



Project update

Modeling combustion gases to reduce carbon

Project details		Key aims
<b>Project title</b>	Equation of State for Combustion Gases and Combustion Gas-like Mixtures	
<b>Participant</b>	Ruhr-University Bochum, Germany	
<b>Start date</b>	2007	<ul style="list-style-type: none"> <li>• Accelerate development of climate-friendly energy technologies</li> <li>• Increase understanding of complex processes in energy production</li> <li>• Highlight the potential role for low carbon technologies in the future energy mix.</li> </ul>
Project summary		
<p>Scientists are developing new computer models that will advance low carbon technologies as part of E.ON's International Research Initiative.</p> <p>The project will provide important information to help the energy industry to bring forward the next generation of sustainable sources of power.</p> <p>The aim is to increase knowledge about complex chemical and physical processes in four key areas:</p>	<ul style="list-style-type: none"> <li>• Clean coal combustion</li> <li>• Advanced gas turbines</li> <li>• Carbon capture and storage</li> <li>• Energy storage using compressed air.</li> </ul> <p>This research proposal was put forward by Professor Roland Span, the Chair of Thermodynamics at the Ruhr-University Bochum, Germany.</p> <p>The project plans to develop new thermodynamic property models - mathematical equations - that reveal what</p>	<p>is happening in the physical and chemical processes more accurately than the models which are currently available.</p> <p>The researchers are focusing on the changes that occur in combustion gases and similar mixtures, and in liquids, vapors and solid compounds as the technologies operate. The new model will cover a range of gas mixtures, at differing temperatures and pressures, all related to producing energy in cleaner ways.</p>

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**The initial phase of the project focused on a thermodynamic property model known as the GERG-2004 Wide Range Equation of State for Natural Gas and Other Mixtures.**

This model is the most accurate description available for representing the thermophysical properties of fluid mixtures in natural gas applications.

Furthermore, it can be employed for a wide range of other applications, such as the working fluid mixtures of advanced fossil-fuel power cycles.

However, the model had not been tested in detail for the range of temperatures, pressures and compositions involved in these technologies. They include oxyfuel cycles, humidified gas turbines, post-combustion CO<sub>2</sub> treatment and compressed air energy storage.

This initial work - one of four areas in the project - consisted of evaluating the model for use with CO<sub>2</sub> mixtures, humid air and combustion gases.

The objectives were to:

- Set up a database of the thermodynamic properties relevant to each of the areas using inputs from commercial and research sources.
- Compare the database with additional data from experiments, published literature, theoretical work and other models. More than 26,000 data points from some 350-plus experimental sources were collected and added to the database.

After processing into standard international units, the data were run through the GERG-2004 model.

The differences between the results and the experimental data provided the

basis for evaluating the model.

A summary of the findings shows that the GERG-2004 model performed "excellently" for some mixtures of elements. But for others - mixtures where CO<sub>2</sub> and/or water are involved - it was not consistent across the range of values.

Nonetheless, it concluded that the model was "superior" to others currently available.

The findings were presented to the project's own advisory board. It was agreed to try to make improvements to the model and carry out minor work to complete the database.

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