

# ***NO ONE WILL NOTICE? EVIDENCE OF EXTERNAL EFFECTS OF BIOMASS PLANTS ON SUBJECTIVE WELL-BEING***

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## **Overview**

Already today we notice the negative effects of climate change due to an enduring, substantial production of CO<sub>2</sub> emissions. The increasing awareness of this development initiated a rethinking process to mitigate CO<sub>2</sub> emissions and decarbonize the electricity sector. As part of the solution, the ongoing expansion of renewable energy technologies is fostered to avoid CO<sub>2</sub> emissions granted in connection with conventional electricity generation. Besides wind and solar photovoltaics, biomass plants contribute a substantial share to world-wide renewable electricity generation (IAE, 2017). Biomass technology is an important piece of the puzzle to successfully implement the transformation of the electricity sector: It is an almost CO<sub>2</sub> neutral technology that provides flexible production capacities, facilitating the integration of other fluctuating renewables into the system, and contributes to sector coupling by utilizing the waste heat of the electricity generation process.

Even the biomass technology comes along with various benefits, it still has negative external effects. Energy crop cultivation and biomass plants themselves lead to a change of land use. Further negative externalities can be caused by an increasing transportation volume of biomass as well as occasional odor emissions, which may not be appreciated by residents (e.g. Bavarian State Office for Environment, 2011; Dockerty et al., 2012; Kortsch et al. 2015). In this paper, we study whether biomass plants have a significant effect on the people living in their close proximity. We quantify these local negative externalities using the life satisfaction approach. Our empirical strategy rests on a difference-in-differences approach using a comprehensive, newly constructed data set of Germany, which exploits geographical coordinates of both households and biomass plants. It contributes to a developing body of literature of environmental valuation. The impact of wind turbines (Krekel and Zerrahn, 2017), air pollution (Ambrey et al., 2014), or climate change (Maddison and Rehdanz, 2011) on individuals' subjective well-being has been assessed already. Preliminary results show weak evidence that subjective well-being is affected by neighboring biomass plants.

## **Methods**

We use the life satisfaction approach integrated in a difference-in-differences framework. Applying different treatment radii, we assign individuals to the treatment group if a biomass plant was newly constructed within this specified radius. If no biomass plant was built nearby an individual, it becomes part of the control group. A further buffer radius leads to a greater distinction between the treated and the control group. By regressing self-reported subjective well-being on the treatment variable which indicates whether a biomass plant is nearby (and other established covariates), we determine the causal effect of a biomass plant on people's life satisfaction. Furthermore, a comparison between the estimated causal impact and the estimated influence of income on personal life satisfaction provides an estimation of caused external costs.

For a credible identification, we ensure exogeneity of treatment with respect to subjective well-being as the dependent variable. Therefore, we include proven socio-economic control variables on micro and macro level in the model. Fixed effects account for secular time trends and unobserved individual heterogeneity. We control for self-selection by excluding all people who moved and all people who might gain from a newly constructed biomass plants such as farmers. Moreover, the common trend assumption between both groups is secured by state-of-the-art matching approaches, i.e. propensity-score matching and spatial matching. Both techniques ensure that individuals in the control and treatment group are comparable concerning their living conditions. In order to disentangle the externality of odor emission from other externalities, such as a negatively perceived change in land use, we assign treated individuals into two subcategories: the windward and leeward group. Comparing the effect on these groups offers further information whether wind and hence also odor emissions affects the result.

We come up with a new and comprehensive panel data set covering the years 2000 to 2012. It combines three different data sets: While the German Socio-Economic Panel Study (SOEP) provides representative information on private households, the Anlagenregister of the German Federal Network Agency and the publicly available data of

EnergyMap contain characteristics of German biomass plants. Since we use two different data sources of biomass plants, we can perform different plausibility checks and ensure a high level of data quality. The hourly wind speeds and directions in our data set are provided by the MERRA-2 dataset by NASA (Bosilovich et al., 2016).

## Results

First results indicate that biomass plants have a negative impact on individuals' life satisfaction. The identified effect is statistically significant but rather small in monetary terms. The analysis shows that the negative externalities decrease with distance, smaller plant size and are only detectable for a limited time.

A more detailed analysis of the odor emissions as a transmission channel of negative external effects suggests that results are mainly driven by other externalities such as land use change and increasing traffic volume. In this context, the odor emissions seem to play a minor role. Further sensitivity checks validate the robustness of our results. We also test different treatment intensity measures.

## Conclusions

In this paper we investigate whether externalities from a newly constructed neighboring biomass plant influence people's life satisfaction. The analysis rests on a comprehensive panel data set which covers the years 2000 to 2012. It combines German private household information from the SOEP with data of biomass plants. We apply a state-of-the-art microeconomic difference-in-differences design. Our preliminary results indicate that negative externalities affect self-reported subjective well-being. The effect is temporarily and spatially very limited. Our preliminary results point out that some individuals notice the presence of a novel biomass plant. The effect might be rather limited because residents value the advantages of the biomass technology in the context of a successful implementation of the German *Energiewende* and hence evaluate a biomass plant less negatively.

## References

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