Europe's resilience of natural gas networks during conflicts and crises probed with maths

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Credit: Wikipedia

Gas networks in Eastern European countries, such as Ukraine and Belarus are less resilient than the UK during conflicts and crises, according to new research from mathematicians at Queen Mary University of London.

The authors suggest that a decentralised approach to managing congestion on gas pipeline networks could be crucial for energy security during geopolitical conflicts or natural disasters, for example.

"Natural gas accounts for 24 per cent of energy consumption in Europe*," said co-author Professor David Arrowsmith from Queen Mary's School of Mathematical Sciences.

"Nations are now undergoing unprecedented change in the nature of energy resources and in their increased interdependency on each other for the security of supply."

Hypothetical scenarios that involve the removal of supply or transit countries from the network were used to create a model that analysed how nations and urban areas are affected.

The scientists found that countries in Eastern Europe are less resilient to a variety of crises than their counterparts in Western Europe.

They analysed the effect of supplying Eastern Europe from Norway and the Netherlands, during an imaginary crisis with Russia, and found that only 5 per cent of demand in Ukraine could be met, even if the West lowered its demand significantly.

They also found that Austria would be considerably affected in such a scenario, not only because of it becoming part of a new West-to-East corridor to supply gas to Eastern Europe, but also because of its considerable dependency on Russian gas.

However, the UK would be spared in a short-term crisis with Russia or Ukraine, but would suffer considerably in a potential crisis with Norway or a loss of supply from Liquefied Natural Gas (LNG).

Co-author Rui Carvalho, Research Fellow at Queen Mary's School of Mathematical Sciences, commented: "Our decentralised control algorithm, which is inspired by mathematical models of internet traffic, manages any disruption automatically, by minimising network congestion in a way that is fair to all parties involved.

"However, to mitigate the effect of crises, nations must ultimately cooperate by sharing access to their energy networks."

Professor Arrowsmith added: "It is a serious challenge to provide informed comment on the resilience of the changing international energy

supply and demand networks, not least in deciding the criteria by which governments and energy supply companies should operate for a beneficial distribution of resource.

"The paper is an attempt to develop a framework for fairness of gas network flow and a discussion of networks at a continental level. We hope that the paper provokes serious discussion."

The research paper is published in the journal *PLOS ONE* today.

More information: 'Resilience of natural gas networks during conflicts, crises and disruptions' will be published in the journal *PLOS ONE* on Wednesday 12 March: dx.plos.org/10.1371/journal.pone.0090265

Provided by Queen Mary, University of London