

## Article

# Evolutionary Analysis of the Solar Photovoltaic Products Trade Network in Belt and Road Initiative Countries from an Economic Perspective

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**Abstract:** Against the backdrop of global energy transition and the imperative for sustainable development, the trade dynamics of solar photovoltaic (PV) products among “Belt and Road Initiative (BRI)” countries gained momentum. This study investigates the evolving trade patterns of PV products within BRI nations, alongside the underlying determinants. The paper constructs and analyzes a solar PV product trade network, elucidating evolutionary trends, structural complexities, and clusters. A novel centrality influence model explores influencing factors across five dimensions. Methodologically, trade data, the “Five Connectivity” framework, and socio-economic indicators from 2001 to 2022 across 65 BRI countries underpin the study. Empirical insights reveal a robust PV product trade network with density exceeding 0.4 and reciprocity surpassing 0.38. China's rising centrality, reflected in a weighted degree surge from 14.38 to 79.37 since 2011, signifies its consolidation within the network. Results show sustained high density and reciprocity in the PV trade network, signaling robust communication among BRI countries. China's centrality in the network has consistently grown since 2011. Trade cluster analysis reveals isolated segments predominant, depicting emerging economies with limited photovoltaic exchanges, mainly export-focused. The study highlights the pivotal role of “Five Connectivity” dimensions in promoting PV trade, while financial connectivity's impact remains modest. The emergence of PV product centers challenges traditional energy hubs, prompting the need for new energy trading paradigms and robust financial hubs.

**Keywords:** solar photovoltaic (PV) products trade; Belt and Road Initiative (BRI); green and sustainable development; comprehensive network model; factors influencing PV products network



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## 1. Introduction

The Belt and Road Initiative (BRI), introduced by China in 2013, aims to enhance trade, foster infrastructure development, and facilitate international collaboration across Asia, Africa, and Europe. As part of this expansive initiative, there was considerable attention directed towards the trade of solar photovoltaic (PV) products due to their potential to drive green and sustainable development [1]. These nations, positioned along the Belt and Road, possess strategic resources such as oil, coal, natural gas, and uranium, endowing them with pivotal roles in global supply chains and offering prospects for mutually beneficial partnerships. Approaching its 10th anniversary, the BRI places a heightened emphasis on achieving green and sustainable growth, given the escalating global greenhouse gas emissions [2]. Solar PV products encompass a broad array of technologies and equipment designed to convert sunlight into electricity through the photovoltaic effect. These include solar cells, which are the basic units for electricity generation, and solar panels, which are assemblies of these cells. Inverters play a crucial role in converting the direct current generated into usable alternating current. Mounting

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investment and promoting private sector development International cooperation can also help by more evenly distributing short term costs across economies

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*Latin American Economic Outlook 2022 Towards a Green and Just Transition* OECD, European Commission, CAF Development Bank of Latin America, Economic Commission for Latin America and the Caribbean, 2022-11-07 What challenges and opportunities does the green transition entail for Latin America and the Caribbean This 15th edition of the Latin American Economic Outlook explores options for the region to recast its production models transform its energy matrix and create better jobs in the process

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provides an overview of the global progress in achieving renewable energy goals through sustainable and economically viable means Volume II covers various potential renewable energy sources such as solar wind hydro and biomass including the technologies associated with each that are economically feasible while still being environmentally sustainable in their implementation This then leads into a discussion of how a transition to a green economy based on renewable energy could be achieved including global opportunities trends policy considerations and societal implications The book will appeal to academics industry professionals and policy makers engaged with the energy economy renewable energy research and environmental sustainability     **Energy** ,1977



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