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Designing the transition of a natural gas pipeline network to hydrogen considering the chicken-and-egg dilemma

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Long-term investment planning of hydrogen infrastructure suffers from high levels of uncertainty as well as an interdependence between supply and demand uptake, where suppliers are waiting for the emergence of demand and vice versa. Conversely, the decreasing demand for natural gas offers an opportunity to repurpose natural gas pipelines for hydrogen at relatively low costs compared to the construction of new pipelines. We consider these complexities in a two-stage distributionally robust multi-commodity network design problem with decision-dependent uncertainty. As the Column-and-Constraint Generation (CCG) algorithm runs into computational issues due to the inclusion of decision-dependent uncertainty, we propose a branch-and-cut framework that integrates CCG. Computational experiments show significant improvements over standard CCG, with solution times dropping up to 50%.