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**Abstract Format**

**Title:** “Transition towards an All Electric System” – A Merit Order of Electrification

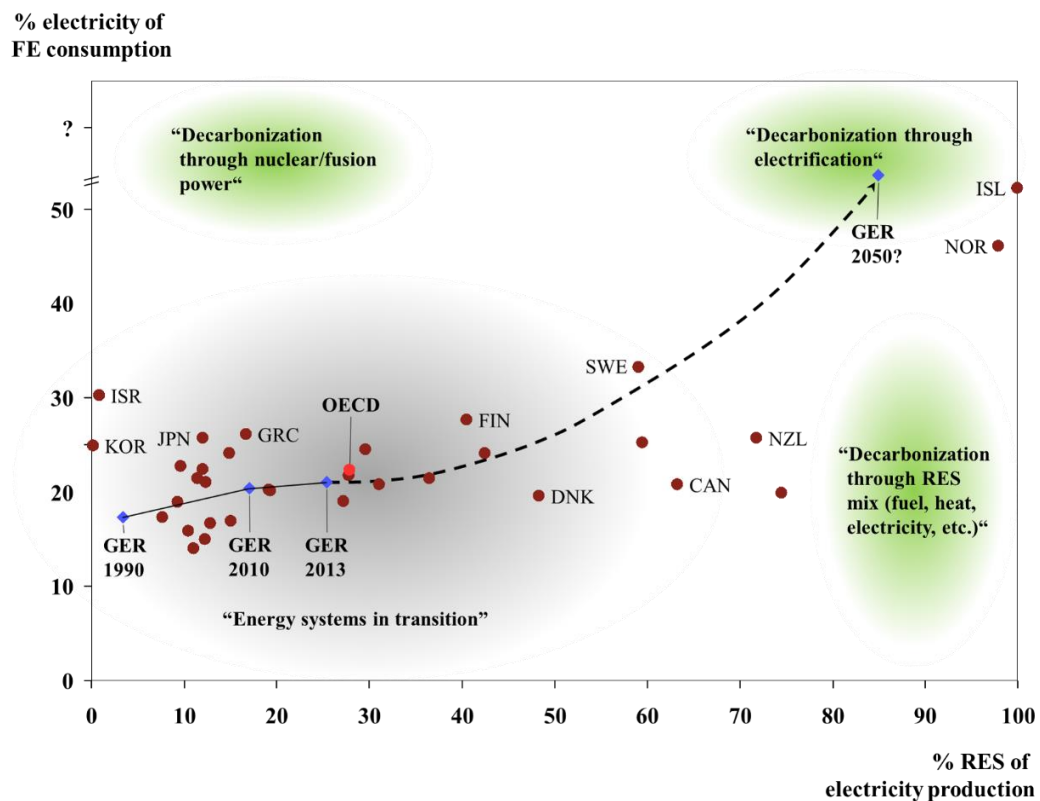
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**Abstract**

In the past, energy system design was primarily focused on securely delivering energy at the lowest cost possible. Today, excessive greenhouse gas (GHG) emissions and the threat of climate change force governments to shift their focus towards decarbonizing their economies.

The German *Energiewende* is considered a pilot project in the field of energy system transition. However, it is unclear which path towards decarbonization the German society will take in future. Installing renewable energy sources (RES), to decarbonize the electricity production sector, is frequently perceived as the central element of the *Energiewende*. Yet to facilitate the reduction of GHG emissions to the target levels set by the German government, fossil fueled processes and applications present in the transport and heating sector also need to be substituted. The green eclipses in Figure 1 represent three possible decarbonization target zones.



**Figure 1 - Current situation in OECD member states and possible paths towards decarbonization<sup>1</sup>**

<sup>1</sup> Own illustration based on data from /IEA-01 14/, /IEA-02 15/, /AGEB-02 13/.

In the light of the nuclear phase out and the rapidly advancing decarbonization of the energy production sector, the target zone “decarbonization through electrification” is a viable option for reducing overall GHG emissions and decreasing Germany’s dependency on oil and gas imports. Consequently, this paper explores to what extent and at what cost Germany’s fossil fueled final energy (FE) can be substituted by electrically powered systems.

In a first step, the FE consumption in households, small and medium enterprises (SME), the industry and the transport sector is analyzed and the theoretical electrification potential determined (TEP). The TEP is defined as the remaining FE after accounting for renewable and electrical FE consumption. The analysis reveals that 60 % of the TEP could be realized by electrifying heating appliances in the domestic, industry and SME sectors. The remaining 40% of the TEP focus predominantly on electrifying the transport sector.

Taking the TEP as a starting point, each sector is analyzed and appropriate electrical substitutes are determined. Using a differential cost approach<sup>2</sup>, the specific cost of electrification is determined in sector specific resolution, by deducting the life-time costs of the most feasible electrical substitute from those of the most common reference technology. The data used is based on values obtained from the literature as well as the Regional Energy System Model<sup>3</sup>. Ultimately, a Merit-Order-of-Electrification is derived from the sectoral results, which depicts the cost-optimal order in which the analyzed processes and applications can be electrified, from an end-user perspective.

## Literature

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<sup>2</sup> Cf. /GOO-01 08/.

<sup>3</sup> Cf. /FFE-04 12/. The Regional Model is an extensive data base, designed by the Research Center for Energy Economics, which delivers demographic, building and energy data in regional resolution.