

# **A comprehensive techno-economic assessment of the impact of natural gas-fueled distributed generation in European electricity distribution networks**

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## **Abstract-**

**This paper combines three models: an energy simulator (eQuest), the Distributed Energy Resources Customer Adoption Model (DER-CAM), and a Reference Network Model (RNM), to quantify the impact of natural gas-fueled distributed generation (NGDG) in electricity distribution networks. First, eQuest is used to determine the energy profile of each type of building. Then, DER-CAM determines the optimal planning and operation of distributed energy resources. Finally, the hourly profiles of all buildings are processed by RNM to assess the impact of NGDG integration in electricity distribution networks. The reason behind this multi-level approach is that prosumers manage distributed energy resources to maximize their benefits, and later these decisions have an impact upon the electricity distribution networks. We assess this impact. The RNM evaluates power flows to size the network components, and determines the new components required, quantifying the corresponding investments in terms of low and medium voltage network and medium to low voltage transformers. We use this methodology to analyze the sensitivity of network reinforcements to NGDG penetration. Six European networks for urban and semi-urban distribution areas in Germany, Italy, and France have been studied. The results show clear differences in the expected impact in each of these countries. They depend greatly on the level of NGDG penetration and selected network, with network costs ranging up to 150&euro; and savings of 900&euro; per building. Energy losses decrease for low NGDG penetration levels and can double at 100% NGDG penetration levels.**

**Index Terms-** Natural gas, distributed, generation, electricity, distribution, network, planning, reference network model, impact, assessment, model.

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**Citation:**

*Mateo, C.; Frías, P.; Tapia Ahumada, K. "A comprehensive techno-economic assessment of the impact of natural gas-fueled distributed generation in European electricity distribution networks", Energy, vol.192, no.116523, pp.116523-1-116523-10, February, 2020.*