出國報告（出國類別：開會）

赴泰國曼谷參加 SEGT 2019 學術研討會

服務機關： 核能研究所
姓名職稱： 黃揮文　研究員
派赴國家/地區：泰國曼谷
出國期間： 108 年 12 月 10 日~108 年 12 月 15 日
報告日期： 108 年 12 月 30 日

摘　要

「2019 年永續能源與綠能科技國際學術研討會(the International Conference on Sustainable Energy and Green Technology 2019, SEGT 2019)」於 108 年 12 月 11 日至 12 月 14 日於泰國曼谷舉行，由泰國國王科技大學(King Mongkut's University of Technology Thonburi, KMUTT)、台灣跨際整合中心(Center of Inter-Integration, CII)，泰國能源與環境聯合研究生院(The joint Graduate School of Energy and Environment, JGSEE)，台灣新世代住商與工業節能研究中心(Research Center of Energy Conservation technology of Residential-Commercial and Industrial sectors, RCEC)以及馬來西亞拉曼大學汽車技術中心(Center for Vehicular Technology, CVT)聯合主辦，主題包括：(1)新能源與再生能源、(2)永續能源轉化技術、(3)環境與氣候變遷、(4)能源管理、政策、經濟學與永續性、(5)能源科學、(6)儲能與動力工程、(7)永續城市、建築與綠色建築、(8)綠能設計、產品和製造流程、(9)智慧電網/智慧城市/智慧交通、(10)生質能等。來自 31 國共 470 名與會者出席了本次研討會，會議中發表 393 篇論文。

黃揮文研究員於研討會中發表論文「鳳山智慧綠色社區之住宅與商業區域用戶端電力韌性分析(A power demand resilience analysis of the residential and commercial areas for Fengshan smart green community in Taiwan)」，並應大會邀請擔任一場論文發表會之會議主席。SEGT 2019 研討會邀請各國研究單位的研究人員與學術單位相關人員，透過此次國際研討會，可掌握東南亞地區能源管理系統之發展現況。

近年來東南亞新興國家因經濟發展，對電力需求日趨增加。這些國家目前雖以火力、水力、生質能發電為主，然而間歇性再生能源發電(如太陽光電與風力發電)建設正在逐步進行，電網穩定度問題也將逐漸顯現，能源管理與電力網路管理需求也將提高，建議持續關注發展，以尋求擴展合作機會。

關鍵字：永續能源與綠能科技國際學術研討會、能源管理、用戶端電力韌性

Abstract

2019 International Conference on Sustainable Energy and Green Technology (SEGT 2019)" was held in Bangkok, Thailand, from December 11 to December 14, 2019, by Kong Mongkut University of Thonburi (KMUTT), Center of Inter-Integration (CII), the joint Graduate School of Energy and Environment (JGSEE), Research Center of Energy Conservation technology of Residential-Commercial and Industrial sectors (RCEC), and Center for Vehicular Technology (CVT). The major topics of the conference include: (1) New and Renewable Energy, (2)Sustainable Technologies for Energy Conversion, (3)Energy Management, Policy, Economics and Sustainability, (4)Energy Sciences, (5)Energy Storage and Power Engineering , (6)Sustainable Cities, Architecture and Green Buildings, ()Green Design, Products and Manufacturing Processes, (7)Green Materials, (8)Waste Management and Waste Water Treatment, ()Heating, Ventilation and Air Conditioning (HVAC), (9)Smart Grid / Smart City / Smart Mobility, (10)Bioresource and Bioenergy, etc., There were 378 papers published in this conference. During the conference, Hui-Wen Huang presented a paper entitled “A power demand resilience analysis of the residential and commercial areas for Fengshan smart green community in Taiwan”.

In recent years, due to economic development, emerging countries in Southeast Asia have increasingly demanded electricity. In these countries, thermal, hydropower and biomass power are the main power sources. Intermittent renewable energy power generation (such as solar photovoltaic) will gradually increase, and energy management and power grid management demands will also increase. In the future, there will be opportunities to cooperate with these countries.

Keywords: International Conference on Sustainable Energy and Green Technology (SEGT), Energy Management, and Power Demand Resilience

目　　次

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一、目的

本次出國公差之目的為參加「2019 年永續能源與綠能科技國際學術研討會(the International Conference on Sustainable Energy and Green Technology 2019, SEGT 2019)」，於 108 年 12 月 11 日至 12 月 14 日於泰國曼谷舉行，由泰國國王科技大學(King Mongkut's University of Technology Thonburi, KMUTT)、台灣跨際整合中心(Center of Inter-Integration, CII)，泰國能源與環境聯合研究生院(The joint Graduate School of Energy and Environment, JGSEE)，台灣新世代住商與工業節能研究中心(Research Center of Energy Conservation technology of Residential-Commercial and Industrial sectors, RCEC)以及馬來西亞拉曼大學汽車技術中心(Center for Vehicular Technology, CVT)聯合主辦，主題包含：(1)新能源與再生能源、(2)永續能源轉化技術、(3)環境與氣候變遷、(4)能源管理、政策、經濟學與永續性、(5)能源科學、(6)儲能與動力工程、(7)永續城市、建築與綠色建築、(8)綠能設計、產品和製造流程、(9)智慧電網/智慧城市/智慧交通、(10)生質能等。來自 31 國共 470 名與會者出席了本次研討會，會議中發表 393 篇論文。

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二、過程

此次出國含往返旅程共計 6 天。行程如下：

日期	行程	工作重點
12 月 10 日 (二)	台北 - 曼谷	去程
12 月 11 日(三)	曼谷	參加「2019 年永續能源與綠能科技國際學術研討會(SEGT 2019) 」
12 月 12 日(四)	曼谷	參加「2019 年永續能源與綠能科技國際學術研討會(SEGT 2019) 」
12 月 13 日(五)	曼谷	參加「2019 年永續能源與綠能科技國際學術研討會(SEGT 2019) 」
12 月 14 日(六)	曼谷	參加 SEGT 2019 技術參訪
12 月 15 日 (日)	曼谷 - 台北	回程

註：2019 年永續能源與綠能科技國際學術研討會(SEGT 2019)相關資訊請參照網址：http://www.isegt.org/

本次國際研討會中，本所陳建宏研究助理也發表「Effect of in-situ CO2 sorption on methane reforming by Ni/Al_2O_3/CaO composite catalyst for hydrogen production」，有助於提高我國在能源研究方面之國際能見度。

三、心得

開幕典禮

SEGT 2019 國際研討會(議程如附錄 1)由泰國能源與環境聯合研究生院(JGSEE)/泰國國王科技大學(KMUTT) Suneerat Fukuda 博士擔任主席。開幕典禮開始由 Suneerat Fukuda 博士代表致辭(如圖 1)，對於泰國主辦 SEGT 2019 國際研討會表示非常榮幸，並歡迎參與 SEGT 2019 國際研討會的來賓。來自 31 國共 470 名與會者出席了本次研討會，會議中發表 393 篇論文。並預祝大會成功，下一屆 SEGT 研討會將在越南胡志明市舉行，歡迎參加。

接下來由聯合國環境規劃署(United Nations Environment Programme, UNEP)副區域主任和副區域代表(Deputy Regional Director and Deputy Regional Representation)Isabella Louis 女士致辭(如圖 2)，泰國國王科技大學校長 Suvit Tia 博士也發表開幕演說(如圖 3)。開幕典禮後全體合照如圖 4。

資料來源：SEGT 2019 現場拍攝

圖 1 Suneerat Fukuda 博士開幕致辭

資料來源：SEGT 2019 現場拍攝

圖 2 Isabella Louis 女士致辭

資料來源：SEGT 2019

圖 3 Suvit Tia 校長發表開幕演說

資料來源：SEGT 2019

圖 4 全體合照

全體會議

全體會議中邀請專家進行專題演講，整理重要演講如下：

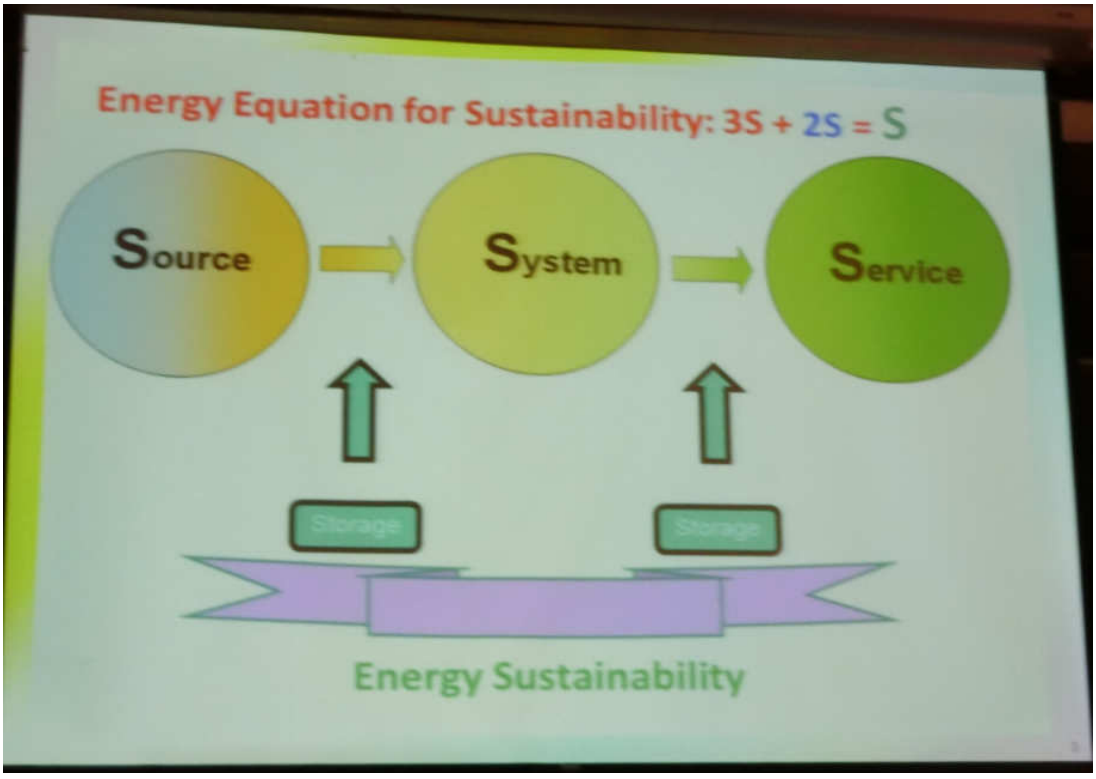
1. 儲能技術在永續發展中的角色 (The Role of Energy Storage Technologies in Sustainable Development)

演講者：International Journal of Energy Research 期刊總編輯/加拿大安大略科技大學(Ontario Tech University)Ibrahim Dincer 教授 (圖 5)

Ibrahim Dincer 教授表示我們一直面臨著關鍵的環境和永續性挑戰，這些挑戰通常與能源有關。我們產生、轉換、儲存、轉移和使用能源的方式直接影響環境，從而影響永續性(如圖 6)。大氣中的溫室氣體，特別是二氧化碳的濃度，這些氣體捕獲了從地球表面散發出來的熱量，從而升高了地球的表面溫度，導致冰川融化，進而升高了海平面。近年來，各種方案已經被開發出來，以解決當前與有害污染物排放有關的環境問題。在這方面，儲能是最關鍵的綠色技術之一，有望在提供更好的環境和永續性方面發揮重要作用。兩個關鍵主題包括：(1)涉及再生能源系統的儲能方案與(2)涉及從交通運輸到發電領域的各種應用的儲能技術。安大略工業大學工程與應用科學學院 (Engineering and Applied Science of University of Ontario Institute of Technology, UOIT) 的清潔能源研究實驗室(Clean Energy Research Laboratory, CERL)在從再生能源到電池的各種應用的儲能技術領域一直處於領先地位。演講中並通過實例和案例研究來討論挑戰、機遇和未來方向。圖 7 說明能源儲存技術，圖 8 說明澳洲抽蓄水力計畫，圖 9 發展儲能之系統整合。

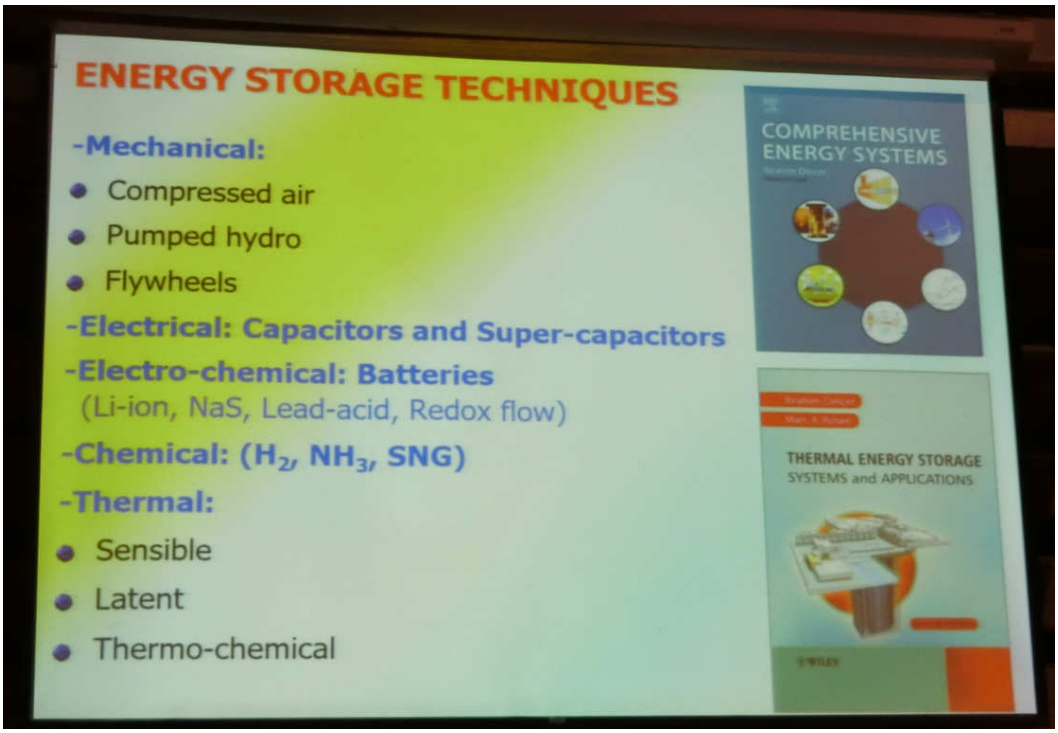
資料來源：SEGT 2019 現場拍攝

圖 5 Ibrahim Dincer 教授進行演講



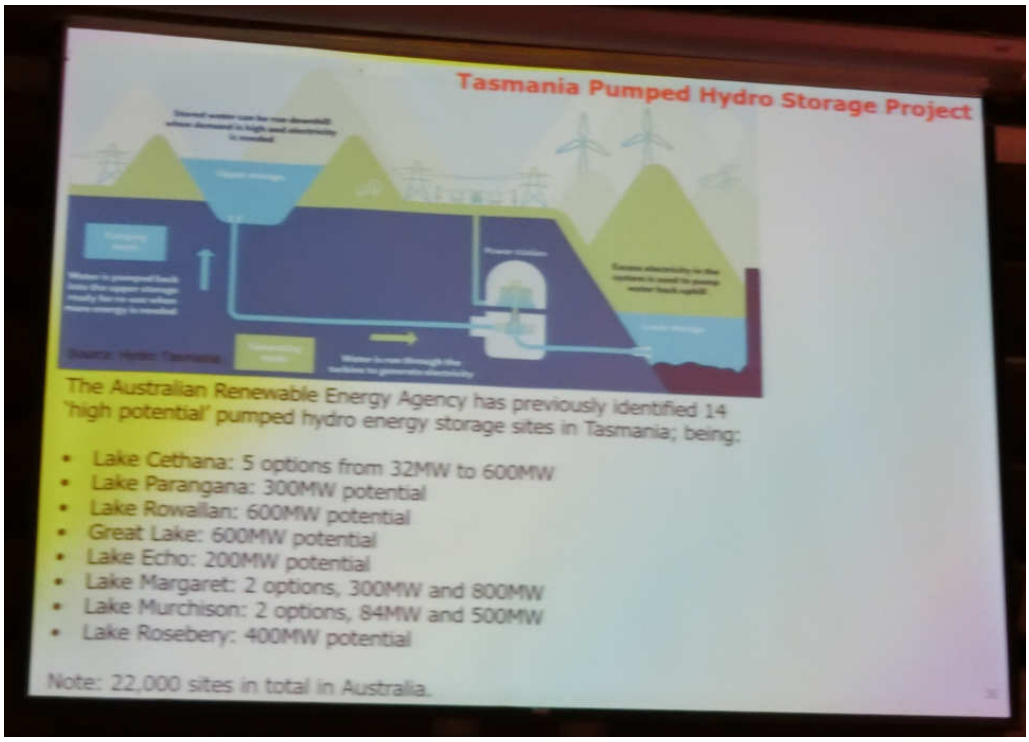
資料來源：SEGT 2019

圖 6 能源永續性



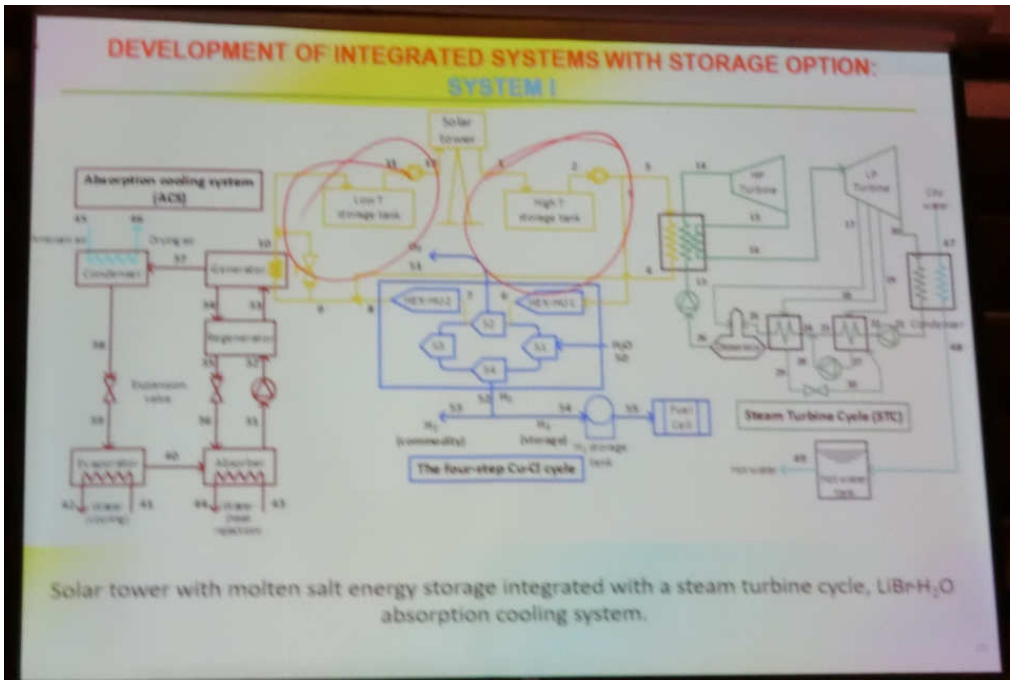
資料來源：SEGT 2019

圖 7 能源儲存技術



資料來源：SEGT 2019

圖 8 澳洲抽蓄水力計畫



資料來源：SEGT 2019

圖 9 發展儲能之系統整合

2. 智慧城市規劃與發展：污染-廢水-地形關聯性 (Smart Cities Planning and Development: Pollution-Effluents-Terrain Nexus)

演講者：Journal of Cleaner Production 期刊協同總編輯/捷克布爾諾理工大學(Brno University of Technology)Jiří Jaromír Klemeš 教授 (圖 10)

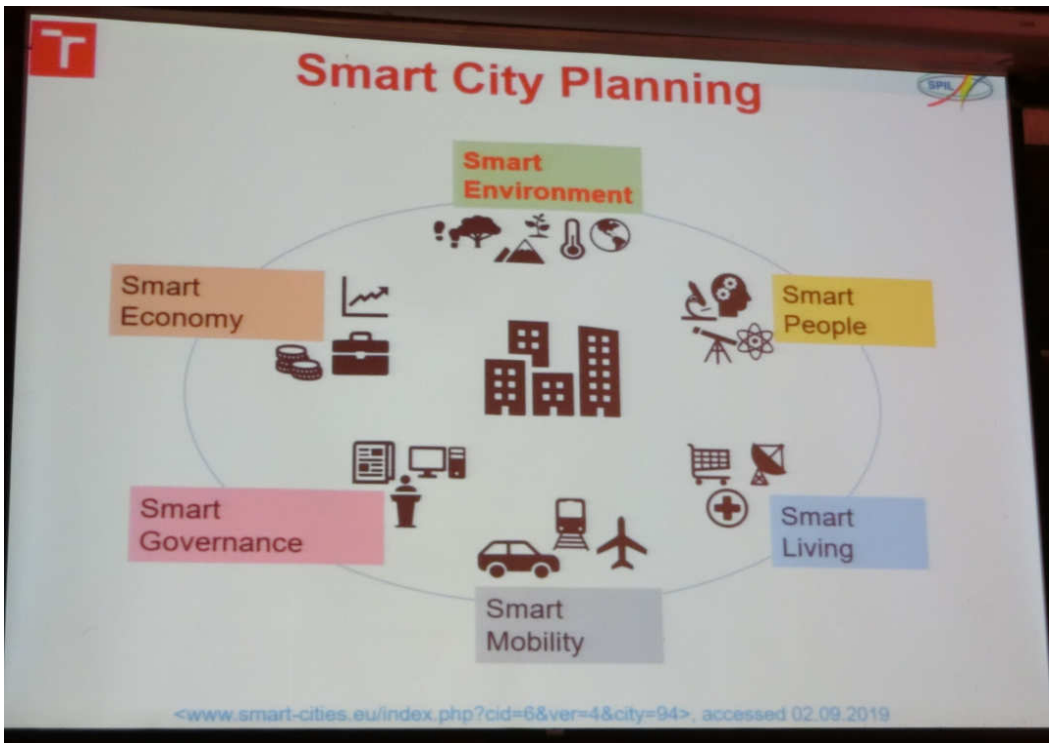
智慧城市已被公認為即將到來的主導市場，到 2020 年其市場規模估計將達到 3×10^{12} 美元。這一價值似乎隱藏在城市的嵌入式運營效率和新企業家精神的背後。這些新企業家中的大多數人一直專注於智慧城市技術的改進和創新。智慧城市正隨著越來越多的智慧治理、智慧經濟、智慧環境、智慧行動和智慧生活而發展。物聯網和機器人化已經引起了很多關注。

但是，在以自然和人類活動地理條件為基礎(例如地形、城市景觀、區域特徵）的智慧城市的規劃和開發過程中要考慮的其他一些基本問題，應引起更多關注在智慧城市決策過程中-尤其是空氣污染地形的聯繫。地形(包括自然景觀和商品景觀)會影響空氣污染的形成、傳播和擴散。這些因素包括局部的氣流和溫度模式、濕度，尤其是在複雜的地形區域，例如盆地、峽谷、山谷。城市汙染有兩種基本類型：(1) 迫使地面垂直和水平傳播空氣污染物的地形；(2) 地形迫使空氣污染物集中。

人類活動是造成大氣污染物排放的重要因素，例如，估計城市排放量約佔全球溫室氣體總排放量的 75%。全球大約 75%的溫室氣體排放、66%的 NOx 排放以及大部分懸浮微粒(particulate matter, PM)排放來自能源部門(energy sector)。能源行業也是中國二氧化硫排放的主要來源(佔 90%)。空氣污染物的主要來源包括固定的、流動的和自然的，前兩個來源與人類的選擇和決策息息相關。主事者應認真參與智慧城市、工業、工廠規劃和發展的決策，為了避免空氣中污染物的濃度過高，應保證通風條件良好。關於自然污染，儘管不是由人類產生的，但在規劃或訂定策略時也應將其考慮在內。圖 11 說明智慧城市規劃，圖 12 說明智慧建築，圖 13 說明智慧廢棄物管理。

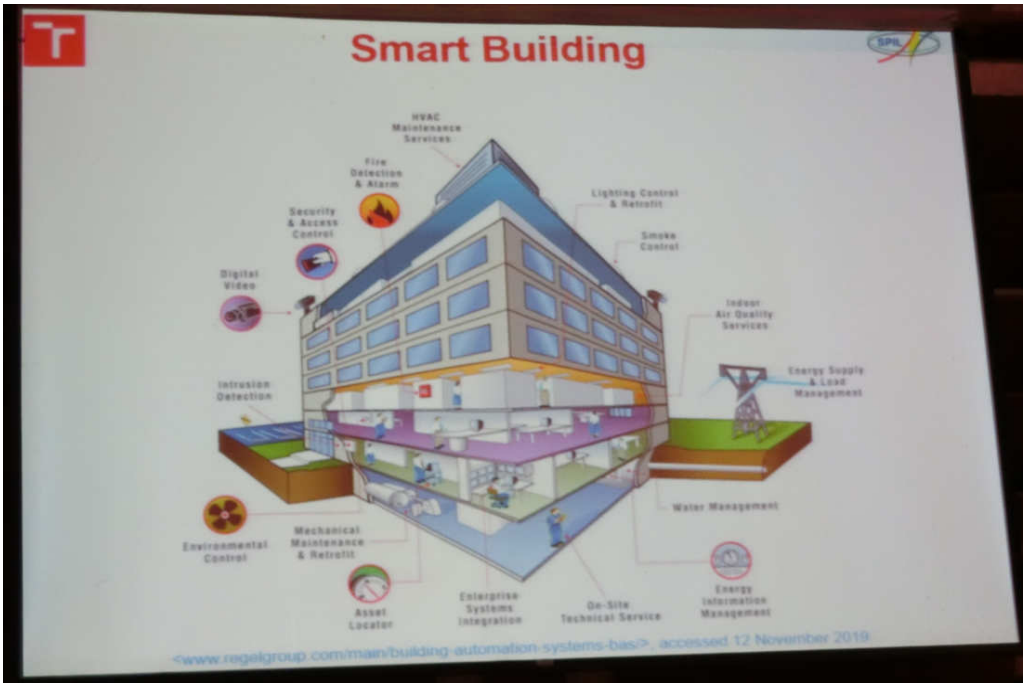
資料來源：SEGT 2019 現場拍攝

圖 10 Jiří Jaromír Klemeš 教授進行演講



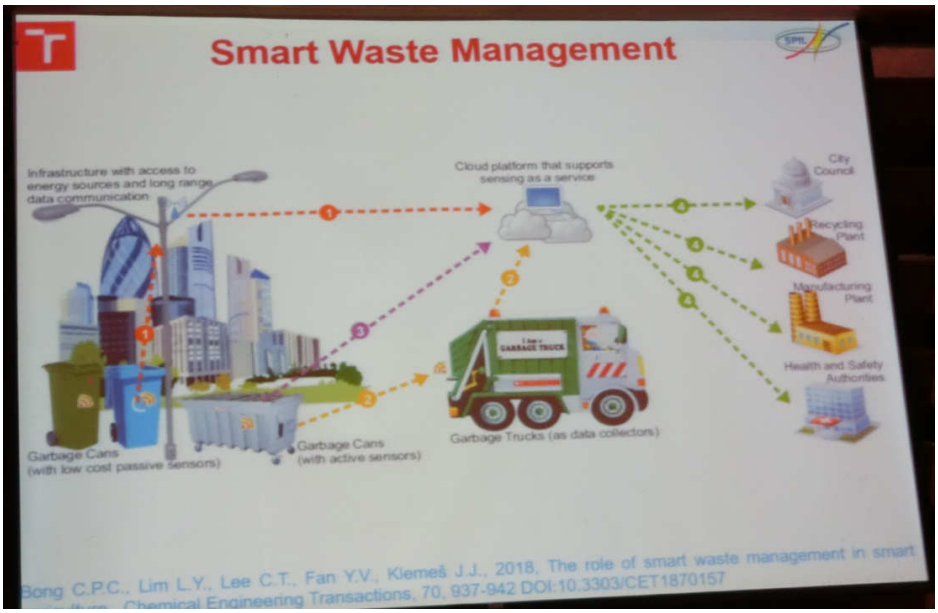
資料來源：SEGT 2019

圖 11 智慧城市規劃



資料來源：SEGT 2019

圖 12 智慧建築



資料來源：SEGT 2019

圖 13 智慧廢棄物管理

3. 奈米流體的強迫對流和核池沸騰傳熱 (Forced Convection and Nucleate Pool Boiling Heat Transfer of Nanofluids)

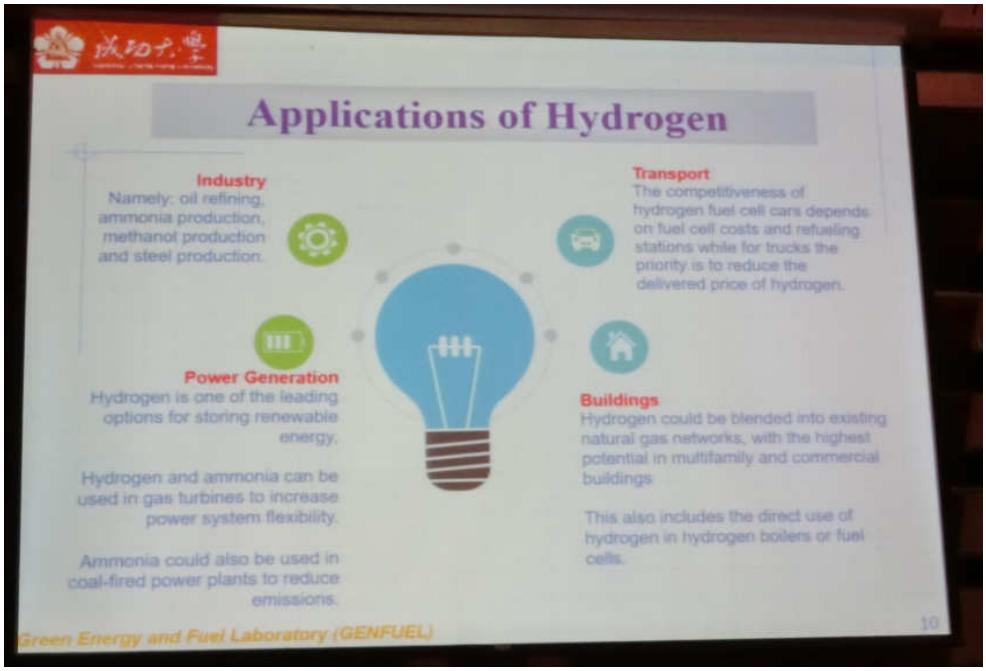
演講者：泰國國王科技大學(King Mongkut's University of Technology Thonburi, KMUTT) Somchai Wongwises 教授

奈米流體是通過將典型尺寸小於 100 nm 的金屬或非金屬顆粒分散在基礎流體中而獲得的新型傳熱流體，本演講介紹了奈米流體的兩種傳熱過程，即奈米流體的強制對流和池沸騰傳熱(Pool Boiling Heat Transfer)。首先，研究了同心管內熱交換器中 TiO_2-水奈米流體流的傳熱係數和壓降特性。將直徑為 21 nm 的 TiO_2 奈米顆粒分散在水中，濃度為 0.2-2 vol.%，作為測試液。並提出了相關性以預測奈米流體流動的 Nusselt 數和摩擦因子。其次，研究了在不同壓力和奈米顆粒濃度下，基於製冷劑的奈米流體(奈米製冷劑)的池沸騰傳熱。TiO_2 奈米顆粒以各種濃度與製冷劑 R 141b 混合，由銅製成的水平圓柱管用作加熱面，將奈米製冷劑的池沸騰數據與基礎製冷劑的池沸騰數據進行比較。結果顯示，隨著濃度的增加，池沸騰會惡化，尤其是在較高的熱通量下。在較高壓力下，在特定的過高溫度下，傳熱係數幾乎相同。

4. 用於綠色能源發展的先進氫生產技術(Advanced Hydrogen Production Technologies for Green Energy Development)

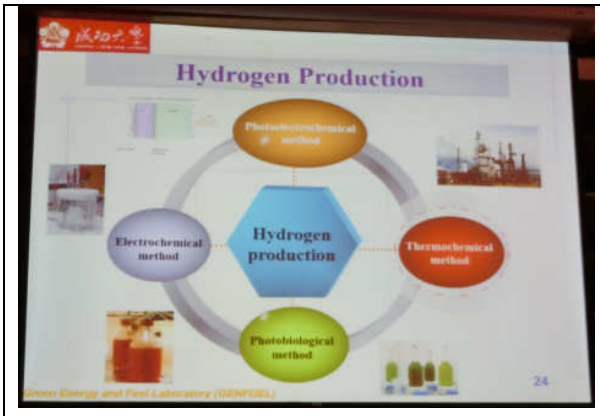
演講者：國立成功大學陳維新(Wei-Hsin Chen)教授

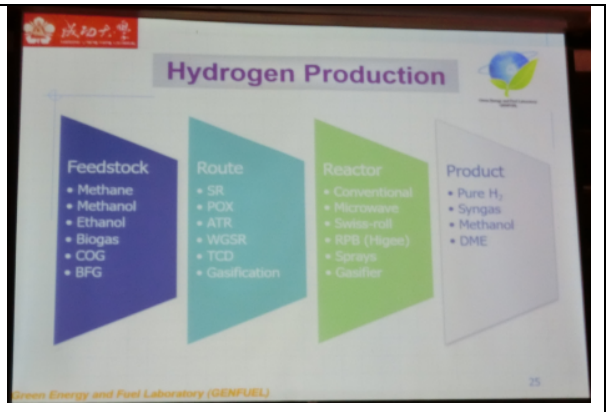
在過去的幾十年中，氫一直被認為是一種有前途的綠色燃料，可以替代化石燃料來發電和發電。這是因為氫是宇宙中最豐富的元素，氫是一種非碳燃料。因此，燃燒氫氣時不會排放任何空氣污染物，同時，氫是一種潛在的能量載體，可以將其輸送到適當的地方使用。近年來，質子交換膜燃料電池(proton exchange membrane fuel cell, PEMFC) 取得了重大進展。可以通過 PEMFC 的應用將氫使用於運輸領域。由於未來可預見氫應用的經濟性，有效途徑產氫成為氫技術發展中的關鍵任務。與其他方法相比，用於製氫的熱化學過程受到了廣泛關注。演講中介紹數種不同的反應器中使用熱化學轉化技術的新穎方法，例如蒸汽重組、部分氧化、自熱重組，以生產氫氣。圖 14 說明氫氣的應用，圖 15 說明製氫技術。



資料來源：SEGT 2019

圖 14 氫氣的應用





資料來源：SEGT 2019

圖 15 製氫技術

5. 以微藻為基礎的生物精煉廠和循環經濟–綠色技術 (Microalgae-based Biorefinery and Circular Economy – A Green Technology)

演講者：演講者：國立成功大學張嘉修(Jo-Shu Chang)教授

微藻是微觀的光合作用生物，具有通過光合作用將大氣中的二氧化碳固定為有機生物質的能力。最近學界對微藻的關注是：(1)它們固有的積油能力(含油藻類)，(2)它們可以用作許多合成保健食品和藥物的天然替代品。它們具備作為生物柴油生產的再生能源原料的潛力，是微藻研究最多的方面，而以微藻類燃料為基礎的商業化，卻受到與生物質的培養和收穫相關的高成本的挑戰。微藻種植的需求通常會與水和肥料等農業資源競爭，而對大規模養殖提供最佳和有效的二氧化碳供應是一大障礙。生命週期分析和經濟評估顯示，微藻栽培中的成本降低，例如栽培設備的安裝和運營成本，再生且廉價的肥料和二氧化碳供應，對於經濟高效的微藻生物質生產至關重要。由於微藻是抗氧化劑(如葉綠素、葉黃素和蝦青素)和其他生物活性成分的天然替代品，因此可以嘗試共同生產其他有價值的化合物。本研究小組從事微藻生物質的大規模生產已有十多年了，我們已經通過多種方式探索了微藻對替代營養源的內在適應性。富含氮，磷和有機碳的廢水都可以用作微藻培養的水和養分來源，眾所周知，微藻通過吸收和同化作用從廢水中去除氮/磷。某些微藻類也可以有效地去除其他廢水污染物，如異化劑、藥品和重金屬。

工業煙氣富含二氧化碳，可作為微藻培養的低成本二氧化碳來源。微藻具有強大的生長特性和對環境的高度適應性，某些藻種能夠利用工業煙氣，沼氣(來自厭氧消化)和發酵廢氣中存在的高濃度二氧化碳。引入藻類生物精

煉概念，其中使用煙氣在富含氮的豬廢水中生長微藻類生物質。將研究所得生物質用於增值產品回收的處理，可以通過生化/熱化學方法處理獲得的生物質，以生產生物燃料，例如生物乙醇、生物丁醇、生物氫、合成氣和富碳生物炭。由於動物蛋白或抗氧化劑含量高，直接以動物飼料或水產飼料的形式施用是可行的方法。富含碳水化合物的微藻生物質也可用於通過發酵生產精細化學品，如乳酸和琥珀酸。

6. 用於永續能源轉換的固態氧化物燃料電池 (Solid Oxide Fuel Cells (SOFCs) for Sustainable Energy Conversion)

演講者：香港理工大學(The Hong Kong Polytechnic University, PolyU) 倪萌(Meng Ni)教授

固態氧化物燃料電池(SOFC)是用於有效能量轉換的電化學裝置，由於其較高的工作溫度，SOFC 非常適合於汽電共生。演講中介紹 SOFC 技術的工作原理和應用。香港理工大學對 SOFC 的研究活動包括：(1)各種等級的 SOFC 的數學模型，例如電極微結構重建和電池模擬；(2)利用甲烷、沼氣、固體碳和塑料廢料等多種燃料對 SOFC 進行實驗測試。

場次會議論文發表

1. 鳳山智慧綠色社區之住宅與商業區域用戶端電力韌性分析(A power demand resilience analysis of the residential and commercial areas for Fengshan smart green community in Taiwan) (簡報資料如附錄 2，論文全文如附錄 3)

論文發表者：核能研究所黃揮文研究員

配合核能研究所研發之即插即用的整合型能源作業系統(Energy Operating System, EOS)，本研究開發了用於 EOS 的營運策略軟體分析模型。此軟體模型可以在不同情況下執行電力負載管理分析，例如發電設施和電力存儲設備的各種組合，以在實體部署之前，規劃因應不同的災難情境之策略。EOS 團隊並可使用本軟體模型為平日之電力負載進行營運策略分析。

本研究應用上述營運策略軟體分析模型，完成四項住宅區域電力需求韌性情境分析，討論了合理的備用發電設施和儲能設施的運用以及電力負載管

理策略。未來本項軟體分析模型可適用於分析類似情況下電力設施的防災工作的合理分配和運作策略。這項研究以鳳山智慧綠色社區為參考案例，並將模擬設施擴展為整合居住區域和商業區域的電力需求韌性分析範圍，其中整合居住區域包括：居住區域、醫療和避難所區域以及電源管理系統(圖 16)。

本研究之電力負載、發電設施與儲能設施數據以鳳山智慧綠色社區原建置數據為基礎，再修訂作為本研究之分析輸入數據。整合居住區域有 620 戶，每日平均電量訂定為 7,979kWh，並採用鳳山智慧綠色社區所測得之電力負載曲線，假設屋頂型太陽光電系統於完全安裝後，最大功率為 1,550 kW，鋰電池以實際裝設的儲電能力為 400 kWh。醫療和避難所區域為假設防災區域，電力負載為居住區域之 10%，電源管理系統為假設電力韌性管理設施，電力負載為 2kW。商業區域假設每日用電量為 3,631.8 kWh，屋頂型太陽光電以實際裝設值最大功率為 600 kW，鋰電池以實際裝設值的儲電能力為 1,000 kWh。鋰電池儲電上下限分別假設為 20%與 80%，意即鋰電池充放電範圍僅為 60%。

本研究完成了四項情境研究說明如下：

(1)基本情境(圖 17)

假設鋰電池的電力存儲容量為原始設計值，分析鋰電池在市電中斷時之防災供電能力。

整合住宅區域：市電於時間=2hr 中斷時沒有太陽光電，鋰電池供電容量為 125kW，低於住宅區的負載需求，僅能對醫療和避難所區域以及電源管理系統提供電力。日出後，太陽光電提供住宅區域電力。日落後，太陽光電無法再提供電力，住宅區域電力再度中斷。鋰電池為醫療和避難所區域以及電源管理系統提供 2 小時電力。

商業區域：市電於時間=2hr 中斷後，鋰電池繼續供電。日間太陽光電從時間=6hr 到時間=17hr 持續供電。日落後，鋰電池維持供電 1 小時。

本情境分析結果顯示原建置之鋰電池電力存儲容量，對於因應市電中斷之能力有限。

(2)“使用柴油發電機” 情境(圖 18)

假設整合住宅區域和商業區域分別設置 500 kW 柴油發電機。

整合住宅區域：在時間= 2hr 市電中斷後，柴油發電機可提供足夠的功率，並與太陽能和鋰電池互補。商業區域情況相似。本情境分析結果顯示，柴油發電機可以充分輔助鋰電池供電不足的時段。

(3)“擴大鋰電池容量” 情境(圖 19)

整合住宅區域：假設鋰電池的存儲容量是擴充為原始存儲容量的十倍，即存儲容量為 4000kWh，放電功率為 1250kW，充電功率為 600kW。當電源中斷時，經過擴充的鋰電池可繼續為該區域供電。日出後，太陽光電提供電力，並為鋰電池充電。日落後，太陽光電在時間= 17hr 停止供電。經過擴充的鋰電池將電力輸出到住宅區域、醫療和避難所區域以及電源管理系統，直到時間= 22 hr，鋰電池供電時間擴增至 5 小時。

商業區域：假設鋰電池的存儲容量擴大到原建置存儲容量的兩倍，即存儲容量為 2000kWh，放電功率為 1000kW，充電功率為 500kW。當市電中斷時，鋰電池將繼續為該區域供電。日出後，太陽光電提供電力並為鋰電池充電。日落後，鋰電池將電力輸出到商業區域，直到時間= 25hr，鋰電池電力下降至 20%下限。分析結果顯示，經過擴充的鋰電池容量，可以延長對住宅區域的供電時間長度至 4 小時。醫療和避難所區域以及電源管理系統仍在時間= 22 hr 被中斷。與日落後的基準情境相比，商業區域的電源持續時間延長了 6 小時。

(4)“擴大鋰電池容量並在整合住宅區域中控制鋰電池電力輸出” 情境(圖 20)

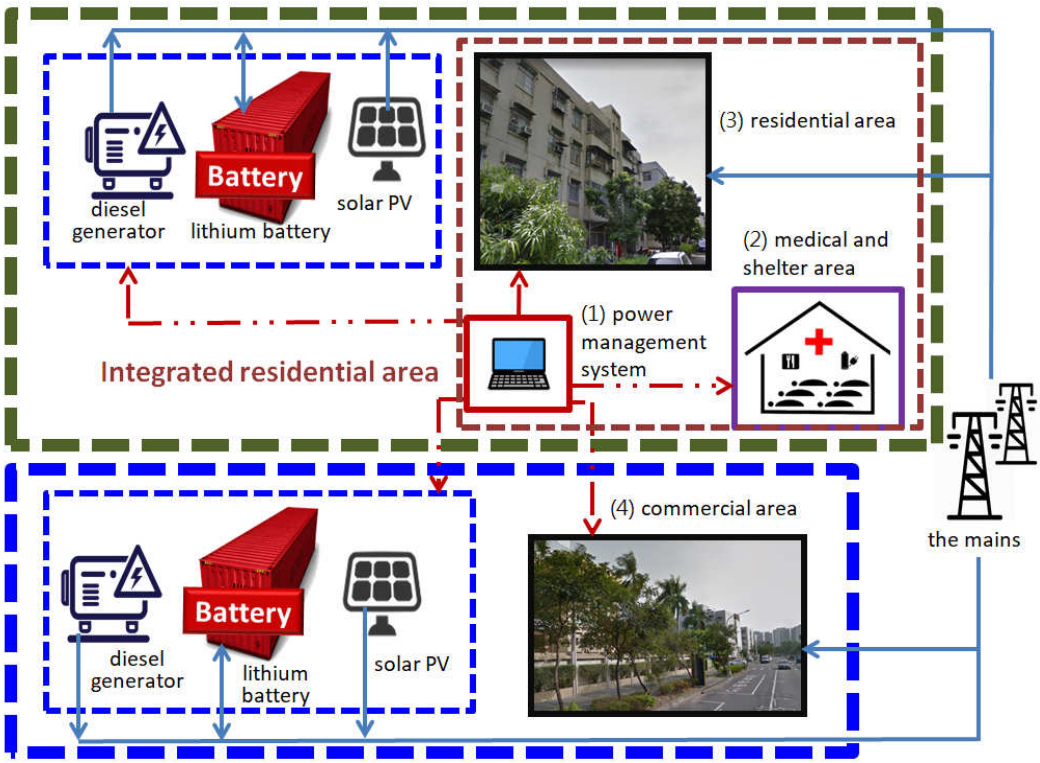
整合住宅區：假定鋰電池的存儲容量是原始存儲容量的十倍。為了確保為電源管理系統以及醫療和避難所區域供電，當存儲的能量低於 60％時，鋰電池將停止向住宅區供電，以保持電能儲存。在從時間= 4hr 到時間= 5hr 以及從時間= 18hr 到時間= 28hr 的時段內，鋰電池停止向住宅區供電，此管理成功地確保了電能儲存，以對電源管理系統以及醫療和避難所區域供電。對於商業區域：分析結果與“擴展鋰電池容量”情境的結果相同。

本情境分析結果顯示，經由擴充鋰電池容量並控制對住宅區中的鋰電池電力輸出，可以為電源管理系統以及醫療和避難所區域有效地確保電力供應。

本研究的結論包括：(1)為應對全球氣候變遷加劇，適當部署各種備用發電設施和電力存儲設施以加強電力韌性，可以有效減緩電力供應中斷的威脅。(2)根據情境研究，原設計之鋰電池的儲能和供電能力不足以因應整合住宅區域之需求。(3)為向電力管理系統和醫療及避難所充分供電，本研究顯示鳳山智慧綠色社區可增強鋰電池的儲能和供電能力。(4)太陽光電為零碳發電；它可以作為電力需求韌性的優先級備用設施。但是，如果陽光不足，則無法使用太陽光電。(5)使用柴油發電機會產生排碳與空氣污染之議題。但是，當其他備用電源與儲能設施供電能力不足時，短暫使用柴油發電機不失為解決問題之有效措施。

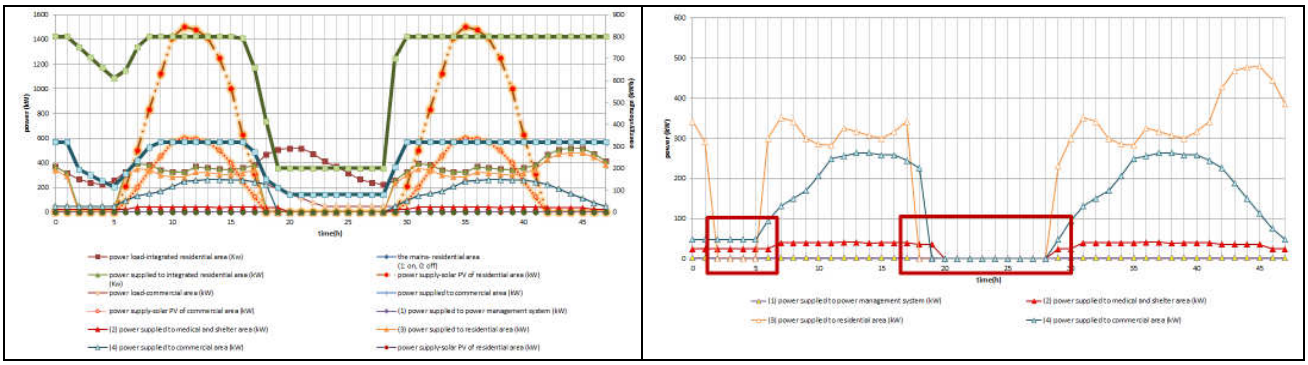
台灣大學陳洵毅副教授提問：「本項研究著重在災難發生後電力韌性之反應，市電並未扮演重要角色，是否考慮進行市電正常時之情境？」。黃員回答：「有關災難發生後電力韌性反應之研究為初步階段工作，目前正在進行市電正常時，配合太陽光電與儲能之情境，將考慮將太陽光電日間多餘能量儲存於鋰電池中，移至夜間放電以供應電力之情境。也將考慮無日照而無太陽光電發電之情境。」

論文發表後，場次會議主席頒發論文發表證書一份如圖 21，作者包括黃揮文研究員與鄭宗杰副組長。



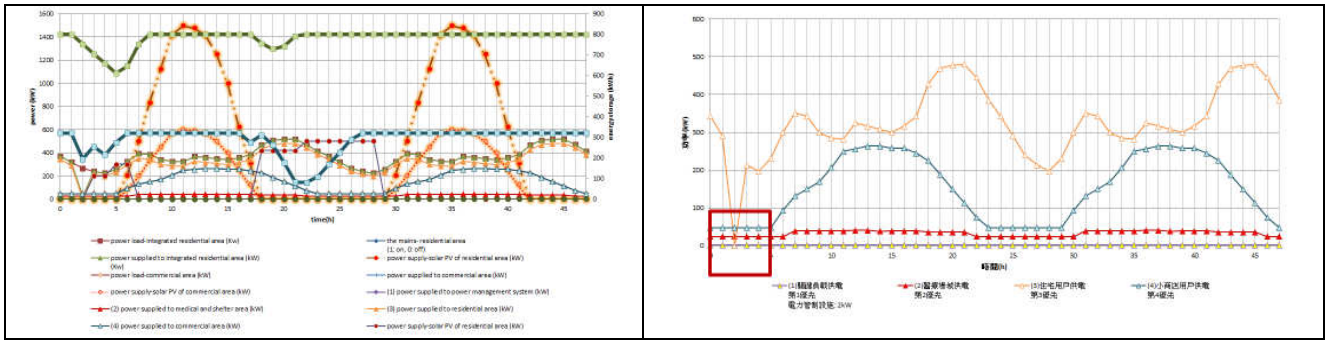
資料來源：核能研究所

圖 16 鳳山智慧綠色社區電力需求韌性架構



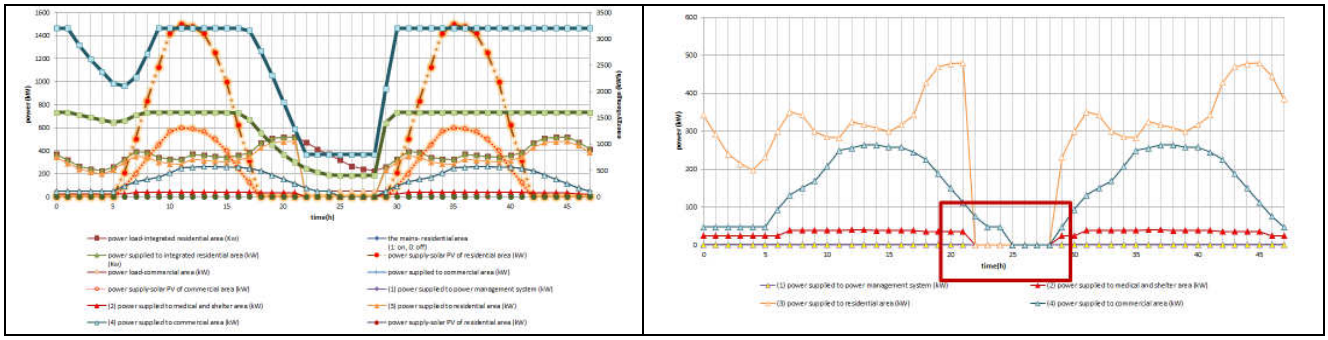
資料來源：核能研究所

圖 17 基本情境分析結果



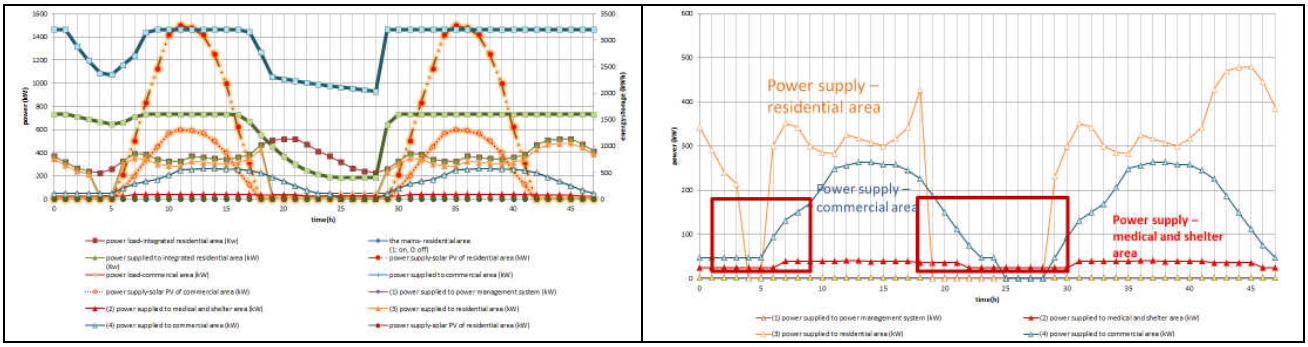
資料來源：核能研究所

圖 18 “使用柴油發電機” 情境分析結果



資料來源：核能研究所

圖 19 “擴大鋰電池容量”情境分析結果



資料來源：核能研究所

圖 20 “擴大鋰電池容量並在整合住宅區域中控制鋰電池電力輸出”情境分析結果

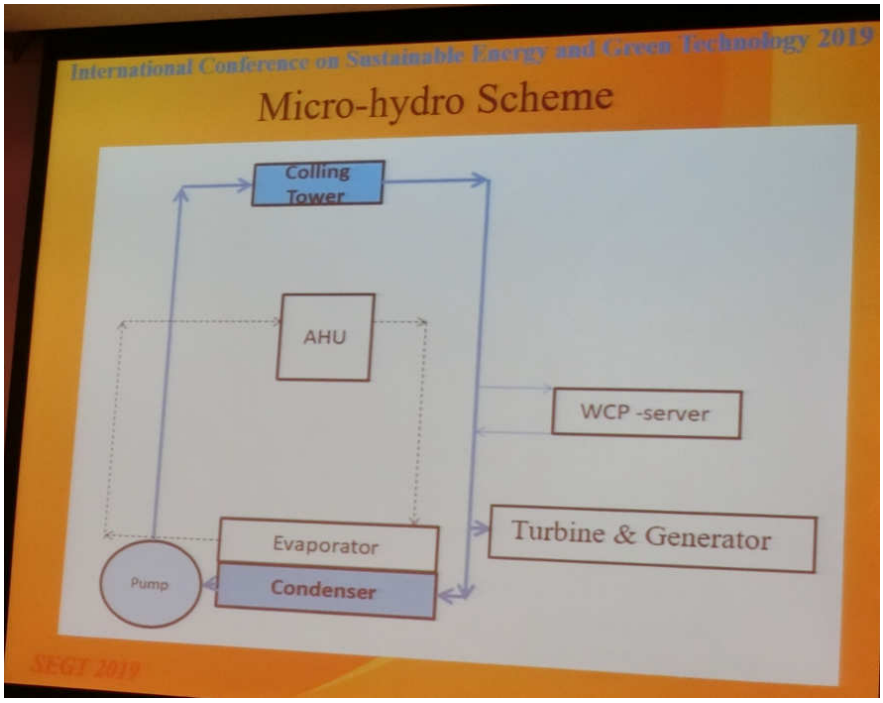
資料來源：SEGT 2019

圖 21 論文發表證書

2. 通過使用具有低齒槽轉矩發電機的微型水力發電以探討高層建築中的最佳化能源管理(Optimizing of the Energy Management Concept in a High-Rise Buildings by applied a Micro-Hydropower with the low Cogging Torque Generator)

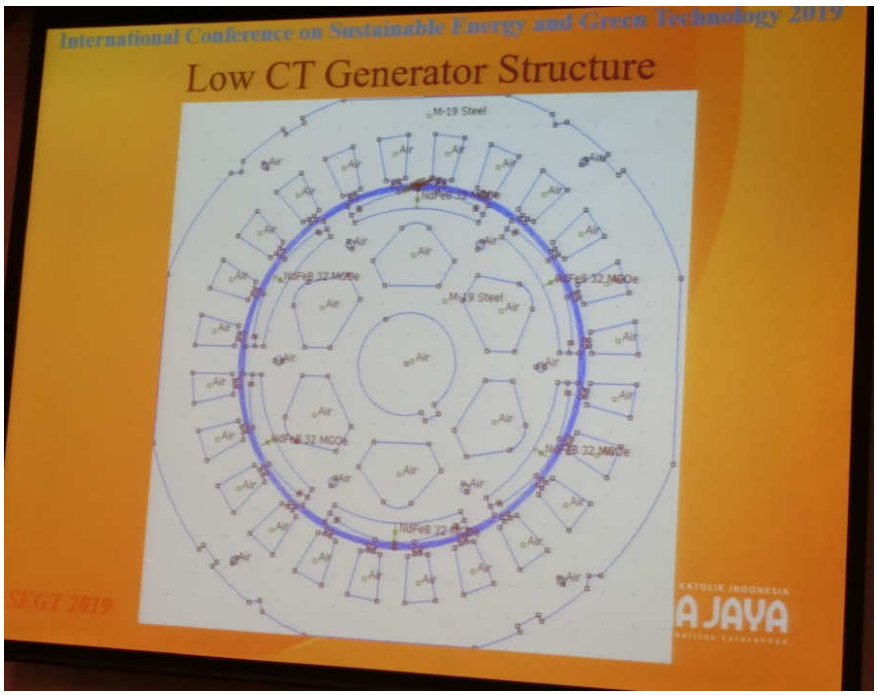
論文發表者：印尼 Atma Jaya 天主教大學講師，Marsul Siregar

本研究以通風和空調(Ventilation & Air Condition, VAC)系統為基礎，結合低齒槽轉矩發電機的水冷凝器泵，探討獲得最佳化重力位能的方法。本研究以雅加達一座高 157 公尺的高層建築為例，採用 2018 年電力公司所擷取的數據。模擬的潛在水流量(Q)為 0.499 m^3/sec，使用一般微型水力發電發產生的電功率(P)為 696.83 kW。然而在應用低齒槽轉矩發電機之後，發電功率可增加 20%至 30%，因此總能量最大值約可提升為 906,100 kW(0.9 MW)。研究顯示使用本研究之低齒槽轉矩發電機，經過 2 年 4 個月後即可達成投資回報(Return on Investment, ROI)。圖 22 顯示微型水力發電流程，圖 23 顯示低齒槽轉矩發電機架構。



資料來源：SEGT 2019

圖 22 微型水力發電架構



資料來源：SEGT 2019

圖 23 微型水力發電架構

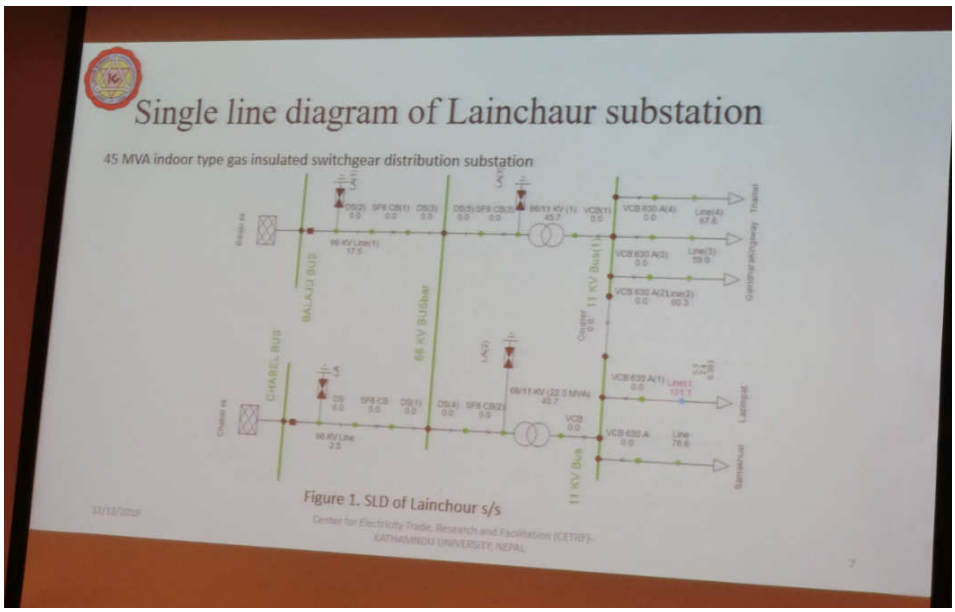
3. 66/11 kV 配電變電站及其相關饋線的可靠性分析與改善-以尼泊爾 Lainchour 變電站為例(Analysis and Improvement on Reliability of 66/11 kV Distribution Substation and Its Associated Feeders: A Case Study of Lainchour substation in Nepal)

論文發表者：尼泊爾加德滿都大學電機與電子工程系(Department of Electrical and Electronics Engineering, Kathmandu University)，Pramish Shrestha

本研究評估自 2013 年以來尼泊爾電力局運營的 Lainchour 配電變電站及其相關饋線的各種可靠性指標和參數，來確定由於頻繁的計畫內和計畫外的持續中斷而導致尼泊爾用電戶面臨的各種中斷原因和問題。為了進行分析，考慮了尼泊爾的 Lainchour 變電站，該變電站為首都加德滿都的密集城市居民消費者供電。

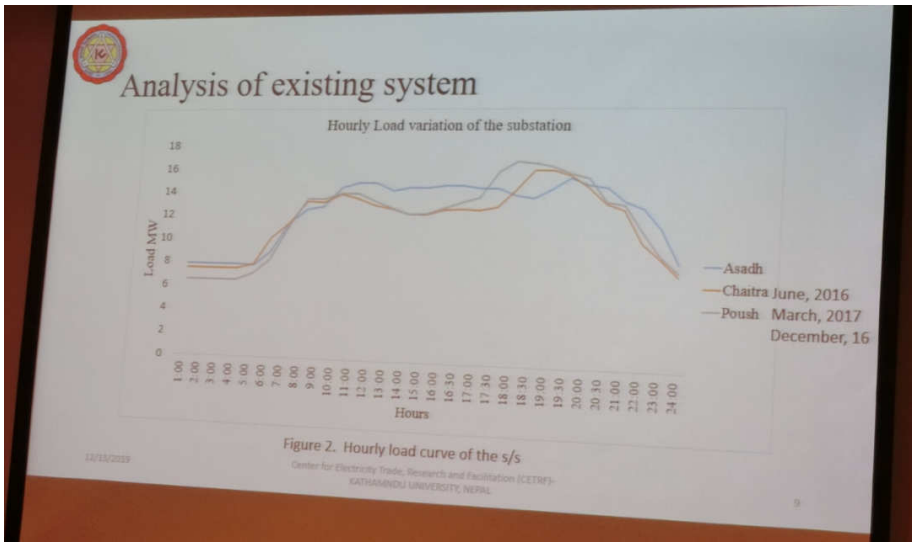
依據分析結果確定改進措施，這些改進措施也可以用作其他配電系統的參考，從而解決與頻繁計畫外停電所引發的客戶不滿意。變電站是配電系統的重要組成。首先僅對變電站配置進行可靠性分析，然後再分析可靠度改進措施，例如採用雙匯流排、平行分佈饋線與地下電纜。此外並分析可靠度指標，例如：系統平均中斷持續時間指標(System Average Interruption Duration

Index, SAIDI)與系統平均中斷頻率指數(System Average Interruption Frequency Index, SAIFI)。研究結論為：(1)電力中斷的主要原因為配電線路和配電變壓器的故障。(2)變電站及其相關設備影響停電的風險較小，而配電變壓器、饋線、饋線保護設施與開關系統對計畫外停電具有更大風險。(3)從可靠度的角度而言，應優先投資加強配電饋線和變壓器，而非變電站。圖 24 顯示 Lainchour 變電站之單線圖，圖 25 顯示變電站每小時負載曲線。



資料來源：SEGT 2019

圖 24 Lainchour 變電站之單線圖



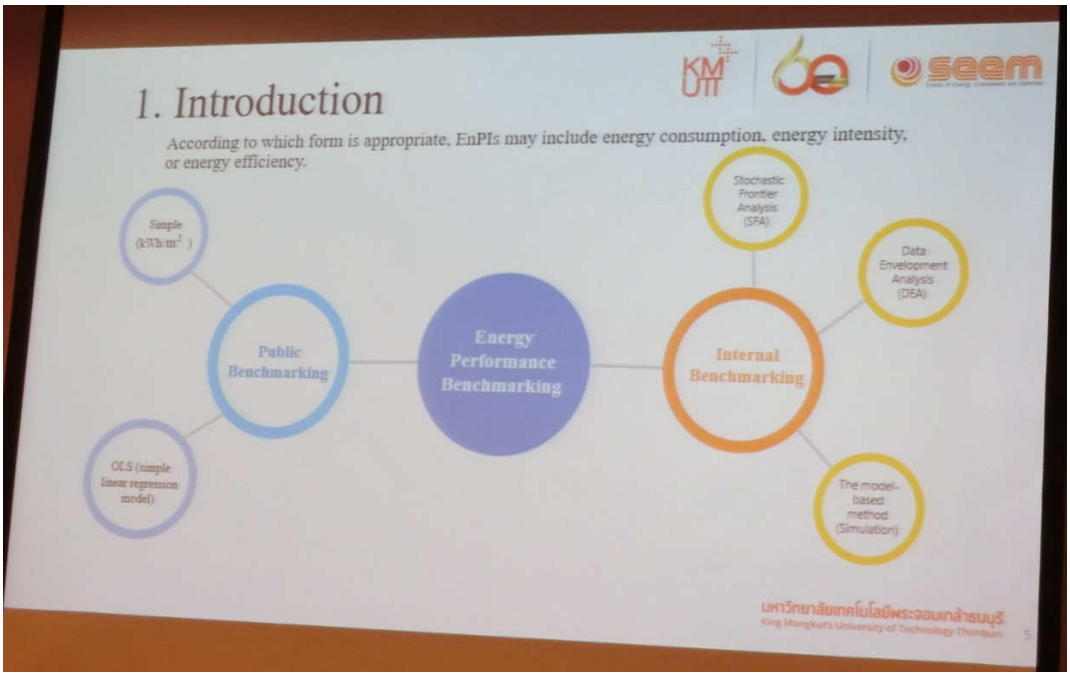
資料來源：SEGT 2019

圖 25 變電站每小時負載曲線

4. 永續能源管理的能源績效指標簡化模型(A Simplified Model of Energy Performance Indicators (EnPIs) for Sustainable Energy Management)

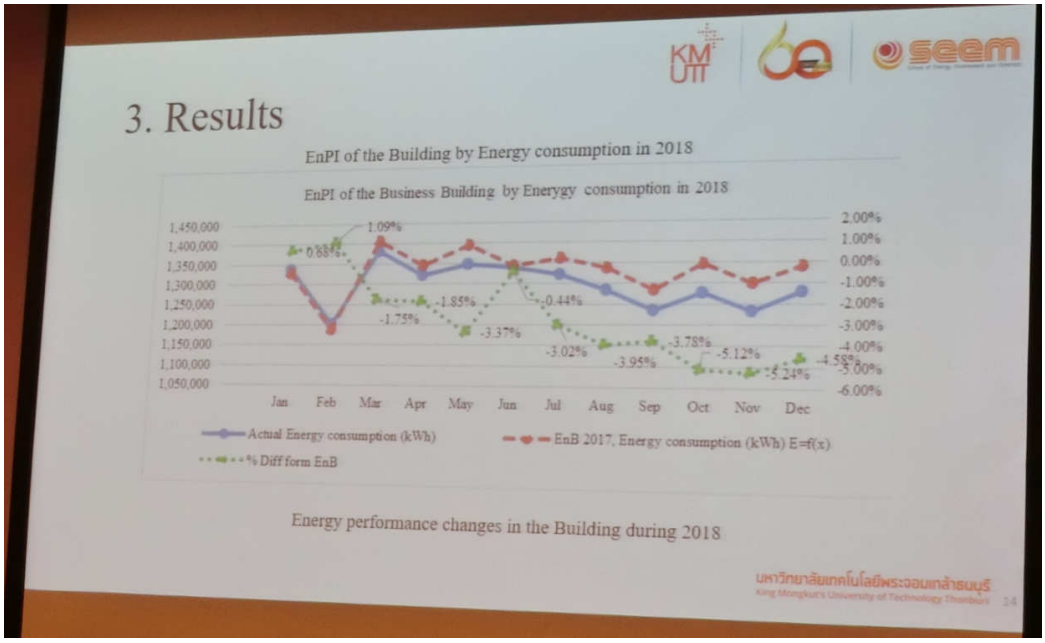
論文發表者：泰國國王科技大學能源、環境與材料學院能源管理技術系(Division of Energy Management Technology, School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi)，Vichan Nakthong

ISO 50001(能源管理標準)已在包括泰國在內的全球組織中得到廣泛應用。該標準的主要目標是持續、永續地提高組織的能源績效，以減少能源消費和成本，包括減輕氣候變遷對環境的影響。該標準規定了使用能源績效指標(energy performance indicators, EnPIs)和能源基準(energy baseline, EnB)衡量能源績效改善的方法。本研究提出了一個簡化的能源績效指標(EnPIs)模型，該模型可有效進行組織層級的 ISO 50001 能源管理。本研究提出了適當的內部校驗方法，以通過能源消費、能源強度和能源效率(energy consumption, intensity, and efficiency)來測量三個級別的能源績效，即組織(organizational)、程序(process)和主機(main machine，如：熱泵、中央空調)。圖 26 顯示能源績效校驗架構。本研究選擇多元線性回歸(Linear regression)來發展能源方程式，以表達能源消費與顯著相關的變量之間的關係，例如服務使用，建築物數量和商業建築物的冷卻度日(cooling degree days, CDD)等。所提出的 EnPI 用於度量泰國商業建築之能源績效，以符合 ISO 50001 標準。本方法可有效地用於度量組織的能源效率以及流程的變化，本研究的結果被認為對每個採用 ISO 50001 系統的組織都是有益的。所提出的方法可以有效地用於監視和度量組織對永續能源管理的能源效率。圖 27 顯示建築物內能源績效改變。



資料來源：SEGT 2019

圖 26 能源績效校驗架構



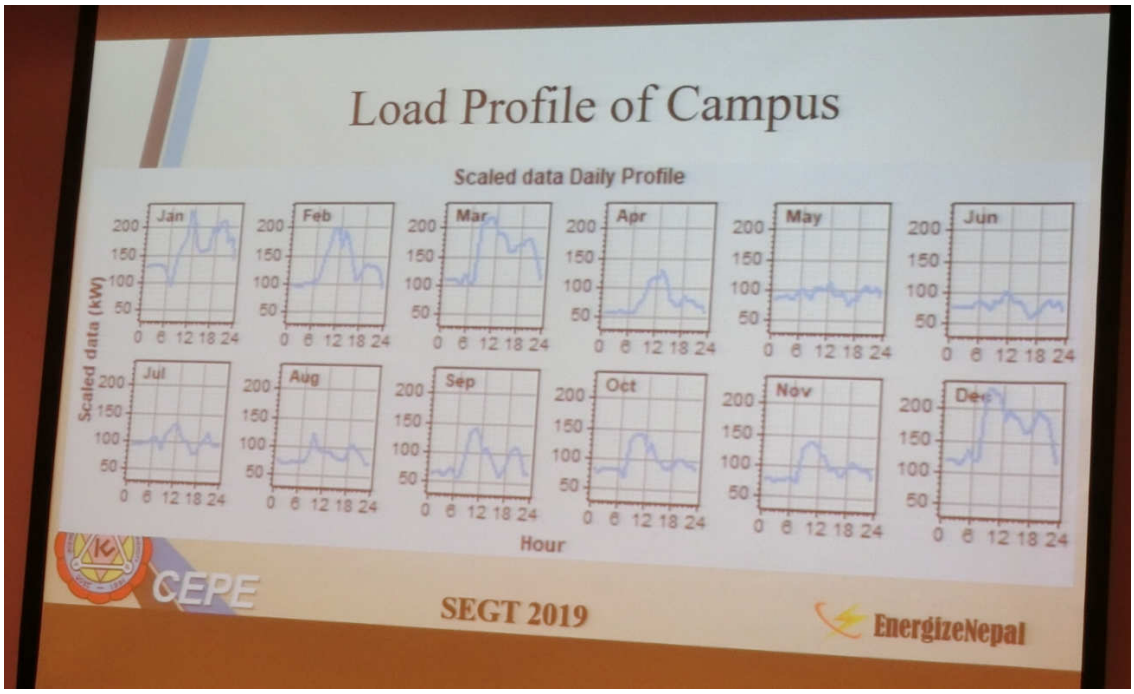
資料來源：SEGT 2019

圖 27 建築物內能源績效改變

5. 永續供電的不同混合能源系統的比較分析：一項案例研究(Comparative Analysis of Different Hybrid Energy System for Sustainable Power Supply: A Case Study)

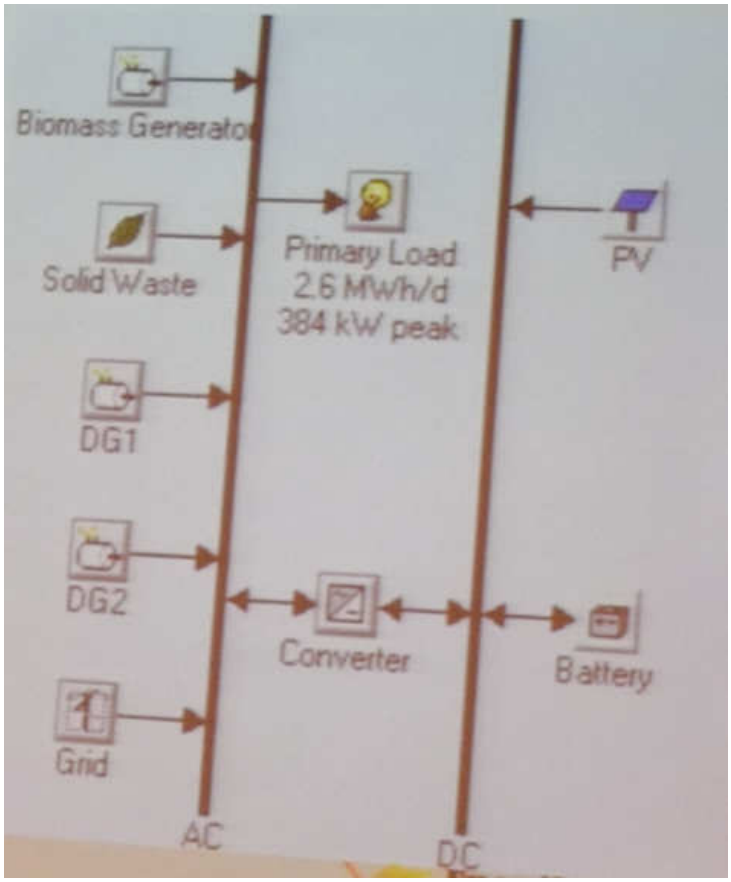
論文發表者：尼泊爾加德滿都大學電力工程中心(Center for Electric Power Engineering (CEPE), Kathmandu University)，Aayush Bista

混合動力系統(Hybrid Power System, HPS)是一種能源系統，結合了不同的再生能源，例如太陽光電、風力發電、地熱與生質能等，以達成能源的永續性。本研究探討併網和獨立混合能源系統滿足社區或組織電力負載需求的可行性，對位於尼泊爾 Dhulikhel 的加德滿都大學中央校園進行案例研究，對太陽光電、風力發電、生質氣體(biogas)等不同能源的潛力進行了全面研究。對併網和離網混合系統進行技術和經濟分析，以獲得向終端用戶提供連續能量的最佳化模型。此外，並分析使用國家電力公司進行淨計量電價(net metering)的可行性，並建議在校區擴增太陽光電規模，以及增加設置儲能設施，以滿足不斷增長的負載需求。圖 28 顯示校區之電力負載曲線，圖 29 顯示校區之電力供需分析架構。



資料來源：SEGT 2019

圖 28 校區之電力負載曲線



資料來源：SEGT 2019

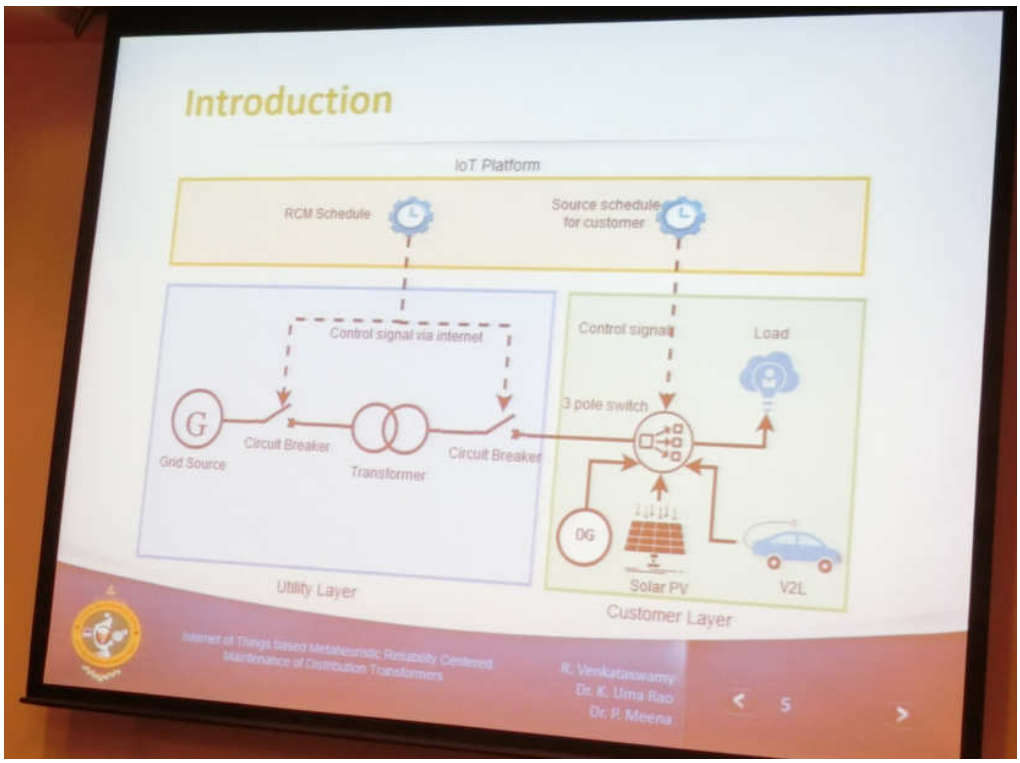
圖 29 校區之電力供需分析架構

6. 以物聯網為基礎之以元啟發式可靠度為中心的配電變壓器維護(Internet of Things based Metaheuristic Reliability Centered Maintenance (RCM) of Distribution Transformers)

論文發表者：印度基督大學電機與電子工程系(Department of Electrical and Electronics Engineering, Christ University)助理教授，R Venkataswamy

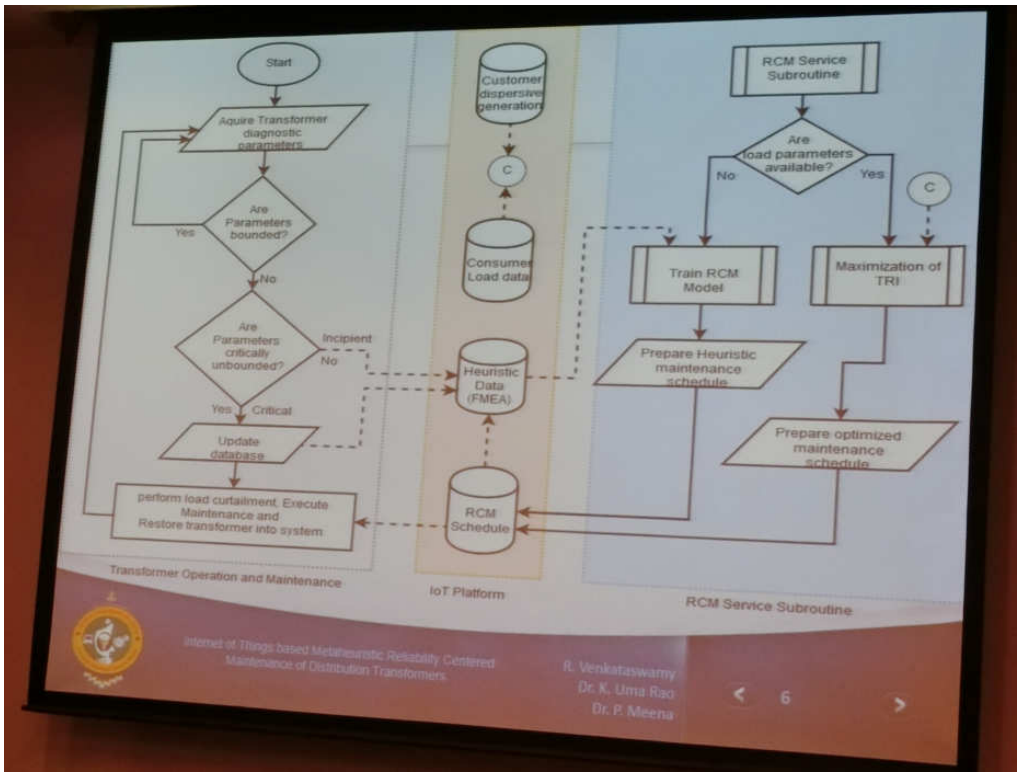
變壓器是電力系統的重要組成部分，由於過載、暫態和故障造成的變壓器持續應力會導致實體損壞。變壓器的隔離會造成巨大的收入損失，系統性能下降，並造成配電用戶帶的不方便。因此需要為消費者提供可靠的電源並適當地執行維護活動，不斷發展的最佳化和預測性維護(predictive maintenance)策略可提高消費者的電源可用性。本研究考慮了對客戶端的分散式發電，即太陽能光電獨立系統，柴油發電機發電以及車輛對負載(vehicle-to-load)的能力。通過變壓器終端單元(transformer terminal unit)觀察變壓器功能參數的初始狀態或臨界狀態，並將其傳送到物聯網平台。遠程處

理單元從所有配電變壓器獲取資訊，並生成最佳化且以可靠度為中心的維護時程規劃。在提出的工作中，定義了有關消費者分散式發電的可靠度指標。啟發式資料集用於通過機器學習演算法合成訓練後的模型，進行了比較研究，得出以時間為基礎的最佳化和預測維護計畫的可靠度。分析結果顯示在案例中，負載端可用的分散式發電對客戶供電的可靠度提高了約 10%。圖 30 顯示物聯網平台，圖 31 顯示分析流程，圖 32 顯示案例分析資料。



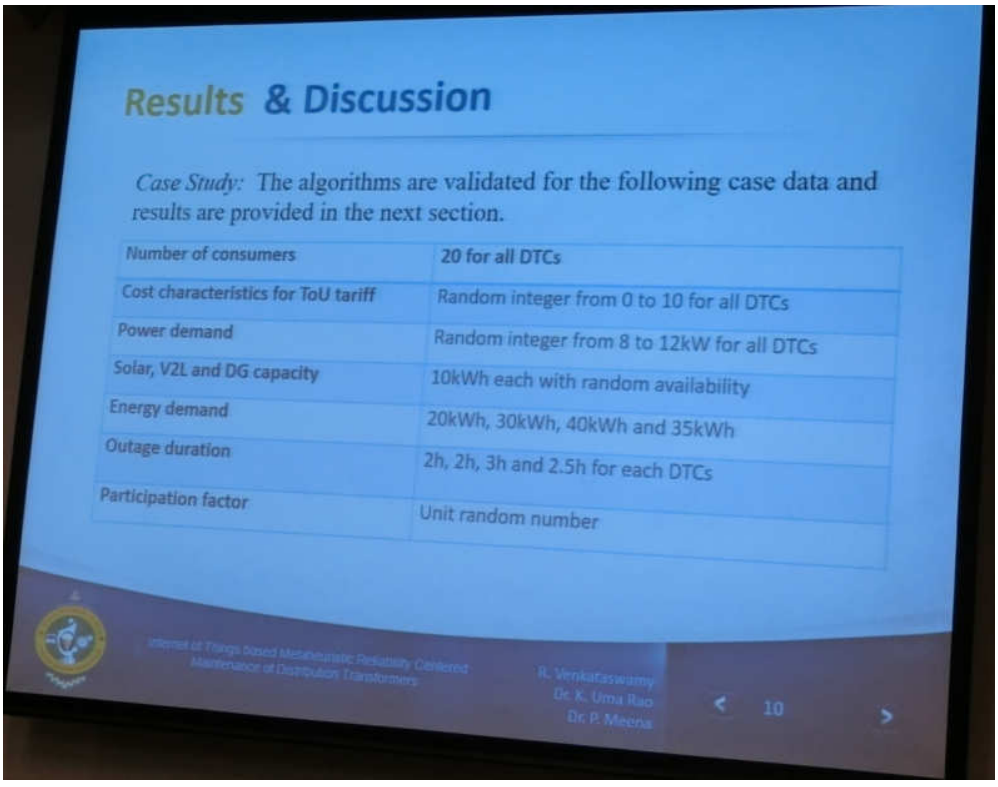
資料來源：SEGT 2019

圖 30 物聯網平台



資料來源：SEGT 2019

圖 31 分析流程



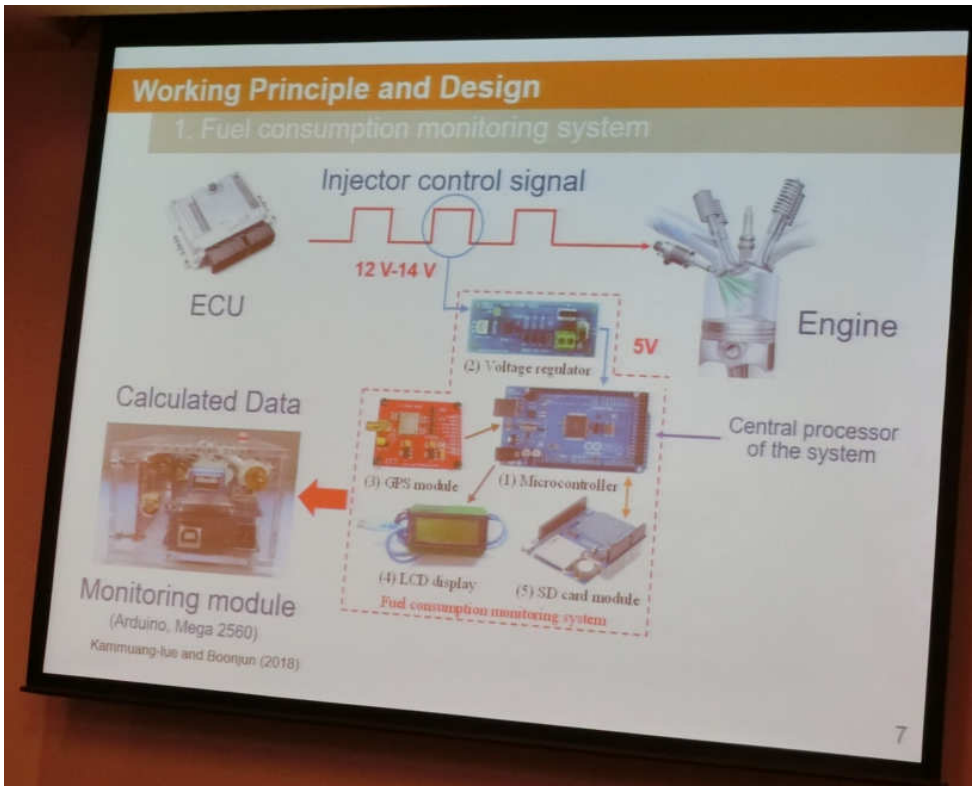
資料來源：SEGT 2019

圖 32 案例分析資料

7. 以網際網路為基礎的即時油耗回報系統的設計和可靠性分析(Design and Reliability Analysis on Internet-Based Real-Time Fuel Consumption Reporting System)

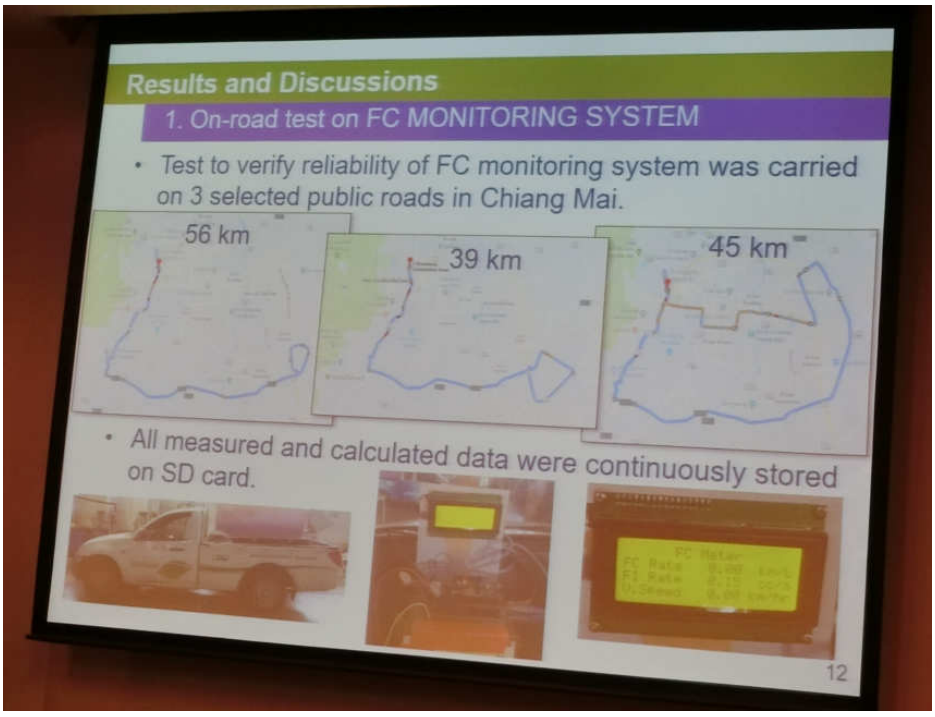
論文發表者：泰國清邁大學工程學院機械工程系(Department of Mechanical Engineering, Faculty of Engineering, Chiang Mai University)助理教授，Niti Kammuang-lue

駕駛員的駕駛行為是影響車輛油耗率的重要因素，因此希望通過控制駕駛員的駕駛行為來降低其車輛的油耗率。為了控制駕駛員的駕駛行為，車輛的即時油耗率是最重要的資訊，必須通過網際網路通訊從任何地方進行遠端觀察。本研究的目的是(1)設計和製造以網際網路為基礎的即時油耗報告系統，以及(2)評估回報系統的可靠度。採用即時油耗監控系統從噴油器控制信號測得的測試車輛的即時油耗率，作為以網際網路為基礎的即時回報的數據。應用通用非同步接收發送器(universal asynchronous receiver transmitter, UART)協議於同步序列通訊的電腦硬體設備，以 Arduino Mega 2560 微控制器作為通訊和傳輸數據設備。接著使用 Quectel BC95-B8 模組傳輸數據，透過窄頻物聯網(Narrow-band Internet of Things, NB-IoT)技術儲存於雲端系統。研究顯示：(1)由雲端系統所顯示之油耗率較由監視系統獲得的計算的燃油消費率低 11.6%。(2)透過網際網路通訊延遲時間少於 9 秒。圖 33 顯示即時油耗回報系統架構，圖 34 顯示車上監視系統監控畫面，圖 35 顯示雲端系統畫面。



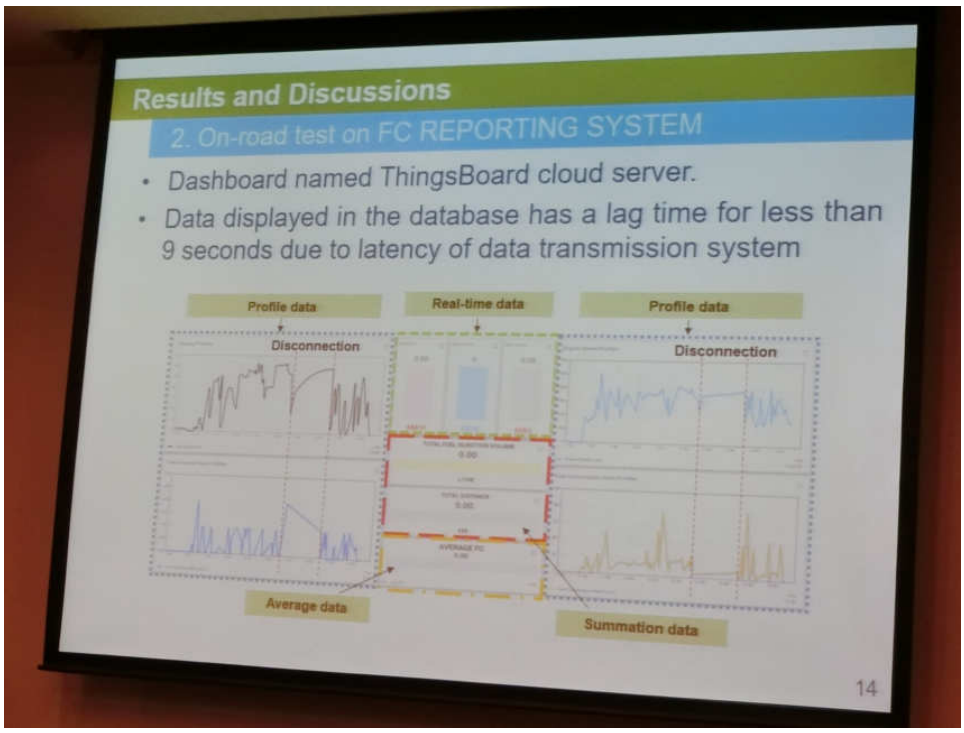
資料來源：SEGT 2019

圖 33 即時油耗回報系統架構



資料來源：SEGT 2019

圖 34 車上監視系統監控畫面



資料來源：SEGT 2019

圖 35 雲端系統畫面

8. 燃料替代：泰國能源安全的可能選擇(Fuel Replacement: A Possible Option for Thailand Energy Security)

論文發表者：泰國朱拉隆功大學能源研究所(Energy Research Institute, Chulalongkorn University)研究員，Nitida Nakapreecha

天然氣在加強泰國的能源安全方面一直發揮著重要作用，因為該國消費的天然氣總量中有 60%以上來自泰國灣。在過去的 20 年中，天然氣需求的平均增長率為每年 5.5%。由於其燃燒時單位產生能量所排放之二氧化碳量較燃煤或燃油為低，因此天然氣被認為是較清潔的燃料。儘管如此，泰國仍在使用碳密集型燃料，例如石油和煤炭。在工業領域，使用天然氣代替石油和煤炭可作為泰國促進國內清潔能源和減少總體碳排放的一種選擇。本文預測用天然氣代替工業領域的石油和煤炭的可能性，本研究檢視泰國法規的局限性，估計所需的天然氣替換量以及預測所有三種燃料的未來價格。該結果將有助於確定適當的政策來支持泰國對天然氣的長期需求。圖 36 顯示泰國能源供應，圖 37 顯示泰國燃料需求預測，圖 38 顯示燃料價格預測。

簡報後，黃員提問：「泰國對未來的再生能源規劃為何？」Nitida Nakapreecha 回答：「會後可以電子郵件提供泰國再生能源發展與能源效率

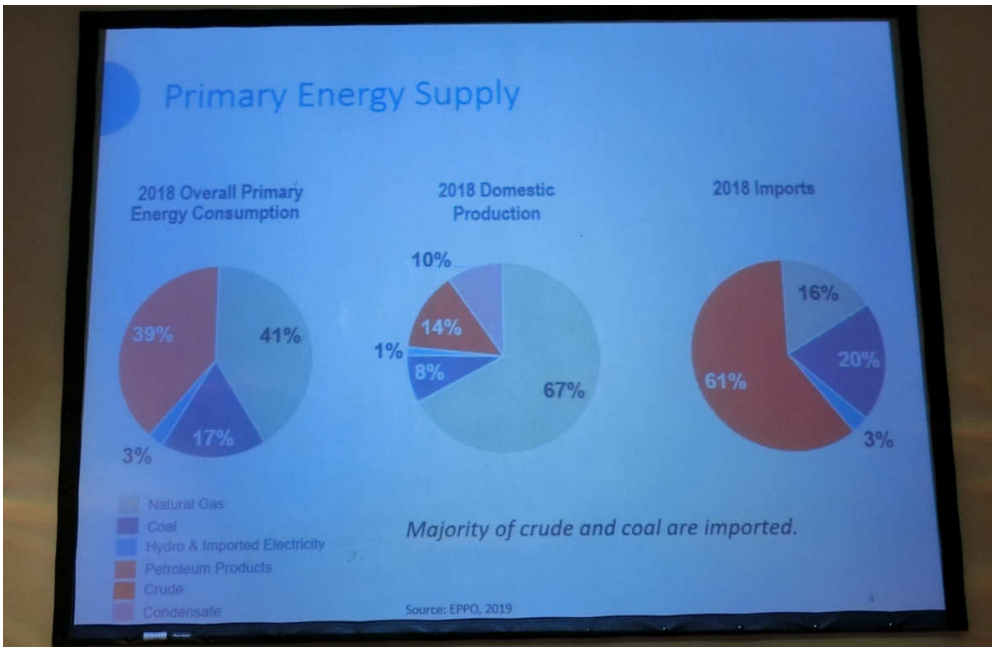
部門(Department of Renewable Energy Development and Energy Efficiency)所規劃的替代能源發展計畫(Alternative Energy Development Plan: AEDP2015)文件作為參考。」

獲得文件後經過再查詢，該文件連結為：

http://www.eppo.go.th/images/POLICY/ENG/AEDP2015ENG.pdf

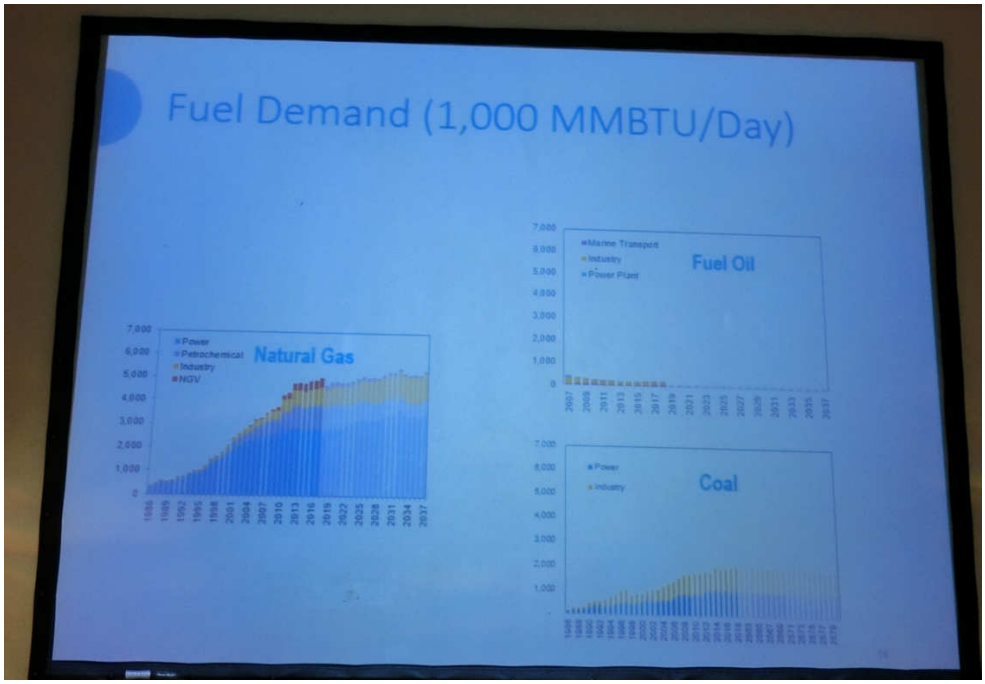
文件顯示泰國的能源藍圖聚焦於能源安全、經濟與生態。能源部於 2015 年建立了 2015-2036 年的五個能源總體規劃，包括：電力發展計畫，能源效率發展計畫，替代能源發展計畫，石油發展計畫和天然氣發展計畫。

表 1 顯示泰國 2012-2014 年再生能源發展，可知位於熱帶的泰國，再生能源以生質能為主流，其次則為太陽光電，風力則占比仍低，2012 年再生能源消費占比為 9.95%，2014 年再生能源消費占比成長為 11.91%。圖 39 顯示再生能源發電量與其占比，再生能源發電占比由 2007 年之 4.3%成長至 2014 年之 9.9%。表 2 顯示泰國再生能源發展目標，泰國規劃於 2023 年泰國再生能源發電占比為 15-20%，整體再生能源消費占比為 30%，除了太陽光電的成長外，風力發電將會大幅成長，屆時再生能源將替代化石燃料的使用約 39,388 ktoe，其估計價值為 5908.2 億泰銖（價格 1 ktoe = 1500 萬泰銖），減少約 1.4 億噸二氧化碳當量(tCO2e)的溫室氣體排放。



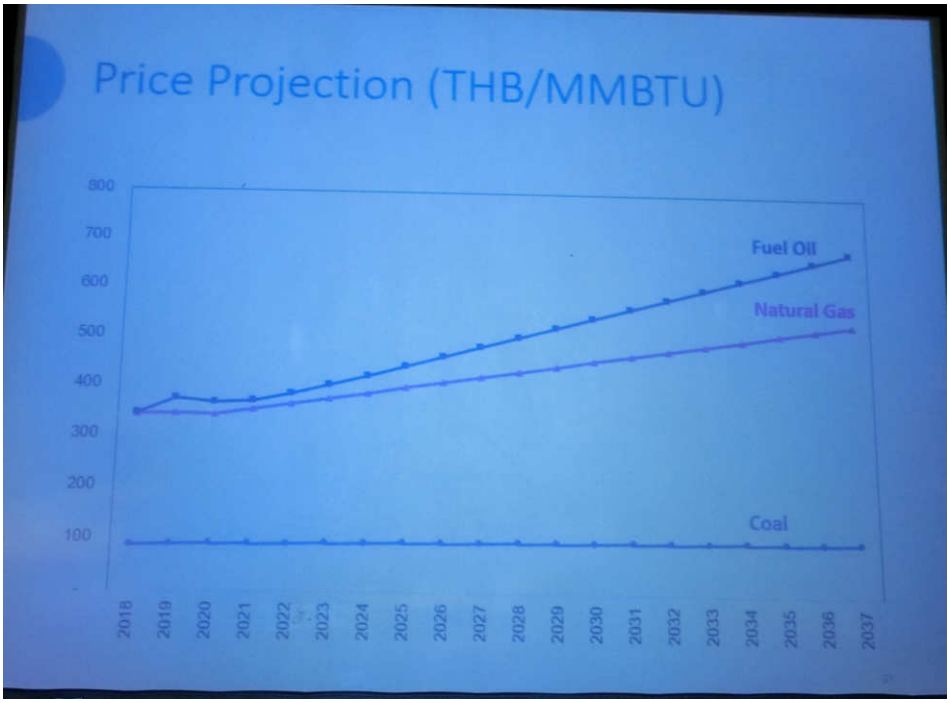
資料來源：SEGT 2019

圖 36 泰國能源供應



資料來源：SEGT 2019

圖 37 泰國燃料需求預測



資料來源：SEGT 2019

圖 38 燃料價格預測

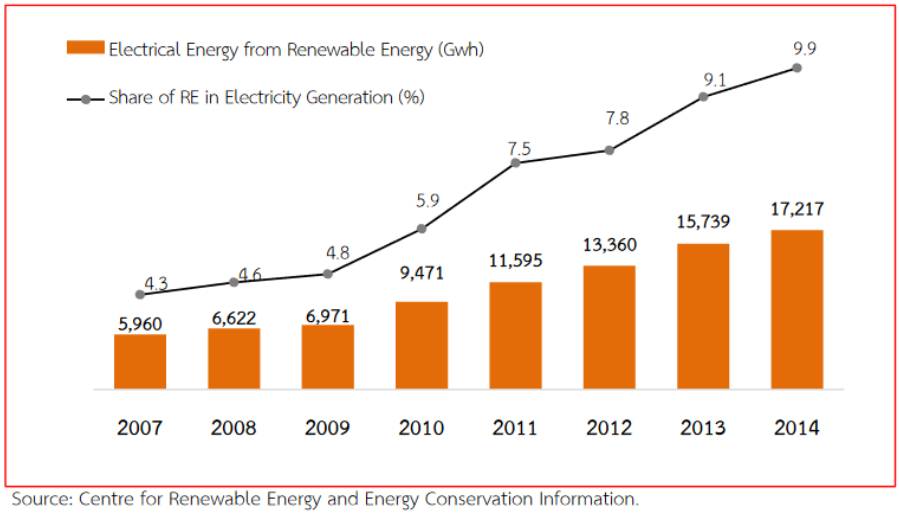
表 1 泰國 2012-2014 年再生能源發展

資料來源：泰國 AEDP2015

Table 2.1 Status of renewable energy development in 2012-2014

Renewable Energy	Unit	Status		
		2012	2013	2014
Electricity*	MW	2,786	3,788	4,494
	ktoe	1,138	1,341	1,467
1. Solar	MW	376.72	823.46	1,298.51
2. Wind	MW	111.73	222.71	224.47
3. Small Hydro	MW	101.75	108.80	142.01
4. Biomass	MW	1,959.95	2,320.78	2,451.82
5. Biogas	MW	193.40	265.23	311.50
6. MSW	MW	42.72	47.48	65.72
Heat	ktoe	4,886	5,279	5,775
1. Solar	ktoe	3.50	4.50	5.10
2. Biomass	ktoe	4,346.00	4,694.00	5,144.00
3. Biogas	ktoe	458.00	495.00	528.00
4. MSW	ktoe	78.20	85.00	98.10
Bio-fuel	Million liter/d	4.20	5.50	6.10
	ktoe	1,270	1,612	1,783
1. Ethanol	Million liter/d	1.40	2.60	3.21
2. Bio-diesel	Million liter/d	2.80	2.90	2.89
RE Consumption (ktoe)		7,294	8,232	9,025
Final Energy Consumption (ktoe)		73,316	75,214	75,804
Share of RE in Final Energy consumption (%)		9.95	10.94	11.91

*Including off grid power generation and not including power from the large hydro power plant



Source: Centre for Renewable Energy and Energy Conservation Information.
Department of Alternative Energy Development and Energy Conservation

Figure 2.1 The generation of electricity from renewable energy sources in 2007-2014.

資料來源：泰國 AEDP2015

圖 39 再生能源發電量與其占比

表 2 泰國再生能源發展目標

資料來源：泰國 AEDP2015

Table 3.1 AEDP Target

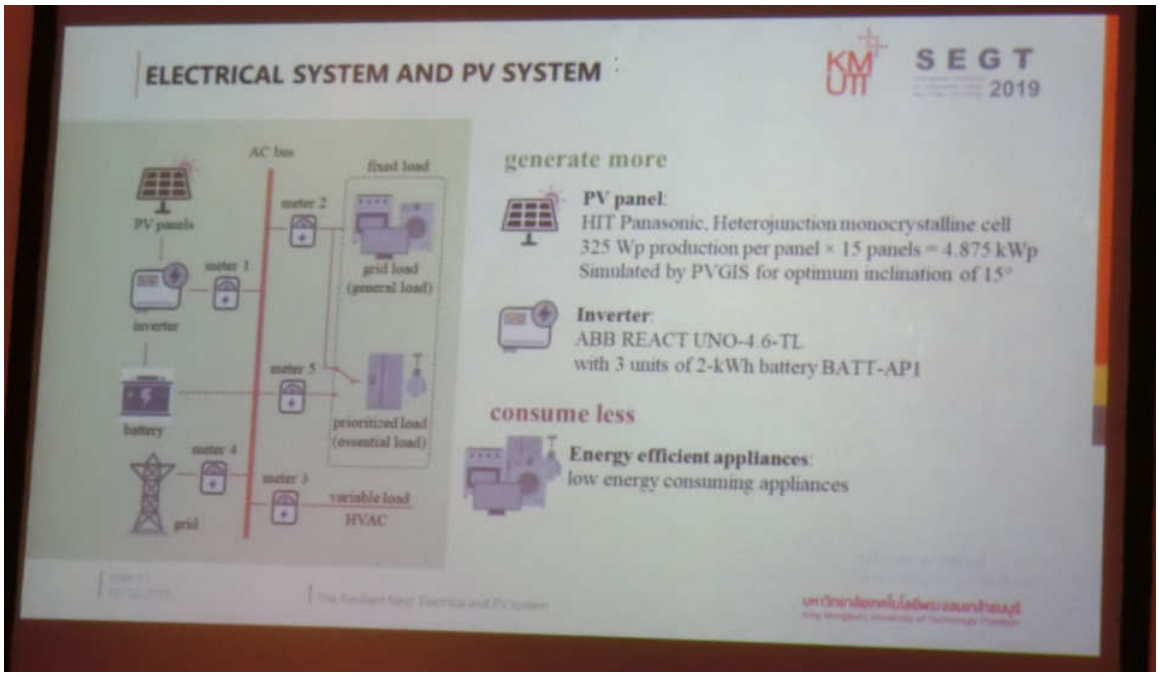
Energy	Share of RE (%)		Final Energy Consumption at 2036
	Status As of 2014	Target by 2036	
Electricity: Electricity	9	15 - 20	27,789
Heat: Heat	17	30 - 35	68,413
Bio-fuels : Fuels	7	20 - 25	34,798
RE : Final Energy Consumption	12	30	131,000

3.1 Target of electricity from renewable energy

9. 適用於城市密集房屋且裝置太陽光電與節能屋頂的韌性巢(The Resilient Nest as a solar powered and energy efficiency rooftop house for urban density)

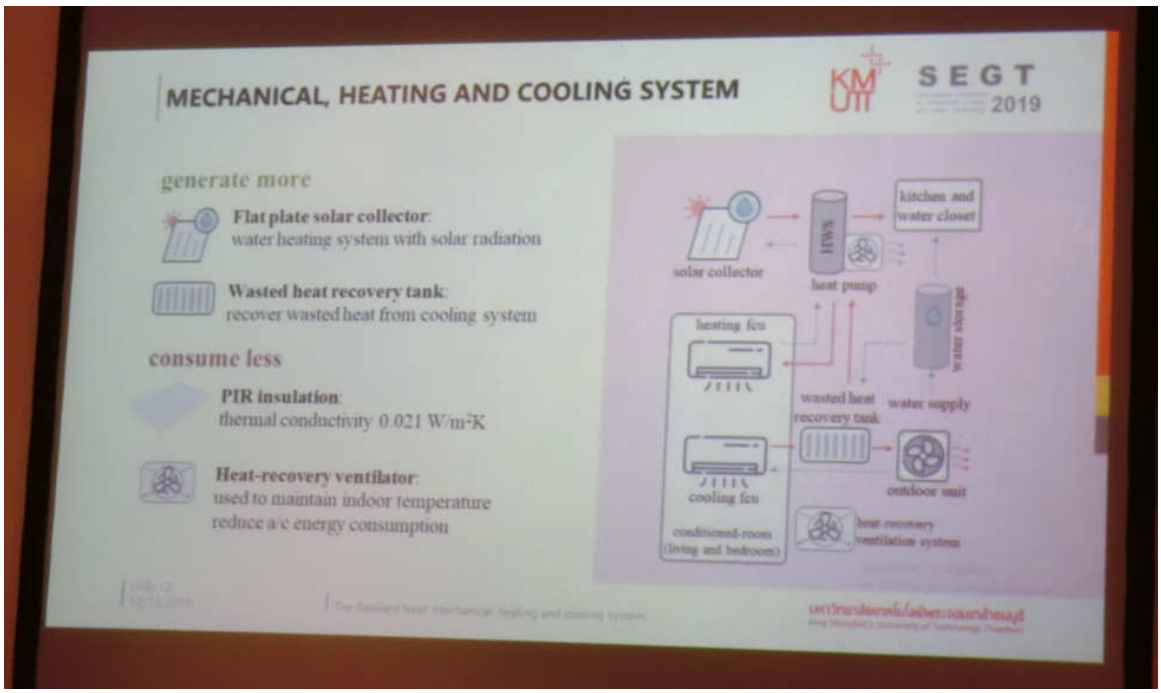
論文發表者：泰國國王科技大學(King Mongkut's University of Technology Thonburi, KMUTT)，Kasan Chanto

本文介紹韌性巢(Resilient Nest)的設計概念和監測結果。韌性巢為整合太陽光電與節能屋頂的設施，可以設置在泰國曼谷的連排房屋的頂部，以應對城市密度增加的趨勢。增加設置的屋頂不僅增加了現有建築物的居住空間，而且還確保了現有建築物變得更加舒適和環保。太陽能既可以來自太陽光電的電能，也可以來自太陽能集熱器的熱能，它們都是可再生能源，既可以容納韌性巢屋頂，也可以容納現有建築物。監測數據顯示，韌性巢在 10 天內發電量為 277.28 kWh，其通風空調系統的電力消耗僅為 37.65 kWh。與泰國政府公共關係部推薦的合適的空調房屋相比，韌性巢的能源消耗要少 14 倍，這要歸功於其高性能的隔熱裝置、熱回收系統和太陽能熱系統。而且低耗能的通風空調系統仍可為提供舒適室內環境。圖 40 顯示電力與太陽光電系統，圖 41 顯示機械、加熱與冷卻系統，圖 42 顯示溫度監測。



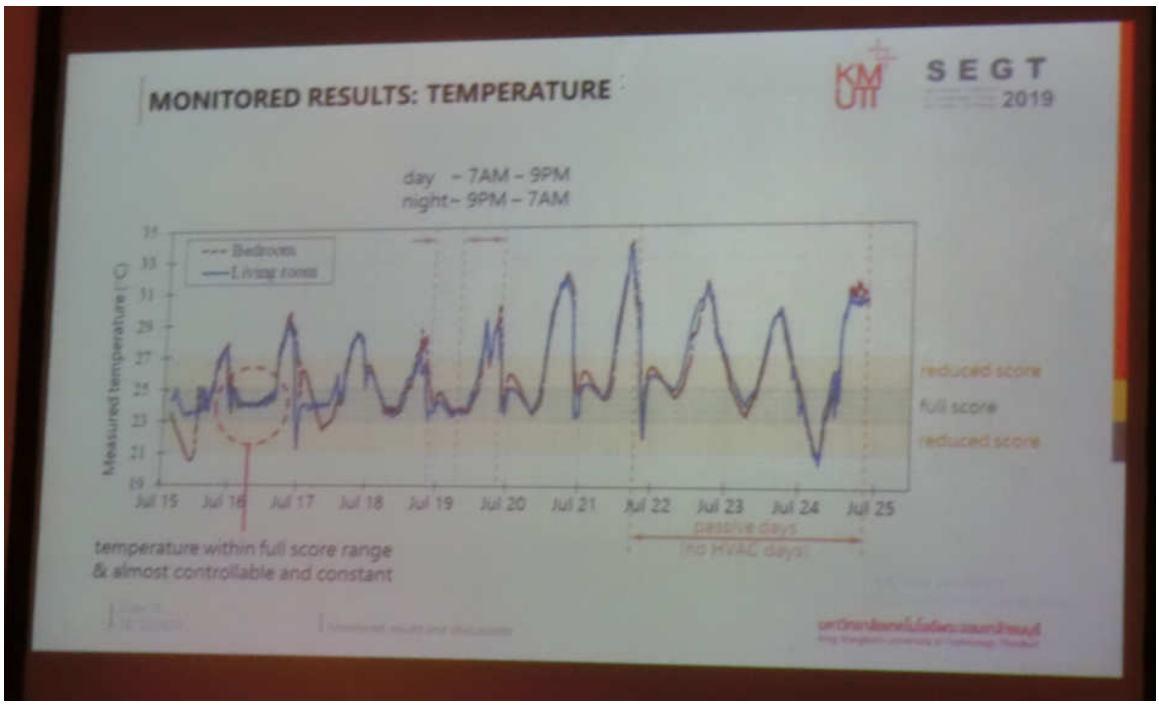
資料來源：SEGT 2019

圖 40 電力與太陽光電系統



資料來源：SEGT 2019

圖 41 機械、加熱與冷卻系統



資料來源：SEGT 2019

圖 42 溫度監測

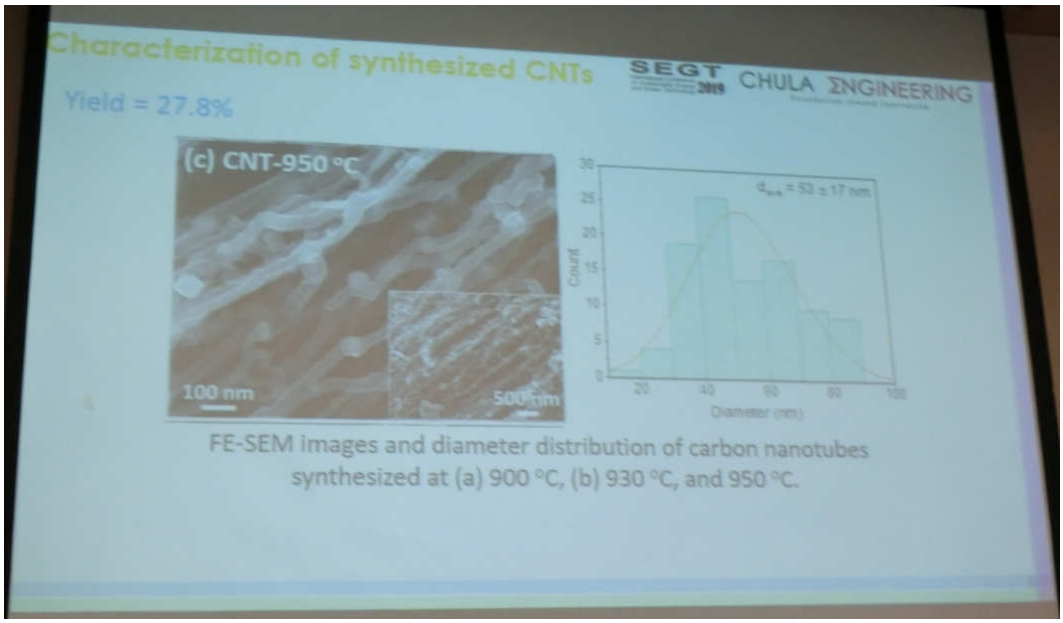
主持場次會議

黃員應大會邀請擔任第 55 場論文發表會之場次會議主席(session chair)，場次會議主題為：永續性、環境、氣候變遷與減緩技術(Sustainability, Environment, Climate Change & Mitigation Technology)。場次會議主席的職責在於維持會議程序，介紹各個簡報學者，並且預先在會前研讀各論文資料，準備問題。於會議中適當時機提問，以維持場面熱絡。

1. 石化廢油合成碳奈米管-金屬複合材料的簡便方法(Facile Approach For Synthesizing Carbon Nanotube-Metal Composites From Petrochemical Waste Oil)

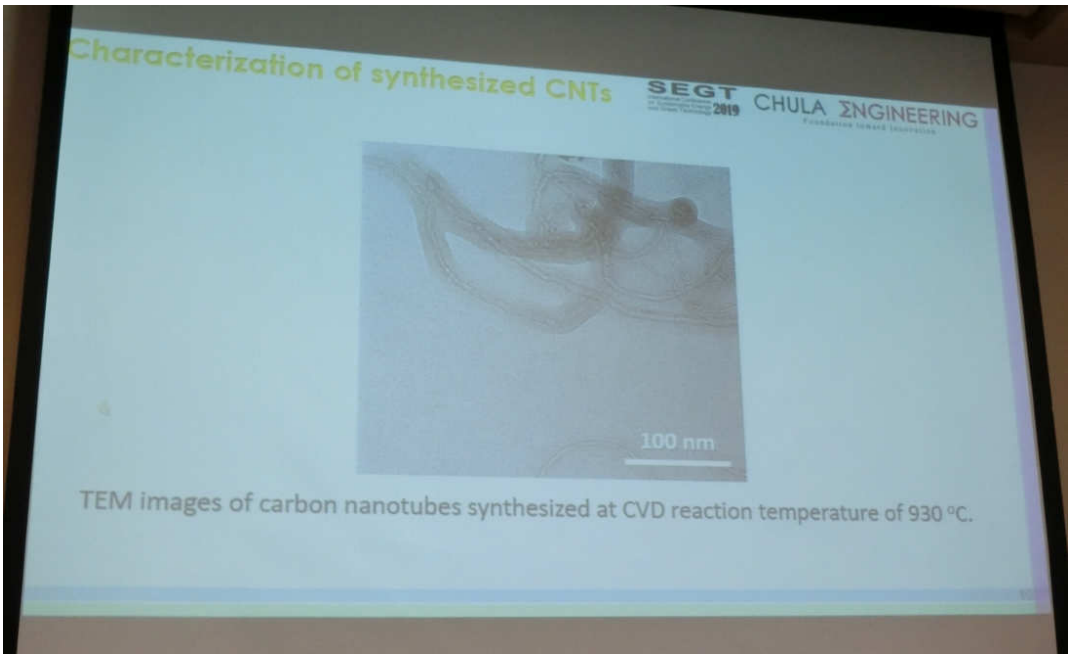
論文發表者：泰國朱拉隆功大學工程學院化學工程系粒子技術卓越中心(Center of Excellence in Particle Technology, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University)，Chosel Lawagon 博士

以增值回收(upcycling)處理石化廢油(Petrochemical Waste Oil, PWO)是一項永續的替代選擇。但是 PWO 處理不當會導致環境和健康危害。本研究從 PWO 合成碳奈米管-金屬複合材料的新方法將具有環境和經濟效益。簡單的催化氣相沉積(catalytic vapor deposition, CVD)用於從 PWO 合成碳奈米管(carbon nanotubes, CNTs)。碳奈米管合成的最佳條件是通過改變溫度(800 – 950℃)，由催化劑與碳前體的比率以及停留時間(0.5 至 1 小時)來確定。金屬奈米層將通過非電鍍法/化學鍍(electroless plating, ELP)沉積在 CNT 表面，然後進行熱處理以調節塗層。碳奈米管-金屬複合材料結構穩定性和完整性也進行了驗證。圖 43 與圖 44 顯示合成碳奈米管特性。



資料來源：SEGT 2019

圖 43 合成碳奈米管特性



資料來源：SEGT 2019

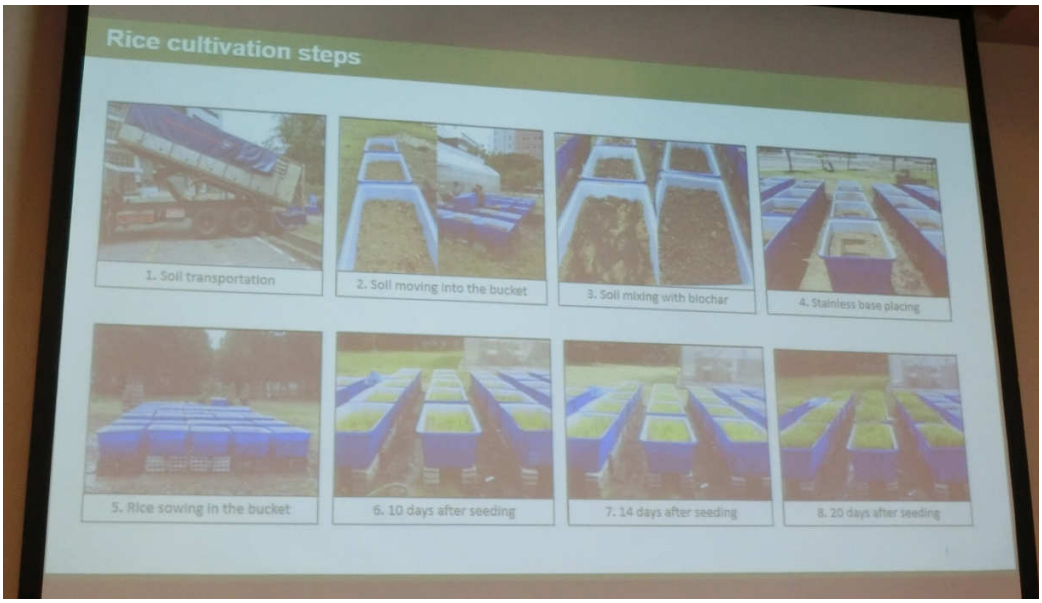
圖 44 合成碳奈米管特性

2. 評估不同生物炭施用量對減少稻田甲烷排放的影響(Evaluating the Effect of Different Biochar Application Sizes on Methane Emission Reduction from Rice Cultivation)

論文發表者：泰國能源與環境聯合研究生院(JGSEE)博士班研究生，Patikorn Sriphirom

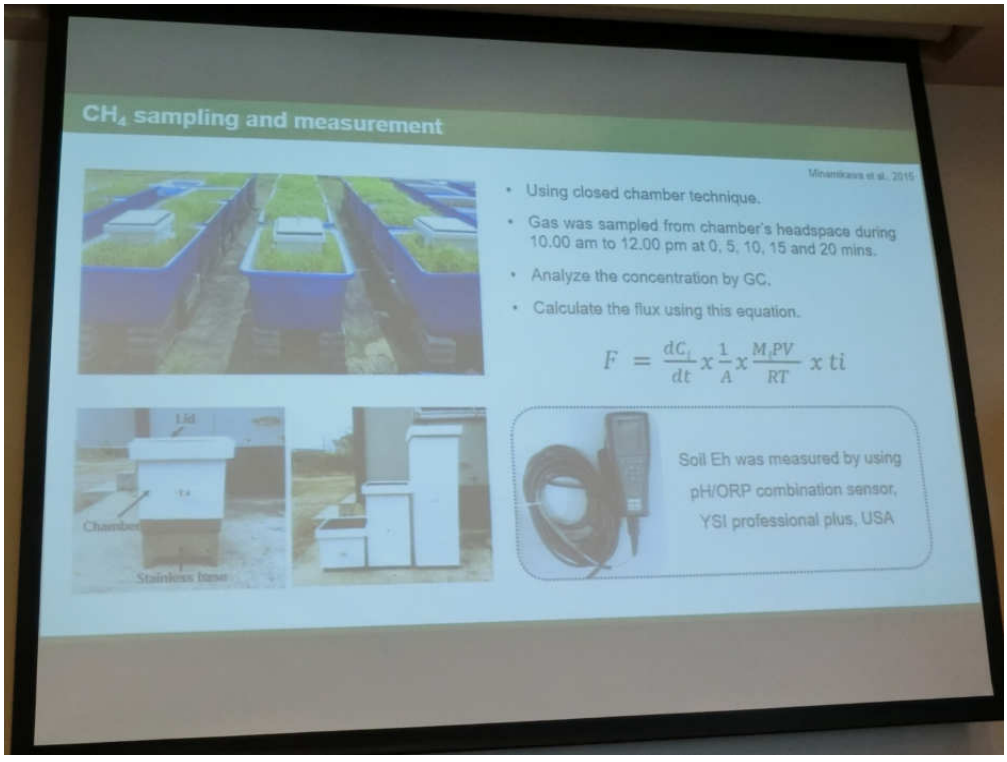
生物炭在土壤中的應用由於其高孔隙率和表面積的獨特特性，已成為種植水稻時緩解排放 CH_4 的技術之一。較小的生物炭尺寸的應用具有豐富的孔體積和表面積可以增強緩解能力。進行水稻種植和土壤培養實驗以評估兩組生物炭尺寸對 CH_4 排放和生產的影響，以顯示緩解潛力。該實驗由三種處理組成，包括無生物炭(no biochar, CT)，小尺寸(0.5-2 mm)生物炭(small size biochar, SB)和大尺寸(2-4 mm)生物炭(large size biochar, LB)。兩種生物炭的尺寸均以當量 10 t ha^{-1} 的比例進行了修改，所有處理均以 100 kg N ha^{-1} 的當量比例施用化肥。結果顯示，與 CT 相比，SB 和 LB 分別減少了累積 CH_4 排放 24.0%和 17.1%，以及累積 CH_4 產生 24.6%和 15.0%。與較大尺寸的生物炭相比，在本研究中使用較小尺寸的生物炭影響了更多的 CH_4 排放緩解能力，因此有必要進一步研究典型生物炭尺寸，以推薦最大緩解潛力的生物炭。圖 45 顯示生物炭混入稻作過程，圖 46 顯示甲烷取樣與量測，圖 47 顯示稻米產量取樣與分析。

簡報後，黃員提問：「今日大氣中溫室氣體濃度過高的主要原因為：人類將大自然歷經千萬年甚至億年的過程，將植物轉化成煤炭，埋在地底；而人類在僅數百年，大量開採煤礦，並燃燒煤炭，產生溫室氣體。是否有可能製作穩定的生物炭，其穩定度與煤炭相近，再將其埋入地底？」Patikorn Sriphirom 回答：「JGSEE 已經在進行製作穩定度與煤炭相近的生物炭，及考慮埋入地底以降低大氣二氧化碳稜度的可行性。生物炭為固體，遠較封存二氧化碳可行。」



資料來源：SEGT 2019

圖 45 生物炭混入稻作過程



資料來源：SEGT 2019

圖 46 甲烷取樣與量測

資料來源：SEGT 2019

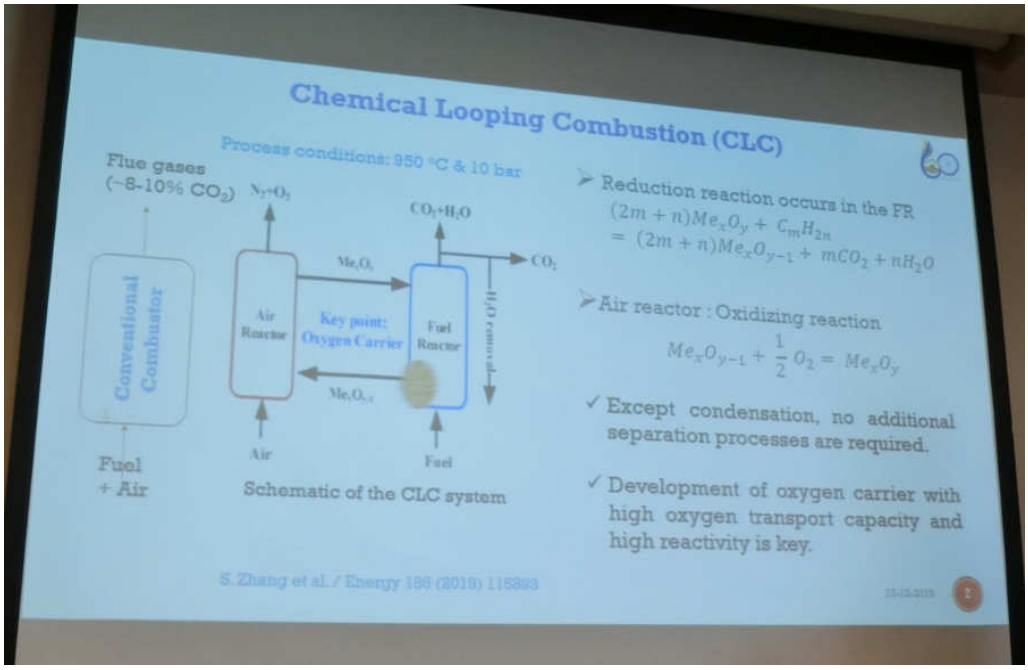
圖 47 稻米產量取樣與分析

3. 煤灰與鐵礦石在化學循環燃燒中的相互作用(Interaction between Coal-Ash and Iron-Ore in Chemical Looping Combustion)

論文發表者：瓦朗加爾國立理工學院化學工程系(Department of Chemical Engineering, National Institute of Technology Warangal)助理教授，Manohar Kakunuri

化學循環燃燒(Chemical looping combustion, CLC)具有固有的 CO_2 捕獲過程，因此被視為清潔發電技術。但是在固體燃料(煤)的 CLC 中，屏蔽金屬氧化物活性和循環穩定性是關鍵挑戰。當煤中的灰分含量高且具有反應性時，這種活性下降是一個嚴重的問題。本研究考慮了具有不同灰分組成的四種煤樣品，以研究金屬氧化物和灰分之間的相互作用。

研究了灰分組成，環境(CO_2、蒸汽和 N_2)和煤灰添加比例(0 至 30%)等不同比率，以研究其對氧化鐵氧載體的影響。相互作用研究是在帶有過熱蒸汽產生器的實驗室規模的臥管式爐中進行的，結果顯示，將煤灰添加到氧氣載體中會顯著影響燃料轉化率。富含 SiO_2 的灰分轉化為矽酸鉀，導致氧載體燒結，導致氧載體反應性降低。相反地，添加具有相對較低的 SiO_2 含量的富 K_2O 灰分可促進燃料轉化。圖 48 說明化學循環燃燒流程。



資料來源：SEGT 2019

圖 48 化學循環燃燒流程

4. 使用不同載氧體的化學循環燃燒整合燃煤電廠的能量和有效能分析 (Energetic and Exergetic Analysis of Chemical Looping Combustion Integrated Coal-Fired Power Plant using Different Oxygen Carriers)

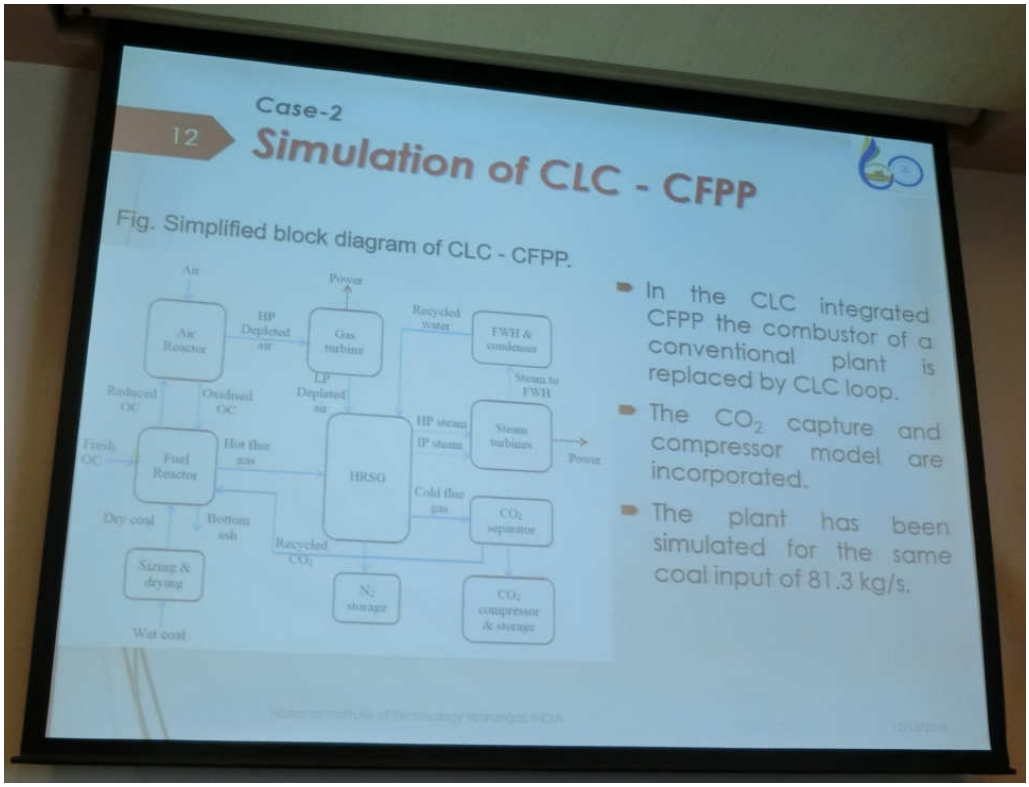
論文發表者：瓦朗加爾國立理工學院化學工程系(Department of Chemical Engineering, National Institute of Technology Warangal)教授，Sarath Babu Anne

減少溫室氣體(greenhouse gas, GHG)排放已成為全球關注的問題，化石燃料的大部分由燃煤電廠(coal-fired power plants, CFPP)用於發電，次臨界 CFPP 的主要占比約為 70%。在整合式 CFPP 中，化學循環燃燒(Chemical looping combustion, CLC)和工業慣用之乙醇胺(monoethanolamine, MEA)燃燒後二氧化碳捕獲，為常用的清潔發電技術。本研究介紹了三種用於高灰分印度煤的系統的穩態模擬：(a)不捕集 CO_2 的傳統 CFPP，(b)以 MEA 為基礎之燃燒後捕集 CO_2 的傳統 CFPP，(c)使用不同氧化載體的 CLC 整合 CFPP。三種類型的金屬氧化物，如 Fe_2O_3、CuO 和雙金屬化合物作為 CLC 整合 CFPP 的氧氣載體。

本研究進行了能量和有效能分析以評估和比較以傳統 CFPP 為基礎案例的 CLC 整合電廠的性能，結果顯示，CLC 整合式發電廠在熱力學上比傳統

的以 MEA 為基礎的 CFPP 更高效。以氧氣載體為基礎的研究顯示，CLC 整合 CFPP 與 Fe_2O_3、CuO 以及 Fe_2O_3 和 CuO 的混合物的淨效率分別為 33.81%、39.73%和 36.30%，而這些電廠的淨效率分別為 31.09%、36.53%和 33.38%。這項研究的成果可以為改善 CFPPs 的電廠性能提供參考，圖 49 顯示 CLC-CFPP 分析流程。

簡報後，黃員提問：「此項研究採用 Fe_2O_3、CuO 和雙金屬化合物作為 CLC 整合 CFPP 的載體，這些載體最後流向為何？」Sarath Babu Anne 回答：「這些載體最後會留在程序的後端，目前正研究蒐集技術。」



資料來源：SEGT 2019

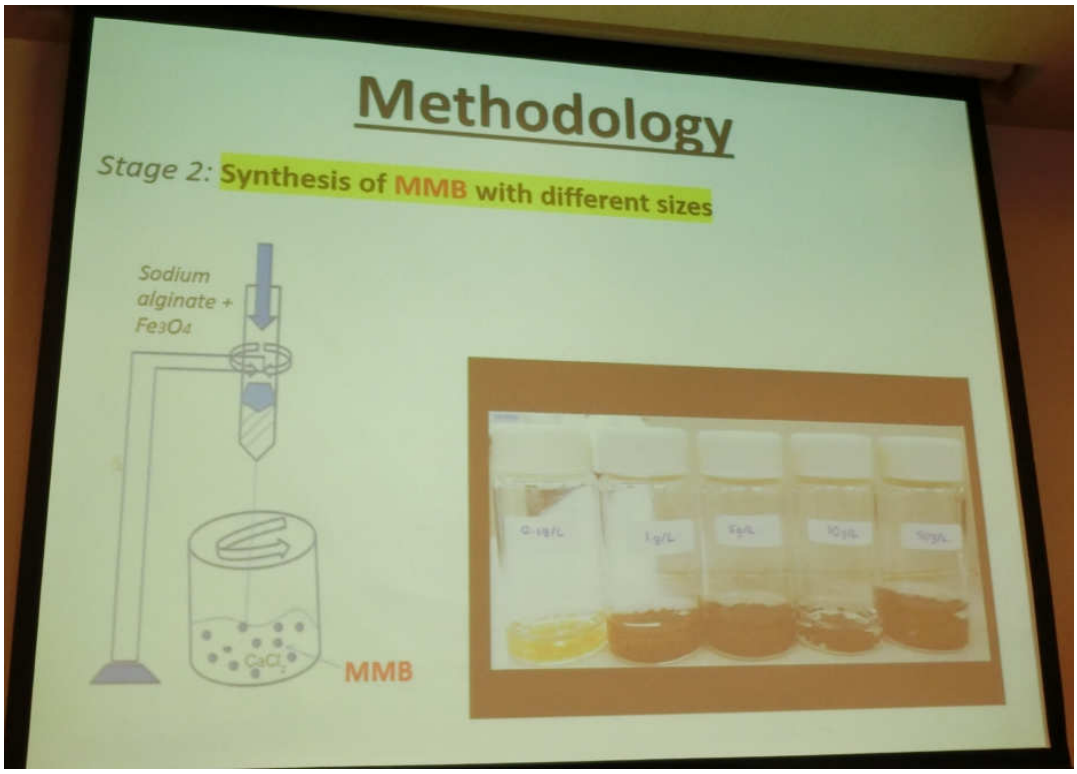
圖 49 CLC-CFPP 分析流程

5. 用於淨水的大尺寸磁珠的合成：通過操控磁珠尺寸和表面形態來最佳化淨水程序(Synthesis of Magnetite Macro-Bead for Water Remediation: Process Optimization via Manipulation of Bead Size and Surface Morphology)

論文發表者：馬來西亞 UCSI 大學化學與石油工程系(Department of Chemical & Petroleum Engineering, UCSI University)，Swee Pin Yeap 博士

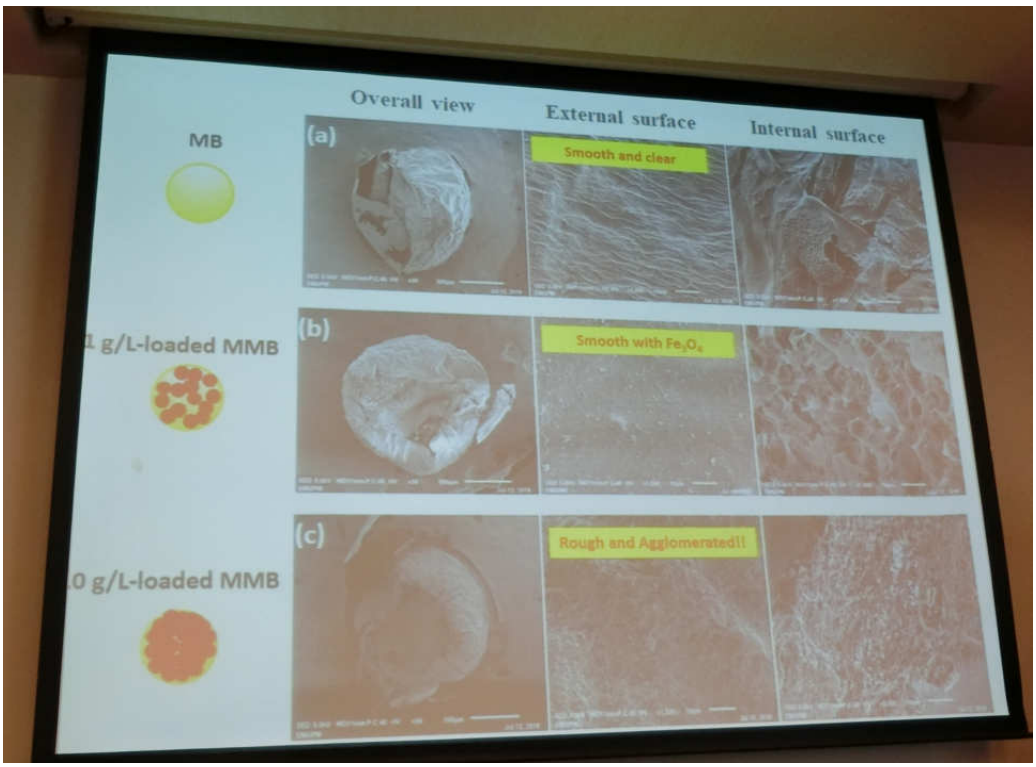
顆粒形式的吸附劑已被積極研究並用於解決水污染問題。儘管取得了階段性成果，但這種方法有其技術上的關注議題，即將吸附劑與處理後的水分離。以常見的過濾或離心方法分離吸附劑顆粒可能會消耗大量能源，本研究目的在合成可以使用磁性收集器將大尺寸磁珠(MMB)分離。將磁鐵奈米顆粒通過簡便的逐滴添加方式被浸漬到藻酸鈣珠粒中，以形成的 MMB 的染料吸附劑。結果顯示，吸附效率隨珠粒尺寸和表面形態的變化而有所不同。特別是，尺寸為 2.0 毫米的 MMB 的去除效率最高。此外，通過測試不同磁珠的表面形態成功地最佳化了吸附效率。珠粒的表面形態因裝入每個珠粒中的磁鐵礦量而改變。高磁鐵礦含量（≥10 g / L）導致染料去除效率降低。在 pH 8，初始染料濃度為 90 mg / L 的條件下，對該技術進行了最佳化分析，使用簡單的 NdFeB 磁體即可快速分離 MMB(不到 5 秒)。與過濾或離心方法相比，本研究將提供更具永續性的處理技術。圖 50 顯示不同尺寸的合成磁珠，圖 51 顯示不同尺寸磁珠顯微鏡影像。

簡報後，黃員提問：「此項研究在實驗室進行時非常成功，也都能確保回收吸附染料的磁珠。然而在大規模工業應用時，如何確保完全回收吸附染料的磁珠，以避免造成二度汙染？」Swee Pin Yeap 回答：「大規模產業應用時，可能將磁珠開放型的流程中，磁珠回收確實為未來產業應用時的議題，將會考慮研究此議題。」



資料來源：SEGT 2019

圖 50 不同尺寸的合成磁珠



資料來源：SEGT 2019

圖 51 不同尺寸磁珠顯微鏡影像

場次會議完成後，大會頒發場次會議主持人證書一份如圖 52。

資料來源：SEGT 2019

圖 52 場次會議主持人證書

技術參訪

SEGT 2019 大會共提供 3 項技術參訪地點，包括：(1)能源與環境聯合研究生院(JGSEE)實驗室、(2)泰國電力局學習中心 (Electricity Generating Authority of Thailand (EGAT) Learning Center)與(3)泰國健康促進基金會-綠色建築(Thai Health Promotion Foundation - Green Building)，黃員選擇位於國王科技大學(KMUTT) Bangkhuntien 校區的能源與環境聯合研究生院(JGSEE)實驗室。

JGSEE 位於曼谷市區南方直線距離約 12 公里處(如圖 53)，JGSEE 是一所自主的研究生院，體制上直屬國王科技大學理事會所管理，成立於 1998 年，目的是實施高等教育委員會的研究生教育和科學技術發展計畫，該計畫目的為加強研究生教育和研究，以此為研究和發展奠定堅實的基礎。發展科學技術，並協助提升泰國的經濟競爭力。而 JGSEE 執行學術研究計畫時則與清邁大學(Chiang Mai University, CMU)、詩琳通國際理工學院-法政大學(Sirindhorn International Institute of Technology- Thammasat University,

SIIT-TU)、北曼谷國王科技大學(King Mongkut's University of Technology at North Bangkok, KMUTNB)及宋卡王子大學(Prince of Songkla University, PSU)有密切合作關係。

JGSEE 之主要實驗室包括：(1)先進燃料處理實驗室(Advanced Fuel Processing Laboratory, AFPL)、(2)建築能源科學與技術實驗室(Building Energy Science and Technology laboratory, BEST)、(3)熱帶氣候系統模型實驗室(Tropical Climate System Modeling Laboratory, TCSM)、(4)先進溫室氣體與氣溶膠研究實驗室(Advanced Greenhouse Gas and Aerosol Research Laboratory, AGAR)、(5)生命週期永續性評估實驗室(Life Cycle Sustainability Assessment Laboratory, LCSAL)、(6)能源與環境政策實驗室(Energy and Environmental Policy Laboratory , EEPL)。

參訪當日 JGSEE 僅開放參觀先進燃料處理實驗室(AFPL)，實驗室的重點為研究和開發符合國家能源安全和環境保護需求的燃料處理技術。主要的研究主題包括：(a)生質氣化和熱解以生產熱能、動力和運輸燃料；(b)褐煤的有效燃燒以及煤和生物質的共燒；(c)木質纖維素生物質綜合轉化為乙醇和工業加值化學品；(d)通過焙乾和製粒技術提升生物質品質；(e)生質氣體之升級利用；(f)通過降解性溶劑萃取，由褐煤和生物質生產高階含碳物質/燃料。圖 54 與圖 55 顯示燃料特性實驗室焙乾固態生物質樣本，圖 56 顯示碳纖維樣本，圖 57 顯示恆溫爐設備，圖 58 顯示自動蒸餾儀，圖 59 顯示碳硫分析儀，圖 60 顯示各式氣瓶(包括：氮氣瓶、氫氣瓶、氧氣瓶、氦氣瓶)，圖 61 顯示高溫沉降管反應爐(High Temperature Drop Tube Furnace) 全貌，圖 62 顯示高溫沉降管反應爐標示與控制盤，此項設備可進行亞煙煤(sub-bituminous coal)極其殘渣(bituminous coal (SB) and its residue)的燃燒效率和氣體排放實驗。

值得一提的是，日本科學技術局(Japan Science and Technology Agency, JST)與日本國際協力機構(Japan International Cooperation Agency, JICA)在 JGSEE 的技術發展中扮演重要角色，JICA 提供資金，JST 提供技術。在參訪中的設備與說明中，經常可看見 JST 與 JICA 的標識。JGSEE 人員也表示許多研究技術都依賴日本支援，可見日本在東南亞布局之用心。

JGSEE 其他實驗室簡介如下：

(1) 建築能源科學與技術實驗室(BEST)

實驗室的目的為促進執行建築的能源科學和能源技術的研究和專業任務，以及進行低耗能建築的研究，以支援泰國和區域國家群組(Regional Country Group)實施建築能源效率計畫。主要的研究主題包括：(a)建築系統和組件之能源效率；(b)窗戶之遮光和採光；(c)制定能源法規和標示計畫；(d)輻射冷卻與太陽能冷卻與除濕。

(2) 熱帶氣候系統模型實驗室(TCSM)

實驗室的目標是進行區域氣候之模型建立與分析，區域和空氣品質之模型建立與分析，水文/海洋/沿海之模型建立與分析，與氣候相關的能源模型建立與分析。主要的研究主題包括：(a)泰國之區域氣候模擬；(b)春武里市的光化學之模型建立；(c)工業區空氣污染物擴散模型；(d)泰國和曼谷的風能資源之模型建立；(e)泰國海灣的沿海之模型建立；(f)再生能源資源模型；(g)跨境空氣污染物之模型建立；(h)氣候和空氣品質/水文耦合模型；(i)城市或地區的毒性空氣污染物之模型建立；(j)大氣和海洋耦合模型。

(3) 先進溫室氣體與氣溶膠研究實驗室(AGAR)

實驗室的主要重點為(a)建立決策支援工具以支援溫室氣體排放監測與預測、(b)為能源和非能源相關部門訂定適當的減緩方案。主要的研究主題包括：(a)由生物質燃燒到大氣的氣溶膠；(b)溫室氣體監測；(c)溫室氣體排放的預測與減緩；(d)研發非能源部門溫室氣體測量的標準方法。

(4) 生命週期永續性評估實驗室(LCSAL)

實驗室的重點是從生命週期的觀點開發分析工具，並對各種慣例和替代能源技術進行永續性評估。此類研究的結果將為泰國的決策者提供技術支援，以因應能源轉換和使用對永續性的影響。生命週期評估為(a)環境評估與 (b)經濟評估和社會生命週期評估的成本計算的主要工具。

(5) 能源與環境政策實驗室(EEPL)

實驗室的重點是進行與政策相關的研究並開發工具，以支援公共機構和企業決策和制訂策略與規劃，以開發和部署能源與環境技術的選擇和措施，從而實現永續的經濟成長與發展。主要的研究主題包括：(a)能源效

率、再生能源和低碳技術；(b)能源系統和低碳情境分析；(c)能源經濟與能源安全；(d)區域能源與環境政策。

資料來源：Google map

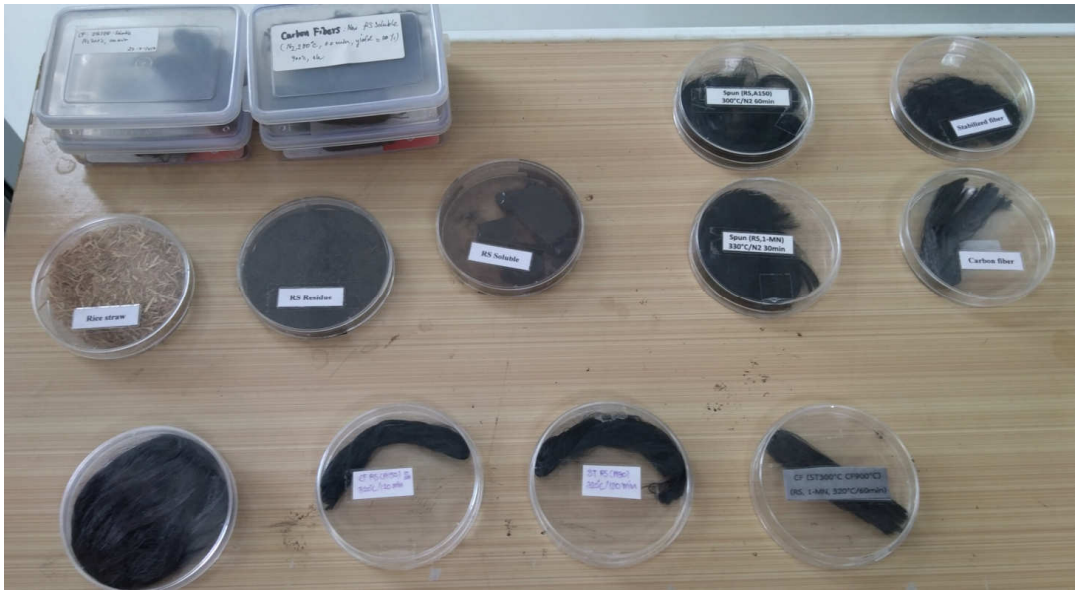
圖 53 能源與環境聯合研究生院(JGSEE)實驗室位置

資料來源：JGSEE 現場拍攝

圖 54 焙乾固態生物質樣本

資料來源：JGSEE 現場拍攝

圖 55 焙乾固態生物質樣



資料來源：JGSEE 現場拍攝

圖 56 碳纖維樣本

資料來源：JGSEE 現場拍攝

圖 57 恆溫爐設備

資料來源：JGSEE 現場拍攝

圖 58 自動蒸餾儀

資料來源：JGSEE 現場拍攝

圖 59 碳硫分析儀

資料來源：JGSEE 現場拍攝

圖 60 各式氣瓶(包括：氮氣瓶、氫氣瓶、氧氣瓶、氦氣瓶)

資料來源：JGSEE

圖 61 高溫沉降管反應爐(High Temperature Drop Tube Furnace)全貌

資料來源：JGSEE 現場拍攝

圖 62 高溫沉降管反應爐標示與控制盤

四、建議事項

「2019 年永續能源與綠能科技國際學術研討會(SEGT 2019)」於 108 年 12 月 11 日至 12 月 14 日於泰國曼谷舉行，主題包含：(1)新能源與再生能源、(2)永續能源轉化技術、(3)環境與氣候變遷、(4)能源管理、政策、經濟學與永續性、(5)能源科學、(6)儲能與動力工程、(7)永續城市、建築與綠色建築、(8)綠能設計、產品和製造流程、(9)智慧電網/智慧城市/智慧交通、(10)生質能等。來自 31 國共 470 名與會者出席了本次研討會，會議中發表 393 篇論文。黃揮文研究員於研討會中發表論文「鳳山智慧綠色社區之住宅與商業區域用戶端電力韌性分析(A power demand resilience analysis of the residential and commercial areas for Fengshan smart green community in Taiwan)」，並應大會邀請擔任一場論文發表會之會議主席。在此提出以下幾點建議：

(一) 建議持續派員參加 SEGT 國際研討會

SEGT 為在東南亞國家舉辦之大型國際研討會，近年來東南亞新興國家經濟成長迅速，且部分國家經濟發展已具有規模，如新加坡、馬來西亞、泰國、印尼、越南與菲律賓。此外印度、巴基斯坦與尼泊爾等南亞國家也積極參與本次 SEGT 國際研討會。因此參加 SEGT 國際研討會有助於了解東南亞與南亞新興國家最新綠能科技發展。

(二) 建議持續推動能源作業系統研發工作

本次研討會在「能源管理與環境政策」與「永續性、環境、氣候變遷與減緩技術」二種場次類別中，共計 10 場次，發表 68 篇論文。顯示氣候變遷問題日趨嚴重的情形下，因天災造成供電中斷而對緊急電力供應需求將會增加，因此能源作業系統仍有相當充裕的研發空間。

(三) 建議持續關注東南亞國家能源管理與電力網路發展

近年來東南亞新興國家因經濟發展，對電力需求日趨增加。這些國家目前雖以火力、水力、生質能發電為主，然而間歇性再生能源發電(如太陽光電與風力發電)建設正在逐步進行，電網穩定度問題也將

逐漸顯現，能源管理與電力網路管理需求也將提高，建議持續關注發展，以尋求擴展合作機會。

五、資料蒐集

- SEGT 2019 會議資料電子檔 USB (已送本所圖書館)

六、附錄

附錄 1 SEGT 2019 國際研討會議程

附錄 2 發表論文簡報

附錄 3 發表論文摘要

附錄 **1 SEGT 2019** 國際研討會議程

Programme at a Glance

Time	Wednesday, 11/December/2019
14:00	**Registration** (near entrance of Ballroom A)
15:00	**"How to write and publish effectively?" Workshop** - *Prof. Ibrahim Dincer* (Ballroom A) (Limited to 100 participants) - 1 hour 30 minutes
17:00	Close - Registration
18:00	**Welcome / Committee Reception** (only for those invited)
21:00	Close

Time	Thursday, 12/December/2019								
8:00	**Registration** (near entrance of Grand Ballroom)								
8:45	**Welcome Remarks & Opening Ceremony** (Grand Ballroom)								
	- Welcome Remarks by Conference Chair, *Dr. Suneerat Fukuda*, JGSEE, KMUTT, Thailand - Welcome Remarks by the Representative from United Nations Environment Programme (UNEP) - Welcome and Opening Address by the President of King Mongkut's University of Technology Thonburi, *Dr. Suvit Tia*								
	Group Photo								
9:40	**Plenary Talk** - *Prof. Ibrahim Dincer*, Ontario Tech University, Canada (Grand Ballroom)								
10:20	**Plenary Talk** - *Prof. Jiří Jaromír Klemeš*, Brno University of Technology, Czech Republic (Grand Ballroom)								
11:00	Coffee Break								
11:30	**Timeslot 1 - Oral presentation : Parallel Session**								
	Session	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Room	Ballroom A	Ballroom B	Ballroom C	Jasmine	Lotus	Orchid	Yangtze	Amazon
	Track	A	H	A	B	C	D	E	F
13:00	Buffet Lunch								
14:10	**Timeslot 2 - Oral presentation : Parallel Session**								**Poster**
	Session	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**P-1**
	Room	Ballroom A	Ballroom B	Ballroom C	Jasmine	Lotus	Orchid	Yangtze	Amazon	Pre-Function
	Track	A	E	UNEP-1	B	C	D	B	F	---
15:40	Coffee Break									
16:00	**Timeslot 3 - Oral presentation : Parallel Session**									**Poster**
	Session	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**P-2**
	Room	Ballroom A	Ballroom B	Ballroom C	Jasmine	Lotus	Orchid	Yangtze	Amazon	Pre-Function
	Track	A	B	UNEP-1	E	F	D	E	H	---
17:30	**Panel Discussion Session / Committee Meeting** (only for those invited)									
19.00	Close									

Time	Friday, 13/December/2019								
8:00	**Registration** (near entrance of Ballroom A)								
8:45	**Timeslot 4 - Oral presentation : Parallel Session**								
	Session	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**56**
	Room	Ballroom A	Ballroom B	Ballroom C	Jasmine	Lotus	Orchid	Yangtze	Amazon	Ganges
	Track	A	C	UNEP-2	B	F	D	E	G	D
10:15	Coffee Break								
10:50	**Timeslot 5 - Oral presentation : Parallel Session**								
	Session	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**57**
	Room	Ballroom A	Ballroom B	Ballroom C	Jasmine	Lotus	Orchid	Yangtze	Amazon	Ganges
	Track	A	F	UNEP-2	B	C	D	E	G	B
12:20	Buffet Lunch								
13:30	**Timeslot 6 - Oral presentation : Parallel Session**								
	Session	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**58**
	Room	Ballroom A	Ballroom B	Ballroom C	Jasmine	Lotus	Orchid	Yangtze	Amazon	Ganges
	Track	A	A	UNEP-3	B	C	G	A	I	J
15:00	Coffee Break								
15:30	**Timeslot 7 - Oral presentation : Parallel Session**								
	Session	**49**	**50**	**51**	**52**	**53**	**54**	**55**	
	Room	Ballroom A	Ballroom B	Ballroom C	Jasmine	Lotus	Orchid	Yangtze	
	Track	A	A	UNEP-3	E	C	A	C	
17:00	Close								
17:30	**Awards Announcement & Closing Ceremony** (Grand Ballroom)								
	- Best Paper & Poster Award Announcement - Report/Summary of Conference - Closing remarks by the President of King Mongkut's University of Technology Thonburi, *Dr. Suvit Tia*								
18:00	**Registration for Banquet** (near entrance of Grand Ballroom) (Full Delegates, VIPs, Guests, Award Winners & those with banquet coupon)								
18:30	**Banquet + Award Presentation + Thai Performance** (Grand Ballroom)								
22:00	Close								

Time	Saturday, 14/December/2019
8:00	**Technical Tour** – 3 options (those NOT joining the technical tour are free to depart) ** Consult registration desk to sign up for tour during registration*
16:00	Close

TRACK	TRACK NAME
A	Renewable Energy & Energy Storage
B	Bioenergy & Biofuels
C	Sustainability, Environment, Climate Change & Mitigation Technology
D	Green Material, Design, Products & Manufacturing Processes
E	Fuel Cell & Other Energy Conversion Technologies
F	Energy Efficiency & Green Building
G	Energy Management & Environmental Policy
H	Hydrogen Energy
I	Special Session 2: Degradation Prediction and Recycling of Renewable Energy and Energy Storage Systems: Scenarios of 2020-2030
J	Special Session 1: Computational Intelligence Techniques for Energy-Efficient Manufacturing Systems
UNEP-1	Life Cycle Costing and Life Cycle Assessment for Sustainable Public Procurement and Circular Economy
UNEP-2	Roles of Digital Technology for Circular Economy
UNEP-3	Combating Plastics Pollution and Marine Litter through Sustainable Public Procurement and Circular Economy

Oral Presentations

12/December/2019 (Thursday)

Session : 1
Track A : Renewable Energy & Energy Storage
Session Chairs : Assoc. Prof. Tan Yong Chai ; Assoc. Prof. Thitima Jintanawan
Time : 11:30 – 13:00
Venue : BALLROOM A

Starting Time	ID	Title of Presentation
11:30	87	**Effects of Aquifer on Heat Exchange Process in Geothermal Appliacations** Zhendi Ma, Guosheng Jia, Qiongxiang Kong, Zhenhua Xia, Xiangzhao Meng, Liwen Jin
11:43	218	**Identification of Cumulative Damage at the Blade Root of AB92 Blade Using Palmgren-Miner's Rule** Gerardo Augusto, Alvin Culaba, Wei-Hsin Chen
11:56	356	**Performance of the Prototype Shaftless Small Scale Horizontal Wind Turbine for Electricity Generating from Industrial Exhaust Air System** Wachira Puttichaem
12:09	387	**All-Solid-State Asymmetric Supercapacitor Based on MnO2/RVC and Activated Carbon** Man Chen, Hsun-Yi
12:22	406	**Sustainable Steady Solar Power (S3P): Innovative Concentrated Solar Energy Storage with MgO and Hydrogen Based Systems** Muhammad Burhan, Qian Chen, Muhammad Wakil Shahzad, Doskhan Ybyraiymkul, Kim Choon Ng
12:35	433	**Influence of Operational and Economic Factors on the Optimal Design of an Electric Vehicle Battery Cooling System** Julius Ezra Gundran, Alvin Culaba, Aristotle Ubando
12:48	452	**Optimum Planning of a Renewable Energy Based Hybrid Mini-Grid System for Embracing the Sustainability Benefits in Southern Myanmar** Aung Ze Ya

Session : 2
Track H : Hydrogen Energy
Session Chairs : Prof. Al Rey Villagracia ; Dr. Steven Lim
Time : 11:30 – 13:00
Venue : BALLROOM B

Starting Time	ID	Title of Presentation
11:30		**Keynote Talk: Advanced Hydrogen Production Technologies for Green Energy Development** Prof. Wei-Hsin Chen
11:56	**64**	**Integration of Semi-Batch Cultivation and Extraction for Maximal Lipid Production in Chlamydomonas Sp. Tai-03** Pau Loke Show
12:09	**118**	**Observation of H2 Gas Replacement in a Pipeline Using Ultrasonic** Takuya Kido
12:22	**157**	**High-Purity Hydrogen Production by Gasification of Pig Hair Biowastes over NiO/Al2O3 Catalyst for a PEM Fuel Cell Application** Sikhumbuzo Kunene, Kuen-Song Lin
12:35	**317**	**Assessment of Carbon Footprint Attributed to Hydrogen Power Generation** Yuki Kudoh, Akito Ozawa, Naomi Kitagawa
12:48	**105**	**Effect of In-Situ CO2 Sorption on Methane Reforming by Ni/Al2O3/CaO Composite Catalyst for Hydrogen Production** Chien-Hung Chen, Ching-Tsung Yu, Wen-Hui Chen, Huan-Ting Kuo

Session : 3
Track A : Renewable Energy & Energy Storage
Session Chairs : Dr. Supachita Krerkkaiwan ; Prof. Zhi-Wen Zhu
Time : 11:30 – 13:00
Venue : BALLROOM C

Starting Time	ID	Title of Presentation
11:30	62	**Self-Made Electromagnetic Vibration Energy Harvester of Different Stroke Length and Number of Coil Turns** Lee Kee Quen, Hooi Siang Kang, Wah Yen Tey, Kiat Moon Lee, Shahrul Azhar Jamsari, Lit Ken Tan
11:43	283	**A Review on Preparation of Nanocellulose for New Green Working Fluid in Heat Transfer Applications** Muhammad Arif Harun
11:56	298	**Effects of Aquifers on Soil Temperature Distribution around Deep Buried Heat Exchanger** Yuping Zhang, Guosheng Jia, Zhendi Ma, Zhenhua Xia, Min Zhao, Liwen Jin
12:09	354	**Experimental Investigation of the Performance of Thermal Energy Storage (TES) with Embedded Phase Change Materials (PCM) as Wall Insulator** Hooi Kee Lee, Jundika Candra Kurnia , Luthfi Ady Farizan Haryoko, Byan Wahyu Riyandwita, Agus Sasmito
12:22	419	**Experimental Study and Performance Evaluation of PV/T's with Novel Absorber Design** Dudul Das, Pankaj Kalita, Akash Dilip Kamble
12:35	465	**Network Reconfiguration and Optimal Allocation of Distributed Generations for Mayangone Distribution System** Ohn Zin Lin, Khine Khine Mon, Tin Tin Htay
12:48	534	**Thermal Performance and Economic Evaluation of Heat Pump Systems with Different Heat Source in Net-Zero Energy House** Hee Won Lim, Beob Jeon Kim, Byung Chil Oh, U-Cheul Shin

Session : 4
Track B : Bioenergy & Biofuels
Session Chairs : Prof. Ling Tau Chuan ; Prof. Khairil
Time : 11:30 – 13:00
Venue : Jasmine

Starting Time	ID	Title of Presentation
11:30	32	**Effects of Substrate Concentration on Biohythane Production via Single-Stage Anaerobic Fermentation in a Two-Compartment Bioreactor** Tan-Phat Vo, Chiu-Yue Lin, Chyi-How Lay
11:43	56	**Physical and Mechanical Properties of Pellets Produced from Upstream Torrefaction/Densification of Woody and Non Woody Biomass** Patrick Rousset, Promporn Keeratiisariyakul, Adisak Pattiya
11:56	103	**Microwave-Assisted Pyrolysis of Magnesium Macrocyclic Compound from Pachira Aquatic Leaves as Electrocatalyst for Oxygen Reduction Reaction in Alkaline Environment** Chen-Hao Wang
12:09	201	**Kinetic Modelling of Bioethanol Production from Microalgae Chlorella Sorokiniana via Simultaneous Saccharification and Fermentation** Nonito John Tatel, Cynthia Madrazo
12:22	254	**Anaerobic Digestion of Synthetic Wastewater (Acetate) in UASB Reactor: Modelling of Microbial Capacity and Stability** Archw Promraksa, Chairat Siripatana, Laddawan Noynoo, Nirattisai Rakmak
12:35	258	**Application of Volumetric Dispersion Approach in Modeling of UASB Reactors: The Role of In-Granules Diffusion, Reactions and External dispersion** Laddawan Noynoo, Archw Promraksa, Nirattisai Rakmak, Sunwanee Jijai, Chairat Siripatana
12:48	281	**Delignification of Oil Palm Empty Fruit Bunch (OPEFB) via Ultrasound-Assisted Deep Eutectic Solvent Pretreatment** Joo Ding Quek, Kiat Moon Lee, Steven Lim, Wah Yen Tey, Hooi Siang Kang, Lee Kee Quen

Session : 5
Track C : Sustainability, Environment, Climate Change & Mitigation Technology
Session Chairs : Dr. Sum Jing Yao ; Assoc. Prof. Dr. Amnat Chidthaisong
Time : 11:30 – 13:00
Venue : LOTUS

Starting Time	ID	Title of Presentation
11:30	**99**	**Degradation of Spent Radioactive Ion Exchange Resins and Its Mechanisms by Fenton Process** Wen-Dong Feng, Yun-Hai Wang, Qing-Yun Chen
11:43	**111**	**Comparative Study of Nitrogen Oxides Removal by Electrolyzed Seawater and UV/Electrolyzed Seawater** Shaolong Yang, Jinxin An, Xianbo Xiang, Zhitao Han, Xinxiang Pan
11:56	**186**	**A Systemic Approach to Integrated Sustainable Solid Waste Management through Community Engagement: A Case Study of Tan Deaw Sub-District, Saraburi province** Pornpod Sridan, Pichaya Surapolchai
12:09	**262**	**Study the Effects of Different Media Derived from Palm Shell for Marine Shrimp Discharge Filtration** Nattakarn Kruatong
12:22	**405**	**Adsorption of Lead from Aqueous Solution Using Lansium Domesticum Peel: Characterization, Kinetics, and Isotherm Study** Manny Anthony Taguba, Allan Alzona, Khrizelle Angelique Sablan, Alexa Ray Fernando
12:35	**434**	**Synthesis of Hew Tiles Using Recycled High-Density Polyethylene (rHDPE) Plastics, Chicken Eggshells and Water Hyacinth (Eichhornia Crassipes) Fibers** Allan Alzona, Manny Anthony Taguba, Franz Santos
12:48	**475**	**Synthesis of Ag-RGO Nanocomposite Using Green Method and Its Application as an Efficient Naproxen Adsorbent** Somen Mondal, Subrata Kumar Majumder

Session : 6
Track D : Green Material, Design, Products & Manufacturing Processes
Session Chairs : Dr. Ng Tan Ching ; Assoc. Prof. Mohd Azmuddin Abdullah
Time : 11:30 – 13:00
Venue : ORCHID

Starting Time	ID	Title of Presentation
11:30	106	**Treatment of Laundry Wastewater Using Chemically Treated Sugarcane Bagasse** Ayu Haslija Abu Bakar
11:43	123	**Engineering Properties of Ancient Masonry Materials in Thailand and Substitution Materials for Historical Structures Preservation** Peerasit Mahasuwanchai, Natthanan Wonganan, Chainarong Athisakul, Weerachart Tangchirapat, Raktipong Sahamitmongkol, Sutat Leelataviwat
11:56	192	**Characterization of Thermal Distribution in 50-Liter Biochar Kiln at Different Heating Times** Tipapon Khamdaeng, Mewadee Srisophon, Numpon Panyoyai, Thanasit Wongsiriamnuay
12:09	222	**Properties Investigation of Deep Eutectic Solvent-Extracted Lignin for Potential Aromatic Bio-Products Conversion** Yee Tong Tan, Adeline Seak May Chua, Gek Cheng Ngoh
12:22	374	**Modified Sugarcane Bagasse as Effective Biosorbent for Copper Ions Removal** Ying Tao Chung
12:35	586	**Influence of Sintering Profile on The Mechanical Properties and Low Temperature Degradation Behaviour of Manganese Oxide Doped 3Y-TZP** Ting Chen Hunt
12:48	61	**Solvent and Non-Solvent Selection for the Chemical Recycling of Waste Polyethylene (PE) and Polypropylene (PP) Metallized Film Packaging Materials** Regino Jr. Gorre, Terence Tumolva

Session : 7
Track E : Fuel Cell & Other Energy Conversion Technologies
Session Chairs : Prof. Shih-Hao Huang ; Dr. Yifei Wang
Time : 11:30 – 13:00
Venue : YANGTZE

Starting Time	ID	Title of Presentation
11:30	84	**Thermodynamic Analysis of a Novel Ejector Enhanced Vapour Compression Cycle (EVCC)** Fahid Riaz, Poh Seng Lee, Muhammad Farooq, Siaw Kiang Chou
11:43	117	**Numerical Investigation into Hydrogen Supply to PEM Fuel Cell System with Passive Venturi Ejector** Jenn-Kun Kuo
11:56	191	**Thermal Effects in H2O and CO2 Assisted Direct Carbon Solid Oxide Fuel Cells** Qijiao He, Meng Ni
12:09	342	**Catalytic Activity of Pt/Graphene Prepared by Strong Electrostatic Adsorption Technique for PEM Fuel Cells** Sukanya Pothaya, Konlayutt Punyawudho
12:22	365	**Study the Low Power Plasma Spray of the La1-XSrXMnO3 Cathode Film for SOFC Using Solution Precursors** Chih-Hao Lee, Bing-Syun Yeh, Tsuen-Nong Yang, Chang-Sing Hwang
12:35	471	**Design and Fabrication of a Bipolar Plate Using Graphite Reinforced Composite Laminate for Proton Exchange Membrane Fuel Cells** Chuang-Wei Ciou, Min-Yuan Shen, Yean-Der Kuan

Session : 8
Track F : Energy Efficiency & Green Building
Time : 11:30 – 13:00
Session Chairs : Dr. Kapil Pareek ; Prof. Yu-Lieh Wu
Venue : AMAZON

Starting Time	ID	Title of Presentation
11:30	16	**The Potential of Integrating Blockchain Technology into Smart Sustainable City Development** Phui Fung Wong, Fah Choy Chia, Mee San Kiu, Eric C.W. Lou
11:43	100	**The Performance of Thermoelectric Exhaust Heat Recovery System Considering Different Heat Source's Fin Arrangements** Sarwo Sofyan, Jalaluddin Yunus, Khairil, Samsul Bahri, Muhajir
11:56	136	**Adaptive DC-link Voltage Control of LLC Resonant Converter** Hung-Yu Pai, Yi-Feng Luo, Li-Chung Shih, Kun-Che Ho, Zong-Zhen Yang, Yi-Hua Liu
12:09	381	**Law and Mechanism for Different Colors of Coating on Building Skin Influencing Energy Consumption of Air Conditioning in Malls** Siru Qian, Enshen Long, Shurui Guo, Yin Zhang, Yan Zhao
12:22	540	**Energy-Efficient Improvement for the Contamination Control Strategy in an Operating Room** Fu-Jen Wang, Riza Siti Azizah, Kusnandar Kusnandar, Dibakar Rakshit, Majeed Olaide Oladokun
12:35	553	**Application of Solar Tube Integrating with Roof for Energy Consumption Reduction in Building** Jiraphorn Mahawan, Atthakorn Thongtha, Kriangsak Prompak, Sant Chansomsak
12:48	520	**Optimizing the Plastic Pyrolysis Process Using Model-Predictive Control: Modeling, Simulation, and Initial Study** Mikale Rizton Ablidas, Armil Monsura, Mariz Arroyo, Rose Marl Cheong, David Joshua Dalisay, Darryl Ofamen, John Ian Santos, Arnold Dwi Hutauruk, Joseph Retumban, Efren Victor Jr. Tolentino

Session : 9
Track A : Renewable Energy & Energy Storage
Session Chairs : Prof. Jin Liwen ; Prof. San-Yuan Chen
Time : 14:10 – 15:40
Venue : BALLROOM A

Starting Time	ID	Title of Presentation
14:10	264	**Parameters Estimation of Hydraulic Power Take-Off System for Wave Energy Conversion System Using Genetic Algorithm** Mohd Afifi Jusoh, Mohd Zamri Ibrahim, Muhammad Zalani Daud , Zulkifli Mohd Yusop, Aliashim Albani, Siti Juwairiyah Abdul Rahman, Safina Mohad
14:23	176	**Hybrid of Photovoltaic and Diesel Power Plant in Celagen Island** Wahri Sunanda, Rika Gusa
14:36	233	**The Effect of Pretreatment Methods for Improved Biogas Production from Oil-Palm Empty Fruit Bunches (EFB): Experimental and Modeling** Pornwimon Wadchasit, Kamchai Nuithitikul, Chairat Siripattana
14:49	272	**A Novel Variable Step MPPT Technique with Adaptive Scaling Factor** Song-Pei Ye, Man-Zai Chuang, Zong-Zhen Yang, Shun-Chung Wang, Yi-Hua Liu
15:02	203	**The Impact of El Niño-Southern Oscillation to the Wind and Solar Energy in Malaysia** Aliashim Albani, Mohd Zamri Ibrahim, Syazwani Ghani, Zulkifli Mat Rofi, Nurul Nisa Abdul Ghani Ganesan
15:15	376	**Optimal Integration of Solar Photovoltaic Distributed Generation for Green and Smart Energy System Considering Reliability Index, Voltage Stability Index and Loss Configuration** Ohn Zin Lin, Moe Khin, Khine Khine Mon
15:28	466	**Optimal Reactive Power Dispatch Using Particle Swarm Optimization Algorithm for Yangon Distribution Network** Ohn Zin Lin, Tin Tin Htay, Khine Khine Mon

Session : 10
Track E : Fuel Cell & Other Energy Conversion Technologies
Session Chairs : Dr. Yeo Wei Hong ; Dr. Thusitha Sugathapala
Time : 14:10 – 15:40
Venue : BALLROOM B

Starting Time	ID	Title of Presentation
14:10		**Keynote Talk: Solid Oxide Fuel Cells (SOFCs) for Sustainable Energy Conversion** Prof. Meng Ni
14:36	**28**	**Numerical Simulation of Sorption Enhanced Ethanol Steam Reforming in a Fixed-Bed Reactor** Chih-Chia Yang, Wen-Jenn Sheu, Ching-Tsung Yu, Yen-Cho Chen
14:49	**165**	**Formability and Performance Testing of Stainless Steel Bipolar Plate for Air-breathing PEMFC** Chun-Min Wang, Nai-Hsien Wu, Yang-En Cho, Kuan-Jen Huang, Chen-Yu Chen, Wei-Hsiang Lai
15:02	**221**	**Mechanics of Fuel Cell Gas-Diffusion Media** Poornesh Koorata
15:15	**294**	**Detection and Diagnosis of Oscillations in SOFC Power System** Xiaobo Zhong, Xiaolong Wu, Yuanwu Xu, Yanlin Liu, Xiaowei Fu, Jianhua Jiang, Xi Li
15:28	**622**	**Studies on the Air-Breathing Fuel Cell Control System Optimization** Kuan-Jen Huang, Guan-Yu Chen, Chen-Yu Chen, Nai-Hsien Wu, Jia-Xuan Zhang, Yang-En Cho, Chun-Min Wang, Cheng-Chung Chen, Wei-Hsiang Lai

Session : 11 (UNEP Session I)
Life Cycle Costing and Life Cycle Assessment for Sustainable Public Procurement and Circular Economy
Time : 14:10 – 15:40
Session Chairs : Prof. Dr. Shabbir H. Gheewala
Venue : BALLROOM C

Starting Time	Title of Presentation
14:10	**Welcoming Remarks** Dr. Isabelle Louis, Deputy Regional Director and Deputy Regional Representative for Asia and the Pacific, United Nations Environment Programme (UNEP)
	Opening Remarks Her Excellency Satu Suikkari-Kleven, Ambassador of Finland to Thailand (TBC)
	Keynote Speech / Presentation on SPP and Circular Economy ISA-MARIA BERGMAN, Johtaja | Director Kiertotalous, Kestävät Hankinnat | Circular Economy and Sustainable Procurement Finland
	Presentation on UNEP-KMUTT joint paper on *―Life Cycle Costing And Life Cycle Assessment For Sustainable Public Procurement And Circular Economy‖*

Session : 12
Track B : Bioenergy & Biofuels
Session Chairs : Assoc. Prof. Ohn Zin Lin ; Dr. Swee Pin Yeap
Time : 14:10 – 15:40
Venue : JASMINE

Starting Time	ID	Title of Presentation
14:10	**52**	**Optimization and Kinetics of SnCl2-HCl Catalyzed Hydrothermal Conversion of Microcrystalline Cellulose to Levulinic Acid** Dexby de Guzman, Rizalinda De Leon
14:23	**74**	**The Effect of Gasoline-Waste Plastics Oil Blends on SI Engine Performance at High-Speed Rotation** Khairil
14:36	**75**	**B12/CNT Anodic Nano Catalysts Applied on Polishing the Performance of Microbial Fuel Cells** Lin Yu-An, Chin-Tsan Wang
14:49	**129**	**Three Solid Stages Anaerobic Digestion (TSS-AD) under Ambient Temperature for Enhanced Biogas Production from Cow Manure** Burachat Sripitak
15:02	**135**	**Pyrolysis Kinetics of Cellulose, Xylan, and Lignin by Using Independent Parallel Reaction Model and Analyzed with Evolutionary Computation** Chun Fong Eng, Wei-Hsin Chen, Yu-Ying Lin
15:15	**349**	**Enhanced Methane Yield of Pig Slurry using Solid-Liquid Separation Strategy** Thamonwan Woraruthai, Thipwan Jiemanukunkij, Pimchai Chaiyen, Thanyaporn Wongnate

Session : 13
Track C : Sustainability, Environment, Climate Change & Mitigation Technology
Session Chairs : Dr. Shaolong Yang ; Assoc. Prof. Dr. Amnat Chidthaisong
Time : 14:10 – 15:40
Venue : LOTUS

Starting Time	ID	Title of Presentation
14:10	**223**	**Fuel Oils Recovery from Waste Tire Rubber Chips Liquefaction and Utilization for Absorptive Recycling of Spilled Oils** Fikile Mavuso, Kuen-Song Lin
14:23	**380**	**Iron Oxide Decorated Graphene Oxide Embedded Polysulfone Mixed-Matrix Membrane (FeSO4GO-PSf MMM): Comparison of Different Types MMM on Antifouling and Performance** Pui Vun Chai
14:36	**429**	**Adsorption of Copper in Wastewater Using Bamboo-Based Activated Carbon** Franz Santos, Manny Anthony Taguba, Allan Alzona
14:49	**477**	**Effect of Biochar and Its Combined Application on Nitrogen Leaching, Greenhouse Gas (GHG) Emissions, and Grain Yield under Alternate Wetting and Drying (AWD) System** Visal Vat
15:02	**554**	**Electronic Waste Based Oxygen Carriers for Direct Coal Fueled Chemical Looping Combustion Technology** Barnali Bhui
15:15	**485**	**Crucial Factors in Shaping Strategies for Thai Energy Business in the Dynamic Era** Nitida Nakapreecha, Jakapong Pongthanaisawan, Weerin Wangjiraniran
15:28	**493**	**Development of Antifouling Poly(Vinylidene Fluoride) (PVDF) Ultrafiltration (UF) Membrane with the Addition of Polyethylene Glycol (PEG) as Additive** Jing Yao Sum

Session : 14
Track D : Green Material, Design, Products & Manufacturing Processes
Session Chairs : Dr. Ting Chen Hunt ; Dr. Ying Tao Chung
Time : 14:10 – 15:40
Venue : ORCHID

Starting Time	ID	Title of Presentation
14:10	**14**	**Laboratory Investigation on Warm Mix Asphalt Incorporating Organo-Silane Additive** Seyed Reza Omranian, Meor Othman Hamzah, Sai Mounik Gunti, Prathap Reddy Kunduru, Yash Maniskumar Kapadia, Sek Yee Teh
14:23	**80**	**Influence of In-House Produced Biochar on Geotechnical Properties of Expansive Clay** Ankit Garg, Guoxiong Mei, He Huang
14:36	**337**	**Mango Drying Process for Healthy Products without Chemical Pre-Treatment** Wanchalee Pengpongsa, Adisak Nathakaranakule
14:49	**362**	**Integrated Algal Biorefinery and Palm Oil Milling for Bioenergy, Biomaterials and Biopharmaceuticals** Mohd Abdullah, Hanaa Ali Hussein
15:02	**519**	**The Potential of Tropical Fruit Peels as Ion Exchangers for Water Hardness Removal** Choon Yoong Cheok
15:15	**604**	**Preparation of SiO2@Ti Doped SNCDs Hybrid Material as an Ideal Photocatalyst for the Degradation of Methylene Blue** Jongsung Kim, Yeji Kim
15:28	**124**	**Synthesis and Characterization of rGO/Fe3O4 Nanocomposite for Electrocatalytic Reduction of Oxygen** Farhanini Yusoff

Session : 15
Track B : Bioenergy & Biofuels
Session Chairs : Assoc. Prof. Dr. Chyi-How Lay ; Dr. Lee Kiat Moon
Time : 14:10 – 15:40
Venue : YANGTZE

Starting Time	ID	Title of Presentation
14:10	**22**	**Torrefaction of Biomass Impregnated with Potassium Carbonate (K2CO3) in a Fixed-Bed Glass Tube Reactor** Gabriel Garcia, Wei-Hsin Chen, Yi-kai Chih, Mark Daniel De Luna
14:23	**267**	**Briquette Production from Rice Husk by Using Screw Compaction** Thanasit Wongsiriamnuay, Narongrit Saneewongnaayuttaya, Numpon Panyoyai, Tipapon Khamdaeng
14:36	**302**	**Circular Bioeconomy with Recovery of Bio-Products and Biofuel from Microalgae-Based Wastewater Treatment** Revathy Sankaran, Tau Chuan Ling
14;49	**303**	**The Investigations of Ignition Quality for Renewable Jet Fuels Produced through Different Processes** Yao Jia-En, Wei-Cheng Wang
15:02	**422**	**Performance of Two-Stage Anaerobic Process in Co-Digestion of Fresh Leachate and Cassava Pulp with Digestate Recycle** Rutrawee Sangcharoen
15:15	**438**	**Factors Affecting the Quality of Fuel Pellets Produced from Waste Biomass** Priyabrata Pradhan, Amit Arora, Sanjay Mahajani

Session : 16
Track F : Energy Efficiency & Green Building
Session Chairs : Dr. Wong Phui Fung ; Prof. Yu-Lieh Wu
Time : 14:10 – 15:40
Venue : AMAZON

Starting Time	ID	Title of Presentation
14;10	**17**	**Experimental Study on Transport Properties of Membranes for the Planar Dehumidifier** Chun-Han Li, Chih-Chang Chang, Wen-Ken Li, Wei-Mon Yan
14:23	**90**	**Numerical Simulation Of Thermal Stratification and Air Quality in an Underfloor Air Distribution System (UFAD)** Neil Stephen Lopez Selena Kay Galeos, Brian Raphael Calderon David Roy Dominguez, Bryan Joseph Uy, Rupesh Iyengar
14:36	**372**	**Vision-Based Equipment Load Detection Using Deep Learning for Efficient Building Energy Management** Shuangyu Wei, Paige Wenbin Tien, John Calautit, Yupeng Wu, Rabah Boukhanouf
14:49	**393**	**Urban Road and Pavement Solar Collector (U-RPSC) System for Heat Island Mitigation: Assessing the Beneficial Impact on Outdoor Temperature and Building Energy Loads** Siti Diana Nabilah Nasir, Becky Vital, Conrad Allan Jay Pantua, Bochao Zhou, John Calautit, Yupeng Wu
15:02	**535**	**Energy Consumption Analysis for Coupling Air Conditioners and Cold Storage Equipments in a Convenience Store** Fu-Jen Wang, Kusnandar Kusnandar, Chang-Yu Liou
15:15	**563**	**Energy Performance and Thermal Comfort Evaluation of an Air Conditioning System Assisted by a Ceiling Fan in the Office Area** Linglan Chang Chang, Fu-Jen Wang, Kusnandar Kusnandar, Bowo Yuli Prasetyo Prasetyo, Manyi Lin
15:28	**594**	**Effect of Biomass Ratio on Co-firing of Biomass with coal on Pozzolanic Properties** Darin Taweetamnusin

Session : 17
Track A : Renewable Energy & Energy Storage
Session Chairs : Prof. Dr. Aung Ze Ya; Dr. Poon Hiew Mun
Time : 16:00 – 17:30
Venue : BALLROOM A

Starting Time	ID	Title of Presentation
16:00	**63**	**Dynamic Behaviours of Damaged Stability for Floating Energy Storage Unit after Accidental Collision** Hooi Siang Kang, Choo Hau Wei, Lee Kee Quen, Wah Yen Tey, Kiat Moon Lee Yu Jie Liu, Chong Wen Tong
16:13	**91**	**Experimental Validation and Improvement of Actuator Line Model in the Large-Eddy Simulation of Wind-Turbine Wakes** Zhiteng Gao, Tongguang Wang
16:26	**161**	**On Stability of Time Marching in Numerical Solutions of Rayleigh-Plesset Equation for Ultrasonic Cavitation** Wah Yen Tey, Habib Alehossein, Zonyi Qin, Kiat Moon Lee, Hooi Siang Kang, Lee Kee Quen
16:39	**270**	**Hydrodynamic Sloshing of Microalgae in Membrane Type Photobioreactor** Wei Han Khor, Hooi Siang Kang, Lee Kee Quen, Xiaoxia Jiang, Cheng Yee Ng, Lit Ken Tan, Collin Howe-Hing Tang
16:52	**325**	**Anodized Stainless Mesh for Flexible Battery Anodes** Kaname Iwai, Kosuke Kawakami, Dang Nguyen, Kozo Taguchi
17:05	**336**	**Numerical Investigation of Heat Storage on a Chemical Heat Storage System for Saving Exhaust Gas Energy in Internal Combustion Engines** Luong Cao
17:18	**389**	**Stochastic Dynamical Response of PZT/Polymer Composites Self-Excitation Nano Energy Transducer** Zhiwen Zhu

Session : 18
Track B : Bioenergy & Biofuels
Session Chairs : Prof. Chen-Hao Wang ; Dr. Sharmeela Matali
Time : 16:00 – 17:30
Venue : BALLROOM B

Starting Time	ID	Title of Presentation
16:00		**Keynote Talk: Microalgae-Based Biorefinery and Circular Economy – A Green Technology** Prof. Jo-Shu Chang
16:26	**265**	**Effect of Process Condition on Biochar Properties from Agricultural Residue** Thanasit Wongsiriamnuay, Waranya Somparn, Numpon Panyoyai, Tipapon Khamdaeng, Nakorn Tippayawong, Samerkhwan Tantikun
16:39	**430**	**Comparison of Mesophilic and Thermophilic Anaerobic Co-Digestion of Fresh Leachate and Cassava Pulp** Pornpan Panichnumsin
16:52	**502**	**NOx Simulation on CFD modelling of Grate Combustion with a Steady-State Discrete Particle Model (DPM) Approach** Surapoom Somwangthanaroj, Suneerat Fukuda
17:05	**518**	**An Energy Analysis of the Production of Torrefied Microalgal Biomass** Diana Rose Rivera
17:18	**444**	**Developing an Artificial Neural Network Model for Predicting the Growth of Chlorella Sorokiniana in a Photobioreactor** Jeremy Magdaong, Alvinf Culaba , Aristotle Ubando, Jo-Shu Chang, Wei-Hsin Chen

Session : 19 (UNEP Session 1 - continued)
Life Cycle Costing and Life Cycle Assessment for Sustainable Public Procurement and Circular Economy
Session Chairs : Prof. Dr. Shabbir H. Gheewala
Time : 16:00 – 17:30
Venue : BALLROOM C

Starting Time	Title of Presentation
16:00	**Presentations (2 to 3) by experts on LCC and LCA**
	Panel Discussions and open floor around following focus: • Science-policy-business interface for LCC and LCA for SPP and CE • Ways and means to engage different stakeholders for furthering of science, policy, and businesses for CE
	Closing with recommendations from the discussions – Follow up actions and suggestions for capacity building in Asia and the Pacific on sustainable public procurement and circular economy based on life cycle approach and life cycle costing.

Session : 20
Track E : Fuel Cell & Other Energy Conversion Technologies
Session Chairs : Assoc. Prof. Dr. Prasenjit Mondal ; Dr. Li Sze Lai
Time : 16:00 – 17:30
Venue : JASMINE

Starting Time	ID	Title of Presentation
16:00	**26**	**Simultaneous Removal of Organic Load and Hydrogen Gas Production from Paper-Pulp Industry Wastewater by Electrodeposited Cathodes in MEC** Amit Chaurasia
16:13	**72**	**Development of a Self-Powered Biosensor for Real-Time Fish Stress Visualization Using Machine Vision** Shih-Hao Huang
16:26	**178**	**Performance Comparison of Photosynthetically Aerated Microbial Fuel Cell and Mechanically Aerated Microbial Fuel Cell** Chamath Dasun Yahampath Arachchige Don, Sandhya Babel
16:39	**181**	**Miniaturized Metal-Air Batteries for Powering the Next-Generation Lateral Flow Test Assays** Yifei Wang,Wending Pan, Holly Kwok, Xiaolong Zhao, Yingguang Zhang, Dennis Leung
16:52	**280**	**Enhanced Oil Recovery: Potential for Oil Production Development In Fang Oilfield, Thailand** Kreangkrai Maneeintr, Jirawat Chewaroungroaj, Thitisak Boonpramote
17:05	**543**	**Performance Investigation on a Compact Unit of Stirling Engine with a Wood Pellet Burner and Gasification System** Sutapat Kwankaomeng, Panya Kansuwan, Sommas Kaewluan, Banterng Silpsakoolsook

Session : 21
Track F : Energy Efficiency & Green Building
Session Chairs : Prof. Wei-Mon Yan ; Dr. Siripha Junlakarn
Time : 16:00 – 17:30
Venue : LOTUS

Starting Time	ID	Title of Presentation
16:00	**211**	**Performance Evaluation of an Evaporative Cooling System with Hollow Fiber-Based Heat Exchanger** Xin Cui, Weichao Yan, Xiaohu Yang, Liwen Jin, Xiangzhao Meng
16:13	**529**	**Application of 3D Printed Structured Materials as the Sound Absorption Panels** Yeong Jin King, Keng Kai Teo
16:26	**537**	**Solar Decathlon Europe 2019: The Resilient Nest as a Solar Powered and Energy Efficiency Rooftop House for Urban Density** Kasan Chanto, Peerasit Mahasuwanchai, Warawit Eakintumas, Choophong Lairat, Nutkitti Thavornsettawat, Kittipat Tanthanawiwat, Kunnapat Wongthavornman, Tawich Pulngern, Wilaiwan Viputhanupong, Waraluk Pansuwan
16:39	**541**	**Recycled Autoclaved Aerated Concrete (AAC) Waste Powder for Low Cost Building Constructions Material: A Review** Rafiza Rahman, Ahmad Fazlizan
16:52	**572**	**An Innovative Indirect Evaporative Colling Technology to Improve Energy Efficiency of Air Conditioning** Kim Choon Ng, Muhammad Burhan, Muhammad Wakil Shahzad, Qian Chen, Doskhan Ybyraiymkul
17:05	**85**	**Experimental Investigations of Tip Leakage Flows in a Turbine Cascade** Hongwei Ma, Yangtao Tian
17:18	**107**	**Evaluation of Physical and Mechanical Properties of Mortar with HDPE Waste Recycled Plastic** Chuthamat Laksanakit, Nuntachai Chusilp

Session : 22
Track D : Green Material, Design, Products & Manufacturing Processes
Session Chairs : Prof. Raymond Joseph Meimban; Dr. Cheok Choon Yoong
Time : 16:00 – 17:30
Venue : ORCHID

Starting Time	ID	Title of Presentation
16:00	94	**Process Optimization for Improvement of the Crystallinity Index of Algal Nanocellulose by Taguchi Methodology** Ria Majumdar
16:13	104	**Design of Structure of Hierarchically Porous Carbon Monoliths with Magnetic Properties for High Efficiency in Adsorption of Lead (II) Ions** Parichart Onsri, Laemthong Chuenchom, Decha Dechtrirat
16:26	284	**Development of Highly Dispersed Supported Palladium Catalyst for Butane Dehydrogenation by Modified Electroless Deposition** Rishabh Saxena, Shiva Shukla, Anand Vibhore, Mohd. Qureshi, Ramgopal Uppaluri, Mahuya De
16:39	346	**Product Lightweight Research in Green Design** Tianyu Zhao, Huiping Liang
16:52	371	**Preparation and Characterization of Bakelite Bonded Magnet NdFeB Used for Electric Generator** Muljadi Muljadi, Ramlan Ramlan
17:05	464	**Energy Sustainability and Industry 4.0** Tan Ching Ng, Morteza Ghobakhloo
17:18	609	**CFD Simulation on The Effect of Pillar Shapes on Chitosan-Coated Zinc Oxide Nanoparticles Flows in Pillar-based Microfilter** Mohd Fadhil Majnis

Session : 23
Track E : Fuel Cell & Other Energy Conversion Technologies
Session Chairs : Prof. Jenn-Kun Kuo ; Prof. Mohd Zamri Ibrahim
Time : 16:00 – 17:30
Venue : YANGTZE

Starting Time	ID	Title of Presentation
16:00	**67**	**Kinetics and Performance Evaluation of Microbial Fuel Cell Supplied with Dairy Wastewater with Simultaneous Power Generation** Payel Choudhury
16:13	**134**	**Modeling and Simulation of Flow Field and Pressure Drop in Proton Exchange Membrane Fuel Cell** Zong-Lin Tsai, Wei-Hsin Chen, Tzu-Hsuan Hsu, Pei-Chi Kuo
16:26	**158**	**Evaluation of Two-Phase Crossflow in Bundle Using Thermal-Hydraulic System Codes for Realistic Safety Analysis of Heat Exchangers** Yunseok Lee, Taewan Kim
16:39	**163**	**High Performance Iron-based Oxygen Reduction Catalyst Supported on Sengon Wood-derived Reduced Graphene Oxide in Acidic Medium** Wai Yin Wong
16:52	**341**	**Effects of Carbon Supporter on Oxygen Reduction Reaction Catalytic Activity in PEM Fuel Cell of Bimetallic Pt-Ni Nanoparticles Electrocatalysts** Laksamee Payattikul, Konlayutt Punyawudho
17:05	**152**	**An SOC-Based Active Equalizer for Fast Charge Balance of Series-Connected Battery Pack** Shun-Chung Wang, Yi-Feng Luo, Yi-Hua Liu

Session : 24
Track H : Hydrogen Energy
Session Chairs : Prof. Dr. Show Pau Loke ; Dr. Wong Wai Yin
Time : 16:00 – 17:30
Venue : AMAZON

Starting Time	ID	Title of Presentation
16:00	160	**Multivariable Control Scheme for Autothermal Reforming of Diesel Fuel for Use in PEM Fuel Cell** Fawad Malik
16:13	345	**The Future Role of Hydrogen for Clean Energy Transition by 2050: a Japanese Case** Akito Ozawa, Yuki Kudoh, Shinichirou Morimoto
16:26	350	**Investigation of Effect of Refueling Parameters on Storage Capacity of Type IV Hydrogen Storage Tank** Shitanshu Sapre, Kapil Pareek
16:39	409	**First Principles Investigation on Hydrogen Adsorption on Nitrogen-doped Planar Aluminene** Gian Pedrosa, Al Rey Villagracia, Dhan Bayasen, Hui Lin Ong
16:52	410	**Hydrogen Adsorption on Calcium-Decorated Planar Aluminene Using Density Functional Theory** Dhan Bayasen, Al Rey Villagracia, Gian Pedrosa, Hui Lin Ong
17:05	439	**Density Functional Theory Investigation on H2 Adsorption on Buckled Aluminene** Al Rey Villagracia, Hui Lin Ong
17:18	396	**Nonlinear Dynamic Characteristics and Bifurcation Analysis of Ti-Zr-Ni Quasicrystal as Hydrogen Storage Material** Jia Xu

13/December/2019 (Friday)

Session : 25
Track A : Renewable Energy & Energy Storage
Session Chairs : Dr. Yossapong Laoonual ; Dr. Gerardo L. Augusto
Time : 8:45 – 10:15
Venue : BALLROOM A

Starting Time	ID	Title of Presentation
8:45	116	**Microscale Surface Structure Designing of Nanoparticle-Based Photocatalyst Films for Enhanced Functionalities and Efficient Energy Utilization** Yuki Kameya, Hiroki Yabe
8:58	127	**Seasonal Variability of Wind Energy in the Gulf of Thailand from a Reanalysis-Data Perspective** Bikash Devkota, Kasemsan Manomaiphiboon, Hoang Thi Trang, Piyatida Trinuruk
9:11	195	**Smart Solar Photovoltaic Panel Cleaning System** Nasib Khadka, Aayush Bista, Binamra Adhikari, Ashish Shrestha, Diwakar Bista
9:24	351	**Performance Analysis of Solar Tunnel Dryer with Thermal Storage and PV System for Drying Star Fruit** Rajesh Kondareddy, Prakash Nayak
9:37	415	**Employing Activated Carbon-Graphite Composite Electrode as the Negative Electrode in Soluble Lead Flow Battery** Kai Jui Pan, Hsun-Yi Chen
9:50	496	**An Outlook on Large-Scale Solar Power Production in Peninsular Malaysia for Scenario Year 2030** Kuen Hou Cheong
10:03	644	**Grid Parity Analysis of Solar Photovoltaic and Battery Stand-alone Systems in Commercial and Residential Sectors** Niel Gabriel Saplagio

Session : 26
Track C : Sustainability, Environment, Climate Change & Mitigation Technology
Session Chairs : Dr. Shinichirou Morimoto ; Dr. Woon-Chan Chong
Time : 8:45 – 10:15
Venue : BALLROOM B

Starting Time	ID	Title of Presentation
8:45		**Keynote Talk: The Development of Industrial Processes in a Context of Sustainability: Examples of Introduction of Electricity in Future Processes** Prof. Jamal Chaouki
9:11	**44**	**Performance of Graphene-Based Hydrogel in Oil Removal Using Graphene Oxide Derived from Powder and Flake Graphite** Law Yong Ng, Jia Jun Lee, Ching Yin Ng, Ebrahim Mahmoudi, Nur Hanis Hayati Hairom, Chin Boon On
9:24	**171**	**Study on the Influence of Foundation Construction of Different Offshore Wind Turbines on Suspended Load in Sea Area** Hsing-Yu Wang, Yun-Chih Chiang
9:37	**208**	**Realising the ASEAN Power Grid through Unbundling: Takeaways from the Philippine's and Singapore's Experience** Hazleen Aris, Bo Nørregaard Jørgensen
9:50	**373**	**Simulation for CO2 Capture Using Tubular Dual-Phase Membrane Module** Li Sze Lai
10:03	**510**	**Assessing the RDF Production Potential Prior Landfill Mining Using Electrical Resistivity Tomography: A Case Study in Nakhon Luang, Phra Nakhon Si Ayutthaya Open Dump Disposal Site** Bongkoch Chungam, Soydoa Vinitnantharat

Session : 27 (UNEP Special session 2)
Role of Modern Technologies in Circular Economy
Session Chairs : Dr. Lerwen Liu
Time : 8:45 – 10:15
Venue : BALLROOM C

Starting Time	Title of Presentation
8:45	**Welcoming Remarks** Dr. Isabelle Louis, Deputy Regional Director and Deputy Regional Representative for Asia and the Pacific, United Nations Environment Programme (UNEP)
	Opening Remarks Mr. Stein Hansen, Regional Director for Asia and the Pacific, United Nations Industrial Development Organization (UNIDO) – (TBC)
	Keynote Speech/Presentation on Industry 4.0 for Circular Economy Dr. Venkatachalam Anbumozhi Economic Research Institute for ASEAN and East Asia (ERIA)
	Presentation on UNEP-KMUTT joint paper on *―Role Of Modern Technologies In Circular Economy‖*

Session : 28
Track B : Bioenergy & Biofuels
Session Chairs : Dr Mehmood Ali ; Dr. Ashokkumar Veeramuthu
Time : 8:45 – 10:15
Venue : JASMINE

Starting Time	ID	Title of Presentation
8:45	**93**	**Upgrading of Woody Biomass by Solvent Treatment Method Using a Petroleum-based Solvent** Janewit Wannapeera
8:58	**217**	**Torrefaction Characteristics and Non-Isothermal Decomposition Kinetics of Leucaena Leucocephala Pellets via Thermogravimetric Analyzer** Sharmeela Matali
9:11	**386**	**A Scheduling and Planning Algorithm for Microalgal Cultivation and Harvesting for Biofuel Production** Jayne Lois San Juan, Andres Philip Mayol, Edwin Sybingco, Aristotle Ubando, Alvinf Culaba, Wei-Hsin Chen, Jo-Shu Chang
9:24	**391**	**Environmental Impact Prediction of a Microalgae to Biofuels Chains Using Artificial Intelligence: A Life Cycle Perspective** Andres Philip Mayol, Alvinf Culaba, Jayne Lois San Juan, Aristotle Ubando, Argel A. Bandala, Edwin Sybingco, Elmer P. Dadios, Wei-Hsin Chen, Jo-Shu Chang
9:37	**495**	**Kinetic Modelling Study of Cyclo-Alkane Oxidation for Transportation Fuels** Hiew Mun Poon, Johnin Tan, Lip Huat Saw
9:50	**503**	**Simulation of a Multi-Fuel Grate Combustion Using a Steady-State Discrete Model** Surapoom Somwangthanaroj, Suneerat Fukuda

Session : 29
Track F : Energy Efficiency & Green Building
Session Chairs : Prof. Fu-Jen Wang ; Prof. Ahmad Syuhada
Time : 8:45 – 10:15
Venue : LOTUS

Starting Time	ID	Title of Presentation
8:45	**578**	**Applications of Hybrid Laplace Adomian Decomposition Method to Non-Newtonian Power-Law Fluid Falkner-Skan Boundary Layer Heat Convection Under Magnetic Field Effect** Cha'o-Kuang Chen, Cheng Hsuan Wu, Yu-Cheng Wu
8:58	**249**	**Study on Transient Heating Process of Transformer Oil Using New Method of Electromagnetic Induction Heating** Lu Zhang, Xiaoling Yu, Kun Wan, Xiangjun Zeng, Liwen Jin, Yunyi Zhang
9:11	**395**	**Forced Convection Boiling Heat Transfer Inside Helically Coiled Heat Exchanger** Luthfi Ady Farizan Haryoko, Jundika Candra Kurnia, Agus Sasmito
9:24	**539**	**Embodied Energy and Life-Cycle Greenhouse Gas of Conventional and the Resilient Nest House** Kittipat Tanthanawiwat, Kasan Chanto
9:37	**577**	**Simulation for Forced Convection of Power-Law Non-Newtonian Nanofluids in a Twisted Elliptical Tube** Cha'o-Kuang Chen, Cheng-Hsuan Ho, Chia-Cen Liu
9:50	**612**	**Optimization and Monitoring of the Impact of the Green Building Certification on Building Energy Performance in a High Rise Office Building (Case Study in SSS Building Jakarta)** Marsul Siregar, Dhian Krisna, Dennis Ronggowarsito
10:03	**637**	**Numerical Simulation of Single-Sided Natural Ventilation: Impacts of Balconies Opening and Depth Scale on Indoor Environment** Nima Izadyar

Session : 30
Track D : Green Material, Design, Products & Manufacturing Processes
Session Chairs : Prof. Chen Zhang ; Prof. Mti Tomas E. Higareda Pliego
Time : 8:45 – 10:15
Venue : ORCHID

Starting Time	ID	Title of Presentation
8:45	**79**	**A Deformation Based Approach to the SOH Estimation of Collided Lithium-Ion Batteries** Jian Zhang, Xiangyang Liu, Alessandro Simeone, Dian Lv
8:58	**81**	**Gas Permeability in Soil Amended with Biochar at Different Compaction States** Ankit Garg, He Huang
9:11	**225**	**Hydrogenolysis of Glycerol over Supported Platinum Catalyst for 1,3-Propanediol Production** Ratanon Ariya
9:24	**248**	**A Systematic Study of Rheological Properties of Water-Ironoxide Nanofluids with Graphene Nanoflakes** A Arifutzzaman, Ahmad Faris Ismail, Md Zahangir Alam, Ahsan Ali Khan, Saidur Rahman
9:37	**274**	**Application of 3D Laser Scanning Technology for Preservation and Monitoring of Thai Pagoda: A Case Study of Wat Krachee Ayutthaya** Phasu Sairuamyat, Peerasit Mahasuwanchai, Chainarong Athisakul, Sutat Leelataviwat, Somchai Chucheepsakul
9:50	**592**	**Phase Formation and Microstructure Analysis of Surfactant-Assisted Sol-Gel Derived La0.6Sr0.4CoO3-δ Material** Abdullah Abdul Samat, Siti Hajar Alias, Murizam Darus, Mahendra Rao Somalu, Nurul Akidah Baharuddin, Nafisah Mohd Isa@Osman
10:03	**ASHRAE Thailand**	**<u>Invited Talk</u>: Crocodile project (CO2 Transcritical Refrigeration System Developed for a Hot-and-Humid Region)** Wallop Lamlertpongpana, Warot Lamlertpongpana

Session : 31
Track E : Fuel Cell & Other Energy Conversion Technologies
Session Chairs : Dr. Sutapat Kwankaomeng ; Dr. Thung Wei-Eng
Time : 8:45 – 10:15
Venue : YANGTZE

Starting Time	ID	Title of Presentation
8:45	40	**A Novel 3D Hierarchical N-Doped Porous Carbon Encapsulated CoP Composite for Electrocatalytic Hydrogen Evolution Reaction** Jing Ma, Huagen Liang
8:58	194	**Modelling the Steady-State of High Temperature Proton Exchange Membrane Electrolyzer Cells (HT-PEMECs) for Hydrogen Production** Dongqi Zhao, Meng Ni
9:11	300	**Effect of Milling Time on the Hardness of NiO-SDC Composite Anode before and after Reduction for Solid Oxide Fuel Cell** Andanastuti Muchtar, Nor Fatina Raduwan, Mahendra Rao Somalu
9:24	469	**High Efficient Enzyme Immobilized Electrodes for Self-Pumping Biofuel Cells** Ngoc Bich Duong, Husan-Hung Yu, Hsiharng Yang
9:37	610	**Analytical modelling and CFD optimization of a Refrigerant Ejector for Low-Temperature Heat Driven Cooling System** Fahid Riaz, Ravi Ranjan, Fu Zhi Yam, Poh Seng Lee, Siaw Kiang Chou
9:50	532	**Investigation of Thermal Performance of Building Roof Using Phase Change Materials for Passive Cooling** Chanita Mano, Atthakorn Thongtha, Somchai Maneewan

Session : 32
Track G : Energy Management & Environmental Policy
Session Chairs : Prof. Jing Ma ; Dr. Mayula Chaikumbung
Time : 8:45 – 10:15
Venue : AMAZON

Starting Time	ID	Title of Presentation
8:45	243	**A Simplified Model of Energy Performance Indicators (EnPIs) for Sustainable Energy Management** Vichan Nakthong
8:58	167	**Analysis and Improvement on Reliability of 66/11 kV Distribution Substation and Its Associated Feeders: A Case Study of Lainchour Substation in Nepal.** Pramish Shrestha
9:11	237	**Comparative Analysis of Different Hybrid Energy System for Sustainable Power Supply: A Case Study** Aayush Bista, Nasib Khadka, Ashish Shrestha, Diwakar Bista
9:24	244	**Internet of Things Based Metaheuristic Reliability Centered Maintenance of Distribution Transformers** Venkataswamy R, Uma Rao, P Meena
9:37	305	**Environmental and Socio-Economic Assessment of Wood Pellet Production from Fast-Growing Trees in Thailand** Piyarath Saosee, Boonrod Sajjakulnukit, Shabbir Gheewala
9:50	521	**Optimizing of the Energy Management Concept in a High-Rise Buildings by applied a Micro-Hydropower with the low Cogging Torque Generator (Case study in the AAA Building in Jakarta)** Marsul Siregar, Joe Martin , Tajuddin Tan
10:03	219	**Design and Reliability Analysis on Internet-Based Real-Time Fuel Consumption Reporting System** Jirawat Boonjun, Niti Kammuang-lue

Session : 56 ***(Time Slot: 4)***
Track D : Green Material, Design, Products & Manufacturing Processes
Session Chairs : Prof. Lorraine Carrillo ; Assoc. Prof. Thitinai Gaewdang
Time : 8:45 – 10:15
Venue : GANGES

Starting Time	ID	Title of Presentation
8:45	**54**	**Magneto-Electro-Elastic Composite Plates for Vibration-Based Energy Harvesting** Subhaschnadra Kattimani, Sonu Kumar, Abhinav Choudhary, Dhruv Paul, Shahare Mayur Madhukar
8:58	**634**	**Recycling of Nutrient-Loaded Biochars Produced from Agricultural Residues as Soil Promoters for Gomphrena Growth** Suchanya Wongrod
9:11	**467**	**3D Printing of Continuous Reinforced Fibre of Kevlar and Carbon Fibre through Coextrusion Method** wei hong yeo, Yeong Jin King, Lip Huat Saw, Jing Yuen Tey
9:24	**412**	**Development of Wireless Data Acquisition System for Soil Monitoring** Joseph Retumban, Efren Victor Jr. Tolentino, Jonrey Rañada
9:37	**478**	**Development of a 3D Printer Filament from Recyclable Polylactic Acid (PLA) Plastic Material** Raymond Joseph Meimban
9:50	**269**	**Design and Development of Prototype Carpal Wrist Cold Gas Propulsion System for Attitude Control Applications** Miguel Antonio Apolinar Gerardo Augusto, Laurence A. Gan Lim
10:03	**516**	**Investigation of Smart Roof Design Using Closed Loop Pulsating Heat Pipe** Lip Huat Saw, Chong Wen Tong, Hiew Mun Poon, Ming Kun

Session : 33
Track A : Renewable Energy & Energy Storage
Session Chairs : Prof. Xianbo Xiang ; Prof. Ashmore Mawire
Time : 10:50 – 12:20
Venue : BALLROOM A

Starting Time	ID	Title of Presentation
10:50	**65**	**Suppression of Hydrodynamic Sloshing in Liquefied Natural Gas Tank with Floating Baffle: Experimental and Numerical Studies** Ummul Ghafir Md Arif, Ching Yun Loo, Hooi Siang Kang, Wonsiri Punurai, Lee Kee Quen, Gavin Nai Yeen Lai, Chong Wen Tong
11:03	**69**	**The Role of Phase Change Material in Solar Water Desalination** Hasan Hasan, Jamil Naser
11:16	**266**	**Production of High Quality Empty Fruit Bunch (EFB) Pellet by Water Washing and Torrefaction** Supachita Krerkkaiwan, Duangkamon boonbumrung
11:29	**397**	**Stochastic Bifurcation Characteristics of KNN Piezoelectric Vibration Energy Harvester** Jia Xu
11:42	**453**	**Design and Analysis of Grid-Connected PV-Diesel Hybrid System** Aung Ze Ya, Hla Aye Thar
11:55	**556**	**Optimal Sizing Method of Standalone PV Systems for Various PV Module Technologies: Rural Electrification Systems for South Mediterranean Countries** Houria Assem
12:08	**630**	**Cobalt Doped Nickel Rich Cathode Material for Enhanced Lithium-Ion and Sodium-Ion Storage** Diwakar Karuppiah, Sivakumar Marimuthu

Session : 34
Track F : Energy Efficiency & Green Building
Session Chairs : Prof. Hongwei Ma ; Dr. Neil Stephen A. Lopez
Time : 10:50 – 12:20
Venue : BALLROOM B

Starting Time	ID	Title of Presentation
10:50		**Keynote Talk: Forced Convection and Nucleate Pool Boiling Heat Transfer of Nanofluids** Prof. Somchai Wongwises
11:16	**46**	**An Experimental Study on Heat and Mass Transfer of a Multi-Stage Planar Dehumidifer with Nafion Membranes** Chun-Han Li, Chen-Yu Chen, Tien-Fu Yang, Wei-Mon Yan, Wen-Ken Li
11:29	**215**	**Convective Heat Transfer Study on the Spiral Finned Tube Heat Exchanger under Various Fin Pitch Arrangements** Ahmad Syuhada, Dedi Afandi, Sarwo Sofyan
11:42	**369**	**A Deep Learning Framework for Energy Management and Optimisation of HVAC Systems for Buildings** Paige Wenbin Tien, Shuangyu Wei, John Calautit, Jo Darkwa, Christopher Wood, Conrad Pantua, Weijie Xu
11:55	**379**	**Prediction and Optimization of Indoor Thermal Environment and Energy Consumption Based on Artificial Neural Network** Yan Zhao, Siru Qian, Chengjun Jing
12:08	**562**	**Energy-efficient Approaches for a University Campus Building through Energy Modeling and Field Measurement** Fu-Jen Wang, Gantulga Bayarkhuu, Kusnandar Kusnandar

Session : 35 (UNEP Session 2 - continued)
Role of Modern Technologies in Circular Economy
Session Chairs : Dr. Lerwen Liu
Time : 10:50 – 12:20
Venue : BALLROOM C

Starting Time	Title of Presentation
10:50	**Presentations (2 to 3) by experts on modern technologies for circular economy**
	Panel Discussions and open floor around following focus: • Science-policy-business interface optimizing role of modern technologies in circular economy • Ways and means to engage different stakeholders for furthering of science, policy, and businesses for CE
	Closing with recommendations from the discussions – Follow up actions and suggestions for optimizing role of modern technologies, including communications and information technologies and artificial intelligence for circular economy.

Session : 36
Track B : Bioenergy & Biofuels
Session Chairs : Dr. Patrick Rousset ; Dr. Rattana Jariyaboon
Time : 10:50 – 12:20
Venue : JASMINE

Starting Time	ID	Title of Presentation
10:50	**51**	**Engine Performance and Emission Testing Using Neem and Jatropha Blended Biodiesel** Mehmood Ali
11:03	**55**	**Investigation on the Impact of Papaya Biodiesel-Diesel Blends on Combustion of an Agricultural CI Engine** Mohammad Anwar
11:16	**273**	**Evaluation of Long-Term Performance of Plant Microbial Fuel Cells** Chang-Ping Yu
11:29	**318**	**Effect of Hemicellulose on the Propensity to Self-Heating of Torrefied Biomass** Nakorn Worasuwannarak
11:42	**149**	**Electrical Power Generation from Bamboo Fermentation Effluent in Microbial Fuel Cell by Shewanella oneidensis MR-1 Dominant** Ngan Hue Dai, Chin-Tsan Wang, Man Van Tran
11:55	**398**	**Assessment of the Bioenergy Policy for the Sustainable Development of Rural-Based Bioenergy Systems in Zambia** Mwansa Kaoma, Shabbir Gheewala
12:08	**600**	**Two-Step Steam Explosion and Hydrothermal Pretreatment of Oil Palm-Trunk and Frond for Bioethanol Production by Using Kluyveromyces Marxianus TISTR 5925** Prawit Kongjan

Session : 37
Track C : Sustainability, Environment, Climate Change & Mitigation Technology
Session Chairs : Prof. Ayman Elshkaki ; Dr. Law Yong Ng
Time : 10:50 – 12:20
Venue : LOTUS

Starting Time	ID	Title of Presentation
10:50	**58**	**An Environmental Decision Support System Using Artificial Intelligence and Life Cycle Assessment Approaches to Support Oil Palm Sustainability** Khaled Obaideen, Yong Chai Tan
11:03	**315**	**Evaluation and Comparison of Carbon Utilization Technologies Based on the Life Cycle Assessment** Shinichirou Morimoto, Yuki Kudoh, Naomi Kitagawa
11:16	**394**	**A Fluid-Structure Interaction (FSI) Modelling of Roof Mounted Renewable Energy Installations in Low Rise Buildings for Extreme Weather and Typhoon Resilience** Conrad Allan Jay Pantua, John Calautit, Yupeng Wu
11:29	**403**	**Development of an efficient recycling process for spent lithium iron phosphate batteries** Hsun-Yi Chen, Cindy Rusly
11:42	**424**	**Bioethanol Fuel Potential in Pakistan – Analyzing the Energy and Environmental Performance in a Life Cycle Perspective** Hafiz Usman Ghani, Shabbir Gheewala
11:55	**603**	**A Power Demand Resilience Analysis of the Residential and Commercial Areas for Fengshan Smart Green Community in Taiwan** Hui-Wen Huang, Tsung-Chieh Cheng
12:08	**611**	**Magnetite Activated Carbon/Chitosan Composite from Biomass for Removal of Diclofenac in Aqueous Solution** Yee How Yoong, Woon Chan Chong, Ying Tao Chung, Hui Chieh Teoh

Session : 38
Track D : Green Material, Design, Products & Manufacturing Processes
Session Chairs : Prof. Meor Othman Hamzah ; Dr. Alessandro Simeone
Time : 10:50 – 12:20
Venue : ORCHID

Starting Time	ID	Title of Presentation
10:50	**119**	**Design of Micro-textured Surface on Turbine Blade for Drag Reduction** Chen Zhang, Pan Wei, Yan Xu
11:03	**378**	**Circular Economy Approach for Mealworm Industrial Production for Human Consumption** Tomas Higareda, Alma Nava , Claudia Barreto, Ricardo Rodriguez, Ivonne Marquez, María Palacios
11:16	**432**	**Research on Creative Design on the Basis of "Internet" Express Package Recycling System** JiaGui Li, Huiping Liang
11:29	**505**	**Utilization of Vegetable Oil Refinery Spent Activated Carbon-Bleaching Earth as an Additive to the Production of Low-Density Facing Bricks** Loudette Bilason, Shania Faith Loveres, John Elijah Paurillo, Cherrylyn Sakay, Carl James Sacobo, Jan Guiller Vergara
11:42	**545**	**Development and Characterization of Heat Storage Aggregate from Industrial Waste for Cooling Load Reduction** Thanongsak Nochaiya
11:55	**595**	**Nanoparticles filled PVA/PVDF Hollow Fiber Membrane towards Enhancing Performance for Air Dehumidification** Yilin Liu, Jincai, Xin Cui, Sicong Zhang, Liwen Jin, Xiangzhao Meng
12:08	**277**	**Simulation and Experimental Analysis of Shell and Tube Heat Exchanger for the Drying System** Numpon Panyoyai, Songchai Pankaew, Thanasit Wongsiriamnuay, Tipapon Khamdaeng, Samerkhwan Tantikul, Nakorn Tippayawong

Session : 39
Track E : Fuel Cell & Other Energy Conversion Technologies
Session Chairs : Prof. Tzi-Yi Wu ; Prof. Andanastuti Muchtar
Time : 10:50 – 12:20
Venue : YANGTZE

Starting Time	ID	Title of Presentation
10:50	**153**	**Combustion Characteristics of Direct Injection Hydrogen in Noble Gases Atmosphere** Norhidayah Mat Taib, Mohd Radzi Abu Mansor, Wan Mohd Faizal Wan Mahmood
11:03	**164**	**Utilization of Palm Mesocarp Fiber and the Impact of Its Physicochemical Properties on the Performance of Direct Carbon Fuel Cells** Wai Yin Wong
11:16	**199**	**Study on the Effect of Temperatures and Relative Humidity on the Water Accumulation of a Large PEM fuel cell** Kwong Kei Lai, Chipok Cheung
11:29	**213**	**Operating Characteristics of the High Temperature PEMFCs Using Stainless Steel Bipolar Plate with Various Coatings** Chen-Yu Chen, Ping-Hsueh Wu, Wei-Mon Yan, Yang-En Cho, Song-Tzer Shieh
11:42	**230**	**Numerical Simulation of Three-Dimensional Microbial Fuel Cell** Kumar Pijush Kataky, Amaresh Dalal, Gautam Biswas, Chin-Tsan Wang
11:55	**353**	**Preparation of Low Cost Catalysts for Proton Exchange Membrane Fuel cell** Pimpaya Yaengthip, Konlayutt Punyawudho

Session : 40
Track G : Energy Management & Environmental Policy
Session Chairs : Assoc. Prof. Dr. Mohammed J.K Bashir ; Dr. Mayula Chaikumbung
Time : 10:50 – 12:20
Venue : AMAZON

Starting Time	ID	Title of Presentation
10:50	**214**	**Microgrid Policies : A Review of Technologies and Key Drivers of Thailand** Thongchai Meenual, Parnuwat Usapein, Thongchai Meenual
11:03	**276**	**Computational Appraisal of the Thermalhydraulic Characteristics of Supercritical Carbon dioxide in Heated Mini-channel for HVAC Applications** Nitesh Kumar, Dipankar Basu
11:16	**331**	**Multi-Objective Optimization of Water Exchanges between a Wastewater Treatment Facility and Algal Biofuel Production Plant** Carlo James Caligan, Maria Mikayla Garcia, Jericho Mitra, Andres Philip Mayol, Jayne Lois San Juan, Alvin Culaba
11:29	**368**	**Multi-Objective Optimal Synthesis of Algal Biorefineries toward a Sustainable Circular Bioeconomy** Celine Marie Solis, Andres Philip Mayol, Jayne Lois San Juan, Aristotle Ubando, Alvin Culaba
11:42	**383**	**Institutions and Consumer Preferences for Renewable Energy** Mayula Chaikumbung
11:55	**454**	**Effective Environmental Management System of Acid Mine Drainage at Kyisintaung Copper Surface Mine in Myanmar** Aung Ze Ya, Myint Aung
12:08	**236**	**Development of an IB-TLB Solver for Fluid-Particle Interaction in Energy Management Systems** Sambit Majumder, Arnab Ghosh, Dipankar Narayan Basu, Ganesh Natarajan

Session : 57 *(Time Slot: 5)*
Track B : Bioenergy & Biofuels
Session Chairs : Dr. Steven Lim ; Dr. Suchanya Wongrod
Time : 10:50 – 12:20
Venue : GANGES

Starting Time	ID	Title of Presentation
10:50	**462**	**Stability of Biogas Plant Involving Co-Digestion of Palm-Oil Mill Effluent and Rubber Latex Wastewater** Laddawan Noynoo, Nattawut Yingthavorn, Archw Promraksa, Chairat Siripatana
11:03	**326**	**Microbial Fuel Cells with Yeast Biofilm Anode and Buckypaper Cathode** Kaname Iwai, Yosuke Ito, Teppei Tamura, Dang Nguyen, Kozo Taguchi
11:16	**311**	**Kinetic Model of Biogas Production from Co-Digestion of Thai Rice Noodle Wastewater with Rice Husk and Different Type of Manure with Ash Supplement** Sunwanee Jijai, Chairat Siripatana, Laddawan Noynoo, Saina Muleng
11:29	**623**	**Kinetic Study of Na+ Doped Nano Hydroxyapatite for the Production of Biodiesel from Schizochytrium Limacinum** Kowthaman CN
11:42	**606**	**Modeling and Simulation of a Biomass-Based Integrated Gasification Combined Cycle with Post Combustion Carbon Capture: Comparison between MEA and Potassium Carbonate** Ikhlas Ghiat, Ahmed AlNouss, Tareq Al-Ansari , Gordon McKay
11:55	**571**	**Review on Design Factors of Microbial Fuel Cell Using Buckingham's Pi Theorem** Jui-Sen Lu, Raymond Tang, Jer-Huan Jang, Chin-Tsan Wang, Hwai Chyuan Ong

Session : 41
Track A : Renewable Energy & Energy Storage
Session Chairs : Dr Henry Kang ; Prof. Dr. Robert H.B. Exell
Time : 13:30 – 15:00
Venue : BALLROOM A

Starting Time	ID	Title of Presentation
13:30	**101**	**Preparation of Corn Stem and Leaves Activated Carbon by Chemical Activation Using KOH for Application in Electric Double-Layer Capacitors** Chatphong Rungwachira
13:43	**162**	**Flow Analysis of the Deep Dynamic Stall of Wind Turbine Airfoil with Single-Row And Double-Row Passive Vortex Generators** Chengyong Zhu, Tongguang Wang, Jie Chen, Wei Zhong
13:56	**187**	**Transition Metal Oxides for High Performance "Water-in-Salt" Aqueous Aluminium-Ion Battery Cathodes** Wending Pan, Dennis Leung
14:09	**159**	**Effect of Microwave Susceptor Design on the Heating Profile of Co-Pyrolysis Empty Fruit Bunches (EFB)/Waste Truck Tire (TT)** Rubia Idris, Atikah Ali, Jahimin A.Asik, Mohd Faizal Hassan, Cheng Tung Chong, Farid Nasir Ani
14:22	**182**	**Three-phase Five Level Diode Clamped Inverter for AC Load Interfacing in DC Microgrid** Soe Win, Zarchi Linn
14:35	**414**	**Experiments of Microbial Full Cells in Phragmites australis and Egeria densa Dominated Wetland Mesocosms** Fu-Sen Zhang, Chin-Tsan Wang, Juan Chung-hsin
14:48	**459**	**Techno-Economic Investigation of a Grid-connected PV-Biomass Hybrid System for Shaping the Sustainable Electrification in Ayeyarwady Delta of Myanmar** Aung Ze Ya

Session : 42
Track A : Renewable Energy & Energy Storage
Session Chairs : Dr. Yang Xiaohu ; Assoc. Prof. Prabu V
Time : 13:30 – 15:00
Venue : BALLROOM B

Starting Time	ID	Title of Presentation
13:30	172	**Using Electrochemical Polarization Analysis to Optimize the External Operation Parameters of Zinc Fuel Cell** Po-Tuan Chen, Cheng-Jung Yang, K. David Huang
13:43	57	**A Review on Offshore Wind Energy Conversion System Development** Zhiheng Li, Jinjiang Li, Guandao Wang, Shaolong Yang, Chong Wen Tong, Xianbo Xiang
13:56	268	**Quality Improvement of Syngas from Gasification Process of Palm Kernels Using NiO/CaO Catalysts on Ceramic Supporter in Coupled with Biochar Absorbent from Agricultural Residues** Wipawee Khamwichit
14:09	370	**Comparative Economic Assessment of Community-Owned Small-Scale Renewable Energy Technologies** Nilubon Luangchosiri, Takaya Ogawa, Keiichi Ishihara
14:22	440	**Comparative Customer Economics on Different Financial Options in Support the Adoption of Residential Rooftop PV in Thailand** Siripha Junlakarn, Phimsupha Kokchang
14:35	460	**Performance Analysis of MPPT Control System for Standalone Wind Power System in Sittwe, Myanmar** Aung Ze Ya, Yee Yee Win
14:48	515	**Feasibility Study of Inexpensive Polypropylene-Based Aluminium-Air Battery** Lip Huat Saw, Haziq Naqiuddin, Ming Chian Yew, Chong Wen Tong, Wei-Hsin Chen, Pei-Yu Kuo, Chin-Tsan Wang

Session : 43 (UNEP Session 3)
Combating Plastics Pollution and Marine Litter through Sustainable Public Procurement and Circular Economy
Session Chairs : Dr. Awassada Phongphiphat
Time : 13:30 – 15:00
Venue : BALLROOM C

Starting Time	Title of Presentation
13:30	**Welcoming Remarks** Dr. Isabelle Louis, Deputy Regional Director and Deputy Regional Representative for Asia and the Pacific, United Nations Environment Programme (UNEP)
	Opening Remarks Her Excellency Kjersti Rødsmoen, Ambassador of Norway to Thailand
	Keynote Speech/Presentation His Excellency Kees Pieter Rade Ambassador of Kingdom of Netherlands to Thailand
	Presentation on UNEP-King Mongkut University joint paper on *―Combating Plastics Pollution And Marine Litter Through Sustainable Public Procurement And Circular Economy‖*

Session : 44
Track B : Bioenergy & Biofuels
Session Chairs : Prof. Chin-Tsan Wang ; Assoc. Prof. Nakorn Worasuwannarak
Time : 13:30 – 15:00
Venue : JASMINE

Starting Time	ID	Title of Presentation
13:30	212	**Effects of Organosolv Pretreatment Using Ethylene Glycol on Degraded Empty Fruit Bunch For Delignification and Fractionation** Danny Wei Kit Chin, Steven Lim , Yean Ling Pang, Chun Hsion Lim, Siew Hoong Shuit
13:43	260	**A Testing of a Modified Small-Scale Biochar Kiln** Thanasit Wongsiriamnuay, Lalita Petchaihan, Numpon Panyoyai, Tipapon Khamdaeng
13:56	401	**Upgrading of Biomass Waste by Hot Press Torrefaction under High Mechanical Pressure** Supachai Jadsadajerm
14:09	547	**The Effect of Heat Storage to Properties and Energy Recovery of Pyrolysis Products from Agricultural Waste** Kanyaphorn Chaiwong, Nattapon Wichan, Surasak Kuimalee, Chakkraphan Thawonngamyingsakul
14:22	598	**Microalgae Cultivation in Municipal Sewage for Biofuel Production and Residues for Metallic Iron Conversion – Algal Biorefinery** Ashok Kumar Veeramuthu, Wei-Hsin Chen, Cheng Tung Chong, Chawalit Ngamcharussrivichai
14:35	558	**Enhancing Particle Dispersion and Power Performance of the MFC by Swirler Channel** Chin-Tsan Wang, Vicky Kumar

Session : 45
Track C : Sustainability, Environment, Climate Change & Mitigation Technology
Session Chairs : Prof. Yun-Hai Wang, Prof. Sarath Babu Anne
Time : 13:30 – 15:00
Venue : LOTUS

Starting Time	ID	Title of Presentation
13:30	261	**Timber Transportation Planning Using Bees Algorithm** Jamhuri Jamaluddi
13:43	323	**Factors Influencing Consumer Awareness towards Single-Use Plastic in Selangor, Malaysia** Sakinah Shukri
13:56	482	**Effect of Queen Pineapple Bran as Feed Supplement to the Growth Performance of Camarines Strain Native Chicken** Michelle Carbonell, Sonia Carbonell
14:09	506	**Effect of Fire Flame Exposure on Basalt and Carbon Fiber Reinforced Concrete** Siti Nooriza Abd Razak
14:22	542	**Medical Waste Treatment and Electricity Generation using Pyrolyzer-Rankine Cycle for Specialty Hospitals in Quezon City, Philippines** Ferdinand Manegdeg, Ronard Pana, Leif Oliver Coronado
14:35	602	**Forecasting GHG Emissions from Coal Based Resource in Power Plant Using a Nonsupervisory Artificial Neural Network** Mohd Fauzi, Kiat Moon Lee, Raja Shazrin Shah RES, Radin Diana R.Ahmad, Sazalina Zakaria
14:48	530	**Experimental Investigation of Lighting System with Cylindrical Mirrors and Estimating Energy Saving Potential in Building** Atthakorn Thongtha, Piromporn Boontham

Session : 46
Track G : Energy Management & Environmental Policy
Session Chairs : Prof. Jang Jer Huan ; Dr. Marsul Siregar
Time : 13:30 – 15:00
Venue : ORCHID

Starting Time	ID	Title of Presentation
13:30	50	**CO2 Emissions from Electricity Generation in ASEAN: An Empirical Spatial-Temporal Index Decomposition Analysis** Tian Goh, B.W. Ang
13:43	202	**Above-Ground Biomass Estimation of Eucalyptus Plantation Using Remotely Sensed Data and Field Measurements** Warakhom Wongchai
13:56	501	**ASEAN Power Grid 20 Years After: An Overview of Its Progress and Achievements** Hazleen Aris, Bo Nørregaard Jørgensen
14:09	168	**Price Allocation of Transmission Line Usage in Open Access System Using MVA KM and MVA Cost Method for Integrated Nepal Power System** Pramish Shrestha
14:22	484	**Fuel Replacement: A Possible Option for Thailand Energy Security?** Nitida Nakapreecha, Supawat Vivanpatarakij, Kulyos Audomvongseree
14:35	491	**Assessment of Environmental, Energy and Economic Prospective of Anaerobic Digestion of Organic Municipal Solid Waste in Malaysia** Mohammed J.K Bashir

Session : 47
Track A : Renewable Energy & Energy Storage
Session Chairs : Dr. Arifutzzaman Rahat ; Asst. Prof. Sutapat Kwankaomeng
Time : 13:30 – 15:00
Venue : YANGTZE

Starting Time	ID	Title of Presentation
13:30	35	**Feasibility on Development of Kinetic-Energy Harvesting Floors** Thitima Jintanawan,Gridsada Phanomchoeng, Suvijak Sintragoonchai,Warapol Lowattanamart
13:43	200	**Effect of Surfactants on Thermal Conductivity of Graphene Based Hybrid Nanofluid** Wei Xian Hong, Nor Azwadi Che Sidik, Saidur Rahman
13:56	209	**Power Management System for Hybrid AC/DC Microgrid Based on High Frequency Isolated Converter** Zarchi Linn, Soe Win
14:09	360	**Experimental Study on Waste Heat Recovery System of an Internal Combustion Engine Using Thermoelectric Technology** Baljit Singh
14:22	441	**Geothermal Resources in Southern Thailand – Part of a Renewable Energy Mix** Helmut Duerrast
14:35	476	**Experimental Investigation of a Diffuser Integrated Vertical Axis Wind Turbine** Xiaohang Wang, Wong Kok Hoe, Chong Wen Tong, Xianbo Xiang, Chin-Tsan Wang
14:48	308	**Comparison of Simulations to Experiment for Heat Transfer Characteristics in Re-Burning Kiln Heat Exchanger** Numpon Panyoyai, Piyathida Panyoyai, Thanasit Wongsiriamnuay, Tipapon Khamdaeng, Samerkhwan Tantikul, Nakorn

Session : 48
Track I : Special session 2: Degradation Prediction and Recycling of Renewable Energy and Energy Storage Systems: Scenarios of 2020-2030
Session Chairs : Assoc. Prof. Akhil Garg ; Dr. Kapil Pareek
Time : 13:30 – 15:00
Venue : AMAZON

Starting Time	ID	Title of Presentation
13:30	227	**A Framework Based on Big Data for Intelligent Monitoring of Battery Packs** Li Wei, Liang Gao, Akhil Garg
13:43	228	**Qualitative framework Based on Intelligent Robotics for Safe and Efficient Disassembly of Battery Modules for Recycling Purposes** Akhil Garg, Lin Zhou, Jun Zheng, Liang Gao, Liu Yun
13:56	290	**Intelligent Optimization of Process Conditions for Maximum Metal Recovery from Spent Zinc-Manganese Batteries** Chaitanya Ruhatiya, Himanshu Tibrewala, Liang Gao, Suwin Sleesongsom, Christina Chin May May
14:09	293	**Efficient Battery Thermal Management System Design to ensure Fast Charging in Extreme Cold** Himanshu Tibrewala, Chaitanya Ruhatiya, Liang Gao, Kapil Pareek
14:22	330	**Development of Time-Series Charge-Discharge Based Models for Li-Ion Batteries Using Analysis of Stack Stress** Kasuntha Nimhani Punchihewa, Chee Pin Tan, Chiew Yeong Shiong, Akhil Garg, Liang Gao
14:35	355	**Experimental Analysis and Model Development for Short Circuit Abuse Condition of Li-ion Battery** Mayank Vyas, Kapil Pareek, Akhil Garg
14:48	361	**Impedance Spectroscopy based Instability Analysis for Non-linear Dynamics of Li-ion Battery** Kapil Pareek, Mayank Vyas, Akhil Garg

Session : 58 ***(Time Slot: 6)***
Track J : Special Session: Computational Intelligence Techniques for Energy- Efficient Manufacturing Systems
Session Chairs : Prof. Farouk Yalaoui ; Dr. Hicham Chehade
Time : 13:30 – 15:00
Venue : GANGES

Starting Time	ID	Title of Presentation
13:30	**108**	**Energy-Cost-Aware Flow-Shop Scheduling Systems with State-Dependent Energy Consumptions** Mohammadmohsen Aghelinejad Yassine, Alice Yalaoui
13:43	**278**	**The Use of Artificial Neural Networks (ANN) in the Prediction of the Energy Consumption of Air-Source Heat Pump in Retrofit Residential Housing** Gulsun Demirezen, Kevin Kai Ye, Alan Fung , Erik Janssen
13:56	**312**	**A Product Arrangement Optimization Method to Reduce Packaging Environmental Impacts** Tan Trinh Truong , Lionel Amodeo, Farouk Yalaoui, Jean-Christophe Hautefaye
14:09	**508**	**A Comprehensive Study for the Voxel Model of Octree Subdivision Functional Gradient Material Parts** Dian Wang, Xiyun Cheng , Guodong Cai, Siqi Chen, Yi Chen, Jie Peng
14:22	**514**	**An Efficient Heuristic Approach for Workforce Scheduling and Routing Problem** Hicham Chehade, Rezvan Sadeghi, Mohamed Mancef Bekdouche

Session : 49
Track A : Renewable Energy & Energy Storage
Session Chairs : Dr. Sun Yanjun ; Prof. Hasan Abdellatif Hasan Hasan
Time : 15:30 – 17:00
Venue : BALLROOM A

Starting Time	ID	Title of Presentation
15:30	36	**Effect of Rotor Length on Generating Power in Horizontal Axis Wind Turbines** Navid Majdi Nasab, Jeff Kilby, Leila Bakhtiaryfard
15:43	204	**Revisiting Tin Melting for Phase Change Model Verification** Mohd Irwan Mohd Azmi, Nor Azwadi Che Sidik, Yutaka Asako
15:56	10	**Innovative Power-Augmented Wind Turbine Design for Offshore Application** Chong Wen Tong, Xianbo Xiang, Wong Kok Hoe, Keen Kuan Kong, Xiaohang Wang, Chin-Tsan Wang
16:09	385	**Role of Solar Energy for Enhancing Sustainable Energy and Electricity in Myanmar: An Outlook** Ohn Zin Lin, Khine Khine Mon, Tin Tin Htay
16:22	525	**Performances Analysis of Serpentine Tube Type PV/T Hybrid Solar Collector with Overheating Prevention** WangJe Lee, HeeWon Lim, HyunSenung Lee, NamChoon Baek, U-Cheul Shin
16:35	631	**The Design of an Active Living Wall as Natural Air Cleaning and Cooling System** Izdihar Zahirah Ibrahim, Chong Wen Tong, Mei Yee Cheah , Sumiani Yusoff, Chin-Tsan Wang
16:48	37	**Prussian Blue Analogues/Biomass Derived Self-Standing NiFeP@NC/BC Cathode for Li-O2 Batteries** Huagen Liang, Xu Gong, Linhui Jia

Session : 50
Track A : Renewable Energy & Energy Storage
Session Chairs : Assoc. Prof. Rajesh Kondareddy ; Dr. Zarchi Linn
Time : 15:30 – 17:00
Venue : BALLOOM B

Starting Time	ID	Title of Presentation
15:30	12	**Performance Comparison of Two Eutectic Solder Based Latent Heat Storage Systems during Discharging** Ashmore Mawire
15:43	39	**Synthesis of Ni-Doped TiO2 Microtubes as Highly Efficient Electrocatalyst for Rechargeable Li-O2 Batteries** Run Chen, Huagen Liang
15:56	479	**HEALTH : A Design of Low cost Heat to Light TEG Based Converter for Houses in Rural Community** Raymond Joseph Meimban
16:09	533	**Performance Analysis of Permanent Magnet Generator for Harvesting of Electrical Energy from Low Wind Speed** Tajuddin Nur
16:22	559	**Co-Pyrolysis and Co-Gasification of Kitchen waste with Indian Coals** Pradeep Sahu, Prabu V
16:35	645	**Hybrid Biomass-Diesel Systems for Missionary Electrification of Small Island and Isolated Grids in the Philippines** Marco Angelo Dejucos, Joey Ocon
16:48	628	**Projecting the Price of Lithium-ion NMC Batteries using a Multi-Factor Learning Curve Model** Xaviery Penisa

Session : 51 (UNEP Session 3 - continued)
Combating Plastics Pollution and Marine Litter through Sustainable Public Procurement and Circular Economy
Session Chairs : Dr. Awassada Phongphiphat
Time : 15:30 – 17:00
Venue : BALLROOM C

Starting Time	Title of Presentation
15:30	**Presentations (2 to 3) by experts on Combating Plastics Pollution And Marine Litter Through SPP And CE.**
	Panel Discussions and open floor around following focus: • Science-policy-business interface for combating plastics pollution and marine litter through SPP and CE • Ways and means to engage different stakeholders for furthering of science, policy, and businesses for CE
	Closing with recommendations from the discussions – Follow up actions and suggestions for capacity building on strategies and actions to combat plastic pollution and marine litter through sustainable public procurement and circular economy.

Session : 52
Track E : Fuel Cell & Other Energy Conversion Technologies
Session Chairs : Dr. Cheng-Jung Yang ; Asst. Prof. Dr. Kreangkrai Maneeintr
Time : 15:30 – 17:00
Venue : JASMINE

Starting Time	ID	Title of Presentation
15:30	102	**Effect of Injection Timing of Syngas Containing Hydrogen on the Emission of a Diesel Engine** Dao-Yi Huang, Jun-De Lin, Te-Jen Kung, Tien-Chuan Liu, Jer-Huan Jang
15:43	536	**Simultaneous Heavy Metal Removal and Electricity Generation with Synergy Membrane-Less Microbial Fuel Cell** Wei-Eng Thung
15:56	421	**Boosting Alcohol Electro-Oxidation Reaction with Bimetallic PtRu Nanoalloys Supported on Robust Ti0.8W0.2O2 Nanomaterial in Direct Liquid Fuel Cells** Hau Quoc Pham, Tai Huynh, Huyen Tong, Van Thi Thanh Ho
16:09	420	**Improvement of Polyalkanoates Production by the Integration of Hydrogen Fuel Cell and The Elctro-Fermentation System** Chi-Wei Lan
16:22	130	**Modeling of Chemical Processes Using Commercial and Open-Source Software: A Comparison between Aspen Plus and DWSIM.** Kwanchanok Tangsriwong, Puttida Lapchit, Tanatip Kittijungjit, Thepparat Klamrassamee, Yanin Sukjai, Yossapong Laoonual

Session : 53
Track C : Sustainability, Environment, Climate Change & Mitigation Technology
Session Chairs : Dr. Sakinah Shukri ; Dr. Yun-Chih Chiang
Time : 15:30 – 17:00
Venue : LOTUS

Starting Time	ID	Title of Presentation
15:30	616	**Development of an Active Botanical Biofilter System towards Better Indoor Environmental Quality** Izdihar Zahirah Ibrahim, Chong Wen Tong, Sumiani Yusoff, Chin-Tsan Wang, Cheah Mei Yee
15:43	635	**Modelling of Arsenic Adsorption in Fixed-Bed Column Containing Sediment Soils from Old Mining Area** Suma Nookaew, Chuthamat Rattikansukha, Laddawan Noynoo, Chairat Siripatana
15:56	388	**Material-Energy Nexus: The Role of Strategic and Rare Earth Metals in the Sustainability of Lighting Technologies** Ayman Elshkaki
16:09	566	**Multi-Criteria Assessment of Energy Sector Nationally Appropriate Mitigation Actions in Sri Lanka** Thusitha Sugathapala
16:22	334	**Impact of Chlorpyrifos on Performance and Morphology of Aerobic Biomass in Sequencing Batch Reactor** Rajneesh Kumar, Gurvinder Kaur Saini, Mohammad Jawed
16:35	400	**NARX-Based Drought Forecasting Model of the Pantabangan Dam, Philippines** John Pepard Rinchon
16:48	210	**Incentivizing Geothermal Energy Business with G20 Collaboration** Tabratas Tharom, Hendro Hadi

Session : 54
Track A : Renewable Energy & Energy Storage
Session Chairs : Dr. Wong Kok Hoe ; Dr. Chen-Yu Chen
Time : 15:30 – 17:00
Venue : ORCHID

Starting Time	ID	Title of Presentation
15:30	307	**A-Site Sr-Boosted Surface Self-Reconstruction in SrIrO3 Perovskite Induces Significant Enhancement in Hydrogen Production under Alkaline Condition** Jie Yu, Meng Ni
15:43	143	**Effect of Metal Foam Filling Ratio on the Melting Behaviour for a Shell-and-Tube Thermal Energy Storage Unit** Xiaohu Yang, Zhaoyang Niu, Jiabang Yu, Gang Liu, Xuanbo Wang, MengYu Zhao
15:56	555	**Heat Transfer Enhancement and Optimization on a Aperture Area of a Compact Parabolic Solar Collector** Pongnarin Savangwong, Panya Kansuwan, Banterng Silpsakoolsook, Sutapat Kwankaomeng
16:09	643	**Hydrothermally Carbonized Waste Biomass as Electrocatalyst Support for α-MnO2 in Oxygen Reduction Reaction** Harold Panganoron
16:22	247	**Numerical Investigation on Melting of Various Nanoparticles Enhanced Phase Change Material (NEPCM) inside a Square Enclosure** Hao Kean Tung, Nor Azwadi Che Sidik
16:35	234	**Business Model and Market Designs for PV Prosumer on Peer to Peer Energy Trading in Thailand** Phimsupha Kokchang, Siripha Junlakarn, Kulyos Audomvongseree
16:48	641	**Characterization of Mechanical Responses of a LiFePO4 Battery under a Variety of Operational Conditions** Eunji Kwak, Du Sue Son, Ki-Yong Oh

Session : 55
Track C : Sustainability, Environment, Climate Change & Mitigation Technology
Session Chairs : Dr. Hui-Wen Huang ; Dr. Nitida Nakapreecha
Time : 15:30 – 17:00
Venue : YANGTZE

Starting Time	ID	Title of Presentation
15:30	**238**	**Facile Approach For Synthesizing Carbon Nanotube-Metal Composites From Petrochemical Waste Oil** Chosel Lawagon, Tawatchai Charinpanitkul
15:43	**246**	**Evaluating the Effect of Different Biochar Application Sizes on Methane Emission Reduction from Rice Cultivation** Patikorn Sriphirom
15:56	**250**	**Energetic and Exergetic Analysis of Chemical Looping Combustion Integrated Coal-Fired Power Plant using Different Oxygen Carriers** Gajanan Dattarao Surywanshi, B. Basant Kumar Pillai, Venkata Suresh Patnaikuni, Vooradi Ramsagar, Sarath Babu Anne
16:09	**275**	**Interaction between Coal-Ash and Iron-Ore in Chemical Looping Combustion** Shailesh Singh Sikarwar, Gajanan Dattarao Surywanshi, B. Basant Kumar Pillai, Venkata Suresh Patnaikuni, Manohar Kakunuri, Vooradi Ramsagar
16:22	**399**	**Photocatalytic Degradation of Methylene Blue Dye on Aqueous Solution under UV-Light Irradiation Using Magnetic $NiFe_2O_4$ Catalyst: Parametric and Kinetic Studies** Manny Anthony Taguba, Allan Alzona Franz Santos Cresencia Vahdanipour
16:35	**489**	**Synthesis of Magnetite Macro-Bead for Water Remediation: Process Optimization via Manipulation of Bead Size and Surface Morphology** Swee Pin Yeap
16:48	**583**	**Value Environmental Assessment of Water-box Irrigation Alternatives** Fawaz Al-Anzi

POSTER PRESENTATION

Session : POSTER-1
Date / Time : 12-DEC-2019 / 14:10 – 15:40
Venue : PRE-FUNCTION

ID	Title of Presentation
122	**The Characteristics of High Temperature Proton Exchange Membrane Fuel Cells with CO and Air-bleeding on the Anode Side** Jia-Xuan Zhang, Yang-En Cho, Chen-Yu Chen, Wei-Hsiang Lai, Kuan-Jen Huang
120	**N-Doped Carbons of Silk Fibroin Induced with Conducting Polymer via Co-Electrodepositing in Inverse Opals for High Performance Supercapacitors** Ta Chung Liu, Tsung-Yu Li, San-Yuan Chen
112	**The Study on the Flow Channel Modification of High Temperature Proton Exchange Membrane Fuel Cells** Chen-Yu Chen, Chien Lin, Chuan-Chia Huang
109	**Acetylene Black and Carbon Nanotue within Microporous Layer Coating for Alkaline Anion Exchange Membrane Fuel Cells** Li-Wei Zheng, Husan-Hung Yu, Hsiharng Yang
97	**Effect of Oxygen Flow Rate on Physical Properties of Al-Doped ZnO Transparent Conducting Films Prepared by Reactive DC Magnetron Sputtering Using Metallic Zn:Al Target** Thitinai Gaewdang, Ngamnit Wongcharoen, Guan-Hua He, Min-Hsing Chang
89	**Rational Design of Membrane/Electrode Interface for Effective Water Management in Alkaline Membrane Fuel Cells** Segeun Jang, Sungjun Kim, Min Her Sang Moon Kim, Yung-Eun Sung, Sung Jong Yoo
66	**Effect of Carbon-Covering Layer on Catalyst Layer in Polymer Electrolyte Membrane Fuel Cell in Low Relative Humidity Condition** Sang Moon Kim, Segeun Jang, Changwook Seol, Ho Seon Ahn, Yun Sik Kang, Sung Jong Yoo
59	**4.2 V Wearable Asymmetric Supercapacitor Devices Based on a VOx//MnOx Paper Electrode and an Eco-Friendly Deep Eutectic Solvent-Based Gel Electrolyte** Jin-Ming Chen, Kueih-Tzu Lu
21	**Efficiency of Zinc Ions (II) Adsorption Using Activated Carbon from Palm Kernel Shell** Jakkrapong Jitjamnong
299	**An Analytical Model for Vertical-butted Geothermal Well with Different Groundwater Flow Directions** Guosheng Jia, Zhendi Ma, Yuping Zhang, YIng Cao, Xiangzhao Meng, Liwen Jin
426	**Effects of Layout Forms on Heating and Cooling Loads in Rural Residential Buildings** Teng Ma, Liwen Jin, Xiangzhao Meng
638	**Geothermal Characteristics of Deep Geothermal U-bend Wells in the Xi'an Depression, Weihe Basin** Yuping Zhang, Liwen Jin
613	**Formation of ZnO/chitosan Beads: An Alternative for Synthetic Dye Degradation under Visible Light Irradiation** Mohd Azam Bin Mohd Adnan

621	**Conversion of Biomass into Fermentable Sugar by Ionic iquid/Surfactant Assisted Biological Pretreatment** Ken-Lin Chang
639	**Bioconversion of Anthocyanin to Anthocyanidin from Fermented Fruit and Vegetable Waste by Leuconostoc Mesenteroides as Probiotic Food Material** Eva Fadilah
597	**The Preparation of Ag(ZnO) Photocatalysts Using Hydrothermal Process for Dye Degradation** Dayoung Kwon, Yeji Kim, Jongsung Kim
332	**Bio Derived Ionic Conductor Based Polyelectrolyte Membrane for Microbial Fuel Cells** Bhanupriya Das, Surendra Singh Gaur, Vimal Katiyar, Chin Tsan Wang
132	**Modeling of Vapor-Liquid Equilibrium for R1234ze(E)/Lubricant Mixtures by PR EoS with Various Mixing Rules and Modified KI Equation** Yanjun Sun, Jian Wang, XiaoPo Wang, MaoGang He
139	**An ANN-Based Output Current Estimation Technique for Server Power Supplies** Song-Pei Ye, Yi-Feng Luo, Guan-Jhu Chen, Shun-Chung Wang, Yi-Hua Liu
205	**Composites of Platinum Particles Embedded into Copolymers Based on 6-Cyanoindole and Bithiophene for Methanol Oxidation** Chung-Wen Kuo, Che-Kai Liu, Ho-Rei Chen, Chih-Wei, Tzi-Yi Wu

Session : POSTER-2
Date / Time : 12-DEC-2019 / 16:00 – 17:30
Venue : PRE-FUNCTION

ID	Title of Presentation
596	**Synthesis and Analysis of ZnO Coated Gold Nanoparticles for Photocatalytic Activity** Ju Young Yoo, Jongsung Kim, Won Sia
551	**Solar Desalination by Combination with Concentrated Solar Power: Exergy Cost Analysis** Roberto Leiva-Illanes
517	**Heterogeneous Catalytic Interesterification Process Derived from Low Value Biomass Wastes For Biodiesel Synthesis** Wan Ying Wong, Steven Lim, Yean Ling Pang, Kam Huei Wong
500	**A Comparative Study on Nb Loading of Co-Precipitated Cu-Nb-CeO2 Catalysts** Dae-Woon Jeong
427	**Fabrication of CuO Nanowires by The Electro-Forcespinning Method** Guan-Hua He, Min-Hsing Chang
333	**Analysis on the Natural Gas Distributed Energy System Scheme of a Large Hospital in Xi'an** Siyan Liu, Nang Liang, Guoqing Li, Zhendi Ma, Qiongxiang Kong

198	**Hydrogen Adsorption and Storage on Porous Thermally Expanded Graphite Oxide** Ji Hoon Kim, Sun Taek Lim, Gyu Hyeon Shim, Byung Hoon Kim, Chang Yeon Lee, Sang Moon Kim, Segeun Jang, Ho Seon Ahn
185	**Material Characterization and Hydrogen Permeation Sr(Ce0.6Zr0.4)0.9Y0.1O3-δ/Y0.08Sr0.92TiO3-δ Composite Membrane** I-Ming Hung, Kuan-Chi Fu, Azam Khan, Yi-Hung Wang
175	**Explore the Influence of Carbopol 940 Additives to the Performance of Zn-Air Fuel Cell** Po-Tuan Chen
154	**Effect on Changing of Intake Temperature to Hydrogen-Methane-Diesel Mixture Combustion Characteristics** Taib Mohamad, Mohd Radzi Abu Mansor
147	**Investigations on the Illumination Intensity and Temperature Dependence of CPV Modules in High Latitudes** Yi-Hao Pai, Ching-Hsiang Wang
125	**Solar Panel Cooling Plates for Higher Conversion Efficiency: Design of Flow Channel for Heat Transfer Enhancement and Pressure Drop Reduction** Pakpoom Nutthawaree, Supakorn Issarakul, Yutthachai Anathamsombat, Kreeta Sukthang, Maytungkorn Sermsuk, Yanin Sukjai
633	**Performance analysis of an Omni-Direction Deflector for Vertical Axis Wind Turbine** Keen Kuan Kong, Chong Wen Tong, Xianbo Xiang, Xiaohang Wang, Wong Kok Hoe, Chin-Tsan Wang
620	**A Study on the Low-Temperature Wet Synthesis of Hydrofluoric Acid from Synthetic Calcium Fluoride and Waste Sulfuric Acid** Ken-Lin Chang
299	**An Analytical Model for Vertical-butted Geothermal Well with Different Groundwater Flow Directions** Guosheng Jia, Zhendi Ma, Yuping Zhang, YIng Cao, Xiangzhao Meng, Liwen Jin
527	**Assessment of Biofuel as an Alternative Fuel Following Production from the Deoxygenation of Oleic Acid over Ni/MG70 Catalyst** Kyung-Won Jeon, Min-Ju Park, Dae-Woon Jeong, Won-Jun Jang
587	**The Performance of Spraying Method of Dehumidification Tower and the Proportion of Mixed Solution for Liquid Dehumidification** Yu-Lieh Wu, Che-Chuan Lee
27	**A 3-D Simulation on Microbial Fuel Cells with Continuous Flow Supply** Jhao-Syuan Lee, Wen-Jenn Sheu, Chin-Tsan Wang, Yen-Cho Chen
528	**On the Possibilities to Reduce CI engine Emissions by Controlling the Reactivity of Diesel-Biofuel Mixtures** Lucian Miron, Alexandru Racovitza, Radu Chiriac
599	**Bio-Ethanol Production from Torrefied Sugarcane Bagasse by Semi-Simultaneous Saccharification and Fermentation** Rattana Jariyaboon
151	**Numerical Investigation of Conceptional Design for Optimizing Cooling/ Heating Performance of Energy Storage System with Heat Pump and Wind Guide** Hwabhin Kwon, Heesung Park

附錄 2 發表論文簡報

A power demand resilience analysis of the residential and commercial areas for Fengshan smart green community in Taiwan

Institute of Nuclear Energy Research
Hui-Wen Huang
December 13, 2019

Outline

- Introduction
- Architecture of the simulated areas
- Flow chart of simulation code
- Case studies
- Discussions

Introduction

- Definition of Resilience
  - Presidential Policy Directive (PPD) 21
    - "the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions.
    - Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents."
  - *PPD-21: Critical Infrastructure Security and Resilience (2013)* (Barack Obama)

Introduction

- As global climate change intensifies,
  - extreme weather, such as strong typhoons or heavy rainstorms, increases in frequency,
  - and the vulnerability of power infrastructure gradually worsens,
  - leading to an increased threat of power supply disruption.
- **Residential and commercial areas** are relatively densely populated areas.
- Backup power generation and storage facilities should be deployed in the areas.

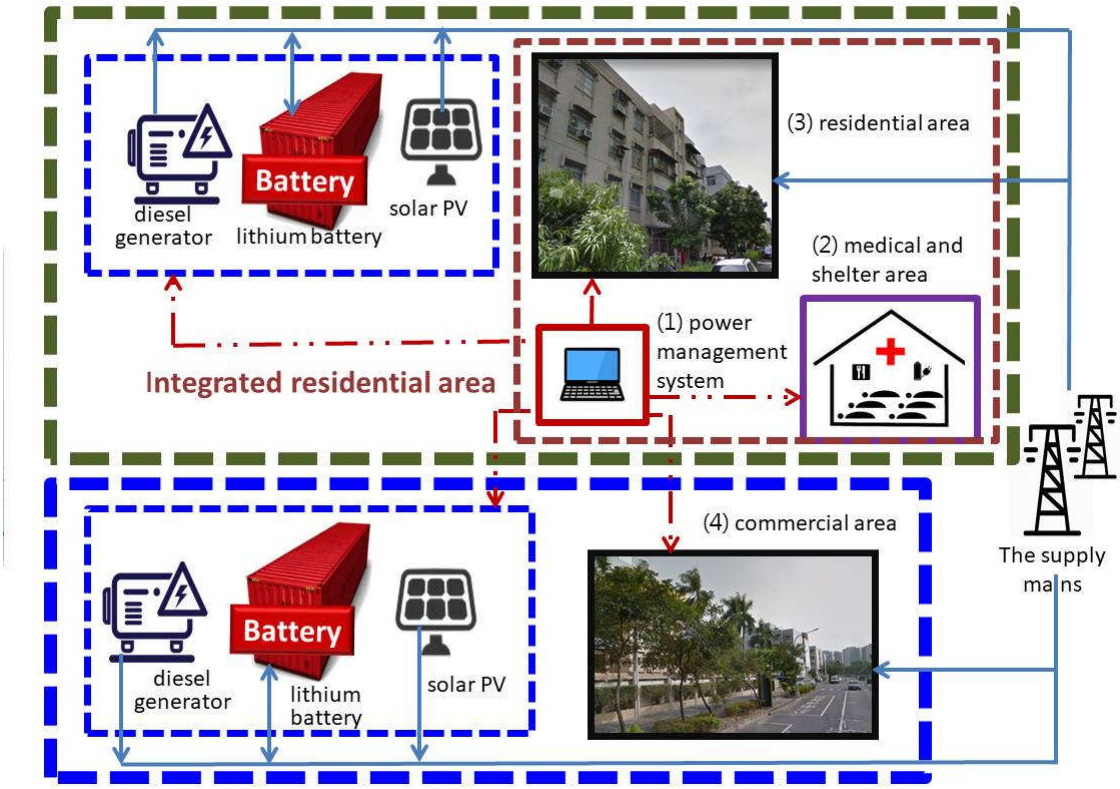
Introduction

- This study establishes a **computer analysis model** of power demand resilience
  - To analyze various power demand resilience scenarios, under the power disruption condition of the supply mains.
  - To discuss the operation of reasonable backup power generation and energy storage facilities
- Determine power supply management and control strategies for specific areas to mitigate disasters
- Programming language: Python

Architecture of the simulated areas

- This study takes the Fengshan Smart Green Community as the reference field
  - an integrated residential area and a commercial area.
- The integrated residential area includes:
  - a residential area
  - a medical and shelter area (simulated)
  - a power management system (simulated)


高鐵左營站
高雄火車站
高雄市
高雄港
小港國際機場
鳳山智慧綠社區
FengShan Smart
Green Community
捷運
鳳山西站
Integrated residential area
約6.75公頃
Commercial area


Battery
diesel
generator
lithium battery
solar PV
(3) residential area
(2) medical and
shelter area
(1) power
management
system
Integrated residential area
(4) commercial area
The supply
mains
Battery
diesel
generator
lithium
battery
solar PV

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Architecture of the simulated areas

- **The residential area**
  - **620 households**
  - According to the data of Taipower Company, the daily electricity consumption is 7,979kWh (simulated).
  - a roof-type solar photovoltaic system provides a maximum power of 1,550 kW (real installation, expanded)
  - a lithium battery (real installation)
    - Original design- storage 400kWh/ discharge 125kW/ charge 60 kW
      - Storage range: 80%(320kWh)/20%(80kWh)
      - only 60% Storage capacity is available
    - Expanded to 10 times –storage 4,000kWh/ discharge 1,250kW/ charge 600 kW
      - Storage range: 80%(3,200kWh)/20%(800kWh)

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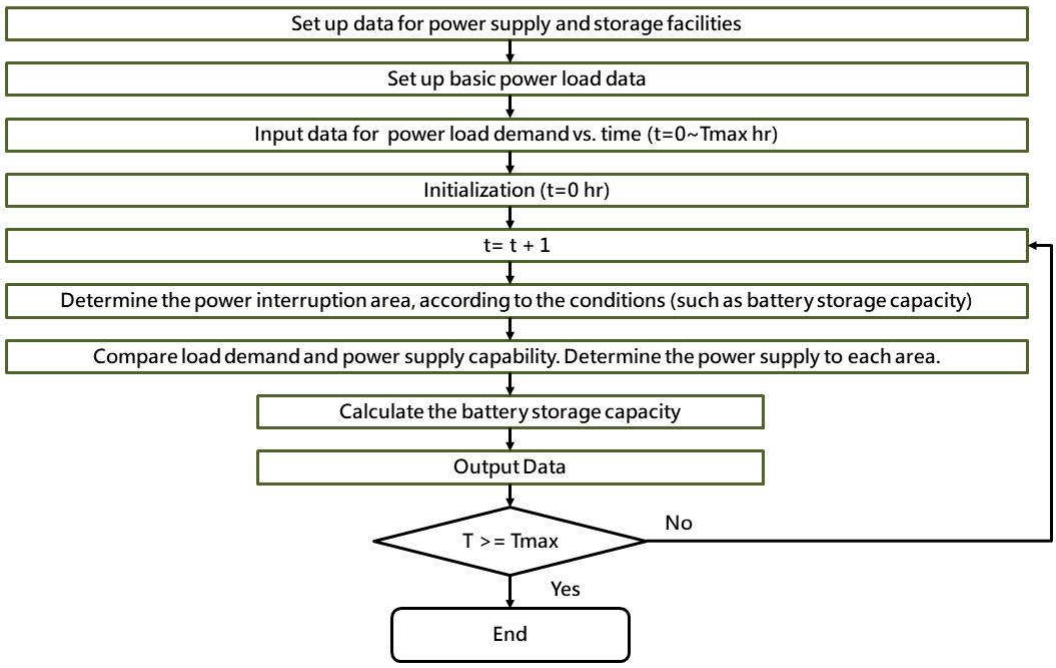
Architecture of the simulated areas

- **The residential area**
  - a diesel generator - 500 kW (simulated)
- **The medical and shelter area (simulated)**
  - The daily power consumption is assumed to be 10% of the residential area
  - Provides medical care and emergency shelter for the residents.
  - The second priority for power supply.
- **The power management system (simulated)**
  - The load demand is assumed to be 2kW
  - Responsible for controlling the power supply and storage facilities.
  - The first priority for power supply.

Architecture of the simulated areas

- **The commercial area**
  - 60 small shop users (simulated)
    - total daily power consumption of 3,631.8 kWh
  - a **roof-type solar photovoltaic system** (real installation)
    - maximum power generation of 600 kW
  - a **lithium battery** (real installation)
    - Original design- storage 1,000kWh/ discharge 500kW/ charge 250 kW
      - Storage range: 80%(800kWh)/20%(200kWh)
    - Expanded to 2 times –storage 2,000kWh/ discharge 1,000kW/ charge 500 kW
      - Storage range: 80%(1,600kWh)/20%(400kWh)
  - a **diesel generator** - 500 kW (simulated)

Flow chart of simulation code

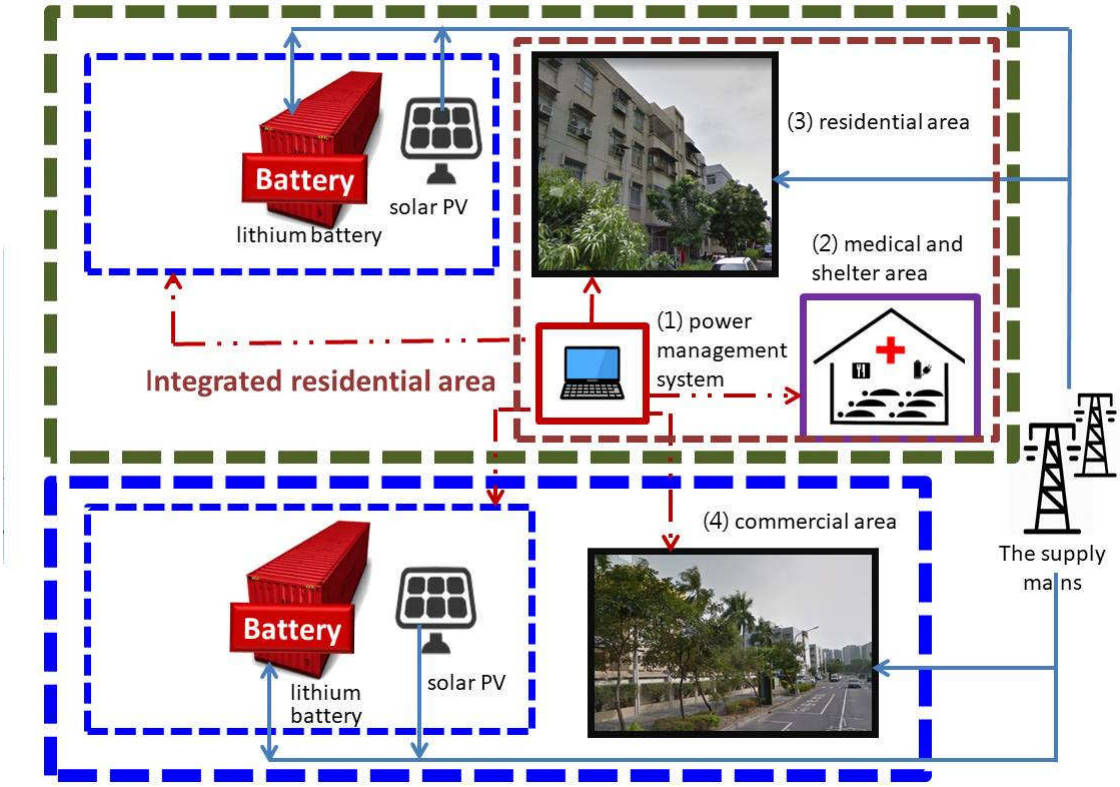


Case studies

- Baseline scenario
- "Activating diesel generators" scenario
- "Expanding lithium battery capacity " scenario
- "Expanding lithium battery capacity and controlling lithium battery power output in the integrated residential area" scenario

Case studies

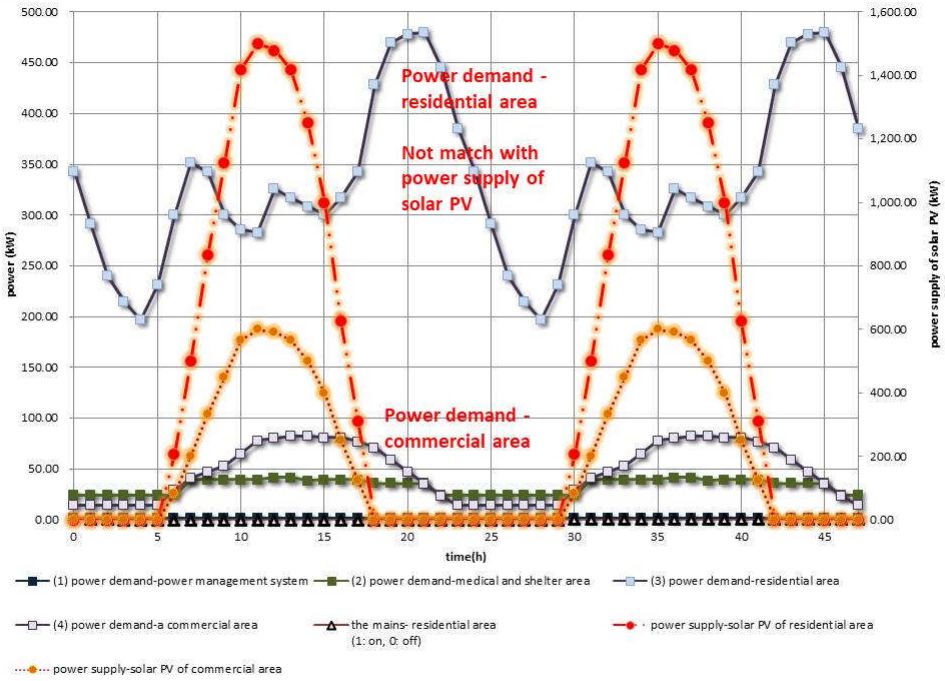
- **Baseline scenario**
  - Assumption
    - The supply mains is terminated at time=2hr., and restored at time = 28hr. (5am, the second day).
  - Analysis result
    - The integrated residential area
      - there is no solar power when the supply mains is interrupted,
      - the lithium-battery power supply capacity is 125kW, which is lower than the load demand in the residential area,
        - » only for the medical and shelter areas and the power management system.



Case studies

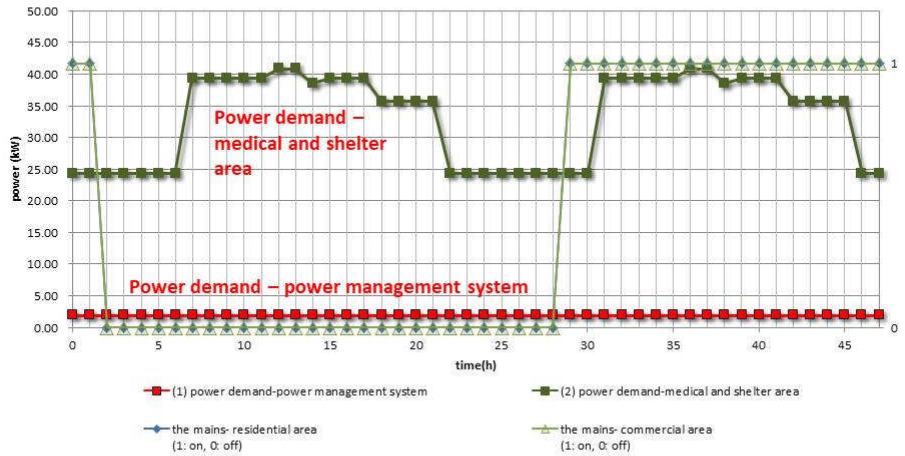
- **Baseline scenario**
  - Analysis result
    - The integrated residential area
      - After dawn, solar power is sufficient to restore power to the residential area.
      - After dark, it is no longer possible to supply solar power to the residential area.
      - The lithium battery supplies power to the medical and shelter area and power management system to time = 18hr (6 pm). ◦
    - The commercial area
      - After the supply mains is interrupted, the lithium battery continues to supply power,
      - the solar photovoltaic continues to supply power from time = 6 hr. to time = 17 hr.,
      - the lithium battery is exhausted time = 17 hr. (5 pm).

Input data



Power demand curve of each area

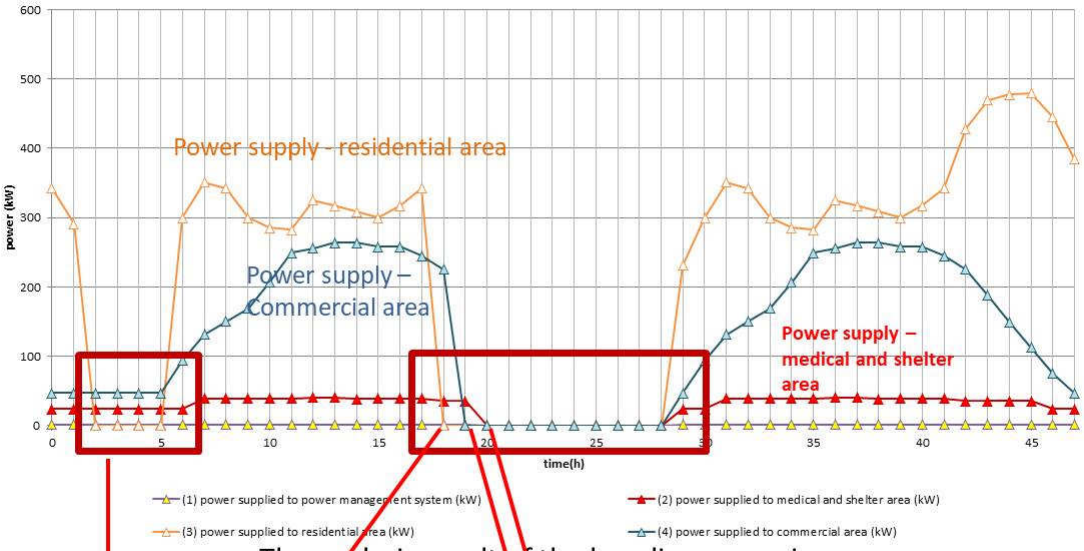
Input data



Power demand curve of the power management system and the medical and shelter area

Analysis result

After dark, without solar PV, the battery can only supply power for a short period of time.

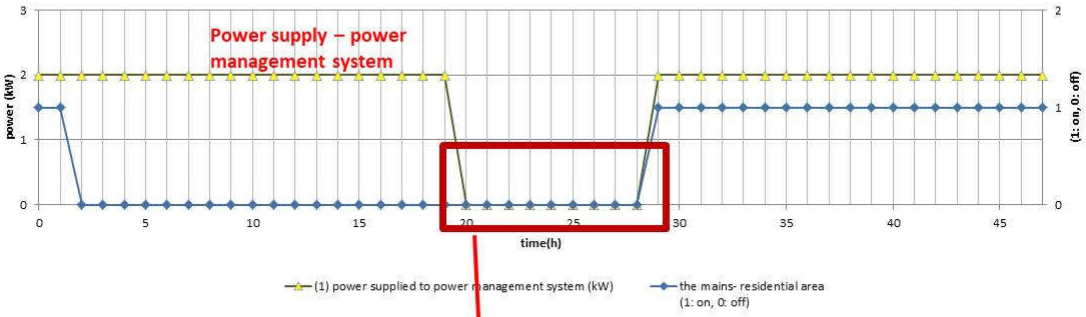


The analysis result of the baseline scenario

Battery discharge power < power demand of residential area

Battery storage capacity < 20%,
No discharge power output.

Analysis result

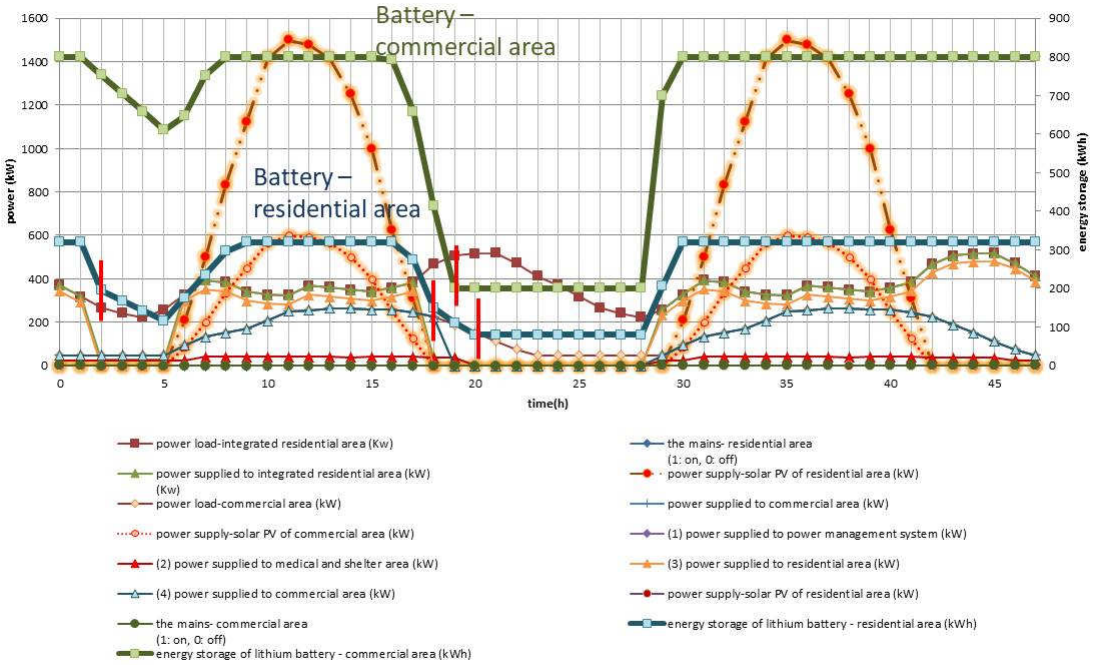


Power supply to power management system

Battery storage capacity < 20%,
No discharge power output.

After dark, without solar PV, the battery can only supply power for a **short** period of time.
Not even for supplying power to power management system.

Analysis result



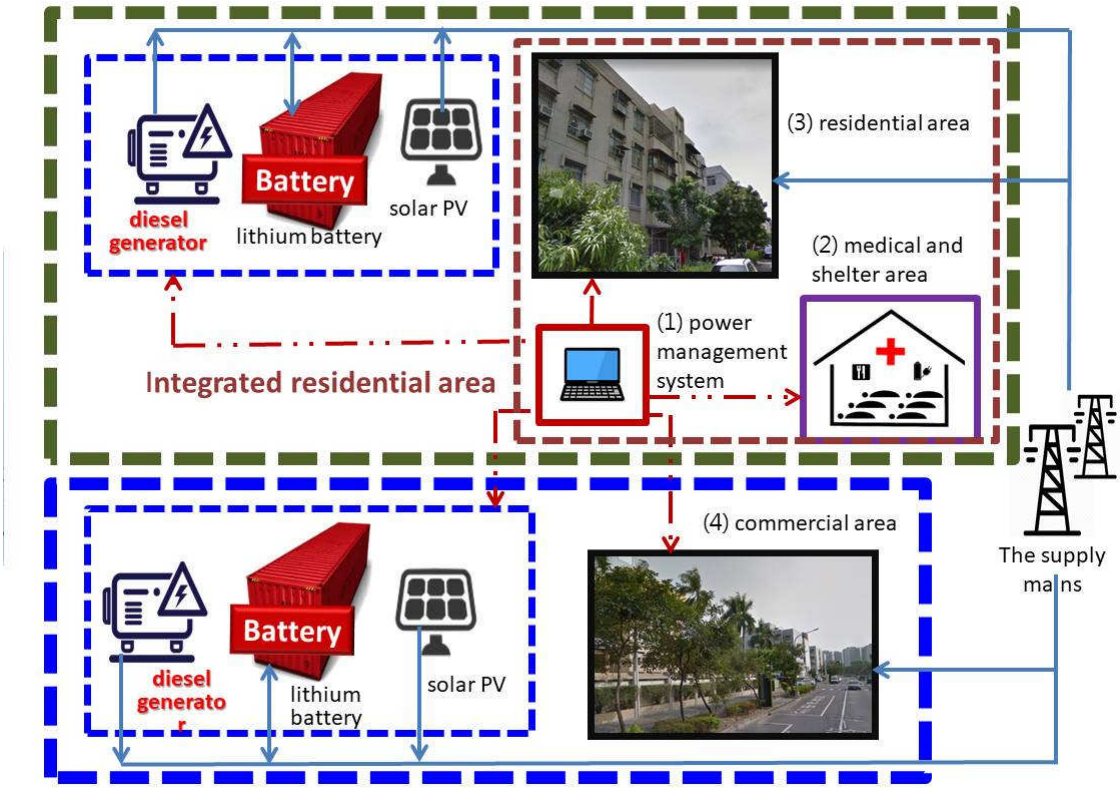
The analysis result of the baseline scenario

Case studies

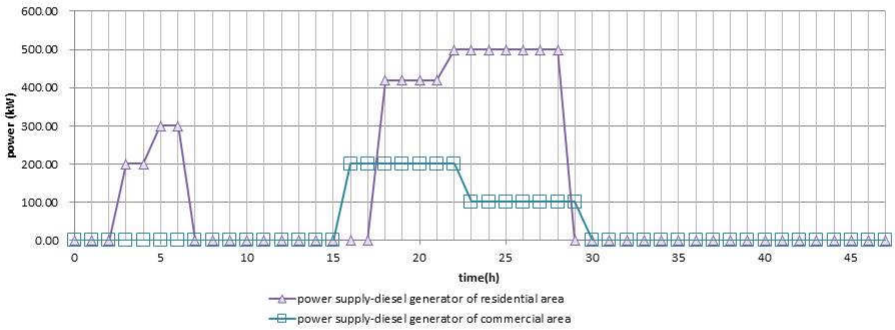
- **"Activating diesel generators" scenario**
  - Assumption
    - the supply mains is terminated at time = 2hr., and restored at time = 28hr.
    - There are 500 kW-diesel generators in the integrated residential area and the commercial area individually.
  - Analysis result
    - The integrated residential area
      - After the interruption of the supply mains at time = 2hr, the **diesel generator** provides sufficient power and is a backup for solar PV and the lithium battery.

Case studies

- "Activating diesel generators" scenario
  - The commercial area
    - –The diesel generator can adequately supply power to the commercial area.
  - This scenario shows that the diesel generators can adequately compensate for the period when the power supply of solar power with lithium battery is insufficient.

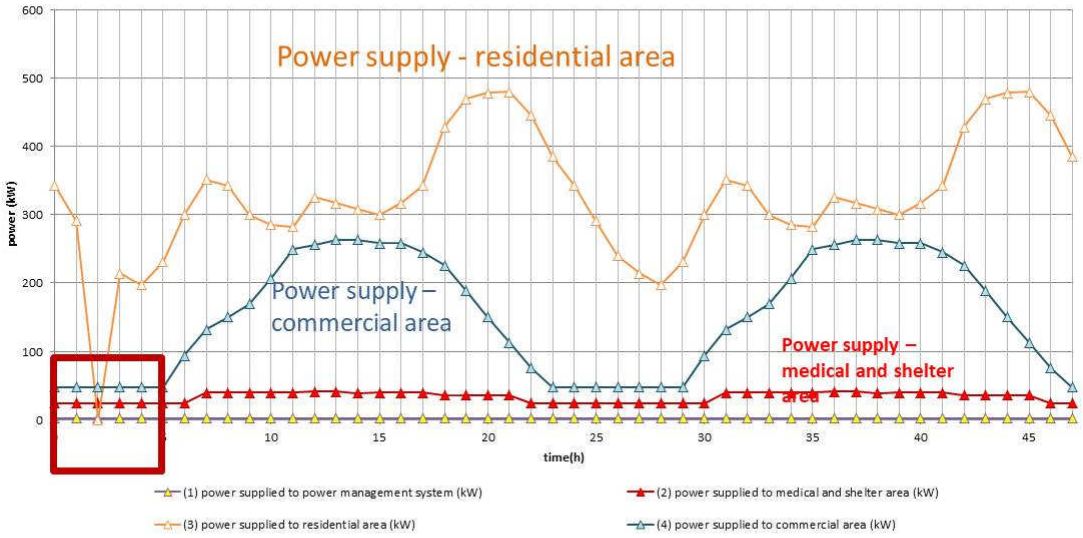


Input data



Power supply curve of the diesel generators

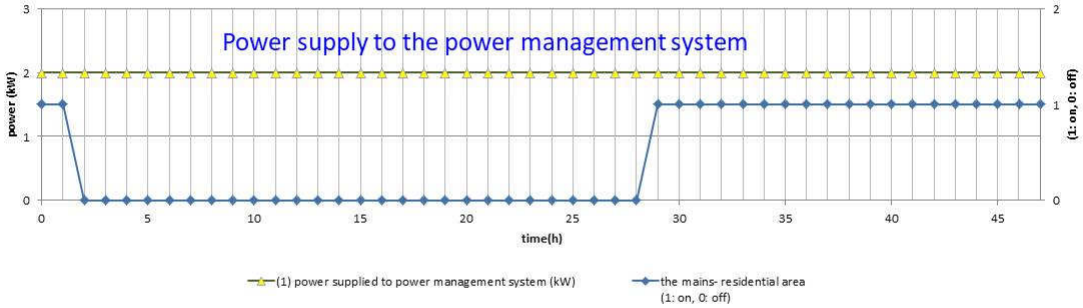
Analysis result



The analysis result of “activating diesel generators" scenario

***No disruption after activating the diesel generators**

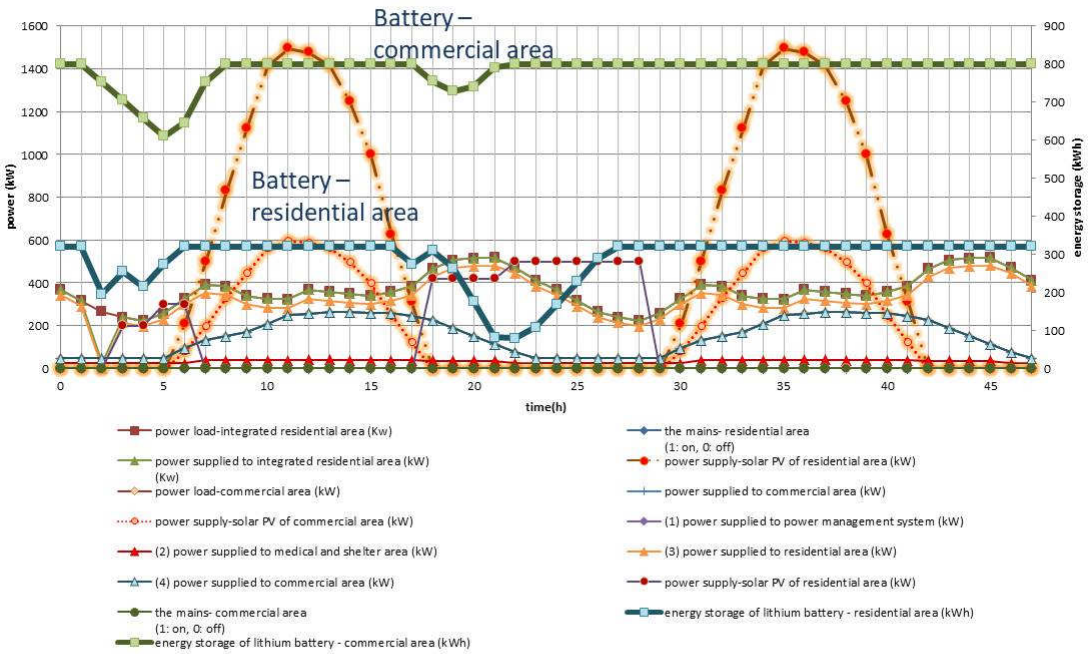
Analysis result



The analysis result of “activating diesel generators" scenario

***No disruption after activating the diesel generators**

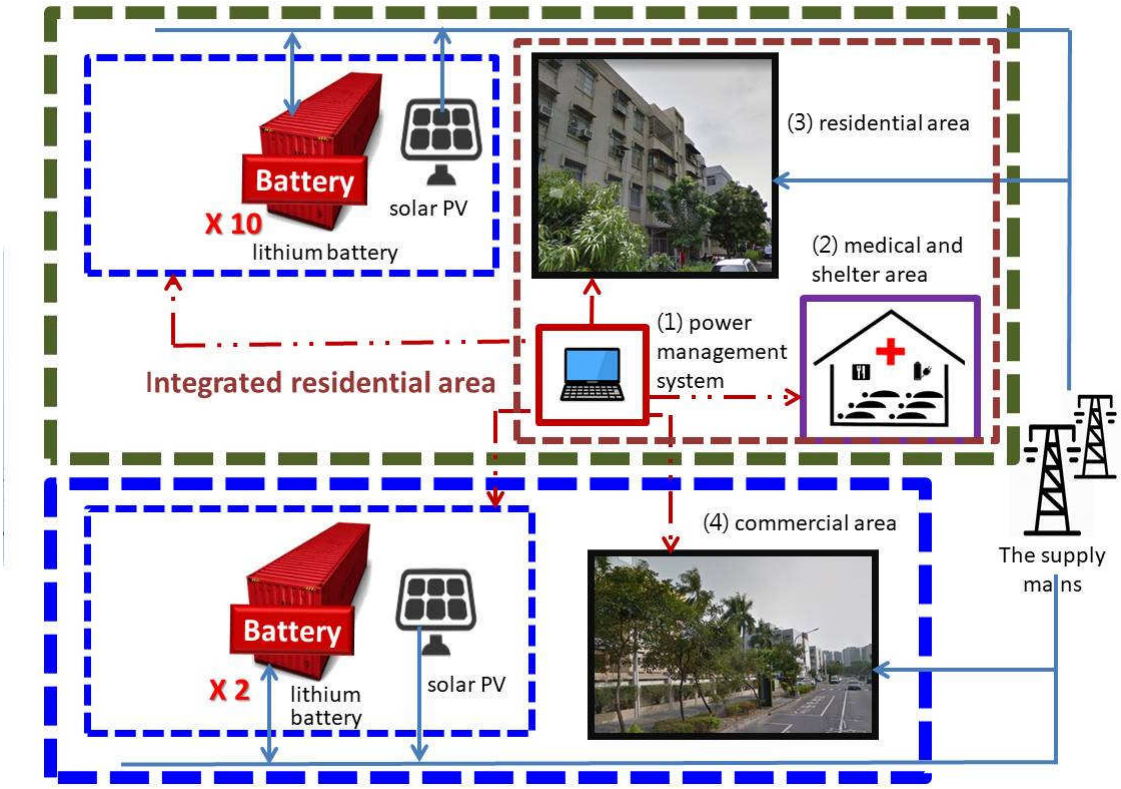
Analysis result



The analysis result of “activating diesel generators" scenario

Case studies

- "Expanding lithium battery capacity " scenario
  - Assumption
    - the supply mains is terminated at time = 2hr., and restored at time = 28hr.
    - The diesel generators are not used.
    - The integrated residential area
      - the lithium battery storage capacity is expanded to be ten times of the original storage capacity
    - The commercial area
      - the lithium battery storage capacity is expanded to be two times of the original storage capacity



Case studies

- "Expanding lithium battery capacity " scenario
  - Analysis result
    - The integrated residential area
      - When the supply mains is interrupted, the expanded lithium battery supplies power to the area continuously.
      - After dawn, the solar photovoltaic provides power and also charges the extended lithium battery.
      - After dark, the solar power was terminated at time = 17 hr.
      - The expanded lithium battery outputs power to the residential area, the medical and shelter area, and the power management system until time = 22 hr,
      - because the expanded lithium battery capacity < 20%.

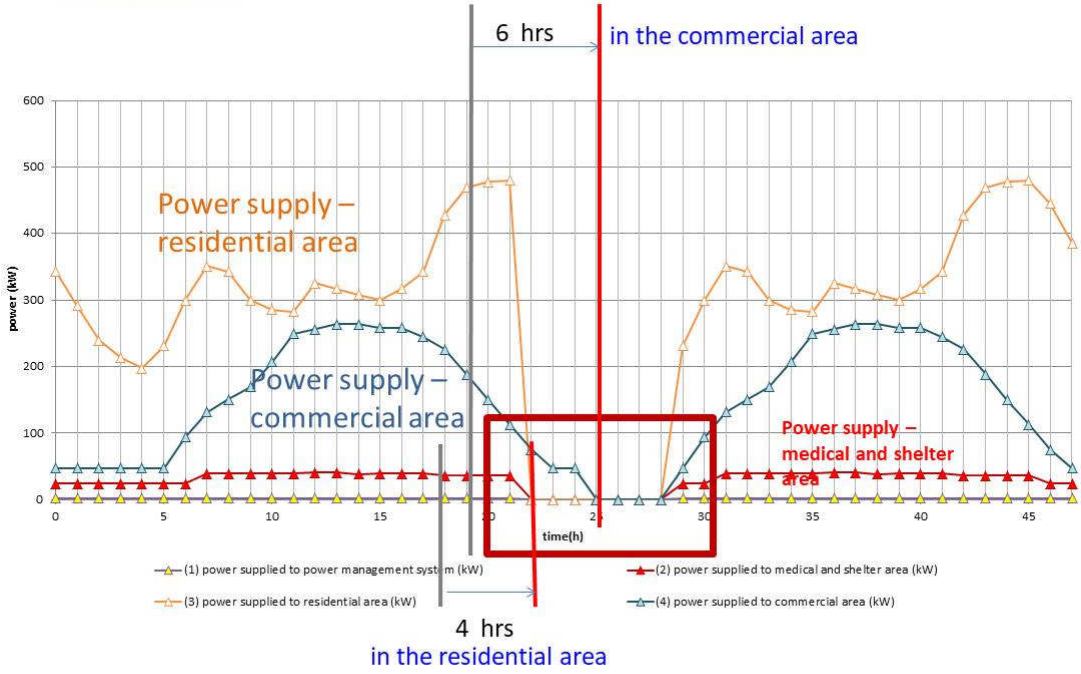
Case studies

- "Expanding lithium battery capacity" scenario
  - Analysis result
    - The commercial area
      - When the supply mains is interrupted, the expanded lithium battery supplies power to the area continuously.
      - After dawn, the solar photovoltaic provides power and also charges the extended lithium battery.
      - After dark, the expanded lithium battery outputs power to the commercial area until time = 25 hr., because the expanded lithium battery capacity < 20%.

Case studies

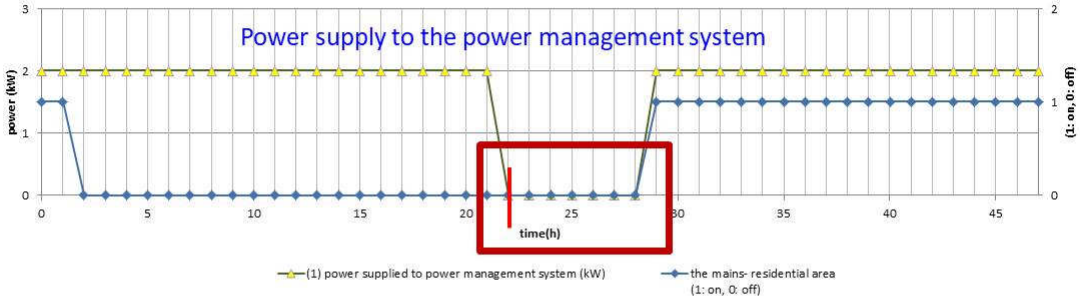
- **"Expanding lithium battery capacity " scenario**
  - Analysis result
    - This scenario shows that expanding lithium battery capacity can extend the power supply duration for 4hrs in the residential area.
      - The medical and shelter area and the power management system are still interrupted at time = 22hr.
    - The power supply duration extends for 6hrs in the commercial area comparing to the baseline scenario after dark.

Analysis result



The analysis result of "expanding lithium battery capacity" scenario

Analysis result

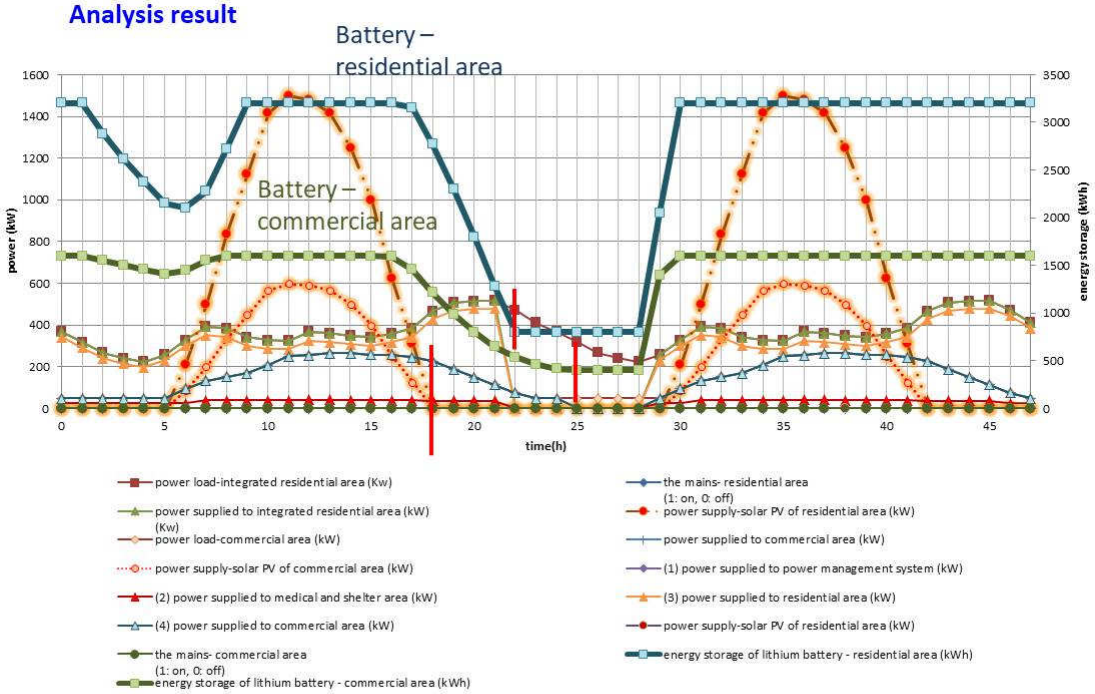


The analysis result of "expanding lithium battery capacity" scenario

After dark, without solar PV, the battery can only supply power for a **longer** period of time.

The expanded lithium battery outputs power to the residential area, the medical and shelter area, and the power management system until time = 22 hr, because the expanded lithium battery capacity < 20%.

Analysis result



The analysis result of "expanding lithium battery capacity" scenario

Case studies

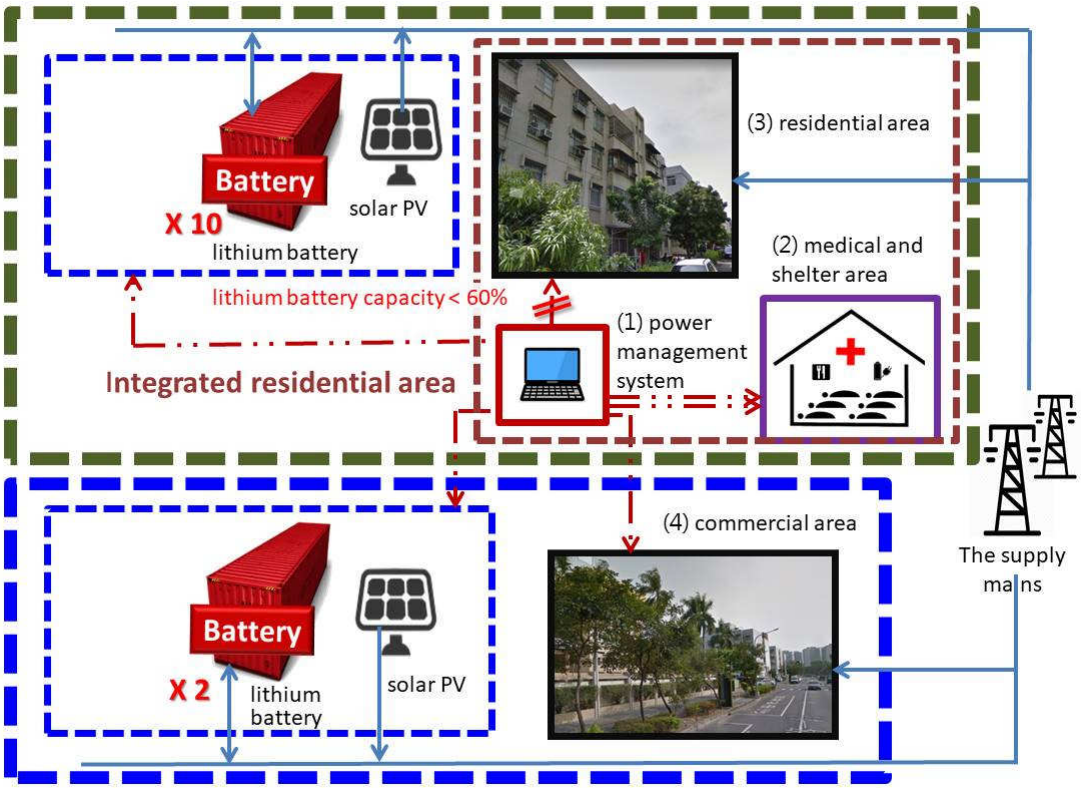
- **"Expanding lithium battery capacity and controlling lithium battery power output in the integrated residential area" scenario**
  - Assumption
    - the supply mains is terminated at time=2hr, and restored at time = 28hr.
    - The diesel generators are not used.
    - The integrated residential area
      - The lithium battery storage capacity is expanded to be ten times of the original storage capacity
      - For ensuring the power supply to the power management system and the medical and shelter area,
      - the lithium battery will stop supplying power to the residential area as the stored energy is below **60%.**
    - The commercial area
      - The lithium battery storage capacity is expanded to be two times of the original storage capacity

Case studies

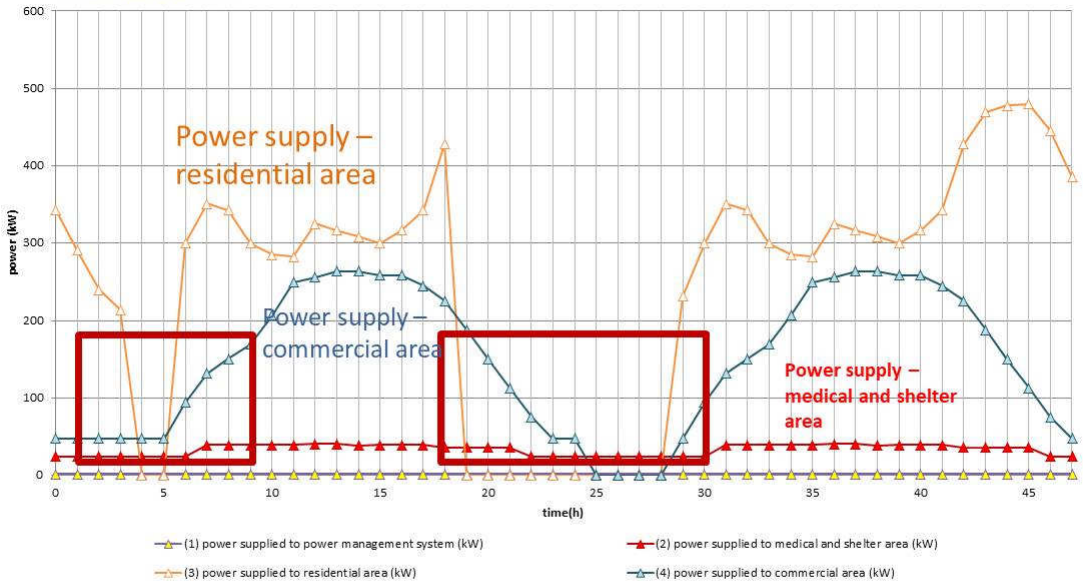
- **"Expanding lithium battery capacity and controlling lithium battery power output in the integrated residential area" scenario**
  - Analysis result
    - The integrated residential area
      - During the periods of time = 4hr. to 5hr. and time = 18hr. to 28hr., the lithium battery stop supplying power to the residential area,
      - this management successfully **ensures the power supply to the power management system and the medical and shelter area.**

Case studies

- **"Expanding lithium battery capacity and controlling lithium battery power output in the integrated residential area" scenario**
  - Analysis result
    - The commercial area
      - the result is the same as that of the "expanding lithium battery capacity" scenario.
    - This scenario shows that by expanding lithium battery capacity and controlling lithium battery power output in the integrated residential area,
      - the power supply to the power management system and the medical and shelter area **can effectively ensure.**



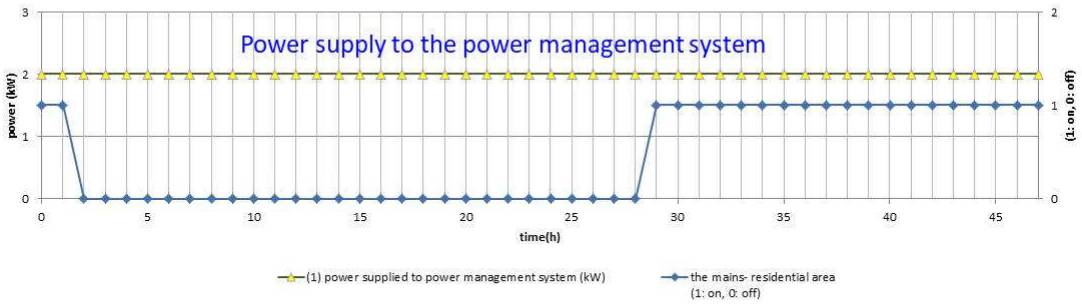
Analysis result



The analysis result of "Expanding lithium battery capacity and controlling lithium battery power output in the integrated residential area" scenario

* The power supply to the power management system and the medical and shelter area **can effectively ensure.**

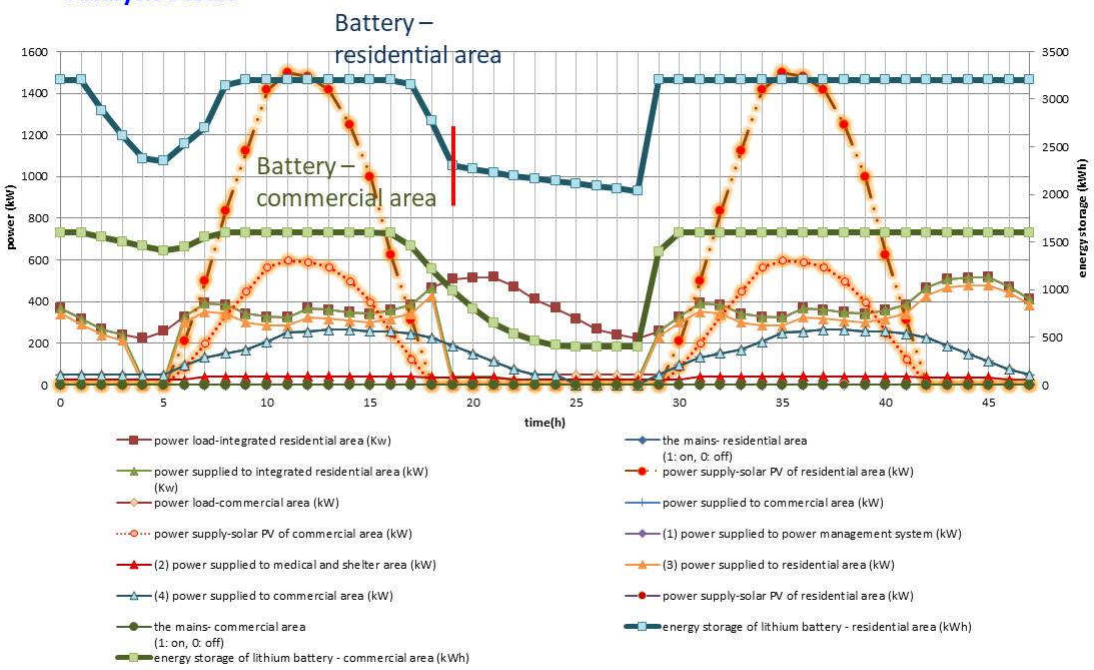
Analysis result



The analysis result of "Expanding lithium battery capacity and controlling lithium battery power output in the integrated residential area" scenario

* The power supply to the power management system and the medical and shelter area **can effectively ensure.**

Analysis result



The analysis result of "Expanding lithium battery capacity and controlling lithium battery power output in the integrated residential area" scenario

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Discussions

- To cope with the intensified global climate change and extreme weather,
  - adequate deployment of various backup power generation and storage facilities to enhance power resilience can effectively mitigate the threat of power supply disruption.
- According to the case study results, there is sufficient solar PV in the residential area of Fengshan Smart Green Community.
  - However, the energy storage and power supply capacity of **lithium battery are insufficient**, and it is challenging to perform the backup power function.

Discussions

- To supply electricity to the power management system and the medical and shelter area adequately,
  - this study suggests Fengshan Smart Green Community expanding the power storage and power supply capacity of lithium batteries.
- Solar PV is zero-carbon power; it can be a first priority backup for power demand resilience.
  - However, solar power would not be available if there is insufficient sunshine.

Discussions

- Diesel generator can flexibly assist the solar PV and lithium batteries to ensure the adequate power supply.
- Although a diesel generator pollutes the environment, under the reason of disaster reduction,
  - it is still a useful disaster reduction facility while other power supply backups are insufficient.


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附錄 3 發表論文摘要

A power demand resilience analysis of the residential and commercial areas for Fengshan smart green community in Taiwan

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Abstract. This study establishes a software analysis model of power demand resilience in the residential area, analyzes various power demand resilience scenarios, discusses the operation of reasonable backup power generation and energy storage facilities, and power load management and control strategies. In the future, these software tools will be used to analyze the rational allocation and operation strategies of disaster prevention at power facilities in similar situations. This study takes the Fengshan Smart Green Community as the reference field, and extends the simulated facilities as the area of power demand resilience analysis, in an integrated residential area and a commercial area. This study has completed four case studies, including: (1) baseline scenario, (2) "use of diesel generators" scenario, (3) "expanding lithium battery capacity" scenario, and (4) "expanding lithium battery capacity and controlling lithium battery power output in the integrated residential area" scenario. The conclusions of this study include: (1) To cope with the intensified global climate change, adequate deployment of various backup power generation and storage facilities to enhance power resilience can effectively mitigate the threat of power supply disruption. (2) According to the case study results, there is sufficient solar photovoltaic in the residential area of Fengshan Smart Green Community. However, the energy storage and power supply capacity of lithium batteries are insufficient, and it is challenging to perform the backup power function. (3) To supply electricity to the power management system and the medical and shelter area adequately, this study suggests Fengshan Smart Green Community strengthens the power storage and power supply capacity of lithium batteries. (4) Solar photovoltaics are zero-carbon power; it can be a priority backup for power demand resilience. However, solar power is not available when there is insufficient sunshine. (5) The use of a diesel generator can flexibly assist the solar photovoltaic and lithium batteries to ensure the adequate power supply. (6) The use of diesel generators for power generation during a time of crisis is not pollution-free. However, their use for management in a crisis or disaster situation is in order when other power supply backups are insufficient or have failed.

Keywords: Software analysis model, Power demand resilience, Power load management