

# **Advanced scoring method of eco-efficiency in European cities**

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## **Abstract-**

**This paper analyzes a set of selected German and French cities' performance in terms of the relative behavior of their eco-efficiencies, computed as the ratio of their gross domestic product (GDP) over their CO<sub>2</sub> emissions. For this analysis, eco-efficiency scores of the selected cities are computed using the data envelopment analysis (DEA) technique, taking the eco-efficiencies as outputs, and the inputs being the energy consumption, the population density, the labor productivity, the resource productivity, and the patents per inhabitant. Once DEA results are analyzed, the Malmquist productivity indexes (MPI) are used to assess the time evolution of the technical efficiency, technological efficiency, and productivity of the cities over the window periods 2000 to 2005 and 2005 to 2008. Some of the main conclusions are that (1) most of the analyzed cities seem to have suboptimal scales, being one of the causes of their inefficiency; (2) there is evidence that high GDP over CO<sub>2</sub> emissions does not imply high eco-efficiency scores, meaning that DEA like approaches are useful to complement more simplistic ranking procedures, pointing out potential inefficiencies at the input levels; (3) efficiencies performed worse during the period 2000-2005 than during the period 2005-2008, suggesting the possibility of corrective actions taken during or at the end of the first period but impacting only on the second period, probably due to an increasing environmental awareness of policymakers and governors; and (4) MPI analysis shows a positive technological evolution of all cities, according to the general technological evolution of the reference cities, reflecting a generalized convergence of most cities to their technological frontier and therefore an evolution in the right direction.**

**Index Terms-** Eco-efficiency; Cities; Emissions; Data envelopment analysis; Malmquist index

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