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Regional greenhouse gas assessement of power production based on biogas in Germany

i. Introduction

In Germany, almost 8,000 biogas plants are in operation. Introducing and promoting this renewable energy is justified by its environmental advantages. Embedded in the joint project „The sugar beet as an energy crop in crop rotations on highly productive sites – an agronomic/economic system analysis“ our subproject „site assessment“ designed a regional economical and ecological model of German biogas production which is able to calculate greenhouse gas emissions on small scale level.

ii. Methodology and model approach

Our model consists of four major parts and is executed for each biogas plant in our data base:

Geocoding
- Almost 8,000 biogas plants
- Address to longitude and latitude

Variable production costs
- Silage corn, sugar beet, winter wheat as whole crop silage and grain
- Subject to site specific production circumstances

Linear optimization of feedstock
- Minimizing feedstock production costs
- Subject to individual biogas plant's requirements

Greenhouse gas emissions
- Functional unit: 1 kWh_{el}
- Cradle to grave approach (Figure 1)

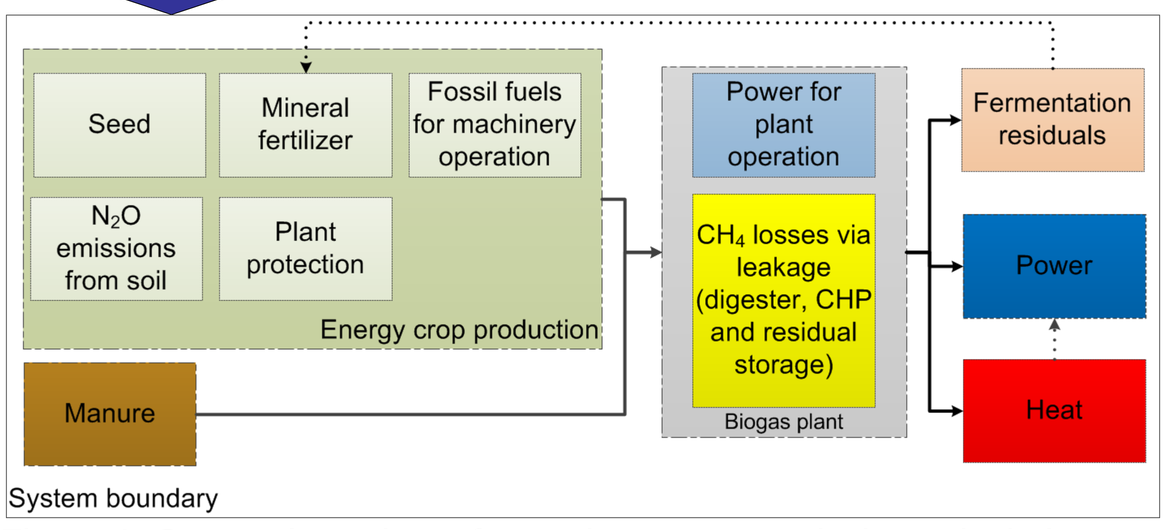

Figure 1: System boundary of greenhouse gas emission calculation

iii. Results

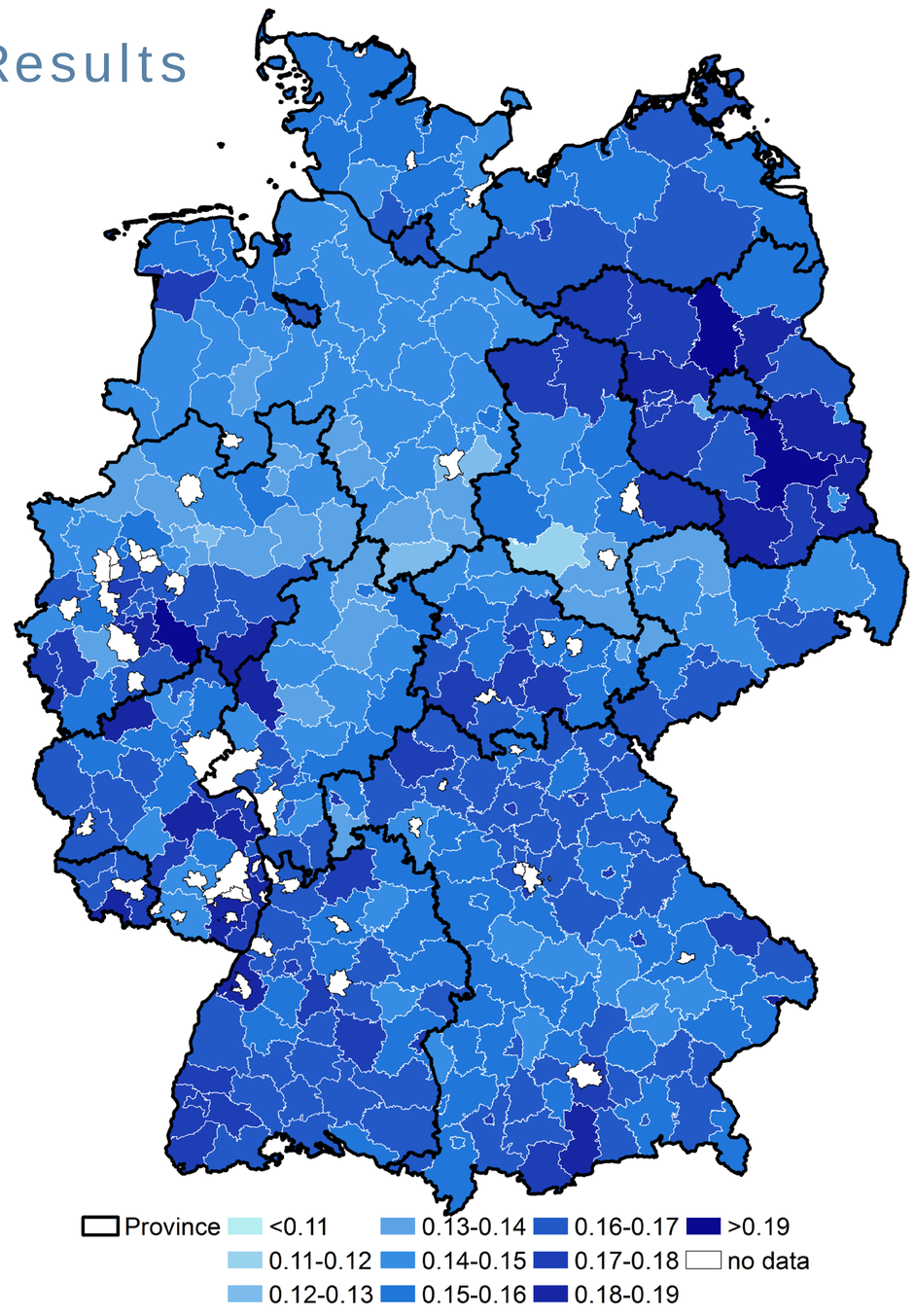

Figure 2: Greenhouse gas emissions of biogas production in Germany; Aggregated on district level in $kgCO_{2eq}/kWh_{el}$

- As the national average, greenhouse gas emissions of biogas production were 0.155 $kgCO_{2eq}/kWh_{el}$ (Figure 2).
- Silage corn was indicated to be the substrate most used (50.1 Mio t y^{-1}), followed by winter wheat as whole crop silage (8.7 Mio t y^{-1}) and sugar beet (0.8 Mio t y^{-1}) (not shown).

iv. Discussion and conclusion

- Greenhouse gas emissions from biogas production are site specific and mainly influenced by energy crop yield.
- Power production based on biogas generally shows a mitigation potential in contrast to current power mix (0,595 kgCO2eq/kWhel) in context of greenhouse gas emissions.
- As greenhouse gas mitigation is a main target of subsidy laws of renewable energies, regional greenhouse gas emissions could be integrated in subsidy programs.

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