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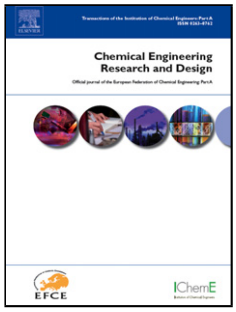

Title: A General Optimization Framework for the Design and Planning of Energy Supply Chain Networks: Techno-economic and Environmental Analysis

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PII: S0263-8762(17)30661-5
DOI: https://doi.org/10.1016/j.cherd.2017.11.043
Reference: CHERD 2922

To appear in:

Received date: 9-9-2017
Revised date: 25-11-2017
Accepted date: 29-11-2017

Please cite this article as: Zulkafli, Nur I., Kopanos, Georgios M., A General Optimization Framework for the Design and Planning of Energy Supply Chain Networks: Techno-economic and Environmental Analysis.Chemical Engineering Research and Design https://doi.org/10.1016/j.cherd.2017.11.043

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ACCEPTED MANUSCRIPT

A General Optimization Framework for the Design and Planning of Energy Supply Chain Networks: Techno-economic and Environmental Analysis

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HIGHLIGHTS

- A unified modeling representation (E-STN) for material and energy supply chains.
- General optimization model for the design/planning of material and energy supply chains.
- Optimization of capacity expansion, energy mix, techno-economic & environmental aspects.
- Emissions caps are more effective measures for emissions reduction than emissions costs.
- Cost versus emissions study via sensitivity analysis and multi-objective optimization.

Abstract

A general spatial optimization framework that relies on the use of a modified state-task network representation for design and planning problems in material and energy supply chain networks is presented. In brief, the proposed optimization framework considers for the tasks and states of the network: (i) the optimal selection and sizing of conversion, transfer and storage technologies, (ii) the capacity expansion for each technology over time, (iii) the inventory level for storable states, (iv) the quantity of states converted or transferred through tasks, and (v) the optimal energy mix. Several variations of an illustrative design and planning problem of a mixed material and energy supply chain network have been solved effectively to study the trade-off between costs and

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