Modeling Advanced Designs for Zero Emission Power Plant Technologies
Klaus S. Lacker, Xin Xin Li

Introduction and Background
The study, a collaborative project undertaken at Columbia University between the Earth and Environmental Engineering Department of the School of Engineering and Applied Sciences and the Lenfest Center for Sustainable Energy of the Earth Institute, is working to develop a computational model that will simulate power plant components and will enable modeling of advanced designs. A methodology pathway that integrates new fuel combustion concepts with high-temperature oxygen separation membranes, advanced turbines, fuel cells and advanced combustion in pressurized fluidized beds will be developed, based on the results of the modeling analysis.

Comparing with Different Power Plant Modeling Methods

<table>
<thead>
<tr>
<th>Power plant modeling methods</th>
<th>Accuracy</th>
<th>Ease of use</th>
<th>Development/Example</th>
<th>FEEDS library</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFD</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Aspen Plus</td>
</tr>
<tr>
<td>Dynamics</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>ASPEN Plus</td>
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<td>Fluid Statics</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>IECM</td>
</tr>
<tr>
<td>Computation</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Chemical Engineering Design (Carcasci, 1996)</td>
</tr>
</tbody>
</table>

Example of Cycles to Be Modelled

A Zero Emission Power Plant Roadmap

A Zero Emission Power Plant utilizing low Arzenes National Laboratories zero emission partial oxidation for heating (ZEP) Technology. Combustion hydrogen without combustion and converted to electricity via a solid oxide fuel cell. Using calcium carbonate from the initial reaction and waste heat from the fuel cell, the plant recycles calcium oxide for further hydrogen production and removes CO2 in concentrated streams for permanent disposal through mineral carbonation.

References: