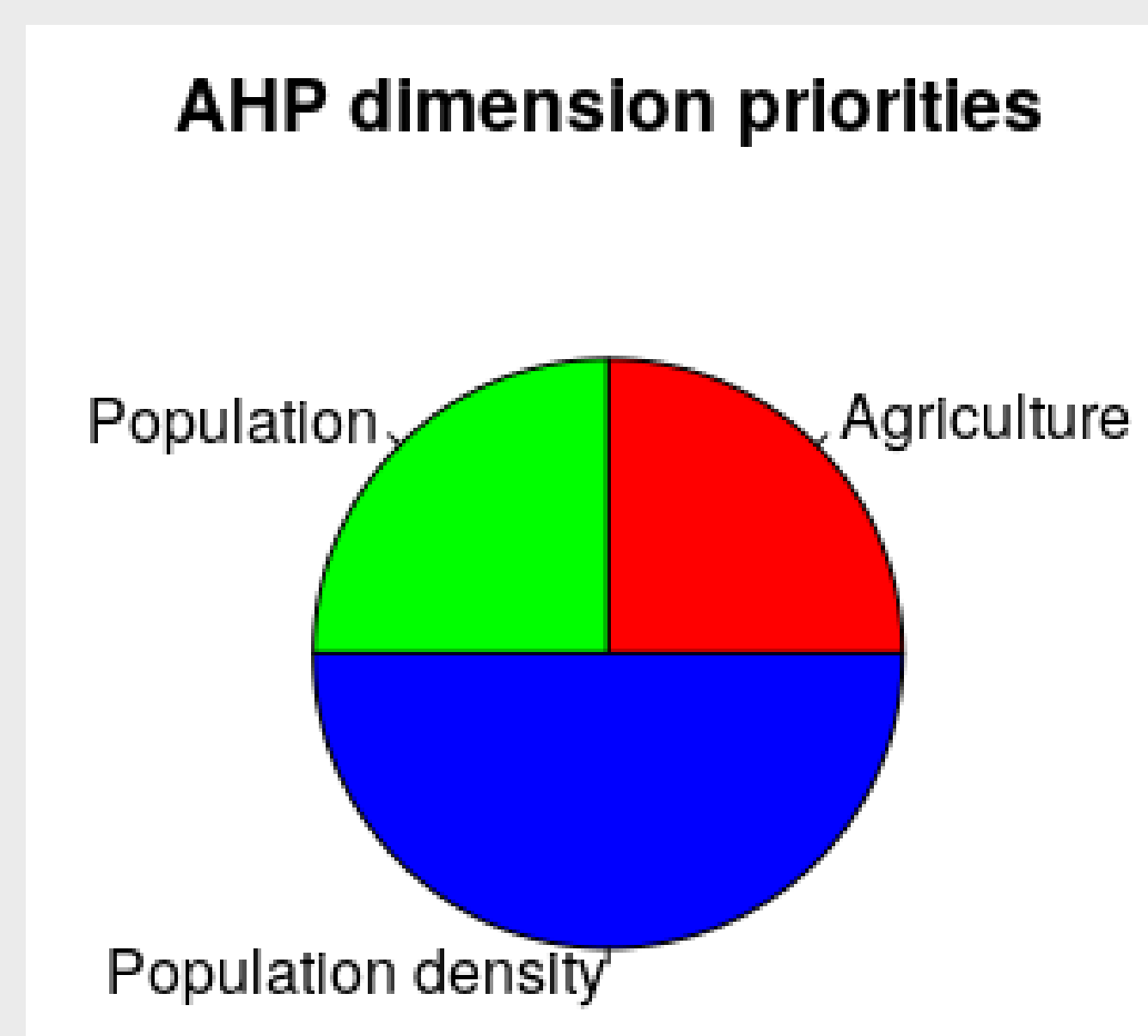
## Population potential assessment



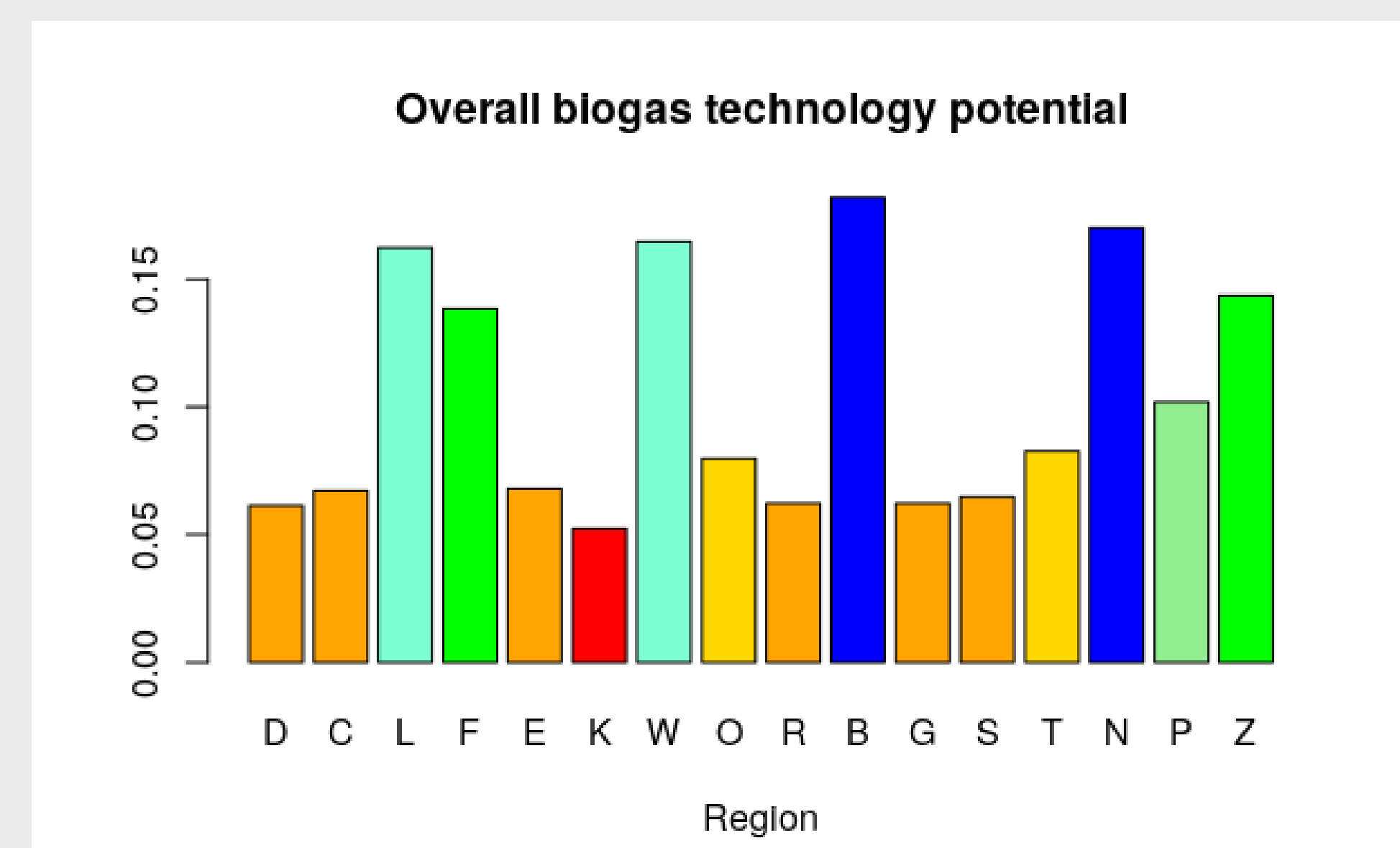
## Population density potential assessment



## Assumed potential dimension share



## Aggregated potential - colors denote identified region classes



## Conclusions & Bibliography

The results of the comparison of actual state of regional biogas technology exploitation with regional potential show that:

1. The majority (9 out of 16) of regions seem not to be capable with regard to exploit actual, even very high (Podlasie region - B, Varmia and Masuria region - N, Lublin region - L, Lubuskie region - F) level of biogas technology potential.
2. A few cases regions coped with biogas technology adoption well (Masovian region - W), even despite evident drawback in existing conditions (Silesian region - S, Minor Poland region - K).
3. Observed disparities in actual results of biogas technology potential exploitation call for urgent intervention of both local and central authorities and legislative actions to help regions in identifying root causes and resolving problems with the dissemination of biogas technology application.
4. Results of regional classification seem to confirm usefulness of proposed way for interpreting AHP/ANP methodology application results in a way which more consistent with intangibility-aware nature of the methodology. Further justification of proposed way and search for other ways, potentially more justified ways are welcome, nevertheless.

### The Bibliography

Ruszel M. (2017). The role of energy resources in electricity production. *Energy Policy Journal* 3(20), 5-15.  
Dubrovskis V., Plume I. (2016). Biogas potential assessment from beer and sugar producing factories waste. *Engineering for Rural Development* 2016-January, 1361-1366.  
Dyah S., Sriharti (2019). Biogas development: Dissemination and barriers. *IOP Conference Series: Earth and Environmental Science* 277(1), 012018.  
Sliz-Szkliniarz B., Vogt J. (2012). A GIS-based approach for evaluating the potential of biogas production from livestock manure and crops at a regional scale: A case study for the Kujawsko-Pomorskie Voivodship. *Renewable and Sustainable Energy Reviews* 16(1), 752-763.  
Chasnyk O., Sokolowski G., Shkarupa O. (2015). Historical, technical and economic aspects of biogas development: Case of Poland and Ukraine. *Renewable and Sustainable Energy Reviews* 52, 227-239.  
Saaty T.L. (2006). There is no mathematical validity for using fuzzy number crunching in the analytic hierarchy process. *Journal of Systems Science and Systems Engineering* 15, 457-464.  
Opricović S. (1998). *Multicriteria Optimization in Civil Engineering*. Faculty of Civil Engineering, Belgrade.

## Acknowledgments

The work was financed by a scientific research subsidy provided by AGH UST.

## Actual potential assessment - colors denote identified region classes

