

City-scale input–output evidence of marine sectors' carbon-efficiency advantage in China

Topic: Input-Output Analysis: Energy policies (2)

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Marine economies in bay-area cities are expanding rapidly, yet their implications for carbon mitigation along integrated land–sea supply chains remain unclear. Here, we construct city-level, environmentally extended multi-regional maritime input-output (MMRIO) tables for China’s three major bay areas and develop multi-scope carbon-efficiency (i.e., carbon emissions burdens relative to value added) metrics that distinguish direct, indirect, complete (direct + indirect), and pull-to-city effects. On a supply-chain basis, marine activities are statistically more carbon-efficient than non-marine activities, and this advantage propagates upstream to supplier cities through national production networks. Consistent with this pattern, 81%–96% of upstream cities across the three bay areas already exhibit decoupling between marine-induced economic growth and associated emissions, and in 56%–62% of cities the marine-induced component is both more efficient than the non-marine counterpart and improving over time. These findings highlight bay-area marine industrial chains function as key carbon-efficient anchors within China’s economy, supporting urban decarbonization beyond coastal hubs. By situating bay-area development within a national supply-chain perspective, our framework offers a reproducible basis for benchmarking sectoral efficiency and for designing coordinated land–sea policies that amplify green spillovers to inland cities.