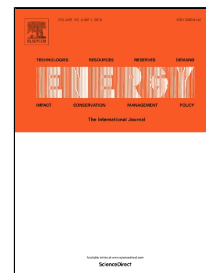


# Accepted Manuscript

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# A Novel Hybrid Exergy/Pinch Process Integration Methodology

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## Abstract:

The trend of global energy demand forecasts a continuous increase in the forthcoming years together with a diversification and differentiation of energy sources. In order to ensure the energy systems transition towards a sustainable functioning mode while avoiding early depletion of energy resources, industrial activities need to foster process improvement. Among energy efficient process design methodologies, pinch analysis and exergy analysis are two powerful methods but each one shows drawbacks. This paper introduces a new methodology that uses the Jacobian Matrix of exergy destruction as a mathematical indicator to couple the Pinch and the exergy analysis and overcome their individual limitations. In the proposed approach, exergy analysis is used not only to assess the exergy losses but also to guide the changes needed in industrial processes structures and operating conditions. And while the pinch analysis considers only heat integration, the proposed methodology allows including other recoverable exergy in a process through thermodynamic conversion. In this paper, the guidelines of the methodology are first detailed. When applied on a basic natural gas liquefaction process, the proposed approach will numerically result in a new improved process comparable to the existing, most widely used natural gas liquefaction process. The main advantage of the methodology is time saving compared to holistic operating conditions improvement as in the traditional process design methods and automatic process structure modification leading to better heat integration.

## Keywords:

Hybrid Methodology, Energy Integration, Exergy Analysis, Process Design.

## 1. Introduction

Industry and industrial processes are in continuous development due to demographic and economic growth. Along with this development, the overall demand of energy is on the rise accompanied by various environmental problems, industrial competitiveness and natural resources depletion. Therefore, there is a need to exploit available resources through the improvement of industrial processes. Pinch analysis and exergy analysis are two powerful energy efficient process design methodologies. However, these two methods, each presenting disadvantages, are used independently of one another and few systematic interactions between them have been studied.

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