

# ***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 (CO<sub>2</sub>). 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 CO<sub>2</sub>. Through smart charging, CO<sub>2</sub> emissions can be reduced by scheduling charging sessions during lower emission periods. Hence, shifting charging towards times when CO<sub>2</sub> emissions are lower can ensure a trade-off between CO<sub>2</sub> emissions and charging costs. To achieve this goal, we calculate short-term predictions of MEF. Therefore, drivers can schedule smart charging according to CO<sub>2</sub> efficiency based on forecasting. The CO<sub>2</sub>-saving potential of the German power system can be calculated by comparing this approach with regular charging throughout the year.

## **References**

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- 2012 MSc degree in “Modelling in Economics and Econometrics” Polytechnic Institute of Tunisia.  
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- 2019 Ph.D. in Quantitative Finance (with Equivalence Certificate to the German Ph.D. from ZAB), Institute of High Commercial Studies of Sousse (IHEC). Advisor: Prof. Lotfi Belkacem

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- March 2022 - present Postdoctoral researcher at the Chair of Energy Economics Brandenburgische Technische Universität Cottbus-Senftenberg
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Member of FRM Financial Risk Meter  
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### 6. Selected publications

- Ben Amor, S., Althof, M., and Härdle, W. K. “Financial Risk Meter for Emerging Markets”. Research in International Business and Finance. V60, 101594. <https://doi.org/10.1016/j.ribaf.2021.101594>.
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