

Accepted Manuscript

Optimal design and operations of a flexible oxyfuel natural gas plant

Holger Teichgraeber, Philip G. Brodrick, Adam R. Brandt

PII: S0360-5442(17)31606-7

DOI: [10.1016/j.energy.2017.09.087](https://doi.org/10.1016/j.energy.2017.09.087)

Reference: EGY 11581

To appear in: *Energy*

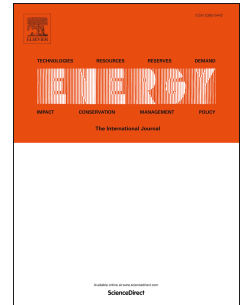
Received Date: 29 June 2017

Revised Date: 18 September 2017

Accepted Date: 18 September 2017

Please cite this article as: Teichgraeber H, Brodrick PG, Brandt AR, Optimal design and operations of a flexible oxyfuel natural gas plant, *Energy* (2017), doi: 10.1016/j.energy.2017.09.087.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Optimal design and operations of a flexible oxyfuel natural gas plant

Holger Teichgraeber^{a,*}, Philip G Brodrick^a, Adam R Brandt^a

^a*Department of Energy Resources Engineering, Stanford University, Green Earth Sciences Building 065, 367 Panama St., Stanford, California, USA*

Abstract

We co-optimize the design and operations of a flexible semi-closed oxygen-combustion combined cycle (SCOC-CC) carbon capture plant under time-varying electricity prices. The system consists of a cryogenic air separation unit, liquid oxygen storage, a gas turbine, a heat-recovery steam generator, and a steam turbine. The gas turbine is modeled allowing part-load operation. Computational optimization is used to maximize net present value (NPV) in order to examine the potential benefits achievable through upfront investments in increased flexibility (i.e., allowing price arbitrage between times of low and high price). Case studies of Germany and California are examined. Flexible SCOC-CC systems are not profitable in either region under current electricity prices. With electricity prices ≈ 2 times current prices, we find systems with positive NPVs. Oxygen storage is used in days with extreme price variability. Optimal designs favor constant operation, without over- or under-sizing system components and without additional oxygen storage. Sensitivity analyses show that external factors such as mean electricity price ($\pm 200\%$), natural gas price ($\pm 150\%$), and nominal discount rate ($\pm 50\%$) have the strongest effect on NPV. Electricity price variability, which is thought to increase with increased penetration of renewables, does not strongly impact system design and profitability.

Keywords: Nonlinear Optimization, Semi-closed oxygen-combustion combined cycle, Thermodynamic and cost modeling, Carbon capture, Gas turbine, Air separation unit

*Corresponding author. Tel: +1-650-725-0851

Email addresses: hreich@stanford.edu (Holger Teichgraeber), brodrick@alumni.stanford.edu (Philip G Brodrick), abrandt@stanford.edu (Adam R Brandt)

Download English Version:

<https://daneshyari.com/en/article/8072640>

Download Persian Version:

<https://daneshyari.com/article/8072640>

[Daneshyari.com](https://daneshyari.com)