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Title: anyMOD – An open framework for innovative energy system modelling

Abstract: Climate objective can only be achieved, if future energy systems will rely on renewables as a primary source of energy, especially wind and solar. This implies that use of renewable electricity from wind and solar cannot be limited to the power sector anymore but must be expanded, in particular to the heat and mobility sector. To allow for complex interaction of technologies across these sectors while maintaining the level of temporal and spatial detail required to capture the fluctuating nature of wind and solar, poses a challenge for energy system models.

The presented framework includes two unique features to address this challenge: First, the temporal and spatial resolution is not required to be uniform across a whole model, but can be varied depending on the respective energy carrier. For example, an hourly power sector model can be extended by a daily gas balance to substantially lower data requirements and computation time. Second, carriers are organized within an inheritance hierarchy and technologies are not either generators or storage, but also may be a superposition of both, to enable a stylized representation of decentralized solutions within large scale models.

As a result, the developed framework enables researchers to dynamically create elaborated linear energy system models with multiple investment time-steps. Furthermore, its compactness and formulation in a high-level programming language facilitate the coupling of such models and the application of advanced solution strategies (e.g. Benders decomposition).

Key words: Energy modeling, Sector integration, Open source, Julia, High-resolution modeling