出國報告（出國類別：開會）

參加 APEC 能源工作小組（EWG）之 APERC 年度會議出國報告

服務機關：台灣電力公司

姓名職稱：吳進忠 副總經理

派赴國家/地區：日本東京

出國期間：112 年 9 月 11 日至 112 年 9 月 15 日

報告日期：112 年 10 月 18 日

行政院及所屬各機關出國報告提要

出國報告名稱：參加 APEC 能源工作小組（EWG）之 APERC 年度會議

頁數 69 含附件■是□否

出國計畫主辦機關／聯絡人／電話：臺灣電力公司／翁玉靜／02-23667685

出國人員姓名／服務機關／單位／職稱／電話：

姓名	服務機關	單位	職稱	電話
吳進忠	台灣電力公司	總經理副總經理室	15 等企業管理監	02-2366-6240

出國類別： □1.考察 □2.進修 □3.研究 □4.實習■5.其他：開會

出國期間：112 年 9 月 11 日至 112 年 9 月 15 日

出國地區：日本 東京

報告日期：112 年 10 月 18 日

分類號／目

關鍵詞：亞太能源研究中心(ASIA PACIFIC ENERGY RESEARCH CENTER, APERC)、區域冷能(District Cooling)、電網及儲能系統(Grid-Scale Battery Storage)、電動車(Electric Vehicle)

內容摘要：

本報告主要以參加「APEC 能源工作小組（EWG）之 APERC 年度會議」各會員經濟體的報告摘要為內容，分別針對 1.能源轉型的資料蒐集與報告；2.氫/氨/e-fuel 的生產與使用；3.區域冷能；4.電網及儲能系統；5. EVs, PHEVs and FCEVs 的能源消耗；6.甲烷排放和二氧化碳封存等議題提出報告。

本報告內容共分四章，

壹、心得與建議

貳、出國目的

參、出國行程

肆、21st APEC workshop on energy statistics 會議紀實

附錄 1

本文電子檔已傳至出國報告資訊網

（http://open.nat.gov.tw/reportwork）

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參加 APEC 能源工作小組（EWG）之 APERC 年度會議

出 國 報 告

壹、心得與建議

1.1 心得

1.本次參加「APEC 能源工作小組（EWG）之 APERC 年度會議」與 APEC 各會員經濟體相關專家進行交流討論，在三天共六個場次的會議討論，分別針對 1.能源轉型的資料蒐集與報告；2.氫/氨/e-fuel 的生產與使用；3.區域冷能；4.電網及儲能系統；5. EVs, PHEVs and FCEVs 的能源消耗；6.甲烷排放和二氧化碳封存等議題進行討論，讓我有機會瞭解各會員經濟體的政策規劃與最新發展進度，特別是氫/氨/e-fuel 的生產與使用、區域冷能、EVs, PHEVs and FCEVs 的能源消耗及甲烷排放和二氧化碳封存等議題是我國目前較少研究和討論的議題，藉由此次參與會議討論，可以瞭解各國的政策規劃方向與最新發展進度。

2.在電網級儲能系統發展方面，相較於 APEC 各會員經濟體，我國的儲能商業模式比較能夠吸引民間業者的投入，同時促進國內相關產業發展，儲能系統裝置容量增加速度也超過各會員經濟體，各會員經濟體對於台電公司與民間廠商合作利用儲能系統提供輔助服務且採取市場競價的方式非常有興趣，APERC 希望後續有機會能夠邀請台灣能源專家針對此項目再進行專題報告。

3.APEC 各會員經濟體在二氧化碳封存(CCS)方面大多只有政策方向，

並沒有實際進度，只有日本自 2000 年以來持續投入 CCS 研究，計劃在 2030 年前制定和實施 CCS 商業模型，最終在 2050 年實現 CCS 的全面應用，年存儲容量在 1.2 億至 2.4 億噸之間，日本計劃在 2024 年之前落實二氧化碳的長程運輸，並建立亞洲 CCUS 網絡（ACN）平臺，日本的發展值得我們關注與交流。

1.2 建議

1. 本公司現有林口及大林電廠共 5 部超超臨界燃煤機組均為日本廠商製造，有關混氨燃燒及二氧化碳捕捉封存(CCS)的最新技術發展，應該可以注意日本方面相關技術的發展進度，並適時與日方交流，以評估本公司推動燃煤機組混氨燃燒發電及二氧化碳捕捉封存(CCS)的引進與發展策略。
2. 本公司電力交易平台的儲能系統商業模式已成功促進我國儲能系統的建置，未來應該將儲能系統的應用更擴大到電網穩定的應用，包括電壓支持、緩解線路雍塞、提供系統慣量、配合電動車智慧充電站等應用，建議積極與亞太各國交流，並配合能源署參與 APEC 相關能源專家小組會議。
3. 有關區域冷能的利用，我國尚無具體運用案例，惟本公司未來可能興建基隆協和電廠天然氣接收站，相關冷能的利用宜參考國際成功案例及早規劃，至少可以引進做為協和電廠發電機組冷卻水來源以減少廠內用電，提高發電效率。

貳、出國目的

亞太經濟合作（APEC）所屬能源工作小組（EWG）設立於東京之亞太能源研究中心(APERC)，邀請各會員經濟體之專家參加其所舉辦之年度會議(21st APEC workshop on energy statistics: Data collection on new energy products and technologies)，會議目的係促進 APEC 成員及其它國際能源組織交流討論，使 APEC 成員得以掌握各會員經濟體能源部門(例如氫能、區域冷卻和其他新興新能源技術-大規模電池儲能系統）最新發展與新能源技術應用情況。本次會議將聚焦電網級儲能設備、氫能、電動車等之資料搜集、運用、分析及資安等議題，會議內容與本公司數位發展業務內容相關，本次會議於 9 月 12~14 日在 Tokyo Bay Ariake Washington Hotel 召開。會議主辦方(APERC/EWG)邀請本公司吳進忠副總經理兼數位長擔任 21st APEC Energy Statistics Workshop: New Energy Technologies 場次之提報人，報告「Grid-scale Electricity Storage Development in APEC」，介紹我國電網級儲能設備及電力交易之發展，並參與圓桌討論。

參、出國行程

出國行程如表 3-1 所列， 112 年 9 月 11 日上午從台北松山機場出發並於中午抵達東京羽田機場，9 月 12 日~14 日參加亞太能源研究中心(APERC)年度會議(21st APEC workshop on energy statistics: Data collection on new energy products and technologies)，會議在 Tokyo Bay Ariake Washington Hotel 召開；9 月 15 日~16 日為順道觀光；112 年 9 月 17 日下午由東京羽田機場搭機返國，圓滿完成任務，結束此次會議行程。

表 3-1 出國行程

時　間	地　點	工　作　概　要
112.9.11	台北→日本東京	往程 (台北→東京)
112.9.12~14	東京 Tokyo Bay Ariake Washington Hotel	參加『21st APEC workshop on energy statistics: Data collection on new energy products and technologies』
112.9.15~16	日本東京	順道觀光
112.9.17	日本東京→台北	返程 (東京→台北)

肆、21st APEC workshop on energy statistics 會議紀實

亞太經濟合作（APEC）所屬能源工作小組（EWG）設立於東京之亞太能源研究中心(APERC)，能源數據與分析專家小組（EGEDA）、新能源和再生能源技術專家小組（EGNRET）和清潔化石能源專家小組（EGCFE）均為 APEC 專家小組，由能源數據與分析專家小組（EGEDA）擔任亞太能源研究中心秘書處，每年舉辦能源研討會。

能源數據與分析專家小組（EGEDA）負責透過收集 APEC 地區的能源數據並管理 APEC 能源資料庫的運行，向亞太經合組織（APEC）機構和更廣泛的社區提供政策相關的能源資訊。

本年度能源研討會『21st APEC workshop on energy statistics: Data collection on new energy products and technologies』，研討會將重點討論五種新技術或再利用的技術：氫（包括氨）、區域冷卻系統、電網規模儲能系統、電動車和二氧化碳封存。由於大多數政府都鼓勵部署新能源技術，因此本次研討會的主要目的為希望增強各會員經濟體對這些新技術的了解，協助各會員經濟體更好地部署並正確衡量這些技術在能源領域的規模和影響所需的數據收集、報告和分析程序。

第 21 屆 APEC 能源統計研討會於 2023 年 9 月 12 日至 14 日在日本東京舉行，主題為「新能源產品和技術的數據收集」。這是繼因新冠肺炎疫情而在線舉辦的三場研討會之後，首次實體舉辦研討會，這也是能源數據與分析專家小組（EGEDA）與新能源和再生能源技術專家小組（EGNRET）和清潔化石能源專家小組（EGCFE）的首次合作。

謹將本次能源研討會議程、各場會議及圓桌會議的重點摘錄如下：

4.1 會議議程

亞太能源研究中心(APERC)主辦 2023 能源研討會『21st APEC workshop on energy statistics: Data collection on new energy products and technologies』議程如圖 4-1~圖 4-3 所示，3 天的議程共有 6 個議題進行討論，分別為：

Session 1: Setting the context: The new data collection and reporting requirement of the energy transition

Session 2: Discussion on Hydrogen/ammonia/e-fuels production and consumption

Session 3: Understanding district cooling/district energy systems and the flow of energy from the plants

Session 4: Grid-scale electricity storage development in APEC

Session 5: Reporting the energy consumption of EVs, PHEVs and FCEVs

Session 6: Understanding fugitive methane emission and CO2 sequestration

本屆研討會有來自 14 個會員經濟體(汶萊、智利、中國、中國香港、印尼、日本、馬來西亞、巴布亞紐幾內亞、秘魯、菲律賓、中華台北、泰國、新加坡、馬來西亞、美國和越南)，以及相關國際組織，包括國際能源總署(IEA)、國際再生能源機構(IRENA)和聯合國環境規劃署(UNEP)和 APEC 論壇 APEC 交通工作小組（TPTWG)、EGNRET 和亞洲太平洋能源研究中心（APERC）的 57 名能源統計學家、專家和發言人參加。研討會由 EGEDA 主席、EGCFE 主席和 EGNRET 秘書處（代表 EGNRET 主席）共同主持。

Asia-Pacific
Economic Cooperation

Draft Agenda

21st APEC workshop on energy statistics: Data collection on new energy products and technologies

12-14 September 2023
Tokyo Bay Ariake Washington Hotel

Tokyo, Japan

The workshop is expected to enhance the participants' knowledge of hydrogen, district cooling, and other emerging new energy technologies such as large-scale battery electricity storage, e.g. definitions, characteristics, etc., to facilitate data collection on these new energy products and technologies.

Experts from international organisations, including the APEC Transportation Working Group were invited and expected to provide detailed information on new energy technologies. Members will also be enlightened about the current new energy technologies in place or planned in each economy from their respective presentations.

This is also the 1st collaboration between EGEDA, EGNRET and EGCFE. These expert groups recommended speakers for relevant sessions.

In addition, the roundtable discussion will also help EGEDA understand the current situation in each member economy.

Day 1	**12 September 2023**
8:30-9:00	**Registration**
Opening Session: To be moderated by Mr Edito Barcelona	
9:00-9:10	Welcoming remarks, **Ms Reiko Eda,** International Affairs Division, METI/EGCFE Chair
9:10-9:20	Welcoming remarks, **Dr Kazutomo Irie,** President, APERC
9:20-9:30	Opening remarks, **Mr Glen Sweetnam,** Senior Vice President, APERC/EGEDA Chair
9:30-9:40	Opening remarks, **Dr Tom H. T. Lee,** EGNRET secretariat
9:40:10:00	**Self-introduction and group photo**
Session 1*: Setting the context: The new data collection and reporting requirement of the energy transition to be moderated by *Mr Glen Sweetnam	
10:00-10:20	*APERC presentation* • New energy technologies and the implications for data collection/reporting *Dr David Wogan, Assistant Vice President, APERC*
10:20-10:40	IRENA presentation • Role of renewables in energy transition IRENA (TBC)
10:40-11:20 (20 mins each)	*Economy presentations* • EIA's modelling efforts *EIA-USA (TBC)* • Energy Transition Plan of Viet Nam *Ms Dinh Thi Thanh Lan,* Researcher, Institute of Energy
11:20-11:35	**Morning break**

11:35-11:55	*Special economy presentation* • Data challenges and modeling limitations in Canada *Mr Christopher Doleman, Senior Researcher, APERC*	
11:55-12:55	Roundtable discussion 1) What new technologies are likely to be employed in your economy? 2) What data challenges will your economy face?	All members
12:55-14:00	**Lunch break**	
Session 2*: Discussion on Hydrogen/ammonia/e-fuels production and consumption to be moderated by *Ms Reiko Eda		
14:00-14:20	*APERC presentation* • Hydrogen Technologies Prospectives *Dr Manuel Heredia Muñoz, Senior Researcher, APERC*	
14:20-14:40	IEA presentation • Hydrogen data collection for the IEA IEA (TBC)	
14:40-15:00	*EGEDA secretariat report* • Hydrogen production, storage, and consumption – data collection in APEC *Mr Nobuhiro Sawamura, Senior Researcher, APERC/EGEDA secretariat*	
15:00-15:15	**Afternoon break**	
15:15-16:35 (20 mins each)	*Economy presentations* • Hydrogen development in Chile *Ms Maria Josefina Ramos Yañez, Statistical Analyst, Ministry of Energy* • Green Hydrogen Development *Professor Yun Hau NG, School of Energy and Environment, City University of Hong Kong* • Hydrogen and Ammonia Development in Japan (1) *Mr. Tomohiko Adachi, Director, Hydrogen and Fuel Cells Strategy Office of METI* • E-fuels in Japan (2) TBD • Development of Hydrogen and Ammonia in the Energy Sector in Malaysia *Ms Aimi Hazwanie, Assistant Director, Energy Commission*	
16:35-17:25	Roundtable discussion 1) What role are hydrogen/ammonia/e-fuels likely to play in your economy? 2) How and who will collect the data?	All members
17:25:17:30	Wrap up	
17:30	**End of day 1**	

圖 4-1 21st APEC workshop 第一天議程

Day 2	13 September 2023	
Session 3: **Understanding district cooling/district energy systems and the flow of energy from the plants to be moderated by** ***Mr Jen-Yi Hou***		
9:30-9:55	***Special presentation*** • District energy systems ***Dr Zhuolun Chen, Senior Advisor UNEP***	
9:55-10:15	***EGEDA secretariat report*** • Update on district cooling data collection ***Ms Elvira Torres Gelindon, Research Fellow/EGEDA secretariat***	
10:15-10:35	Economy presentation • District lake water cooling system (TBC)	
10:35-10:50	**Morning break**	
10:50-11:30 (20 mins each)	***Economy presentations*** • District Cooling System in Hong Kong, China ***Ms Vicky Lui, Engineer, EMSD*** • District cooling system in Malaysia ***Mr Zaharin Zulkifli, Deputy Director, Energy Commission***	
11:30-12:30	Roundtable discussion 1) What role do district cooling systems/district energy systems play in your economy? 2) Is your economy ready to collect and report the data?	All members
12:30-13:30	**Lunch break**	
Session 4**: Grid-scale electricity storage development in APEC to be moderated by** ***Dr Tom Lee***		
13:30-13:55	***EGNRET presentation*** • Grid-scale electricity storage development in APEC ***Dr Chin-Chung Wu, Vice President, TaiPower***	
13:55-14:15	IEA presentation • Data collection on grid-scale battery storage (TBC)	
14:15-14:35	***EGEDA secretariat report*** • Proposed data collection on grid-scale battery storage in APEC Mr Edito Barcelona, Senior Research Fellow/Head EGEDA secretariat	
14:35-14:55	***APERC presentation*** • Energy battery storage ***Mr Alexander Izhbuldin, Senior Researcher, APERC***	
14:55-15:15	***Economy presentation*** • The Development of New Power Systems and Power Storage in China ***Dr Su Ming, Director, Energy Research Institute***	
15:15-15:30	**Afternoon break**	
15:30-16:10 (20 mins each)	***Economy presentations*** • Grid-scale electricity storage in the Philippines ***Mr Michael B. Coligado, Science Research Specialist, DOE*** • New Renewable Energy Strategy and Development in Chinese Taipei ***Mr Wei-Chih Huang, Section Chief, BOE***	
16:10-17:10	**Roundtable discussion** 1) Electricity storage plans in your economy? 2) What are the data collection and storage challenges? 3) How and who will collect the data?	All members
17:10-17:15	Wrap up	
17:15	**End of day 2**	

圖 4-2 21st APEC workshop 第二天議程

Day 3	14 September 2023	
Session 5*: Reporting the energy consumption of EVs, PHEVs and FCEVs to be moderated by *Mr Glen Sweetnam		
9:30-9:55	*Special presentation* • Energy consumption of electric vehicles – measurement, estimation, and data collection *Mr Morgan Watkins, Chair, Land Expert Group APEC Transportation Working Group*	
9:55-10:15	*APERC presentation* • Electric vehicle technologies *Mr Finbar Maunsell, Assistant Researcher, APERC*	
10:15-10:35	*EGEDA secretariat report-* • Electricity consumption in the road transport sector *Mr Edito Barcelona*	
10:35-10:50	**Morning break**	
10:50-11:30 (20 mins each)	*Economy presentations* • Electricity consumption data of battery electric vehicles (BEVs) *Mr Jen-Yi Hou, Vice President, TRI Chinese Taipei* • Electric Vehicle Program in Thailand *Ms Narumon Fromhold, Chief, Energy Information Development Group*	
11:30-12:30	**Roundtable discussion** 1) What are your economy's plans to electrify road transport? 2) How and who will collect the data?	All members
12:30-13:30	**Lunch break**	
Session 6*: Understanding fugitive methane emission and CO_2 sequestration to be moderated by *Mr Edito Barcelona		
13:30-13:55	*Special presentation* • Global Methane Initiatives TBD	
13:55-14:15	*APERC presentation* • CCS Development *Dr Phung Quoc Huy, Senior Researcher, APERC*	
14:15-14:35	*EGEDA secretariat report* • Proposed data collection of fugitive methane emissions (including IPCC methodologies), and carbon transportation and sequestration *Mr Nabih Matussin, Researcher, APERC*	
14:35-15:05	*Economy presentation* 1) Fugitive methane emission **ANRE-METI, Japan (TBC)** 2) Carbon dioxide capture and storage *Mr Norihiko Saeki, Director, Carbon Dioxide Capture and Storage Policy Office of METI*	
15:05-15:20	**Afternoon break**	
15:20-16:20	**Roundtable discussion** 1) Does your economy produce significant fugitive methane emissions? 2) Does your economy plan to sequester CO_2 3) How and who will collect the data?	All members
16:20-17:00	Wrap up and identify next steps	
17:00-17:10	**Closing remarks**	**Mr Glen Sweetnam**
17:10	**End of the workshop**	

圖 4-3 21st APEC workshop 第三天議程

4.2 能源研討會的目的與開幕致詞

研討會在日本經濟產業省 (METI) 國際事務部自然資源與能源研究部主任、EGCFE 主席 Reiko Eda 女士的歡迎致詞中拉開序幕。Ms. Reiko Eda 強調，由於氣候變化，國際能源情勢正在發生巨大變化，而應對氣候變遷的措施正是碳中和的目標。平衡的能源轉型非常重要，同時須要考慮永續經濟成長、氣候變遷措施和能源安全。本次研討會的目的在幫助 APEC 經濟體提高成員收集氫/氨等新能源產品和技術數據的能力，這些產品和技術對於實現能源平衡轉型越來越重要。

APERC 主席 Dr. Kazutomo Irie 也發表了他的歡迎詞，並對各國專家撥冗參與研討會並進行演講表示感激。他再次強調研討會的目標－提升 EGEDA 成員對新技術或再利用技術（包括氫氣、區域制冷系統、電網規模的儲能系統、電動車、二氧化碳封存等）的瞭解，各會員經濟體可以更有效地蒐集所需的數據、報告和分析程序，以正確地測量這些技術在能源領域的規模和效應。最後，他鼓勵與會者以開放的態度參加研討會，並共同追求一個共同目標：獲取見解、分享知識，建立聯繫。

APERC 高級副總裁兼 EGEDA 主席 Glen Sweetnam 先生也感謝專家和演講者參加研討會，並強調 EGEDA 成員的參與對於這次研討會的重要性，因為各國正在制定政策以加速能源轉型，但卻產生了一些意外的後果，突顯了收集數據以了解實地情況的必要性。

最後，EGNRET 秘書長 Tom Lee 博士則表示在能源政策制定和能源轉型過程中，能源統計發揮著重要作用，APEC 各會員經濟體正在推動再生能源領域的發展，計劃採用新的能源產品和技術，以加速減

少 APEC 地區的碳排放。因此，準確收集和分析數據變得非常重要。

4.3 Session 1: The new data collection and reporting requirement of the energy transition

Session 1 由亞太能源研究中心（APERC）Senior Vice President 暨能源資料分析專家小組(EGEDA)主席 Mr Glen Sweetnam 主持，共有 6 篇報告，分別為：

1-1 APERC presentation：

New energy technologies and the implications for data collection and reporting

Presenter：Dr David Wogan, Assistant Vice President, APERC

Wogan 博士強調，決策日益依賴量化分析，可靠的數據是基本要素。儘管現在有更多數據可供收集和報告，但用於收集和傳播的基礎設施仍然滯後。

1-2 International Renewable Energy Agency (IRENA) presentation：

Role of renewables in the energy transition

Presenter：Nazik Elhassan, Energy Statistics, IRENA

IRENA 統計專員 Ms. Nazik Elhassan 強調再生能源在多個領域中扮演著重要角色，包括碳排放減少、提高能源安全性、推動技術和能源基礎設施的創新，以及為公正的能源轉型帶來顯著的社會經濟效益。此外，加速能源轉型並監測其進展應優先考慮。

1-3 Economy presentations：

Battery Storage, Electric Vehicle, and Hydrogen Developments

in the United States

Presenter：Vikram Linga, Renewable Energy Analyst, EIA-USA

USA EIA 再生能源分析師 Vikram Linga 簡報提供了有關 EIA 以及電池、電動車和氫能的現有和計畫中發展的概述，以及它們的數據需求。

1-4 Economy presentations：

Energy Transition Plan of Viet Nam

ELECTRICITY PRODUCTION ASPECT

Presenter：Ms Dinh Thi Thanh Lan, Researcher, Institute of Energy

越南能源研究院的研究員 Ms Dinh Thi Thanh Lan 簡要介紹了越南的能源轉型計畫及其具體目標，包括電力部門的擴展。她指出在使現有的燃煤發電廠更加清潔和高效方面存在一些挑戰，以及在增加再生能源、電池儲能系統和氫氣部署方面的挑戰和解決方案。

1-5 Special economy presentation：

Electromobility, Energy Storage and Green Hydrogen - PERU

Presenter：Ms. LUCERO LUCIANO DE LA CRUZ

GENERAL DIRECTORATE OF ENERGY EFFICIENCY, MINISTRY OF ENERGY AND MINES

Ms. Lucero Luciano De La Cruz 介紹秘魯在電動交通、綠色氫和儲能方面的進展。她分享了秘魯在走向電動交通、能源儲存和綠色氫方面的過程，與經濟的能源效率計劃、電力計畫

和 2050 年的綜合能源計畫相一致。

1-6 Special economy presentation：

Transitioning Canada towards a net-zero electricity grid

Presenter ： Chris Doleman, Senior Researcher, Asia Pacific Energy Research Centre (APERC)

APERC 高級研究員 Mr. Christopher Doleman 說明實現電力部門的淨零對於加拿大的氣候變遷至關重要。由於資源變異性和省級自治權導致各地區的電力系統多樣性，加拿大能源監管機構（CER）正在制定靈活的政策方法，以實現其監管的核心原則，同時考慮資源的變異性和自治權；CER 的排放性能標準允許水蒸氣甲烷重組系統用於氫氣（SMRs）。此外，加拿大能源建模中心（EMH）旨在為政策制定者提供建模工具。

4.4 Session 2: Discussion on Hydrogen/ammonia/e-fuels production and consumption

Session 2 由日本經濟產業省(Ministry of Economy, Trade and Industry，METI) International Affairs Division Director/ Expert Group on Clean Fossil Energy (EGCFE)主席 Ms Reiko EDA 主持，共有 8 篇報告，分別為：

2-1 APERC presentation：

Hydrogen Technologies Prospectives

Presenter：Dr. Manuel Heredia, Senior Researcher, APERC

APERC 的 Manuel Heredia 博士的簡報題目為氫氣技術前景，

在氫氣的供應面，H_2 生產約佔全球二氧化碳排放的 2.5%；幾乎所有 H_2 都用作工業過程中的原料，並使用化石燃料（如天然氣和煤）生產；H_2 也可以通過生物質氣化生產。在需求方面， H_2 主要用於分配和運輸部門。最後，Manuel Heredia 博士強調 H_2 作為有效存儲和運輸綠色能源的重要性。

2-2 IEA presentation：

Hydrogen data collection

Presenter：Luca Lorenzoni, IEA

Mr. Luca Lorenzoni 簡報 IEA 的氫氣數據收集。IEA 的氫氣數據收集分為兩個面向。第一面向是氫氣的關鍵趨勢，強調氫氣作為支持氣候抱負和增強能源安全性的工具的重要性。目前 IEA 和歐洲統計局（Eurostat）合作制定了一份新的氫氣聯合問卷，因為氫氣需求不斷增長，生產項目不斷擴大，簡而言之， IEA 認為到 2030 年，氫氣的生產和貿易將大幅增加。第二面向強調包括氫氣、氨氣和電力燃料在能源統計中的方法。

2-3 EGEDA secretariat report：

Hydrogen production, storage, and consumption– Data collection in APEC

Presenter：Nobuhiro SAWAMURA, Senior Researcher, Asia Pacific Energy Research Centre (APERC), EGEDA Secretariat

APERC/EGEDA 秘書處高級研究員 Mr. Nobuhiro Sawamura 的簡報包括有關氫氣相關事項的術語定義，以及強調“有

CCS”和“無 CCS”的更新的氫氣數據收集格式。EGEDA 秘書處將參考 IEA/Eurostat 的手冊製作氫氣手冊。他強調關於氫氣的討論，這些討論在 2022 年 10 月在菲律賓舉行的 EGEDA33 會議和 2023 年 4 月在夏威夷舉行的 EGEDA34 會議（與 EGNRET 58 聯席會議）中進行討論。EGEDA 秘書處將在 2023 年底前（將收集的數據為 2022 年數據）發送數據收集格式。

2-4 Economy presentations：

Hydrogen and Ammonia Policy and Development in CHILE

Presenter：Josefina Ramos, Statistical Analyst, Ministry of Energy

智利能源部的統計分析師 Ms. Maria Josefina Ramos 簡報“智利氫能發展”，包括智利的經濟背景，強調其主要產業是採礦，如銅和鋰，儘管智利依賴進口石油和天然氣。智利在南部有巨大的太陽能潛力，在北部有風能潛力，預計未來將出口從增加的風能和太陽能發電中生產的綠色氫。智利目標在成為拉丁美洲綠色氫投資的首選地，並提供地球上最便宜的綠色氫。

2-5 Economy presentations：

Green Hydrogen Development

Presenter ： Professor Yun Hau NG, School of Energy and Environment, City University of Hong Kong

香港中文大學能源與環境學院的 Professor Yun Hau NG 介紹 2017 年發布的“中國香港氣候與 2030+行動計劃”和 2021 年發布的“中國香港 2035 年清潔空氣計劃”。 “中國香港

2035 年清潔空氣計劃”有六個重要的行動領域，其中包括“綠色交通”（如電動汽車路線圖和新能源渡輪）和“清潔能源”（如發電廠排放減少和綠色能源）。他預測煤氣公司將來會使用氫能源和光觸媒板系統，將水轉化為太陽能氫源。有關燃料電池汽車和電動汽車成本，哪一種更具競爭力，Professor Yun Hau NG 回答在平坦的道路上，電動汽車更具競爭力，但在山區，燃料電池汽車更具競爭力，因為它們有更多的動力。

2-6 Economy presentations：

Hydrogen and Ammonia Development in Japan

Presenter：Tomo Adachi, Director, Hydrogen & Fuel Cells Strategy Office, Hydrogen & Ammonia Division, METI

日本經濟產業省氫能與燃料電池戰略辦公室主任 Mr. Tomo Adachi 簡報“日本的氫和氨發展”，介紹日本的政策和氫基本戰略，包括其供需量目標。解釋日本在生產、海運、能源、交通和工廠熱能使用等方面的氫政策。最後，他宣布氫能源部長會議將於 2023 年 9 月 25 日舉行。

2-7 Economy presentations：

Japan’s e-fuels policy

Presenter：Mai YAGUCHI, Director, International Strategy on Energy Resources Office, Natural Resources and Fuel Department, Agency for Natural Resources and Energy, METI

日本國際能源資源辦公室主任 Ms. Mai Yaguchi 簡報“日本的電力燃料”，因為電力燃料具有很高的體積和質量密度，可以利用現有的燃料基礎設施，儘管它們的生產成本必須降低。電力燃料對於日本實現 2030 財政年度溫室氣體排放目標下降 46%和實現 2050 年碳中和至關重要。她亦說明日本政府支持的電力燃料、電甲烷、可持續航空燃料和綠色液化石油氣等方面的研發項目，這些項目是“碳循環燃料”在綠色創新基金中的一部分。

2-8 Economy presentations：

Development of Hydrogen & Ammonia in the Energy Sector in Malaysia

Presenter ： Ms Aimi Hazwanie, Assistant Director, Energy Commission

馬來西亞能源委員會的 Ms. Aimi Hazwanie 簡報『馬來西亞能源部門氫和氨的發展』,說明馬來西亞的氫生產和消耗仍處於較小規模且主要是試點研究，介紹馬來西亞的氫經濟和技術路線圖(HETR)以及馬來西亞的 2022-2040 年國家能源政策，包括制定氫經濟路線圖和長期氫路線圖，確定國家戰略以優化氫生產地點並制定相關法規、Petronas 的氫價值鏈項目和砂拉越的氫項目。

4.5 Session 3: Understanding district cooling/district energy systems and the flow of energy from the plants

Session 3 由台灣綜合研究院(TRI)副院長/能源資料分析專家小

組(EGEDA)副主席 Mr Jen-Yi Hou 主持，共有 5 篇報告，分別為：

3-1 Special presentation：

Implementing district cooling to cool down the cities

Presenter：Dr. Zhuolun Chen, Senior Advisor UNEP

聯合國環境規劃署哥本哈根辦公室的高級顧問 Dr. Zhuolun Chen 介紹區域冷能(***district cooling)***的基本原理、背景和最新趨勢，系統組件以及一些建議。他建議填補數據缺口，將冷能規劃納入城市規劃中，並引入創新技術/財政支持，以開發區域冷能項目。使用區域冷卻系統是否提高效率？陳博士回答，效率提高取決於兩個因素，即電源來源（電源結構將直接影響碳排放）和冷卻系統的效率。

3-2 EGEDA secretariat report：

District cooling system in APEC

Presenter：Elvira Torres Gelindon, Research Fellow, APERC /EGEDA secretariat

APERC/EGEDA 秘書處的研究員 MS. Elvira Gelindo 報告 APEC 區域冷能系統的數據收集工作，展示關於 2016 年數據收集的冷水生產的修訂問卷格式、區域冷能研究以及全球努力方向，包括 TT-SIEC 的活動。她表示：冷能系統和能源系統的區域供熱一樣重要，需要投入更多研究冷能系統。

3-3 Economy presentation：

Natural cooling resources for district cooling

Presenter：Dr. Zhuolun Chen, Senior Advisor UNEP

Dr. Zhuolun Chen 利用自然冷卻資源進行區域冷能的情況進

行簡報，展示研究案例包括埃及埃薩馬林的海水/冷凍機冷能案例以及中國鄭州的污水/廢水熱泵區域冷能案例。Dr. Zhuolun Chen 解釋自然冷能資源的位置、自然冷能資源的溫度、環境影響評估等組件是區域冷能的重要資源。關於 APEC 區域冷能的未來潛力，Dr. Chen 表示 APEC 具有巨大的潛力，並以中國為例，中國計劃建設約 70 萬至 100 萬噸的區域冷能容量。

3-4 Economy presentation：

District Cooling System in Hong Kong, China

Presenter：Ms. Vicky LUI, Engineer, Electrical and Mechanical Services Department, Hong Kong SAR, China

中國香港代表 Ms. Vicky Lui 報告紹香港中國區域冷能系統，強調香港的碳中和政策、區域冷能系統的實施以及展示啟德區域冷能系統的大綱/能源優化/人工智能應用。

3-5 Economy presentation：

District cooling system in Malaysia

Presenter ： Mr Zaharin Zulkifli, Deputy Director, Energy Commission

馬來西亞代表 Mr. Zaharin Zulkifli 簡報馬來西亞區域冷能，介紹了區域冷能的背景以及有關區域冷能的當前/未來數據收集。馬來西亞區域冷能數據收集的試運行正在進行中，將與 ESTO 分享。

4.6 Session 4: Grid-scale electricity storage development in APEC

Session 4 由 Expert Group on New and Renewable Energy Technologies (EGNRET) secretariat Dr Tom H. T. Lee 主持，共有 7 篇報告，分別為：

4-1 EGNRET presentation：

Grid-scale electricity storage development in APEC

Presenter：Dr Chin-Chung Wu, Vice President, TaiPower

簡報內容如附錄 1，簡述如下：

併網型儲能通常也被稱為表前儲能(Front the meter)，常常跟它拿來相比的是表後儲能，它們的差異最主要是規模和應用方式：表後儲能(Behind the meter)不一樣，通常拿來做負載管理應用，容量也比較小，從 1kW 到幾 MW 不等；而併網型儲能的容量比較大，大概從 1MW 起跳，到百 MW 等級

併網儲能的應用也比較多元，大概可以分成表後儲能輔助服務、電能調度、和電網應用三種，目前電能調度和頻率反應是最熱門的應用，對於儲能用於壅塞處理和電網傳輸的需求則漸漸浮現，Grid forming 目前比較少，但可以預期它將是下一個儲能應用的重點。

APEC 國家中儲能應用和發展的情況如下，首先是澳洲，澳洲 Tesla2018 年在 Hornstale 的案場幾乎是儲能應用的典範，100MW 的儲能提供頻率服務，給了全世界的電網跟投資人很多信心，而目前澳洲的儲能裝置量已經超過 1GW，主要應用涵蓋了幾乎前面所述的所有項目，除了輔助服務外，也參與電力市場，並且在幾個 Victoria 的案場也將作為輸電線路使

用，我們也有觀察到 Hornstale 案場也有進行過 inertia 的測試，所以表示澳洲也有在關注 grid forming 未來的應用。

日本方面，到 2022 年的裝置量是 160MW，主要應用大概是舊制的 Frequency response，和新制的 Tertiary reserve，同時也有在電力市場上接受調度。

韓國方面，在 2023 年的裝置量已經到 426MW，主要應用在 substation operation optimization，同時也提供 Frequency regulation，依蒐集到的資料來看比較沒電力市場的應用。

中國在儲能的裝置量目前看起來是最高的，約有 13GW，這些儲能目前應用於再生能源整合、電力市場、電費管理和補助，未來將針對市場和調度機制做進一步的應用和開放。

儲能在台灣的發展目標和應用方式：在 2025 年的裝置目標預計到 1500MW，其中 1000MW 是 Grid service，另外 500MW 是 PV integration，在 Grid service 中又可以分為 Power type 跟 Energy Type，Power type 主要是做 dynamic frequency regulation，簡稱 dReg；Energy type 是複合式應用，在提供 dReg 的同時，也要接受調度做 load shifting。到 2023 年底，我們預計 dReg 有 500MW 以上的裝置量，而 E-dReg 可以到 100MW 以上，今年我們也剛招標了 70MW 的 PV+BESS。目前儲能在台灣的設置情況，北中南的容量設置分佈蠻平均，都在 20%上下，東部裝置容量比較高，因為饋線（併網點）充裕的關係，目前總裝置容量大約是 350MW，在 2023 年底，預計會有額外的 300MW 上線，總共預計有 650MW。

台灣的儲能發展大約從 2018 年開始，我們先透過跟國內研究

院的研究計畫，透過電腦模擬和小型案場測試，證實儲能的運轉規格和可行性；接著在 2019 年，我們發包了一個小型採購合約，目標是採購 15MW，不過後來有 89MW 投入競標，證明我們所提出的方案對於開發商是有吸引力的。這樣的成功，鼓勵了我們開啟電力市場，於是在 2020 進一步設計了日前輔助服務市場，大量開放儲能業者參與，目前有 350MW 儲能每日進行競價，隨著再生能源的增加，我們也看到了電能轉移的需求，於是去年在電力市場上新增了一項 Load shifting 商品，也就是 Energy type，市場需求量預估約為 500MW。

推動電力市場採購儲能服務遇到了哪些問題、如何解決？最主要的挑戰來自於一個簡單的問題：Who builds the batteries? 這個問題複雜的原因，是因為台電是一個 vertical-integrated power company，當時有兩個選項，台電自己蓋，或是開啟當時國內沒有的電力市場。當時我們很清楚，後者是比較好的選項，因為如果開啟輔助服務市場，那麼就可以透過市場機制的優點，提供合理的經濟誘因跟商業模式，這些開發商在市場競爭之下，就會盡可能提高效率、降低成本、和提高可靠度，這不管在管理或是目標達成的角度，都是很吸引人的但開啟市場最大的問題，就是當時台灣沒有自由交易的電力市場，所以法規(policy)將會是最大的問題，此外，還有 IT 整合，包含投標、調度、監控、結算的問題。

在 2018 年我們所遇到的問題主要有四個，包含併網的 grid code 和容量，對於儲能都沒有一套標準，市場和設備的相關規範，當時的規則也是非常模糊。模糊的 Grid code 和規則，

對於 stakeholder 來說是非常不好的消息，第一，他們不易熟悉規則，第二，這樣對他們來說風險很高，導致沒有投資或融資信心；最後是 IT 整合，包含分散式通訊和中央調度監控。

如何解決？首先是併網方面的問題，我們在 1 年內就完成了 Grid code 針對併網型儲能的更新，並且釋放出併網容量給 BESS，這樣一來，儲能併網就可以順利無阻，在 2021 年，已經有 1GW 通過併網註冊，這個數字在今年達到 5GW。接著是市場和設備法規，首先調整了國內電業最高位階的電業法，開放儲能參加電力市場，接著設計了一整套電力市場交易規範，並開啟電力市場；設備安全方面，我們也將國際標準納入為國家標準，使得業者有法源可以依循。在成果方面，在電力市場上，活躍的儲能開發商已經超過 40 家，而總交易容量也已經到達 300MW 以上。有了前面兩項的努力，接著最大的問題就是要跟 stakeholders 溝通，電力市場對台灣的 stakeholder 來說非常的陌生，於是我們將所有資訊公開透明放到網路，並且舉辦了 7 場以上的公聽會，蒐集業者的意見並適度調整規則，同時還製作了線上電力市場教材，讓所有 stakeholder 可以了解市場運作，建立一個公開、透明且穩定運作的市場，讓業者很有信心投資，銀行也願意融資超過 70% 的專案。最後一個 Challenge 是 IT 整合，因為原有的調度系統都是針對傳統大型發電機，對於小型分散式的儲能調度仍有困難，於是我們引進了 SDWAN 和 IEC61850 系統，首先改善了儲能通訊問題，讓儲能可以上市場投標，並接受調度

指令，把每秒實際運轉數據傳回給調度單位，調度單位可以即時監管、結算，同時也允許小資源聚合，現在可以調度的最小容量是 100kW，未來將引入 MMS 的市場管理系統，進一步做調度最佳化。

目前台灣電力市場的交易商品，儲能主要是提供 Frequency regulation，在 spinning reserve 和 supplemental reserve 目前還沒有儲能參加，regulation 可以分成 power type 的 dReg 和 energy type 的 E-dReg，Power type 的能量要求是 0.5 小時，Energy type 因為要做 load shifting 的關係，能量要求是 2.5 小時。

如前所述，IT 整合是促成外部開發商可以接受儲能調度的重要工作，但我們也不是一開始就找到最佳的作法，一開始合格交易者跟電力交易平台之間的通訊是用 VPN over IPSec 但這個架構很容易造成資料遺失，缺值對於結算來說是很大的問題，因此改採用 VPN/SDWAN，透過強化通訊架構，改善了缺值的問題，SDWAN 可以說是我們在儲能和電力交易發展方面，在短期的一個 last mile，是一個很重要的 milestone 因為有了穩固的通訊架構，我們才能準備儲能未來更進一步的發展。

由於過往儲能的成本較高，於是電網應用較為受限，但在過去 2-3 年，台灣已經在 Frequency regulation 和 load shifting 獲得一定的成功，接下來台灣儲能系統的發展，應該跟隨國際的腳步，進一步往 Real time dispatch，甚至是 Congestion 和 Grid forming 的應用，才會讓儲能真正發揮它的價值，並且幫

助電網容納更多再生能源，進一步的幫電網減碳，讓台灣朝淨零的目標更邁進一步。

4-2 IEA presentation：

Data collection on grid-scale battery storage

Presenter：Luca Lorenzoni, , IEA

Luca Lorenzoni 提供 IEA 的大規模電池儲存數據收集的全面報告，解釋其定義以及在推動清潔能源轉型中的關鍵作用。在數據收集方面，包括 IEA 的年度電力和熱能問卷，以及電池在發電和商品平衡中的顯示方式，這是 IEA 首次收集此類數據，因此目前還沒有有關電池的歷史數據，IEA 歡迎各經濟體對這項新技術及其數據收集提供反饋。

4-3 EGEDA secretariat report：

Proposed data collection on grid-scale battery storage in APEC

Presenter：Mr Edito Barcelona, Senior Research Fellow/Head EGEDA secretariat

EGEDA Mr. Edito Barcelona 提出他對 APEC 大規模電池儲存數據收集的建議，並簡要概述了抽蓄式儲能和大規模電池儲能系統，以及對 EGEDA 在這些儲能技術的當前數據收集做法的評估。對於 2022 年年度數據的收集，EGEDA 秘書處將與其他組織和成員經濟體討論修訂年度電力和熱能問卷，以有效收集電池儲能數據和容量數據。更新的版本將在年底發布。

4-4 APERC presentation：

Electricity storage: technologies and applications

Presenter：Mr Alexander Izhbuldin, Senior Researcher, APERC

有關全球或 APEC 地區是否有任何計劃中的抽水儲能項目，同時提到美國近幾十年來缺乏新的抽水蓄能項目。Mr Alexander Izhbuldin 首先強調了抽水儲能和電池儲能之間的區別，並提到電池儲能更容易採購和安裝，而抽水儲能需要特定的地質條件，因國家和地點而異。他確認中國計劃擁有更多的抽水儲能，目前正在建設約 100 GW 的抽水儲能容量。

4-5 Economy presentation：

The Development of New Power Systems and Power Storage in China

Presenter：Dr Su Ming, Director, Energy Research Institute

能源研究院處長蘇明博士報告中國新能源系統和能源儲存的發展，內容包括中國發展新能源系統的計劃，提供了有關風能和太陽能光伏的當前能力的見解，說明傳統能源系統和新能源系統之間的區別，並強調了新能源在新能源系統中所面臨的日益增加的挑戰。報告深入探討了三種能源儲存方式的狀態、政策和前景，包括抽水儲能、新能源儲能（主要是電化學能量儲存）和綠色氫能。

4-6 Economy presentation：

Grid-scale electricity storage in Philippines

Presenter：Mr Michael B. Coligado, Science Research Specialist, DOE

能源部的科學研究專家 Michael B. Coligado 博士報告強調菲律賓對電池儲能系統的迫切需求。在面臨能源基礎設施挑戰的情況下，包括高成本和不穩定的電力供應，電池儲能被證

明是一種可靠和成本效益的解決方案。Michael B. Coligado 博士提供有關能源儲存系統（ESS）、電池能源儲存系統（BESS）和混合 ESS 項目的承諾和指示能力的寶貴見解。報告亦闡述了有關電網規模電力儲存相關數據的報告方法。

4-7 Economy presentation：

New Renewable Energy Strategy and Development in Chinese Taipei

Presenter：Mr Wei-Chih Huang, Section Chief, BOE

由能源局部門主管黃韋智先生簡報中華民國目前的能源規劃，介紹能源結構以及設定於 2025 年的能源轉型計劃，並強調 2050 年實現淨零排放的承諾。報告亦提供了有關中華民國能源儲存的當前狀況以及面臨的巨大挑戰，包括電網整合以及保持供需平衡等看法。

4.7 Session 5: Reporting the energy consumption of EVs, PHEVs and FCEVs

Session 5 由亞太能源研究中心（APERC）Senior Vice President 暨能源資料分析專家小組(EGEDA)主席 Mr Glen Sweetnam 主持，共有 5 篇報告，分別為：

5-1 Special presentation：

Energy consumption of electric vehicles – measurement, estimation, and data collection

Presenter：Mr. Morgan Watkins, Chair, Land Expert Group APEC Transportation Working Group

APEC TPTWG 的 Land Expert Group 主席 Morgan Watkins 表示：交通運輸占全球溫室氣體排放的約 25%，為實現零排放交通，TPTWG 認為交通減碳的最有效策略之一是車輛電動化，包括一些插電混合動力和氫燃料電池電動車的使用，以及清潔能源生產來提供動力能源。如果用燃煤發電的電力替代汽油車，能源使用可以減少 31%。如果電力來自天然氣，能源使用減少 48%，如果電力來自水電，減少率高達 75%。

5-2 APERC presentation：

Electric vehicle technologies

Presenter：Mr. Finbar Maunsell, Assistant Researcher, APERC

APERC 研究員 Mr. Finbar Maunsell 介紹電動車技術以及如何估算它們的能源消耗，提出一個簡單的公式，可以使用車輛數量、平均里程和每公里的電力消耗來計算能源消耗。另外要計算家庭部門中的汽車電池充電，則需要使用公共充電數據，總計算消耗減去公共充電將等於家庭部門中的電池充電。對於混合動力和燃料電池汽車的消耗，無需計算電力消耗，因為這些汽車使用石油和氫。

5-3 EGEDA secretariat report：

Electricity consumption in the road transport sector

Presenter：Risa Pancho, Energy Statistics and Training Office (ESTO), APERC

APERC ESTO/APERC 研究員 Ms. Risa Pancho 報告 APEC 能源統計中的道路運輸用電消耗，她指出近年來電動汽車的數量迅速增加，但電力消耗並未相應增加。她懷疑 EV 的電力

消耗數據並未完全包含在報告的電力消耗數據中。她請求 EGEDA 成員在道路運輸的電力消耗數據報告應包括這些新的 EV 的消耗。

5-4 Economy presentations：

Electricity consumption data of battery electric vehicles (BEVs)

Presenter：Mr Jen-Yi Hou, Vice President, TRI Chinese Taipei

台灣綜合研究院副院長、EGEDA 副主席侯仁義先生簡報台灣的電動汽車用電數據的方法和結果，與 Maunsell 先生介紹的方法類似。計算使用車輛庫存或已註冊的 BEV、平均里程和每公里的平均電力消耗。至於重新分配包括在工業、服務和居住部門的 BEV 的電力消耗，台灣使用每五年進行的調查結果。同時說明未來的發展方向，例如對 BEV 充電行為進行調查，從交通部收集電動公共汽車數據，以及在安裝先進計量基礎設施後，從台灣電力公司收集 BEV 數據等。

5-5 Economy presentations：

Electric Vehicle Program in Thailand

Presenter：Ms Narumon Fromhold, Chief, Energy Information Development Group

Ms. Narumon Fromhold 報告『泰國的電動車計劃』，泰國致力於推動電動車（EV）和電動車零部件的製造業，並積極提供支持。這包括基礎設施和電池技術的發展以支持 EV 的發展。泰國政府已成立國家電動車政策委員會促進 EV 的採用和推廣。泰國被視為全球主要的電動車和電動車零部件生產基地。泰國的電動車計劃強調幾個關鍵方面：1.推動製造業，特別是

電動車和電動車零部件的生產、2.建設相應的基礎設施，以支持電動車的充電和運行、3.評估電動車的推廣對燃料消耗和溫室氣體排放的影響，以確保環境可持續性、4.推動電動車的採用，以實現更清潔和可持續的能源未來。

4.8 Session 6: Understanding fugitive methane emission and CO2 sequestration

Session 6 由亞太能源研究中心（APERC）Senior Research Fellow / The Expert Group on Energy Data and Analysis (EGEDA) Head secretariat Mr Edito Barcelona 主持，共有 4 篇報告，分別為：

6-1 Special presentation：

APEC GHG emissions data

Presenter：Edito Barcelona, Senior Research Fellow Asia Pacific Energy Research Centre

APERC 的高級研究員 Mr. Edito Barcelona 簡報 APEC 溫室氣体排放數據，EGEDA 秘書處一直在收集有關燃料燃燒產生的二氧化碳排放數據，而有關逸散排放、二氧化碳的運輸和儲存的數據則未被收集。另鑒於 APEC 提出的新目標是將甲烷排放減少 50%，EGEDA 秘書處決定修訂當前的數據收集模型，以包括甲烷、一氧化二氮排放以及二氧化碳的運輸和儲存。最後，EGEDA 秘書處要求各成員經濟體向秘書處提交額外的排放數據。

6-2 APERC presentation：

Carbon capture and storage (CCS) technology perspectives

Presenter：Dr. Phung Quoc Huy, Senior Researcher, APERC

APERC 的高級研究員 Dr. Phung Quoc Huy 報告碳捕獲和儲存（CCS）技術的展望，說明在全球和 APEC 地區的發展情況。Dr Phung Quoc Huy 提出透過多種措施降低 CCS 的總成本的可能性，包括擴大規模、模組化、示範專案、低成本能源供應、技術創新和補貼/創新。最後，從政策、財務和技術的角度呈現了 CCS 部署的機會和挑戰。

6-3 EGEDA secretariat report：

Proposed data collection of fugitive methane emissions (including IPCC methodologies), and carbon transportation and sequestration

Presenter：Mr. Nabih Matussin, Researcher, APERC

APERC 研究員 Mr. Nabih Matussin 簡報有關逸散排放和二氧化碳運輸和儲存數據收集，以及根據『政府間氣候變化專門委員會（IPCC）指南』收集和計算逸散排放以及二氧化碳運輸和儲存的一些方法。他同時報告透過 IPCC Tier 1 和選定 APEC 經濟體提交的逸散甲烷排放之間的重大差異。

6-4 Economy presentation：

Fugitive methane emission: JOGMEC Initiatives and Technology for Methane Emission Management

Presenter：Makoto Shimouchi, ANRE-METI, Japan (TBC)

JOGMEC 甲烷管理工作組的技術總監 Makoto Shimouchi 報告 JOGMEC 的甲烷排放管理舉措和技術，其中包括各種由上而下和由下而上的測量技術。由上而下的測量是通過衛星和

飛機，而由下而上的測量是通過 OGCI 攝像機和氣體分析儀進行的。他說明 JOGMEC 目前在 JGC 研發中心設有一個測試設施，用於進行各種實驗活動（控制釋放甲烷的定量精度和甲烷檢測性能）。

6-5 Economy presentation：

Carbon dioxide capture and storage: Japan Policy for Full-Scale CCS Operation by 2030

Presenter：Mr. Norihiko Saeki, Director, Carbon Dioxide Capture and Storage Policy Office of METI

日本經濟產業省（METI）CCS 政策辦公室 Mr. Norihiko Saeki 表示，日本自 2000 年以來持續投入 CCS 研究，當時首次在長岡 CCS 計畫進行研究。根據日本的長期路線圖，該國計劃在 2030 年前制定和實施 CCS 商業模型，最終在 2050 年實現 CCS 的全面應用，年存儲容量在 1.2 億至 2.4 億噸之間。他同時報告選定的先進 CCS 項目的位置以及將有助於實現目標年存儲容量的公司。此外，還提到日本計劃在 2024 年之前落實二氧化碳的長程運輸，並介紹了亞洲 CCUS 網絡（ACN）平臺，旨在分享知識，為整個亞洲的 CCS 利用開發業務環境。

4.9 Grid-scale electricity storage 議題圓桌會議交流討論

1. Electricity storage plans in your economy?

大概可以把儲能的規劃分成短、中、長期。短期而言，台灣在 2025 年目前規劃是 1.5GW 的建置容量，其中 500MW 是做為頻率調整的用途；另外 500MW 是做為電能移轉使用；剩餘的 500MW 則是

做為光電案場的電能轉移使用，其電能儲存量大約會有 3GWh。

短期目標就是先將儲能的相關建置、運轉經驗累積起來，同時也將儲能設備的相關管理規範，尤其是設備安全、資訊安全及消防安全等法規順利建立起來。先經由這 4-5 年的實際運轉經驗，再來評估儲能系統對於電網運轉安全的具體效益，並規劃下一階段的應用。

中期來說，儲能的應用還是會以電能移轉的應用為主，但操作會更接近 Realtime，並且加入 Grid forming 的相關功能，這可能有包括：real-time balancing 的調度、壅塞處理、電壓調整、虛擬慣量等等的應用。但具體的裝置容量還沒有明確的政策目標。

長期規劃方面，由於低碳化電網將需要持續時間更長的電能移轉，屆時將視儲能系統的成本而定，應該會不只侷限於鋰電池的應用，而是會考慮更多不同的先進儲能技術，包括鈉硫、釩液流、氫能、空氣壓縮。

總結來說，會在成本與技術可行的情況下，透過不同的儲能技術解決不同階段的電網問題。

2. What are the data collection and storage challenges?

數據蒐集最主要的挑戰是數據解析度、數據品質、資料傳輸以及資通訊安全，而這些都跟成本高度相關。

解析度方面，當然越高越好，台灣儲能系統現在要求的取樣率是 1 秒鐘的等級，精準度是小數點後第二位；但對於未來其他應用而言，或許 0.1 秒、小數點第三位會更符合電網需求，但這對於電力表計要求、傳輸品質和資料存取成本都是一大挑戰。

其次在 Data quality、資料傳輸以及資通訊安全則是資通訊技術與成本有很大的關係，主要是儲能系統是小容量的分散式資源，資料

傳輸以 internet 比較可行，但我們之前選用 VPN 的方式，即時資料容易受網路狀態影響，造成缺值的情況，現在換了一個比較穩定的 SDWAN 架構，大幅改善了數據品質，同時通訊的資訊安全也強化了許多，但是成本也是之前的四倍以上。

3. How and who will collect the data?

儲能的運轉數據會首先由儲能案場的 EMS 系統紀錄，並儲存在案場和業者所指定的數據裝置中，資料備份的長度至少為 3 個月。Taipower 要求併網型儲能的所有數據皆須使用 IEC61850 的 protocal 回傳每秒鐘的資料到電力調度單位，這些即時資訊幾乎涵蓋所有即時的訊息，如電壓、頻率、實功率、需功率、SOC 等，若是做負載轉移的儲能系統更要進一步使用 API 回傳一整天每 15 分鐘的充放電排程資料。若是即時資料傳輸過程無法完整傳送到交易部門，則業者需要在結算之前補齊所有缺失的資料。

4.10 各場次圓桌會議交流討論各會員經濟體發言摘要

表 4-1 Session 1 Round table discussion

Economy	Update
Brunei Darussalam	• Deployment of 200 MW Solar PVs by 2025. • Aiming to reach 30% of the total energy mix from solar by 2035, predominantly from large-scale solar PVs. • Currently planning to deploy electric vehicles and CCUS for oil and gas facilities. • Current challenges include verification of collected data, and concerns on security of data collected.
Chile	• Looking into accelerating transmission lines capacity to align with rapidly expanding renewables capacity. • Further developments may pose socioeconomic challenges, e.g., affecting indigenous communities.
China	• Ready to accept new technologies to integrate into existing systems. • Currently there are many off-grid systems within China which make data collection a challenge.

Hong Kong, China	• Limited land areas in the economy pose challenges to expanding renewables capacity. • Typhoons may also pose challenges for Building Integrated Photovoltaics (BIPVs) and floating solar PVs deployments. • The economy is also prioritising buildings energy efficiency conservation measures given the high population densities across the economy.
Indonesia	• Fuel-cell buses are available but only operating on special occasions/events. • Indonesia is now making progress on collecting data on uses of solar water heaters and uses of biogas and biomass in industries.
Malaysia	• Just launched the 2nd phase of the National Energy Transition Roadmap in August 2023, focusing on six levels such as EEC, renewables, hydrogen, bioenergy, green mobility, and CCUS. • For hydrogen, green hydrogen for power generation is being considered. • Current CCUS project is located on one of the gas fields in Sarawak. Future CCUS projects will be expanded to power and industry sectors. •Cross-cuting enablers such as financing and investment, capacity building, governance, policy and measures, have been identified. • Legal framework for data collection is one of the biggest challenges.
Papua New Guinea	• Looking into green hydrogen coming from domestic renewable resources. • Aiming to have 70% of its energy mix from renewables in 2030 and reach 100% by 2050. • Currently building capacity in data collection and is aiming to have an established one by 2024.
Peru	• Increase of solar and wind generation by 20% by 2030. • About 12 GW of renewables capacity projects are ready for integration, amid current limitations in transmission lines capacity which need expansion.
Philippines	• Aiming to reach 35% of total installed capacity from renewables by 2040 and further increase the ambition to reach 50% in the same year. • Challenges include the high upfront cost of deployment of renewables and new transmission lines, the lack of existing infrastructures to support renewables, the lack of public awareness, and the need for government intervention.
Chinese Taipei	• Launched its Pathway to Net-Zero Emissions in 2050 in March 2022. • Renewables to make up 20% of the total generation by 2026, and eventually reaching 60-70% by 2050. • Supply side technologies include ocean energy, geothermal and energy storage. • User-side technologies include CCUS and recycled waste. • Data collection challenges include collection and re
Thailand	• The Electricity Generating Authority of Thailand (EGAT) currently has a few pilot projects, one of which is a wind-green hydrogen hybrid project with a capacity of 300 kW.

	• EGAT plans to blend hydrogen with natural gas in its power generation, as well as installing CCUS in a number of power plants in Thailand.

表 4-2 Session 2 Round table discussion

Economy	**Update**
Brunei Darussalam	• Still conducting a study of green hydrogen production. In BD, ammonia is produced from natural gas for fertiliser production.
China	• Focusing on hydrogen development. In China, each province is making efforts for demonstrations. The National Statistics Bureau will collect hydrogen data and fill out templates in the future.
Hong Kong, China	• Would like to know which unit is used besides TJ. HKC also would like to know what process hydrogen produced from town gas is categorised. • No ammonia production, but it is extracted from wastes as byproducts. EGEDA Secretariat shared that hydrogen produced from town gas may be regarded as other processes.
Indonesia (INA)	• There is no hydrogen production and consumption data in INA. However, hydrogen is considered a new energy used in the near future.
Malaysia	• Hydrogen is produced on a small scale by Sarawak Energy. Also, hydrogen is produced by Petronas for export and transport. Ammonia is produced at gas facilities as feedstock. Agencies are still engaged in hydrogen and ammonia data collection. • Believes it needs to discuss with other economies how to fill out the format specifically.
PNG	• Not looking into hydrogen and ammonia yet. Hydrogen data collection will be considered in the future.
Peru	• As mining companies had pilot transport projects, Peru included hydrogen in its EBT format. Ammonia is used as a fertiliser in Peru.
Philippines	• Believes hydrogen, ammonia and e-fuel have the potential to achieve its target of energy security. DOE of Philippines established the fuel cell research testing facility. The challenge is the lack of infrastructure.
Chinese Taipei (CT)	• Chinese Taipei is concerned with the division of H2 production into Non-energy and Energy use for energy statistics. H2 is also used by the chemical industry and producing other products. • The EGEDA Secretariat is still determining if the total ammonia will be incorporated into the energy statistics. CT will monitor this development and include whatever is discussed in the reporting manual at TT-SIEC meetings. IEA defined e-fuels as how they are produced, not composed.
Thailand	• The target year for the commercial usage of hydrogen is 2030. It is still in the stage of pilot to produce electricity. Ammonia is produced for fertilisers now.

United States (USA)	• Focusing on the hydrogen production side. The Energy Information Agency has been preparing for the data collection survey.
Viet Nam	• No e-fuels right now. Ammonia is used to produce fertilisers. In the future, Viet Nam believes hydrogen will have potential for energy use.

表 4-3 Session 3 Round table discussion

Economy	Update
Brunei Darussalam	• No District Cooling plan as of now
Chile	• No District Cooling plan as of now
China	• Has few DC projects. The national statistics group will collect district heating/cooling data.
Hong Kong, China	• Exploring the technical feasibility and financial viability. Both projects are in the new development areas because it is challenging to develop DC in an existing urban area. Hong Kong, China has reported NACOP yearly to APERC for a few years. More detailed data will be provided in the coming years by introducing AI.
Indonesia	• The government/company is taking it more seriously regarding District Cooling due to the partnership. We can put the district cooling data into the Energy Balance Table and see how it will impact energy consumption.
Malaysia	• APERC can join the meeting with the association to collect the data which is filled in the questionnaires.
Papua New Guinea	• No District Cooling system as of now
Peru	• Conducted small feasibility studies but have not yet collected the data. The economy can submit the data in the future.
Philippines	• Don’t have new plans for the investment of new DC. There are two existing DC providers in BGC and Northgate Alabang, both are operated by private entities and not the government.
Chinese Taipei	• District cooling has not yet recorded the data in EBT, and private companies might have cooling data. CT raised a question about whether EGEDA is following the definition of the cooling data because it's a byproduct of a process.
Thailand	• The DC system is operational at Suvarnabhumi International Airport. Thailand has not yet recorded/collected the data on district cooling.
United States	• Conducting an annual commercial energy consumption survey that came out in December 2022 which includes district cooling data. 55,000 buildings have DC systems as of 2018. • No projection and it is not publicised. According to the latest projection, there’s no huge increase in the DCs. • No specific policy for the district cooling or hea□ng for now.
Viet Nam	• No DC plan in the energy master plan and a plan to collect the data yet.

表 4-4 Session 4 Round table discussion

Economy	Update
Viet Nam	• Has plans for both pumped storage and batery energy storage systems (BESS). They aim to have 15MW of BESS by 2025, with a project currently in feasibility study. In 2030, a 1,200 MW hydroelectric pumped storage project is planned in the south. • For data collection, it is expected that the Electricity Corporation of Vietnam will handle data collection, with support from the Institute of Energy Vietnam and the General Statistics Office Vietnam.
United States	• Has nearly 15 gigawats of large-scale batery storage, expected to double in the near future and potentially reach 100 gigawats by 2030. • Data on batery storage, including capacity, charging, discharging, and cost, is already collected and publicly available. • They are interested in obtaining more detailed data on hourly performance and revenue streams.
Thailand	• Has grid-scale batery storage of 37MW and hydro-pumped storage capacity of 1,031MW. • Data collection for grid-scale batery and pumped storage is not seen as a problem. • The challenge lies in defining and collecting data for off-grid storage systems.
Chinese Taipei	• Has plans for multiple pumped storage projects of varying capacities. • Short-term plans include BESS options. • Data collection challenges arise from the decentralised nature of batery storage installations. • There are no regulations requiring enterprises to report energy storage data to the Department of Energy in Chinese Taipei. Efforts will be made to discuss with power provider enterprises and request voluntary data submission.
Peru	• Working on energy storage regulations and mechanisms to integrate this technology into the grid. • Laws in Peru promote the use of lithium for energy storage, given the country's lithium reserves.
Papua New Guinea	• Depends mainly on hydro, and there is no large-scale energy storage. • The National Energy Authority would be responsible for data collection if energy storage systems are deployed in the future.
New Zealand	• Planning the Lake Onslow pumped hydro project, with capacity ranging from 3 to 8.5 terawat hours. • The project is still under development, with phase two investigations planned.
Malaysia	• Plans to introduce energy storage systems in Sabah and Peninsular Malaysia, with a focus on the east coast of Sabah. • They have three electricity grids across different regions of

	Malaysia. • Energy storage development is ongoing, and data collection will likely be managed by relevant authorities.
Hong Kong, China	• The government hasn't actively promoted energy storage due to land limitations but is aware of power companies' progress in deploying energy storage systems.
China	• Batery storage development is market-driven, and data collection is challenging due to the wide variety of installations and operational frequencies.
Chile	• Has about 65 megawats of batery energy storage systems (BESS) under development. • Regulatory frameworks for energy storage are still evolving. • Data collection faces many challenges. National Commission of Energy, which is the energy regulator will be the one who collect regulator,
Brunei Darussalam	• Is in the feasibility study and market research phase for energy storage. • Data collection will be considered in the future when energy storage systems are deployed.

表 4-5 Session 5 Round table discussion

Economy	Update
Brunei Darussalam	• Has plans to electrify transport, promote the increase of electric vehicles and deploying batery-charging infrastructure • EV charging is not yet separated from residential or commercial consumption
Chile	• There is a plan to expand the EV fleet. There are 4000 EV and HEV and more than 2000 public transport or 31% of the total fleet of the capital city or 2.5% of the nationwide fleet • EV consumption is not yet separated from residential and commercial sector consumption; estimation is done for this • Main issue is average mileage which is very hard to collect especially that survey became less regular with the last one made in 2015; a lot has changed from that year until now.
China	• EV penetration increased very fast in China; Currently, more than 1/3 of vehicles are EVs. • EV consumption recorded by the grid corporation; Price of EV charging is different from other consumers therefore these are recorded separately by the grid corporation but maybe included in the service sector. • Car company also has information on possible electricity consumption of EVs • Make use of big data in the future for collecting EV charging data.
Hong Kong, China	• The 2021 roadmap for EVs aims to install more than 150,000 private charging facilities and more than 5000 units of public charging facilities • By 2035 all vehicles that will be registered are EVs. No more ICE and HEVs.

	• Electric companies would install smart meters in 2025 to have more accurate electricity consumption data.
Indonesia	• There is a government policy on EVs specifically in motorcycles; subsidy on electric motorcycles is provided but only up to the middle income • EVs are only mandated in government • Maybe electricity company can report electricity charging but not the private households.
Malaysia	• Steering commitee for EV in-charge of EV policy. Electricity consumption collected by an agency, streamlined data collection utility company can monitor using smart meters • There will be 10,000 Charging stations in 2025, which can also monitor actual energy consumption. • EVs will be 80% of all vehicles by 2050 for both two wheelers and 4-wheelers.
Papua New Ginea	• Steering commitee for EV comprising an inter-agency commitee in collaboration with Department of Transportation and Climate Change and Development Authority (CCDA) • There are two electric vehicles in the economy but no data collection yet • Government is encouraging companies to use EVs and might start in 2024
Peru	• There is a roadmap for electric mobility, installation of charging stations; the Ministry of Energy and Mines will work together with other ministries in encouraging EVs for private vehicles to begin in 2023. • Five percent of public buses will be EVs in 2050 • Peru energy balance included electricity consumption in transport
Philippines	• Enacted RA 11697 or the electric vehicles industry development act which provides incentives in the development of EVs • The target is that 10% of vehicles will be EV by 2040 • The Department of Energy (DOE) is responsible for the collection of data as well as in policies and programs for EVs
Thailand	• Incentives for both producer and consumer (most especially) led to the increase in the number of electric cars in the last two years • Having a car is still a luxury in Thailand. Incentives might not be enough to achieve the EV target • There are also complaints about not enough public charging in long distance travels • Electricity consumption in private charging might still be in the residential sector.
USA	• Consumption of EVs is not yet separated from the sector where it is charged but the EIA is working on it. • In promotion of EVs ICE are still cheaper than EVs and people buy what they can buy • Will install 1.2 million public charging by 2030. • Collecting data from public charging but would need to estimate for private charging.
Viet Nam	• Electric vehicles have been introduced recently but the number it not

	yet so many. • Few interests in electric vehicles due to the length of time to charge especially during long-distance driving • Consumption of EVs is not yet separated from the sector where it is charged • The Institute of Energy (IE) and General Statistics Office (GSO) are in charge of collecting data

表 4-6 Session 6 Round table discussion

Economy	Update
Brunei Darussalam	• Not a significant producer of fugitive emissions but is expected to further lower its emissions in the future from current levels. • No policy on CCS yet but the government is considering implementing carbon pricing for all operators. • One of the operators is considering implementing CCS in the future and if it goes through, the Brunei Climate Change Secretariat will the agency responsible for collecting the CCS data.
China	• Major producer of coal and produces significant volume of oil and gas, hence emits large fugitive emissions. • Measure and collect fugitive emissions from their coal mines in the past. • Has around 40 CCS projects in operation or under construction. Ministry of Technology is now understood to collect the data on CCS.
Hong Kong, China	• Does not produce significant volume of fugitive emissions. • The rate of leakage of the economy's city gas (including methane) as of now is about 0.045% • No information on the plans for CO2 sequestration as well as on how and who will collect both fugitive emissions and CO2 sequestration data.
Indonesia	• Already calculating fugitive emissions based on the IPCC guidelines. • Has 15 planned projects of CCS throughout Indonesia. Any data pertaining to CCS would be collected from the Directorate-General of Oil and Gas of MEMR, which will be used to calculate GHG emissions.
Japan	• Has several CCS projects in the pipeline, as per earlier presentation. • Will collaborate and develop technologies to further reduce the overall CCS cost. • Aims to develop regulations and import/export mechanisms of CO2 export. • Does not emit significant fugitive emissions. • NIES is employing satellites to measure and estimate fugitive emissions which will help improve GHG inventories in the future.

Malaysia	• Currently fugitive emissions accounted for 9% of total energy sector emissions in Malaysia. • For CCS, Malaysia is commited to develop a project located in Sarawak basin, targeted to be operational by 2025. In addition, Malaysia is planning to have three CCS projects by 2030, and an additional two projects by 2050 (up to 80 million tonnes CO2 per annum). • Currently data are being collected by the Climate Change Division, Ministry of Natural Resources, Environment and Climate Change, with Energy Commission being one of the focal points for energy sector data.
Papua New Guinea	• Emphasised the need to strengthen data collection in PNG.
Peru	• Fugitive emissions in Peru are mostly from oil and gas facilities. • There are small feasibility studies for CCS developments.
Philippines	• Has several CCS projects in the pipeline: 1) at Subic coal-fired power plant, 2) at a cement manufacturing plant in Cebu 3) at fertiliser plant in Laguna. • The Department of Energy is working to develop a set of guidelines on CCS developments in Philippines.
Chinese Taipei	• To sequester about 1.76 – 4.6 million tonnes CO2 by 2030, where 1.76 million tonnes is the baseline goal achieved via demonstration projects. 4.6 million tonnes are subject to further regulations and infrastructures. • Demonstration projects on locating and verifying geological storage sites to be carried out by state-owned companies. • Fugitive emissions are calculated via IPCC guidelines, and almost 300 000 tonnes of CO2e in 2022.
Thailand	• Fugitive emissions from energy are starting to be collected recently by the Ministry of Energy (MOE) by the request of the Ministry of National Resources and Environment (MONRE). • No policy on CCS yet, but oil and gas operators have completed their feasibility studies on CCS development and now doing front-end engineering designs. Expected to be completed and operational in three to four years. • Department of Alternative Energy of the MOE will be the agency responsible to collect the CCS data.
United States	• Methane emissions accounted for about 10% of its total emissions in 2021, covering oil and gas, agriculture, etc.

4.11 會議合影

圖 4-4 與會人員大合照

圖 4-5 台灣電力公司吳進忠副總經理專題報告-1

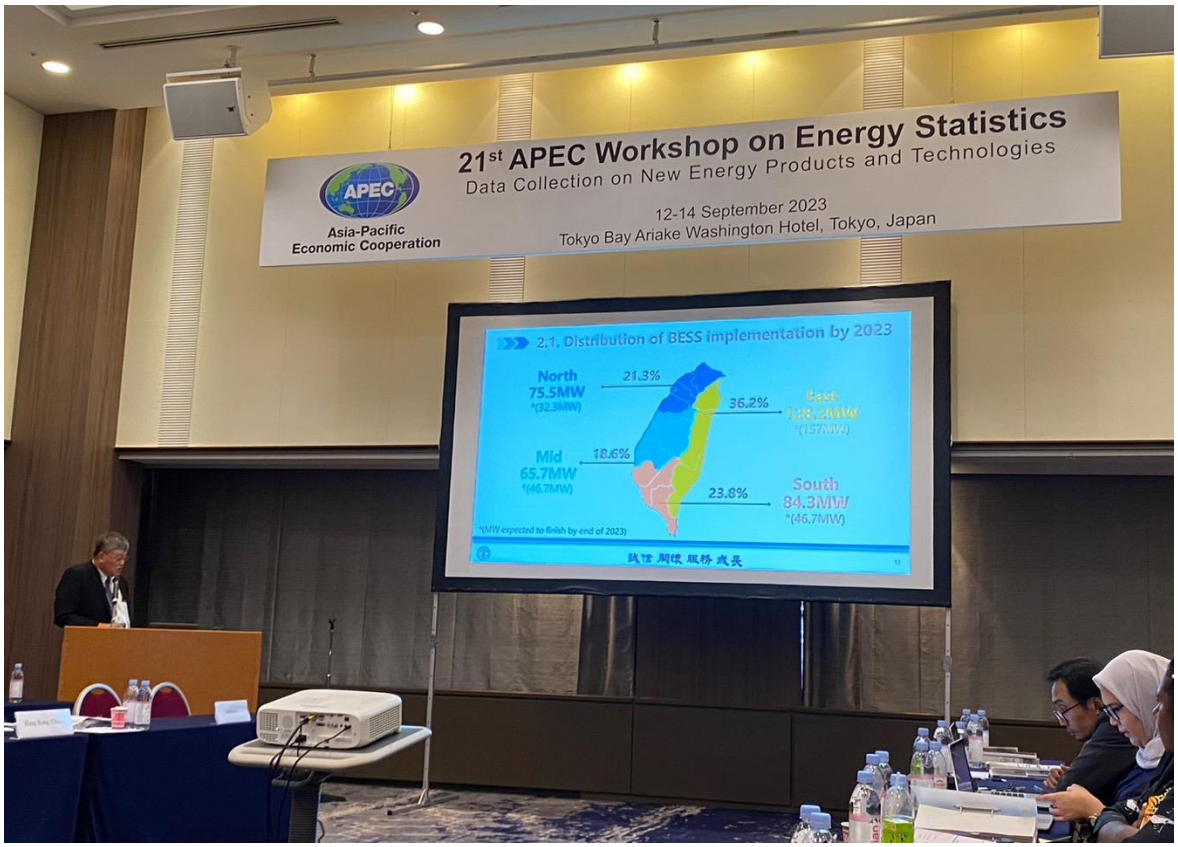

圖 4-6 台灣電力公司吳進忠副總經理專題報告-2

圖 4-7 台灣電力公司吳進忠副總經理專題報告-3

附錄1

Grid-scale electricity storage development in APEC

Dr. Chin-Chung Wu
Vice President, TaiPower Company

September 13, 2023

1

Outline

1	Introduction	• BESS development in APEC
2	BESS in Chinese Taipei (CT)	• Development targets • Challenges & solutions • Operation & Data communication
3	Conclusion	• Prospects & future BESS application

誠信 關懷 服務 成長

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1 Introduction

1.1 Main applications of BESS

1.2 Use cases in APEC member economies

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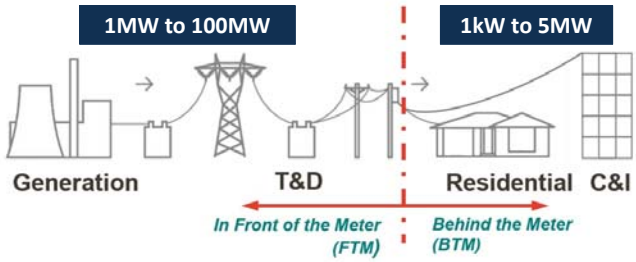
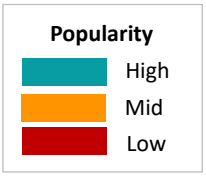
1.1. Main applications of grid-scale BESS





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1.2. Use cases in APEC member economies

Australia

Installed capacity	1,011 MW (2023)
Registered capacity	4 GW
Main Applications	• FCAS (Frequency Service) • SIPS (Network protection) • NEM market (Energy dispatch) • T&D deferrals • Congestion management • Renewable energy integration • Inertia (Grid forming)

Source:
NEM Generation Information July 2023
AEMO Annual Report 2022
ESB Post-2025 Market Design Final advice to Energy Ministers
https://reneweconomy.com.au/

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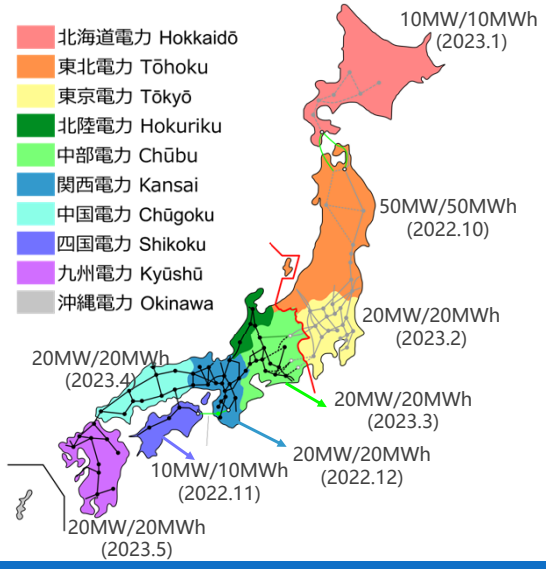
1.2. Use cases in APEC member economies



Japan

Installed capacity	160 MW (2022)
Registered capacity	-
Main Applications	• 電源I' (Frequency Service) • 三次調整力 (Frequency Service) • Wholesale market (Energy dispatch)

Source:
OCCTO - 蓄電設備・需要設備のグリッドコード検討会での取扱い 2023

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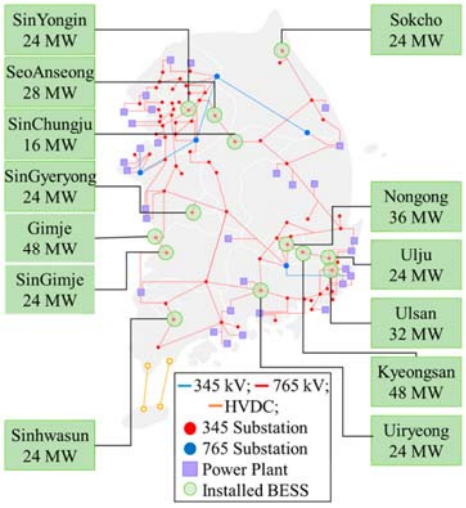
1.2. Use cases in APEC member economies



Korea

Installed capacity	426 MW (2023)
Registered capacity	-
Main Applications	• Frequency regulation (Frequency Service) • Substation operation optimization (Network protection)

Source:
828Form 20-FFY22 KEPCO's Form 20-F as filed with the U.S. SEC
https://www.mdpi.com/1996-1073/12/21/4060

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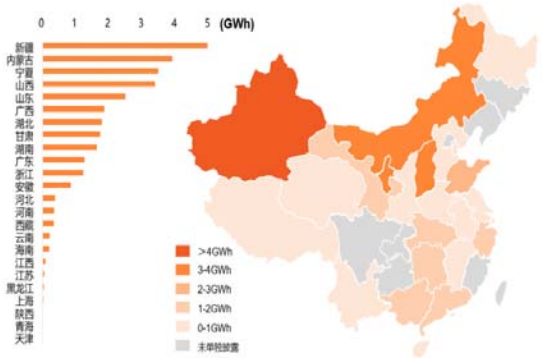
1.2. Use cases in APEC member economies



China

Installed capacity	13,100 MW (2022)
Registered capacity	-
Main Applications	• Current: Renewable energy, electricity markets, tariffs, and subsidies • Upcoming: Market and dispatch mechanisms

Source:
China Energy Storage Alliance - Energy Storage Industry White Paper 2023
https://pdf.dfcfw.com/pdf/H3_AP202302101583001313_1.pdf?1676042740000.pdf

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2 BESS in Chinese Taipei(CT)

2.1 Development Targets & Trajectory
2.2 Challenges & Solutions
2.3 Operation & Data Communication

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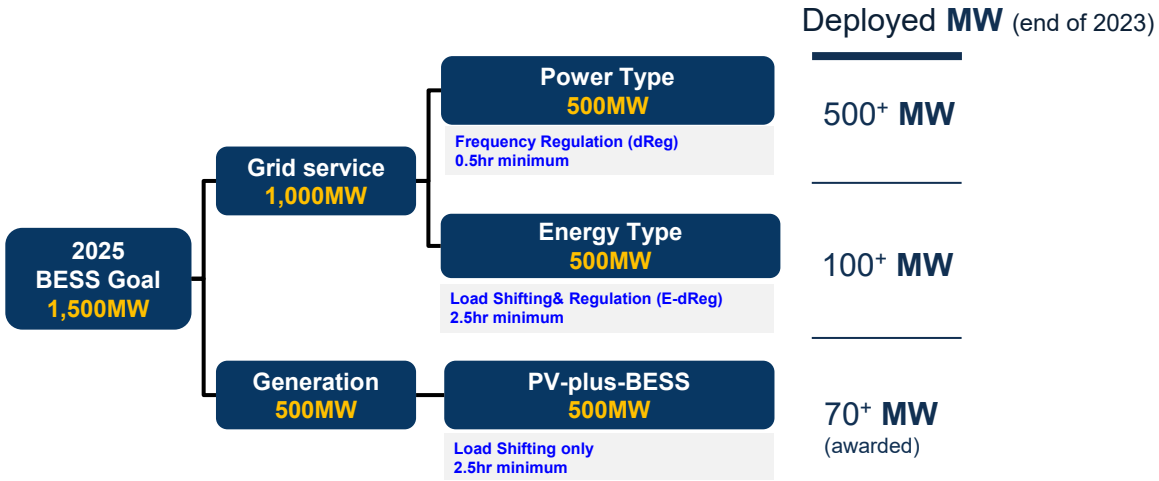
2.1. BESS in CT - 2025 Development Target



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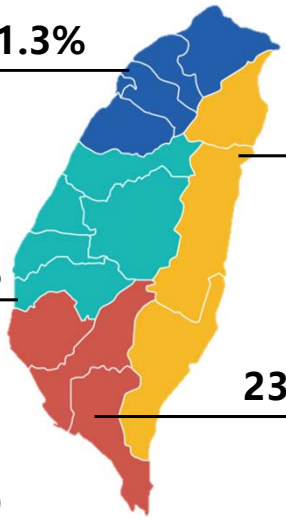
2.1. Distribution of BESS implementation by 2023

North
75.5MW
*(32.3MW)

21.3%



36.2%

East
128.2MW
*(157MW)

Mid
65.7MW
*(46.7MW)

18.6%

23.8%

South
84.3MW
*(46.7MW)

*(MW expected to finish by end of 2023)

2.1. BESS in CT - Development Trajectory

2018
1
Research & Pilot Project
Proof of concept by research project conducted by ITRI
- Modelling and simulation
- Telemetry and technical specs
- 1 MW pilot project

2019
2
Demonstration Procurement
Proof of commercial feasibility
- Frequency containment product
- 6 years bilateral contract
- 15 MW procured (60MW bids received)

2020
3
Ancillary Services Market
Day-ahead hourly capacity bidding
- Frequency regulation product
- 350 MW commissioned

2022
4
Load Shifting Trading Product
Day-ahead capacity and energy bidding
- Load shifting + Frequency regulation
- 500 MW market size

2 BESS in Chinese Taipei(CT)

2.1 Development Targets & Trajectory
2.2 Challenges & Solutions
2.3 Operation & Data Communication

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2.2. Main development challenge

Who builds the BESSs?

EPC by TaiPower* Itself	vs	Unbundle Electricity Market
Tender based	Business model	Market based
Ownership; authority	Benefits	Efficiency; cost; reliability
Low	Policy barriers	High
Simple	IT integration	Complex

*TaiPower as a state-owned, vertical-integrated power company

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2.2. BESS in CT - Various aspects of challenges

		Challenges
Grid Connection	■ Grid Code ■ Capacity	• Tech-specs for BESS were missing • LV feeder preliminary for PV
Dedicated Regulations	■ Market Rules ■ Safety Standards	• Not ready for BESS • High complexity of standards integration
Stakeholders	■ Developers ■ Banks	• Unfamiliar with power market • Lack of investment & loan confidence
IT Integration	■ Distributed communication ■ CDCC monitoring	• Unable to dispatch small resources • Rather conventional and inefficient

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2.2. BESS in CT - Various aspects of challenges

		Challenges	Solution	Current Situation
Grid Connection	■ Grid Code ■ Capacity	• Tech-specs for BESS were missing • LV feeder preliminary for PV	• Grid code revision within 1 year • Unleash LV feeder for BESS	2021: 1GW approved 2023: 6GW approved
Dedicated Regulations	■ Market Rules ■ Safety Standards			
Stakeholders	■ Developers ■ Banks			
IT Integration	■ Distributed communication ■ CDCC monitoring			

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2.2. BESS in CT - Systematic transformation

Grid Connection

- Grid Code
- Capacity

Dedicated Regulations

- Market Rules
- Safety Standards

Stakeholders

- Developers
- Banks

IT Integration

- Distributed communication
- CDCC monitoring

Item	Approved Capacity
Distribution Level	845.6MW
Transmission Level	5441.2MW
Total	6286.8MW

2.2. BESS in CT - Various aspects of challenges

Grid Connection

- Grid Code
- Capacity

Dedicated Regulations

- Market Rules
- Safety Standards

Stakeholders

- Developers
- Banks

IT Integration

- Distributed communication
- CDCC monitoring

Challenges	Solution	Current Situation
Not ready for BESS	Amendments to Electricity Act + Launch AS market	300MW BESS commissioned
High complexity of standards integration	Set IEC, UL9540 as national standard	

2.2. BESS in CT - Various aspects of challenges

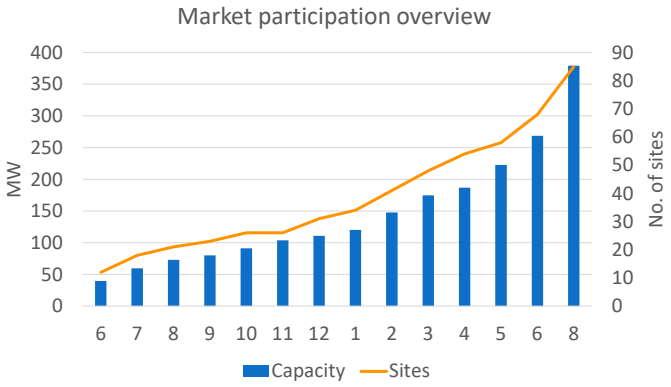
Grid Connection

Dedicated Regulations

Stakeholders

IT Integration

- Grid Code
- Capacity
- **Market Rules**
- **Safety Standards**
- Developers
- Banks
- Distributed communication
- CDCC monitoring



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2.2. BESS in CT - Various aspects of challenges

Grid Connection

Dedicated Regulations

Stakeholders

IT Integration

- Grid Code
- Capacity
- Market Rules
- Safety Standards
- **Developers**
- **Banks**
- Distributed communication
- CDCC monitoring

Challenges	Solution	Current Situation
• Unfamiliar with power market • Lack of investment & loan confidence	• 7 public hearings • Online power market tutorial • Transparent market rules & information	• Over 42 active BESS developers • BESS loans up to 70% in major banks

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2.2. BESS in CT - Various aspects of challenges

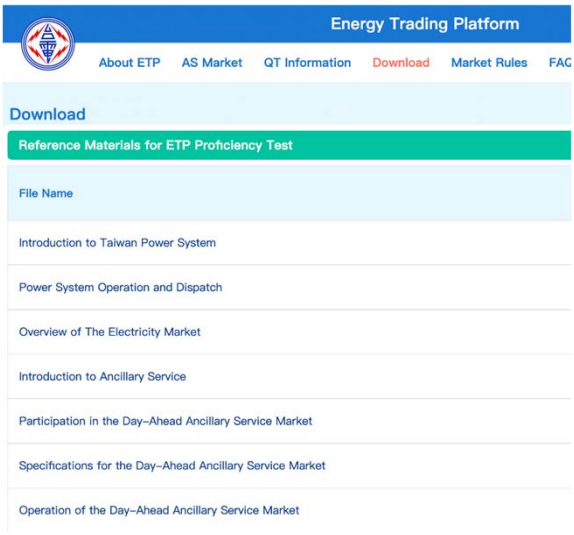
Grid Connection

Dedicated Regulations

Stakeholders

IT Integration

- Grid Code
- Capacity
- Market Rules
- Safety Standards
- **Developers**
- **Banks**
- Distributed communication
- CDCC monitoring



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2.2. BESS in CT - Various aspects of challenges

Grid Connection

Dedicated Regulations

Stakeholders

IT Integration

- Grid Code
- Capacity
- Market Rules
- Safety Standards
- Developers
- Banks
- **Distributed communication**
- **CDCC monitoring**

Challenges	Solution	Current Situation
• Unable to dispatch DER resources	• SDWAN + IEC61850	• DER aggregation to 100kW
• Rather conventional and inefficient	• MMS system	• ETP up & running

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2.2. BESS in CT - Various aspects of challenges

Grid Connection

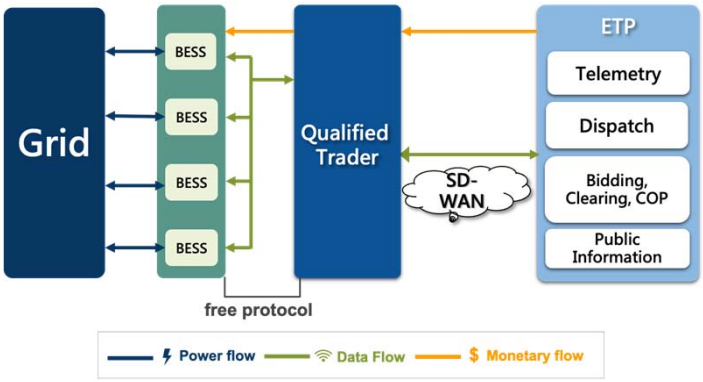
Dedicated Regulations

Stakeholders

- Grid Code
- Capacity
- Market Rules
- Safety Standards
- Developers
- Banks

IT Integration

- Distributed communication
- CDCC monitoring



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2.2. BESS in CT - Then vs Now

		Challenges		Current Situation
Grid Connection	Grid Code Capacity	• Tech-specs for BESS was missing • LV feeder preliminary for PV		2021: 1GW approved 2023: 5GW approved
Dedicated Regulations	Market Rules Safety Standards	• Not ready for BESS • High complexity of standards integration		300MW commissioned
Stakeholders	Developers Banks	• Unfamiliar with power market • Lack of investment & loan confidence	4 years	• Over 42 active BESS developers • BESS loans up to 70% in banks
IT Integration	Distributed communication CDCC monitoring	• Unable to dispatch small resources • Rather conventional and inefficient		• DER aggregation to 100kW • ETP up & running

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2 BESS in Chinese Taipei(CT)

2.1 Development Targets & Trajectory
2.2 Challenges & Solutions
2.3 Operation & Data Communication

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2.3 Technical Specifications of A/S Products

Day-Ahead Ancillary Service Market				
	Frequency Regulation Reserve		Spinning Reserve	Supplemental Reserve
	Dynamic (dReg)	Enhanced (E-dReg)		
Objective	Automatedly change output power in response to system frequency deviation	Simultaneously provide dReg and follow DA dispatch instruction for load shifting	Currently not provided by BESS	
Response Time	≤ 1s	≤ 1s		
Required energy level	0.5hr	2.5hr		

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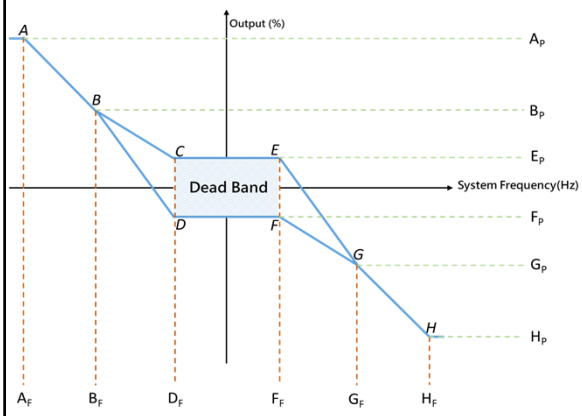
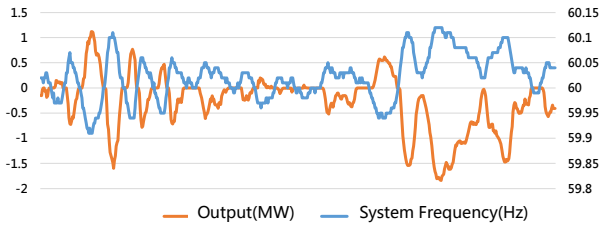
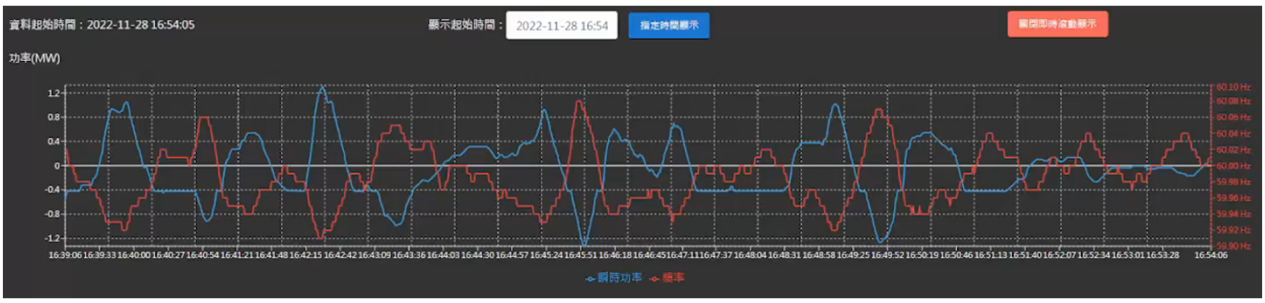
2.3 Example of dReg operation







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2.3 Example of dReg operation - low frequency

- **Contingency event: Coal power plant tripped**
- **Nadir frequency: 59.75**
- **Max output power of a single BESS site: 5MW**

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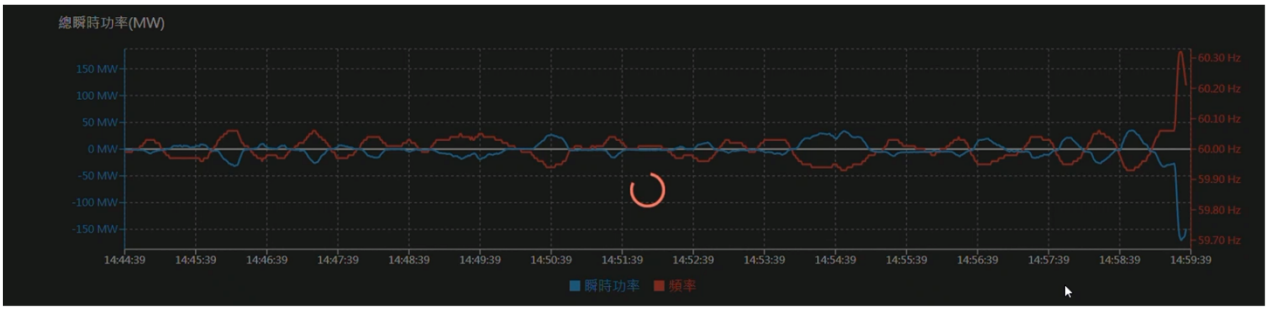
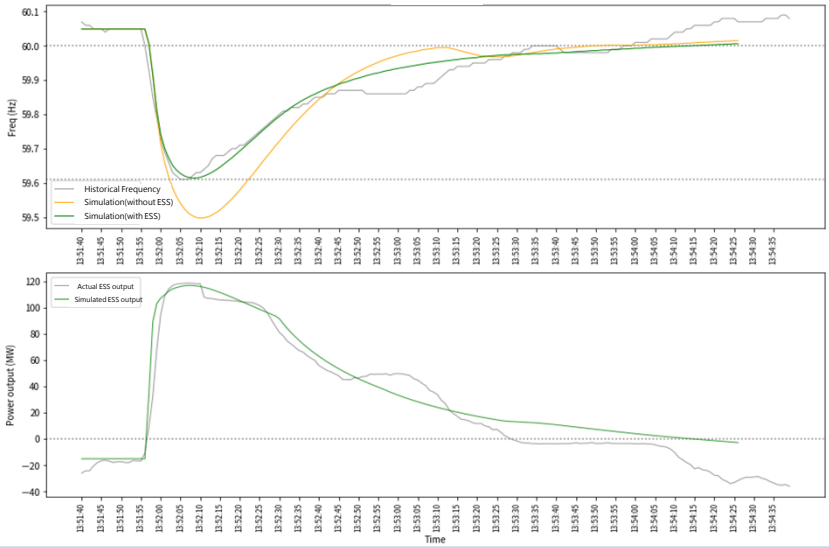
2.3 Example of dReg operation - high frequency



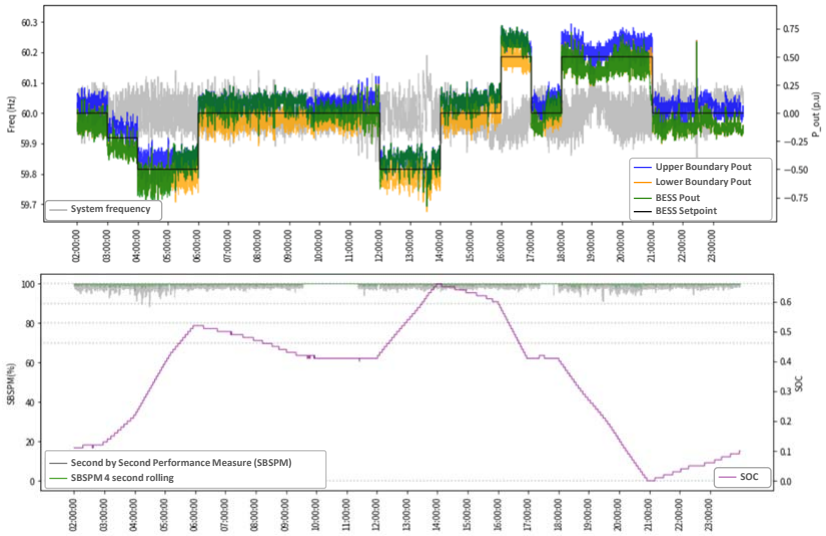
- **Before** and **after** contingency: **Frequency regulation**
- **Upon** a contingency: **Frequency containment**

2.3 Quantified contribution of nadir frequency



Item	Parameter
Date of event	2023/3/3
Tripped generator	Coal power unit
Tripped capacity	780 MW
BESS Installed capacity	140MW
BESS response power	120MW
Nadir Frequency (With BESS)	59.61 Hz
Nadir Frequency (Without BESS)	59.50 Hz

2.3 Dispatch example of E-dReg(load shifting)



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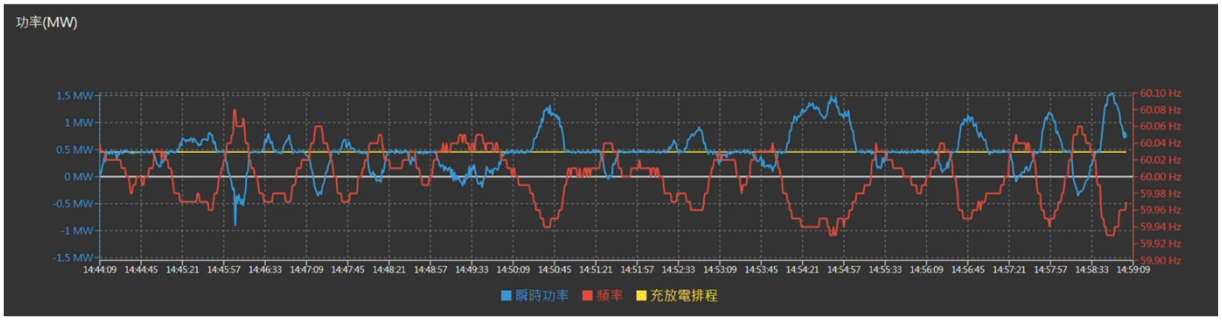
2.3 Dispatch example of E-dReg(load shifting)



- **BESS operation in this clip:**
  1. **Frequency regulation**
  2. **Frequency containment**
  3. **Load shifting + frequency regulation**

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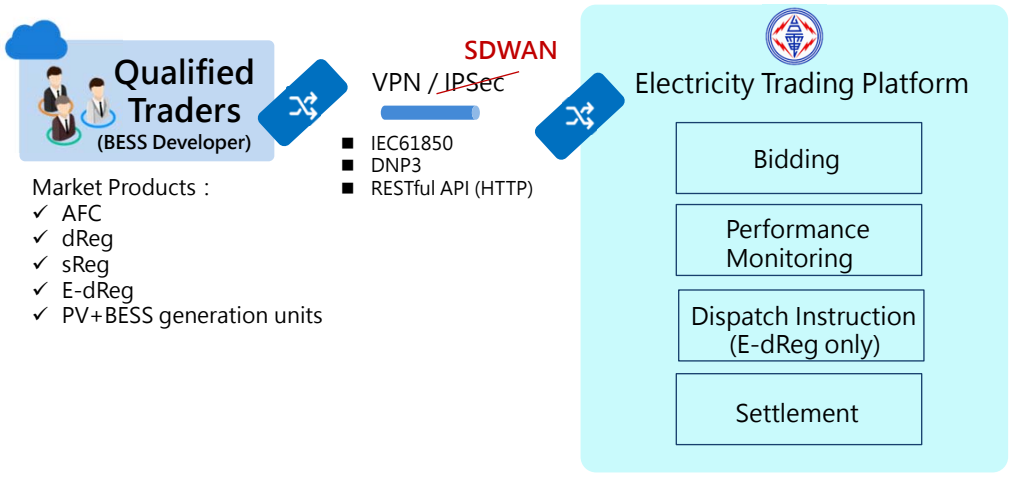
2.3 Telemetry and data communication



Market Products：
- ✓ AFC
- ✓ dReg
- ✓ sReg
- ✓ E-dReg
- ✓ PV+BESS generation units

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3 Conclusion

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Conclusion

- Due to the high cost of battery energy storage, after establishing foundational technical capabilities (Level1, Level 2), BESS development should follow international experience to explore more complex applications. Focusing on the current dispatch requirements from 2023 to 2030, the following outlines Level 3 Level 4 dispatch technologies and pathways:

Dev. Level	Schedule	Frequency regulation	Voltage	Daily Schedule (Load shifting)	Real Time Dispatch	Congestion + Grid Forming
Level1	2021 (achieved)	v	v			
Level2	2023 (achieved)	v	v	v		
Level3*	2025 (Planed)	v	v	v	v	
Level4**	2026 (Planed)	V	v	v	v	v

Thank You!
Questions?