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以再生能源為主之分散型能源之發展趨勢及其影響與因應

Renewable Energy under Climate Change and 2050 Net Zero Emissions

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摘　要

本研究旨在探討氣候變遷及全球淨零排放趨勢下，以再生能源為主之分散型能源之發展方向，針對台灣目前準備情況，參考各國減碳路徑及作法，歸納其中之機會與挑戰，提出看法與建議。

Abstract

This study aims to explore the path of renewable energy (RE) under climate change and 2050 net zero emissions (NZE). The contents of this study comprise issues of climate change and energy transition, preparation of Taiwan government, the NZE paths put forward by IPCC and IEA, etc. The said contents may serve as reference for Taipower to cope with the challenges initiated by climate change and NZE.

關鍵詞(Key Words)：再生能源(Renewable Energy)、氣候變遷(Climate Change)、淨零排放(Net Zero Emissions)、國家自主貢獻(Nationally Determined Contributions, NDCs)、碳預算(Carbon Budget)。

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配電饋線之 IEC 61850 保護策略研析

A Study of IEC 61850 Based Distribution Feeder Protection Schemes

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摘 要

隨著變電所通訊技術演進，世界各電業公司陸續導入IEC 61850國際標準以發展變電所自動化技術並接軌智慧電網。本公司配合政府政策，積極推動IEC 61850標準，於全國陸續建置IEC 61850變電所。透過數位化的優點，除了設計上更富有彈性外，利用標準化的資料模型，電業公司可運用IEC 61850標準互操作性的好處，於多台不同廠牌的智慧電子裝置間進行保護協調。

本文介紹了IEC 61850在資料交換與通訊協議上的原理，並蒐集國外相關文獻，對於IEC 61850標準中通用物件導向變電所事件(Generic Object Oriented Substation Event, GOOSE)通訊技術於變電所之實務應用進行研究，並對其應用情境加以分析。

Abstract

Along with the evolving substation communication technologies, worldwide electric utilities have successively adopted international standards of IEC 61850 in the aspect of developing substation automation technology to be in line with smart grid. To cope with government policies, Taipower has been actively promoting IEC 61850 standard and building IEC 61850 substations in Taiwan. Through the advantages of digitization, e.g., greater design flexibility, standardized data models, may now allow electric utilities to utilize the advantages of IEC 61850's interoperability to realize protection coordination between multiple intelligent electronic devices from different brands.

This paper introduces the principles of IEC 61850 in data exchange and communication protocols, the practical applications and scenario analysis of the Generic Object Oriented Substation Event (GOOSE) communication technology regarding IEC 61850 standards for substations.

關鍵詞(Key Words)：IEC 61850、GOOSE、斷路器失靈保護(Breaker Failure)、智慧電子裝置(IED)。

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回頁首

小管曲線推進工法(長距離)案例分享

A Case Study of Long-distance Curved Pipe-jacking Method

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摘　要

都會區地底管線密集且複雜，採用明挖管線方式施工，易影響鄰近居民生活環境，衝擊交通等問題，此時免開挖工法得以應用。本文介紹「北港～四湖雙分歧澎湖161kV線(第三期)電纜管路設計及施工統包工程」小口徑曲線推進工法案例，利用日本下水道管渠推進技術協會建議之經驗公式分析，探討設計與施工上小口徑曲線推進工法之應用，並介紹相關推管施工步驟，與推管內PVC管佈管、填實灌漿等之實際作業情況。鑒於小口徑曲線推管(雙層)於輸電線路工程案例較少，因此期許本文可提供相關的技術與經驗，於未來電纜線路工程設計與施工上提供參考。

Abstract

Underground pipelines are dense and complex in metropolitan areas. It is apt to affect the quality of life of neighboring residents while adopting open-cut pipeline construction, and it also cause traffic jams and noises as well. In order to avoid the abovementioned situations, the trenchless method may be considered. This article aims to introduce the trenchless construction method of small-diameter curve pipe-jacking construction in the case of "Beigang ~ Sihu Double Divergent Line of Penghu 161kV (Stage 3) Electricity Cable Duct Design and Construction Turnkey Project" The empirical formula analyses are recommended by the Japanese Sewer Pipe Channel Pipe-Jacking Technology Association to illustrate the design and applications of small-diameter curve pipe-jacking construction method, along with relevant construction steps, practical operation of installing PVC pipe within RC pipes, and grouting in RC pipes. In view of the fact that there are only few cases of small-diameter curved pipe-jacking (double-layer) excuted in electricity cable duct construction work, it is expected that this article may serve as reference of relevant technologies and experiences for similar projects in the future.

關鍵詞(Key Words)：曲線推管(Curved Pipe-jacking)、推進力(Pipe-jacking Force)、小口徑(Small-diameter)、雙層(Double-layer)。

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「電力電磁場的健康效應」之科學澄清

Effect of EMF on Human Health: A Science-based Clarification

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摘　要

民眾易於擔憂電力電磁場，甚至引起諸多抗爭。首先，工程解法包括使用高導電性或磁性金屬材料屏蔽，但可能不合成本效益。其實，最佳策略是比較諸如人體生理學等自然現象與電力電磁場，就知前者遠大於後者而無需電磁恐慌。第二，諸如世界衛生組織與美國國家科學院等深具公信力組織已經聲明「至今無證據顯示電力電磁場對人體有害」，但一些國民要求電磁場絕對安全，看似合理其實不然，例如，生活充滿風險，並無絕對安全，但民眾無此認知或不在乎。對應地，科學無法證明絕對無害，因無法證明「虛無假設」。第三，2002年，國際癌症研究署聲明「電力電磁場可能致癌」，似乎弄得科學界無力招架，因「可能」包羅萬象。本文架構相關的科學證據與科學推理，提出新的風險認知典範「科技適用性原理」，而得充分地澄清該聲明微妙的「可能」語意與平息疑慮。

Abstract

Power-frequency electromagnetic fields (EMFs) have long been a topic of public concern and protests are thus mounted from time to time. First, engineering solutions, such as using high conductivity or permeability metal shielding to reduce EMFs, may not be cost-effective. Actually, the best strategy is to compare power-frequency EMFs with those caused by natural phenomena. Since the former are much greater than the latter, there is no need to be afraid. Second, as the World Health Organization and the US National Academy of Sciences indicated, so far there is no evidence showing that power-frequency EMFs are harmful to human health. Still, some people may demand absolute safety, which sounds reasonable but unrealistic. Life itself is full of risks, and there is no absolute safety. But some people just lack this risk perception or they just choose to ignore the facts. Correspondingly, science can't prove absolute safety, because it can't prove the "null hypothesis." Third, the International Agency for Research on Cancer in 2002 claimed that power-frequency EMFs were possibly carcinogenic. It blowed the science community out of the water, because "possibly" was encompassing. This paper, synthesizing scientific evidences and reasoning to create the principle of technology applicability, looks forward to summoning up a new paradigm of risk perception- hopefully may clarify the subtle connotation of "possible" and dissipate the doubts.

關鍵詞(Key Words)：電磁場 (Electromagnetic Field, EMF)、電磁暴露 (Electromagnetic Exposure)、心電圖與腦波圖 (Electrocardiogram and Electroencephalogram)、虛無假設 (Null Hypothesis)、反安慰效應 (Nocebo Effect)、科技適用性原理 (Principle of Applicability of Technologies)。

*環保署「非游離輻射預警機制風險評估諮詢小組」前主席

疫情下住宅部門用電影響因素探討與分析

Factors Influencing the Electricity Consumption of Residential Sector under COVID-19

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摘 要

2020年起臺灣受COVID-19疫情影響，住宅用電於2021年突破527億度電，創下歷史新高，因此，本研究透過文獻收集及數據分析(迴歸分析及柏拉圖分析)，探討疫情對臺灣住宅用電影響關鍵因子，再以工研院綠能所2021年家庭用電消費習慣調查資料為基礎，探討疫情下民眾生活型態及用電行為的轉變。調查分析結果顯示，極端氣候變化高度影響住宅用電；而家庭規模與結構具影響住宅用電；確診人數攀升短期影響住宅用電；新生活型態產生增加電器使用時數及烹飪時間；屋齡30年以上或低所得家戶的老舊電器比例相對較高。未來建議可加強推動氣候調適措施，推廣智慧家電應用；疫情期間新購電器需求增加，可強化宣導選用1級節能產品，持續推廣居家節電手法，訴求民眾行為改變；針對屋齡較高、低所得家戶或獨居老人，推動家庭用電健檢、能源弱勢關懷，打造安全友善環境，另結合企業推行汰換老舊電器及節能教育宣導，降低家庭能源支出的負擔。

Abstract

Affected by the COVID-19 pandemic since 2020, the electricity consumption of residential sector in Taiwan reached a historically high of 52.7 GWh in 2021. The research explored the result through the efforts of literature review, data analysis, and key-factors researching, such as the lifestyles and energy consumption behaviors of the public under the influence of pandemic from the ITRI GEL's research titled "2021 The Survey of Household Electricity Consumption Behavior". As this research indicated, the electricity consumption of residential sector has been influenced by the factors of climate changes, family structure, and the number of confirmed cases for the short term. Moreover, lifestyles and behaviors may also affect the use time of electric appliances, such as cooking at home more frequently consuming more power. In addition, high percentage of inefficient electric appliances within houses more than 30 years old and low-income households may be the causes of the increase of electricity consumptions. As follows are our suggestions: strengthening the promotion of climate adaptation, disseminating information associate with smart appliances, enhancing the promotion of energy efficient appliances, energy saving tips, and appealing to the public regarding behavior change. For households of old houses, low-income families and solitary seniors, home energy diagnosis and

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energy poverty upgrade program may help secure their quality of living. Last but not the least, phasing out inefficient electric appliances and promotion of energy conservation programs may also help saving the electricity bills of households.

關鍵詞(Key Words)：新冠肺炎(Coronavirus Disease 2019, COVID-19)、住宅用電因子(Residential Electricity Factor)、行為改變(Behavior Change)、迴歸分析(Regression Analysis)、入戶調查(In-house Visit)。

感應耦合電漿裂解除役太陽光電模組材料循環研究

PV Module Recycling Using Inductively Coupled Plasma Technology

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摘　要

近年來太陽能已列為我國能源轉型重要發展項目，我國政府規劃在2025年提升再生能源發電占比達20%，其中太陽光電累積裝置容量目標為20 GW，促使太陽光電設置量成長快速，成長趨勢顯示未來廢棄太陽光電模組數量之增加。根據行政院環境保護署預估廢棄太陽光電模組於2031年預計產生超過1萬公噸，至2043年超過10萬公噸。為使太陽光電模組能循環再利用且降低掩埋及不當棄置對環境造成的衝擊，本研究擬開發太陽光電模組創新循環再利用模式，針對廢棄太陽光電模組發展感應耦合電漿技術無氧熱裂解模組封裝材料醋酸乙烯酯聚合物，從廢棄模組中提煉純化銅和銀等有價金屬、玻璃基板則利用高溫熔融噴吹抽絲製作玻璃纖維原物料。本研究可解決國內光電產業循環經濟之技術缺口，使其發展無後顧之憂，建構光電半導體產業永續經營成長之規範。

Abstract

In recent years, renewable energy (RE) technologies such as solar have been acknowledged as priority development projects to realize the energy transition in Taiwan. According to the government's planned target, the percentage of RE generation and the cumulative installed capacity of solar photovoltaic (PV) shall reach 20% and 20 GWs respectively, to enable rapid installation of PV modules. Nevertheless, this will consequently lead to a fast growing amount of solar panel waste (SPW). According to the estimation of the Environmental Protection Agency under Executive Yuan, there will be more than 10,000 and 100,000 metric tons of SPW respectively in 2031 and 2043. Thus, a thorough waste removal strategy is urgently needed. To seek proper treatment of solar panel waste to avoid harmful influences to the environment, such as landfills, this study aims to develop technologies for SPW recycling. In this project, an inductively coupled plasma system will be applied to pyrolysis ethylene vinyl acetate (EVA) in solar photovoltaic module, and valuable metal materials, such as copper and silver from the wasted solar photovoltaic module, will be refined. Glass in solar module will also be melted to produce vitreous fiber by nozzle blowing method. By filling in the vacancy of the

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end-stream treatment problems of optoelectronic technology, this study may not only make contribution to circular economy, but also serve as a good demonstration for the sustainable development of optoelectronic semiconductor industry.

關鍵詞(Key Words)：太陽光電模組(Solar Photovoltaic Module)、感應耦合電漿(Inductively Coupled Plasma)、熱裂解(Thermal Pyrolysis)、玻璃纖維噴吹(Glass Fiber Blowing)。

電力線通訊技術應用於 345kV 電纜洞道之實證研究

A Study on Power Line Communication and Case Analysis of 345kV Cable Tunnel

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摘 要

本研究針對電力線通訊的原理、標準和通訊品質的影響作說明，並蒐集國內外的電力線通訊應用案例，同時，探討將電力線通訊技術運用於高雄五甲超高壓變電所電纜洞道之可行性研究。其中，針對高雄五甲超高壓變電所電纜洞道潛盾段的110V電源迴路來做電力線通訊的量測。

Abstract

This study aims to discuss the principles, standards, and impacts of the quality of PLC communication, along with useful cases. In the feasibility study of applying PLC to a 345kV Extra-High-Voltage (EHV) substation cable tunnel of Taiwan Power Company in Wuja, Kaohsiung, a 110V power circuit loop in the cable tunnel is considered to measure the system throughput of PLCs.

關鍵詞(Key Words)：電力線通訊(Power Line Communication)、超高壓變電所(Extra-High-Voltage Substation)、傳輸控制協定(Transmission Control Protocol)。

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