The transition to a sustainable power system is posing numerous challenges for system planning and operation. Driven by the intermittent nature of renewable production, there is an increasingly large space of reasonable future operational states that should be covered in planning models. This work proposes a novel method to extract operational states for transmission planning from large input data sets and condense them into a smaller set of representative periods. For this purpose, a machine learning algorithm is leveraged, inspired by the emerging branch of learning-assisted optimization. \*Insert results\*. The obtained improvement in computational efficiency enables future planners to efficiently leverage multi-decade datasets for planning models.

The shift towards a sustainable power system presents formidable challenges in both planning and operation due to the intermittent nature of renewable energy sources. This study introduces an innovative approach for extracting operational states essential for transmission planning from extensive datasets and consolidating them into a reduced set of representative periods. Leveraging machine learning techniques, inspired by the evolving field of learning-assisted optimization, our method achieves insert specific results. This improvement in computational efficiency empowers future planners to effectively harness multi-decade datasets for enhanced planning models, facilitating the transition to a sustainable energy landscape.