


## OVERVIEW

# Dynamic Line Rating Models and Their Potential for a Cost-Effective Transition to Carbon-Neutral Power Systems

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## ABSTRACT

Most transmission system operators (TSOs) currently use seasonally steady-state models considering *limiting* weather conditions that serve as reference to compute the transmission capacity of overhead power lines. The use of dynamic line rating (DLR) models can avoid the construction of new lines, market splitting, false congestions, and the degradation of lines in a cost-effective way. DLR can also be used in the long run in grid extension and new power capacity planning. In the short run, it should be used to help operate power systems with congested lines. The operation of the power systems is planned to have the market trading into account; thus, it computes transactions hours ahead of real-time operation, using power flow forecasts affected by large errors. In the near future, within a “smart grid” environment, in real-time operation conditions, TSOs should be able to rapidly compute the capacity rating of overhead lines using DLR models and the most reliable weather information, forecasts, and line measurements, avoiding the current steady-state approach that, in many circumstances, assumes ampacities above the thermal limits of the lines. This work presents a review of the line rating methodologies in several European countries and the United States. Furthermore, it presents the results of pilot projects and studies considering the application of DLR in overhead power lines, obtaining significant reductions in the congestion of internal networks and cross-border transmission lines.

## 1 | Introduction

Currently, several transmission system operators (TSOs) use a “steady-state” thermal equilibrium model that takes as reference

extreme seasonal weather conditions to design the maximum capacity of transmission (aka “*ampacity*”) allowed per transmission line for each season, a process usually referred to as *seasonal static line rating* (SSLR) (Karimi et al. 2018; Mínguez