# *A SWITCHING REGIME MODEL FOR THE ESTIMATION OF MARGINAL EMISSION FACTORS AND THE IMPLEMENTATION OF SMART CHARGING STRATEGIES*

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## Overview

Global warming has become a major issue, affecting the environment and causing economic losses. The generation of electricity is considered a major driver of climate change, as it emits carbon dioxide (CO2). Therefore, energy system emission changes precipitated by a change in energy generation should be accurately estimated. The marginal emission factor (MEF) is used to describe this change.

## Method

Based on econometric models, this paper proposes a robust empirical methodology for estimating MEF. More precisely the paper proposed three regression models to estimate the MEF, including the simple regression model [Hawkes (2010 & 2014)] the Kalmar filter regression model, and the smooth transition regression (STR) model. Our methodology is applied using hourly data on carbon emissions and generation in Germany.

## Results

Compared to the simple regression model and the Kalmar filter regression model, our smooth transition regression (STR) model performs well.

## Conclusions & Policy Implications

Our findings have several interesting policy implications. To exemplify, when battery electric vehicles charge electricity generated by fossil fuel plants, they produce CO2. Through smart charging, CO2 emissions can be reduced by scheduling charging sessions during lower emission periods. Hence, shifting charging towards times when CO2 emissions are lower can ensure a trade-off between CO2 emissions and charging costs. To achieve this goal, we calculate short-term predictions of MEF. Therefore, drivers can schedule smart charging according to CO2 efficiency based on forecasting. The CO2-saving potential of the German power system can be calculated by comparing this approach with regular charging throughout the year.

## References

Hawkes, A. D. (2010). Estimating marginal CO2 emissions rates for national electricity systems. Energy Policy, 38(10), 5977-5987.

Hawkes, A. D. (2014). Long-run marginal CO2 emissions factors in national electricity systems. Applied Energy, 125, 197-205.