Is natural gas a 'bridge' to a hotter future?

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A natural gas plant in Moss Landing, California, courtesy of Carnegie President Matthew Scott. Credit: Carnegie President Matthew Scott

Natural gas power plants produce substantial amounts of gases that lead to global warming. Replacing old coal-fired power plants with new natural gas plants could cause climate damage to increase over the next decades, unless their methane leakage rates are very low and the new power plants are very efficient.

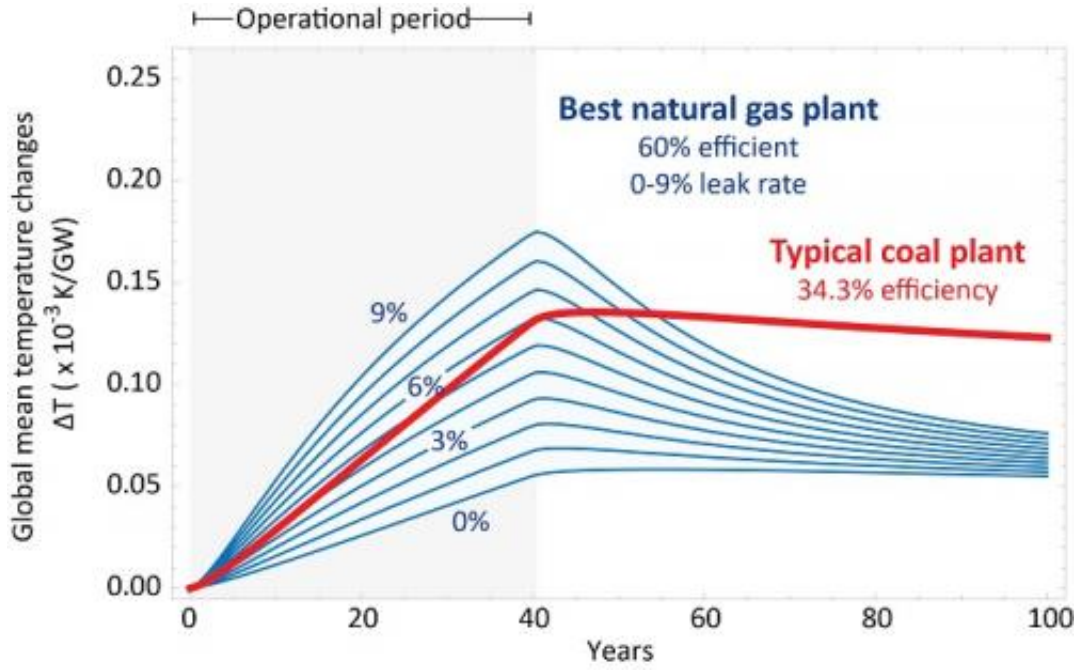
These are the principal findings of new research from Carnegie's Ken

Caldeira and Xiaochun Zhang, and Nathan Myhrvold of Intellectual Ventures that compares the temperature increases caused by different kinds of coal and natural gas power plants. Their work is published in *Environmental Research Letters*.

There is an ongoing debate among people concerned with power plants and the future of energy policy and greenhouse gas emissions. Does it makes sense to replace old coal-fired power plants with new natural gas power plants today, as a bridge to a longer-term transition toward near zero-emission energy generation technologies such as solar, wind, or nuclear power? A key issue in considering the decision has been the potential climate effects of natural gas versus coal. Studies have yielded different results by focusing on power plants with different characteristics and using different definitions of what it means to be "better" for climate.

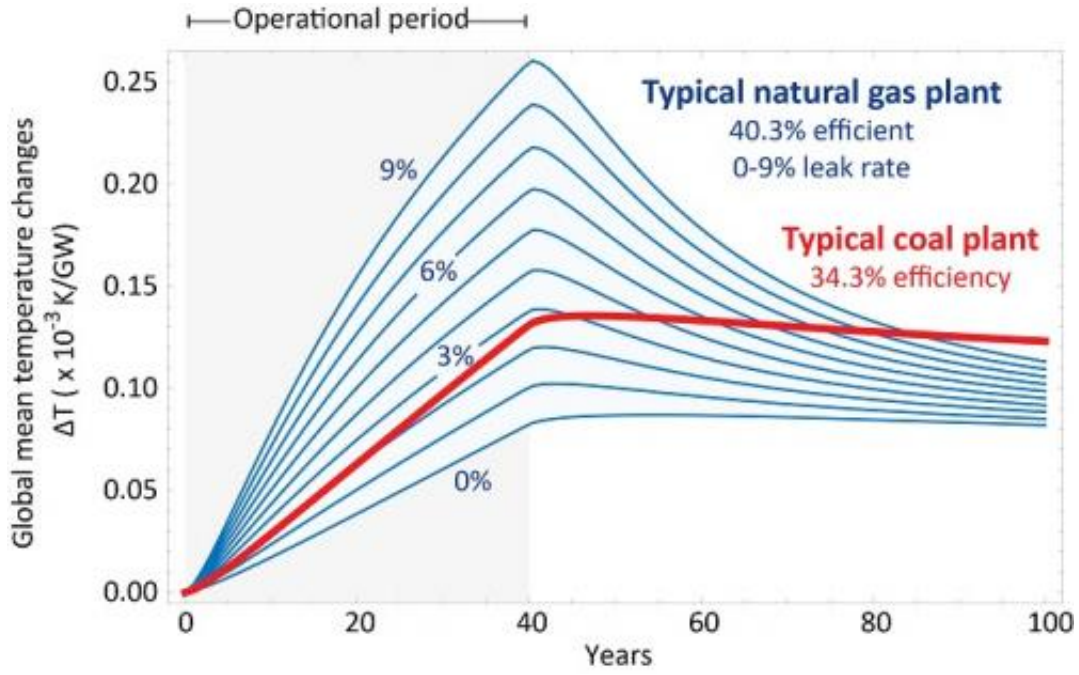
Carnegie's Caldeira and Zhang, along with Myhrvold, aimed to identify the key factors that are responsible for most of the difference in greenhouse gas emissions between individual gas and coal plants. The key factors, they found, are power plant efficiency and, in the case of natural gas plants, methane leakage during the supply process. They used these factors to derive a simple model for resulting temperature change caused by the carbon dioxide and methane released by a particular plant.

The team chose a simple and understandable way to compare climate effects of different types of power plants. They predicted how much global warming would be produced by different kinds of power plants during and after their period of operation.



A comparison of the best natural gas plant with the typical coal plant, courtesy of Ken Caldeira. Credit: Carnegie's Ken Caldeira

They found that because natural gas plants are overall more efficient than coal plants, producing more energy per unit of carbon, they could cause less warming in the long term. However, it all depends on the amount of methane leakage that occurs. Natural gas plants that leak a substantial amount of methane during their supply process can produce more warming than comparable coal plants.



A second comparison of the typical natural gas plant with the typical coal plant, courtesy of Ken Caldeira. Credit: Carnegie's Ken Caldeira

"If there is substantial natural gas leakage, then building new natural gas plants would lead to more near term climate damage than using the old dirty coal plants," explained Caldeira. "But natural gas plants would help reduce other types of air pollution that damage our health, and would be somewhat better for climate in the long term."

If faced with the choice of shutting down either a typical coal plant or a typical gas plant and methane leakage from the natural gas plant is below about 2 percent of total fuel, there would be a short-term climate benefit to shutting down the coal plant instead of the natural gas plant, the team found. But if methane leakage would be greater than 2 percent, there would be less warming in the near term if the natural gas plant were shut down instead of the coal plant.

Regardless, the team emphasized that meeting upcoming greenhouse gas emission targets will require deeper emissions cuts than just building natural gas plants with low methane leakage. If natural gas is to be a part of a future near-zero emission energy economy, methods for capturing and storing carbon from gas-fired power plants will likely be necessary.

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