Natural gas contributes roughly 20% of world energy consumption. Natural gas reserves are plentiful and globally distributed, and natural gas produces less CO2 per unit of energy generated than any other hydrocarbon. The liquefied natural gas (LNG) segment in particular is growing very rapidly and is enabling the emergence of a global natural gas market.

Natural gas value chains have very distinctive features arising from the low volumetric energy density of natural gas, and the significance of gas quality and pressure in supply chain operations. Gas infrastructure investments can be risky due to uncertainties in sources and markets, and the high capital cost and specificity of the infrastructure. This often leads to complex ownership and contractual agreements amongst multiple parties to manage this risk.

This talk will present three case studies applying global optimization formulations to the optimal design and operation of natural gas value chains: a) short-term operational planning in upstream supply chains, b) design and operation of production infrastructure under uncertainty and c) novel liquefied energy chains for the exploitation of remote offshore gas combined with CO2 capture and sequestration with enhanced oil recovery. The case studies underline the ubiquity of nonconvex models and the need for global optimization methods to address the key features of these problems. Moreover, they motivate the development and demonstration of novel methods for large-scale global optimization, in particular: a) reduced-space global optimization, b) global optimization of algorithms and c) duality-based decomposition methods for global optimization under uncertainty.