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國際跨海進口電力發展借鏡與初期導入作法研析

Insights from International Cross-Border Electricity Imports and Initial Implementation Strategies

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摘要

在全球邁向淨零碳排與電力市場整合的趨勢下，跨國輸電與海底電纜建設日益成為各國能源轉型與能源安全的重要策略工具之一。臺灣若欲參與區域電力合作，亟需借鑑國際經驗，建立適合本土條件之制度與推動策略。本文聚焦於近十年國際主要跨海輸電專案，從中篩選出義大利與蒙特內哥羅電纜、愛爾蘭與法國電纜等具我國政策參考價值之案例。

研究發現，跨國電力合作除仰賴技術成熟與財務可行性，更需建立完備法規與多邊合作架構首先案場推動皆以法制先行，並建立電力進口審查或碳排規範；商業面，雙方投資比例與資產分配機制需事前明確，方能確保專案可行；技術面，深海電纜面臨長度、深度與承包風險，且涉及跨國合作開發時程往往長達 10 年以上。如欲投入，應及早評估相關法規、制度與技術配套，並與理念相近之民主國家合作，共同推動區域經濟發展與減碳目標。

Abstract

Amid the global transition toward net-zero carbon emissions and increasing electricity market integration, cross-border electricity transmission and submarine cable infrastructure have become strategic tools for advancing energy transition and ensuring energy security. For Taiwan to participate effectively in regional electricity cooperation, it is essential to draw lessons from international experience and establish regulatory frameworks and policy strategies adapted to domestic conditions. This study reviews major international submarine interconnection projects over the past decade, highlighting cases of particular relevance to Taiwan's policy context, including the Italy–Montenegro Interconnector and the France–Ireland Celtic Interconnector.

The analysis reveals that successful cross-border electricity projects depend not only on mature technologies and financial feasibility but also on robust legal frameworks and multilateral cooperation mechanisms. Specifically, early-stage initiatives emphasize legal groundwork, including import approval procedures and carbon emission standards. Commercial arrangements, such as clearly defined investment shares and asset allocation mechanisms, are crucial for project viability. Technically, deep-sea cables face challenges associated with transmission distance, seabed depth, and contractor capacity, with project development timelines often exceeding ten years. To advance Taiwan's involvement, early assessment of relevant legal, institutional, and technical frameworks is recommended, along with strategic partnerships with like-minded democratic countries, thereby supporting regional economic integration and carbon reduction objectives.

關鍵詞(Key Words)：跨國輸電(Cross-border Electricity Transmission)、海底電纜(Submarine Cable)、區域電網(Regional Power Grid)。

161kV 大豐~信南線充油電纜改接設計解決方案

Design Solutions for the Re-routing of the 161 kV Dafeng-Xinnan Oil-Filled Cable

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摘要

本工程為第七輸變電計畫，施工內容包含充油電纜(O.F.cable)引接至連接站，並擴充為複導體，惟經現場勘查電纜台架為單導體台架且平台空間不足無法擴充，以致需增加平台面積滿足擴充需求，另現今電纜以 XLPE 電纜為主，充油電纜之材料已少量購置，使本案需調用本公司庫存電纜，並透過充油補油及油槽容量設計，選定材料規格，及架空導線(ACSR)的改接、連接站引下線的換相，原目標需於 2019 年完成，惟需待 161kV 深美~七張線加入系統後方能改接，倘深美~七張線未完成，而逕改接信南~大豐線為台北~信南、大豐線及秀朗~信南、大豐線時，發生另一回線事故，則大豐 D/S、七張 D/S 及店捷 C/S 將同時全黑，系統風險極高，需俟深美~七張線送電後方解進行停電改接。

Abstract

This project forms part of the Seventh Transmission and Substation Development Program. The scope of work includes rerouting oil-filled (O.F.) cables to a junction station and expanding the system configuration to a multiple-conductor arrangement. However, site investigations revealed that the existing cable rack was designed for a single conductor and that the available platform space was insufficient to accommodate the required expansion. As a result, an increase in platform area is necessary to meet the expansion requirements. Given that cross-linked polyethylene (XLPE) cables are now the dominant cable type and that only a limited quantity of O.F. cable materials is commercially available, this project requires the use of cables from the company's existing inventory. Material specifications are determined based on oil filling requirements and oil reservoir capacity design, together with the reconfiguration of overhead conductors (ACSR) and phase rearrangement at the connection stations.

Although the project was originally scheduled for completion in 2019, the rerouting work can only be carried out after the 161 kV Shenmei-Qizhang Line is energized and integrated into the power system. If the Shenmei-Qizhang Line is not completed and the Xinnan-Dafeng Line is rerouted prematurely to form the Taipei-Xinnan-Dafeng and Xiulang-Xinnan-Dafeng circuits, a subsequent fault on any one circuit would result in a simultaneous blackout at the Dafeng Distribution Substation (D/S), Qizhang Distribution Substation (D/S), and Dianjie Converter Station (C/S), posing an extremely high system risk. Therefore, the rerouting must be deferred until the Shenmei-Qizhang Line is commissioned to ensure system reliability and operational safety.

關鍵詞(Key Words)：充油電纜(Oil-filled Cable)、電纜橋(Cable Bridge)、橋樑附掛(Bridge Attachment)。

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鋼套管氣動鑽掘式擋土柱與回收式地錨工法之監造實務應用

Supervisory Practices for Steel-Casing Pneumatic DTH Drilling Retaining Piles and Removable Ground Anchor Method

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摘要

本文旨在介紹鋼套管氣動鑽掘式擋土柱與回收式地錨工法於台電水滴配電中心第一期配電大樓地下室開挖工程之應用。該基地位於台中市北屯區水湳路及水湳路 118 巷交叉口，地質以卵礫石夾砂土層為主，且鄰近人口密集區及學校，施工條件受限。為因應場地條件與提升施工安全及品質，採用氣動鑽掘式擋土柱作為主要的垂直擋土結構，負責抵抗土壤壓力，維護開挖面穩定；而回收式地錨則作為水平支撐，提供擋土柱額外的反力與穩定性，共同確保整個開挖工程的安全。本文說明工法原理、施工流程、監造實務，提供深開挖工程在複雜地質與都市環境下之應用參考。

Abstract

This article presents the practical application of the steel-casing pneumatic down-the-hole (DTH) drilling retaining piles and removable ground anchor method in the basement excavation project of Phase I of the Shuinan Power Distribution Center building, Taiwan Power Company. The site, located at the intersection of Shuinan Road and Lane 118 in Beitun District, Taichung City, is underlain predominantly by gravelly sand layers interbedded with cobbles, and is situated near densely populated areas and schools, imposing significant construction constraints. To accommodate site conditions and enhance excavation safety and quality, pneumatic DTH drilling retaining piles were adopted as the primary vertical support to resist soil pressures and maintain excavation stability. Removable ground anchors were employed as horizontal supports, providing additional reaction forces and overall structural stability. The article details the underlying method principles, construction workflow, site-specific challenges, mitigation strategies, and supervision practices. The findings offer a practical reference for implementing deep excavation works in complex geological conditions within urban environments.

關鍵詞(Key Words): 氣動鑽掘式擋土柱(Pneumatic DTH Drilling Retaining Piles)、鋼套管(Steel Casing)、回收式地錨工法(Removable Ground Anchor Method)、回收式鋼鍵(Tendon)。

公有路外停車場設置電動汽車快速充電站之最佳化選址-以臺北市為例

Optimal Site Selection for Electric Vehicle Fast-Charging Stations at Public Off-Street Parking Facilities : A Case Study of Taipei City

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摘要

本文旨在建構臺北市公有路外停車場設置電動汽車快速充電站的最佳選址模型，研究中首先分析設置充電站的重要考量因素，並設定三種電動汽車市占率情境，接著蒐集臺北市的小客車數量、公有路外停車場位置、主要交通幹道等相關資料，以估算充電站數量。最後，利用 GMM 演算法進行分群，使充電站分布不會過度集中，並以與交通幹道距離最短為目標函數，進行最佳化求解。研究結果顯示，臺北市應最優先設置快速充電站之公有路外停車場共有 5 座。而在電動車低度發展情境下，須設置 27 座快速充電站；在中度與高度發展情境下，分別須設置 68 座及 119 座快速充電站，本研究可作為臺北市未來於公有路外停車場設置充電基礎設施之參考。

Abstract

This study aims to develop an optimal site selection model for the deployment of electric vehicle (EV) fast-charging stations at public off-street parking facilities in Taipei City. We first identifies key factors influencing charging station siting and establishes three EV market penetration scenarios. Data on the number of passenger vehicles, the locations of public off-street parking facilities, and major traffic corridors in Taipei City are then collected to estimate the required number of fast-charging stations.

To prevent excessive spatial concentration, a Gaussian Mixture Model (GMM) clustering algorithm is applied to group candidate sites, and an optimization model is formulated with the objective of minimizing the distance between charging stations and major traffic corridors. The results indicate that five public off-street parking facilities should be prioritized for the initial deployment of fast-charging stations in Taipei City. Under the low EV adoption scenario, 27 fast-charging stations are required, while the medium and high adoption scenarios require 68 and 119 stations, respectively. The findings of this study provide a reference for the future planning and deployment of EV fast-charging infrastructure at public off-street parking facilities in Taipei City.

關鍵詞(Key Words): 電動汽車(Electric Vehicle, EV)、公共充電設施選址(Public Charging Station Site Selection)、快速充電站(Fast-Charging Station)、GMM 演算法(GMM Algorithm)。

高壓用戶參與需量反應操作特性之查詢應用系統開發

Development of the Query Application System for Analyzing the Demand Response Characteristics of High-Voltage Users

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摘要

為協助台電公司同仁提升推動高壓用戶參與「需量反應負載管理措施」之效率，本研究以產業製程特徵、過往需量反應執行實績、用戶用電行為趨勢等為基礎，建置「高壓用戶需量反應特性查詢應用系統」。查詢應用系統不僅呈現產業製程之程序特徵及具降載/卸載潛力之製程設備，亦整合同產業用戶需量反應執行成效，以引導用戶之同儕比較效應。本研究成果可作為實務端推動需量反應之資訊支援工具，透過本查詢應用系統，台電公司同仁可於拜訪前快速掌握目標用戶背景與需量反應執行建議，提升溝通效率與輔導精準度。

Abstract

To enhance the efficiency of promoting high-voltage customer participation in the Demand Response Load Management Program, this study develops the Query Application System for Analyzing the Demand Response Characteristics of High-Voltage Users. The system is constructed based on industrial process characteristics, historical demand response performance, and trends in electricity consumption behavior. It not only presents the procedural features of industrial production processes and identifies process equipment with potential for load reduction or shedding, but also integrates demand response performance data from users within the same industry to facilitate peer comparison effects. The proposed system serves as an information support tool for the practical implementation of demand response programs. Through this query application system, Taipower staff can rapidly obtain background information on target users and receive recommendations for demand response implementation prior to site visits, thereby improving communication efficiency and the accuracy of user guidance.

關鍵詞(Key Words)：需量反應(Demand Response)、生產製程(Production Process)、資訊查詢系統(Information Query System)。

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淨零轉型下電業研發關鍵績效指標之探討

A Study on Key Performance Indicators for Power Industry R&D under the Net-Zero Transition

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摘要

面對全球氣候變遷趨勢，台電身為我國推動零碳能源的重要角色，對於電力產業的創新轉型並與利害關係人及社會大眾進行有效溝通，已成為當前重大課題，本文透過文本分析，參考韓國電力公司、日本東京電力公司、德國萊茵集團及美國南方電力公司等國際電業組織經驗，借鏡其研發策略目標、主要績效展現重點與指標項目，作為台電研發關鍵績效指標之優化參考，藉此具體反映台電研發計畫的研發投入量能，同時，也評估其運用效益與對產業的影響力。

Abstract

In response to the global climate change, Taipower plays a pivotal role in advancing Taiwan's transition toward zero-carbon energy. Promoting innovation and transformation within the power industry, while effectively communicating with stakeholders and the general public, has become a critical challenge.

This article employs text analysis to examine and draw insights from the experiences of international electric power utilities, such as Korea Electric Power Corporation (KEPCO), Tokyo Electric Power Company (TEPCO), RWE, and the Southern Company. By analyzing their R&D strategic objectives, key performance emphases, and indicator frameworks, this study provides reference points for optimizing Taipower's R&D key performance indicators. These indicators aim to more concretely reflect Taipower's R&D investment capacity, assess the effectiveness of resource utilization, and evaluate the broader industrial impacts of its R&D initiatives.

關鍵詞(Key Words)：淨零碳排(Net-Zero)、研究發展(Research and Development, R&D)、關鍵績效指標(Key Performance Indicators, KPI)。

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2035 台灣電力前瞻情境規劃研究

Prospective Scenario Planning for Taiwan's Power Sector in 2035

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摘要

本研究之目的在於透過系統性與科學化的方法，描繪 2035 年台灣電力前瞻發展的可能樣態，探討台電達成 2035 年減碳最大化的可行策略，並以具時間軸的策略藍圖呈現。本研究採用情境基礎策略藍圖(SBSR)方法，透過情境分析建構 2035 年台電減碳最有利、最可能與最不利之 3 種情境。再由情境內容之推導與分析，及透過台電主管會議之討論，選擇「提高氫氣混燒比例」、「增加 CCS 設置與應用」與「擴大再生能源發電占比」等 3 項發電端之關鍵議題，進行減碳策略影響因素之探討，以形塑可行之 1) 發展海上 PV；2) 更新陸域風電；3) 購買競標離岸風電；4) 發展深層地熱；5) 燃氣混氫發電；6) 燃氣 CCS；7) 燃煤 CCS 等七項減碳策略。最後分別描繪 3 種情境之七項減碳策略的策略藍圖，以供台電實現 2035 年減碳目標參酌。

Abstract

This study employs a systematic and scientific approach to explore potential development pathways of Taiwan's power sector through 2035, with a focus on identifying feasible strategies for Taipower to achieve maximal decarbonization. The research objectives are twofold: (1) to examine viable strategic options for meeting Taipower's 2035 carbon reduction targets, and (2) to present these strategies in a time-based roadmap that informs long-term planning and policy decisions.

The study employs the Scenario-Based Strategic Roadmapping (SBSR) methodology to construct three distinct scenarios for 2035: most favorable, most likely, and least favorable, based on scenario analysis. These scenarios provide the analytical foundation for evaluating decarbonization strategies. Through scenario derivation, analysis, and insights from executive discussions at Taipower, three critical generation-side issues are identified for in-depth investigation: increasing the share of hydrogen co-firing, expanding the deployment and application of Carbon Capture and Storage (CCS) technologies, and enhancing the contribution of renewable energy generation.

Based on these critical issues, seven specific decarbonization strategies are developed: (1) offshore photovoltaic (PV) development, (2) onshore wind power repowering, (3) participation in offshore wind power competitive bidding, (4) deep geothermal development, (5) gas-hydrogen co-firing power generation, (6) gas-fired CCS, and (7) coal-fired CCS. Finally, time-based strategic roadmaps for each of the three scenarios are illustrated to guide Taipower's efforts in achieving its 2035 decarbonization goals.

關鍵詞(Key Words)：情境基礎策略藍圖(Scenario-Based Strategy Roadmapping, SBSR)、前瞻情境(Prospective Scenario)、減碳策略(Decarbonization Strategy)。

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