

出國報告（出國類別：其他）

## 參加 2016 永續與再生能源工程國際研討會(ICSREE 2016)出國報告

服務機關：核能研究所

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派赴國家：韓國首爾

出國期間：105 年 5 月 4 日~105 年 5 月 8 日

報告日期：105 年 5 月 16 日



## 摘要

此次公差主要為配合核研所目前執行的「風能系統工程」計畫，前往韓國首爾參加 2016 永續與再生能源工程國際研討會(International Conference on Sustainable and Renewable Energy Engineering, ICSREE 2016)於 105 年 5 月 5 日 ~ 105 年 5 月 7 日舉辦。2016 永續與再生能源工程國際研討會研討會，約有 18 個國家參加及 52 篇論文投稿。本所風機技術團隊發表 1 篇會議論文，除推廣核研所自製風機與研發技術外，亦對於計畫績效有所貢獻，且可聽取相關領域之專家學者研發成果，增進風能系統工程之研究議題之交流，提升我國於中小風機與大型風機之研發技術能量，與精進設計驗證相關之技術。此次職發表之論文亦獲選為最佳論文。

綜合此次公差之成果與心得，提出以下幾項建議：(一)以大陸地區的風電發展目標而言，陸域之風電之比重高於離岸風電，此是因為大陸地區有廣大的陸域面積可設置陸域風電，但我國陸域有限且安裝之陸域風電幾近飽合，故我國應更積極朝向離岸風電之發展；(二)就風力機安裝比例而言，大陸地區於 2014 年安裝量提高 23.2%高居全球第一，遠高於排名第二美國之 4.9%，因此大陸地區為近年來發展風電最主要的國家，其相關經驗亦可供我國發展風電之參考，我國應持續關注其發展狀況，情況許可下與其適當交流學習；(三)我國因 98.5%之能源仰賴進口，且目前主要仍是以燃煤之火力發電為主，故煤之價格波動對我國之能源安全影響堪巨，而發展風電等再生能源則可降低此風險，因此我國應持續投入風力等再生能源之發展，並有效提高其比例；(四)離岸風電工程開發與建設涵蓋的領域相當廣且及技術甚為複雜，而大陸地區結合探油技術與封存之離岸設施之建立，包括各種海上工程與船運、港口等建設之經驗，於我國發展離岸風電所遭遇到之技術瓶頸，或可供參考，我國應持續觀察此方面的發展狀況，並就技術層面進行適當的交流與學習；(五)目前本所風機分組主要採用 IEC 與 GL 之規範，但如何將本土化之各種負載，如颱風及地震等極端條件及軟弱海床等特性納入規範當中，乃是應持續且積極進行之研究方向。

**關鍵字：** ICSREE、離岸風機、水動力分析、支撐結構

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# 一、目的

國內目前配合政府再生能源發展的政策規劃，經濟部於 101 年 7 月通過風力發電離岸系統示範獎勵辦法。此外，科技部為配合國內離岸風機的設置亦透過能源國家型計畫，推動離岸風力主軸計畫，整合各界之科技研發資源，以協助相關技術的建立，以期能夠順利推動風力發電政策。

核能研究所之風機分組過去的風機研發主要以中小風機技術建立為主，經歷 400W、25 kW 及 150 kW 的中小型風機研製，是目前國內唯一具有完整之設計與系統整合技術能力的國家級實驗室。而另外大型與離岸風機亦開始著手就國際規範 IEC 與 GL 於本土化環境之適用性評估之工作，並嘗試由分析結果建立適用於本土化環境之設計驗證程序。因此，為精進中小型風機系統設計、分析、測試及運轉之機械系統整合工程技術能力與大型及離岸風機之技術能力，此次公差主要為配合核研所目前執行的「風能系統工程」計畫，前往韓國首爾參加 2016 永續與再生能源工程國際研討會(International Conference on Sustainable and Renewable Energy Engineering, ICSREE 2016)於 105 年 5 月 5 日 ~ 105 年 5 月 7 日舉辦，並於會議中發表 1 篇論文，題目為：「Hydrodynamic Analysis for a Jacket-type support structure of the offshore wind turbine」。

此次公差參與 2016 永續與再生能源工程國際研討會共計 5 天，主要藉由參與國際研討會發表論文，以及瞭解國外於風機之技術發展現況與相關經驗，除對於計畫績效有所貢獻外，並可聽取專家學者之研發成果，增進風能系統工程研究議題之交流，提升我國於中小風機與大型風機之研發技術能量，與精進設計驗證相關之技術。相關成果有助於本所「中小型風機工程技術研發」計畫及「大型風機工程技術研發」計畫的執行及未來風能研發方向之規劃。

## 二、過 程

此次公差由 105 年 5 月 4 日至 5 月 8 日，共計 5 天。主要是參加在韓國首爾之 Mercure Ambassador Gangnan(江南國賓美居酒店)所舉辦的「2016 永續與再生能源工程國際研討會」，相關行程規劃如表一。此行主要藉由參與國際研討會並發表論文，以瞭解國外於風機技術之研發現況與相關經驗，除對於計畫績效有所貢獻外，並可聽取專家學者之研發成果，增進風能系統工程之研究議題之交流，提升我國於中小風機與大型風機之研發技術能量，與精進設計驗證相關之技術。

表一 公差行程表

日期	行程
5/4(星期三)	去程
5/5(星期四)	註冊報到、簡報資料整理與準備
5/6 ~ 5/7(星期五 ~ 六)	參加 ICSREE 2016 研討會
5/8(星期日)	回程

行程及工作日誌大要如下：

### (一) 5 月 4 日至 5 日，去程及資料準備

按照原定計畫搭乘 5 月 4 日 13 點 25 分之中華航空之班機前往韓國，約於 17 時抵達仁川國際機場。並於當地時間晚上 20 時抵達江南區之會議酒店。5 月 5 日則前往大會之會場進行報到與註冊之手續，並領取相關會議文件後，回到房間進行資料研讀，並選定與研究計畫相關之論文發表場次準備前往聆聽與交流，並準備論文發表之預演。

## (二) 5月6日至7日，ICSREE 2016 研討會

5/6 日前往舉行 ICSREE 2016 研討會之會場參與會議並準備發表論文；圖一為職於會場入口處之照片。



圖一、ICSREE 2016 研討會會

本次會議參與者來自許多不同國家，就亞洲區包括：香港、大陸地區、馬來西亞、泰國、越南、台灣、菲律賓、日本與主辦國南韓等，歐洲則有來自德國的專家，亦有來自美國之專家，另外還有包括以色列、印度、南非、俄羅斯，澳洲與阿拉伯聯合大公國等國家之成員參與，足見此次會議之重要性。當天出席人員的合照如圖二所示。



圖二、ICSREE 2016 參與人員合影

本次大會於 5/6 早上 09:00 由來自香港大學之 Dennis Y. C. Leung 教授致詞並隆重舉行開幕儀式，如圖三所示。





圖三 開幕儀式

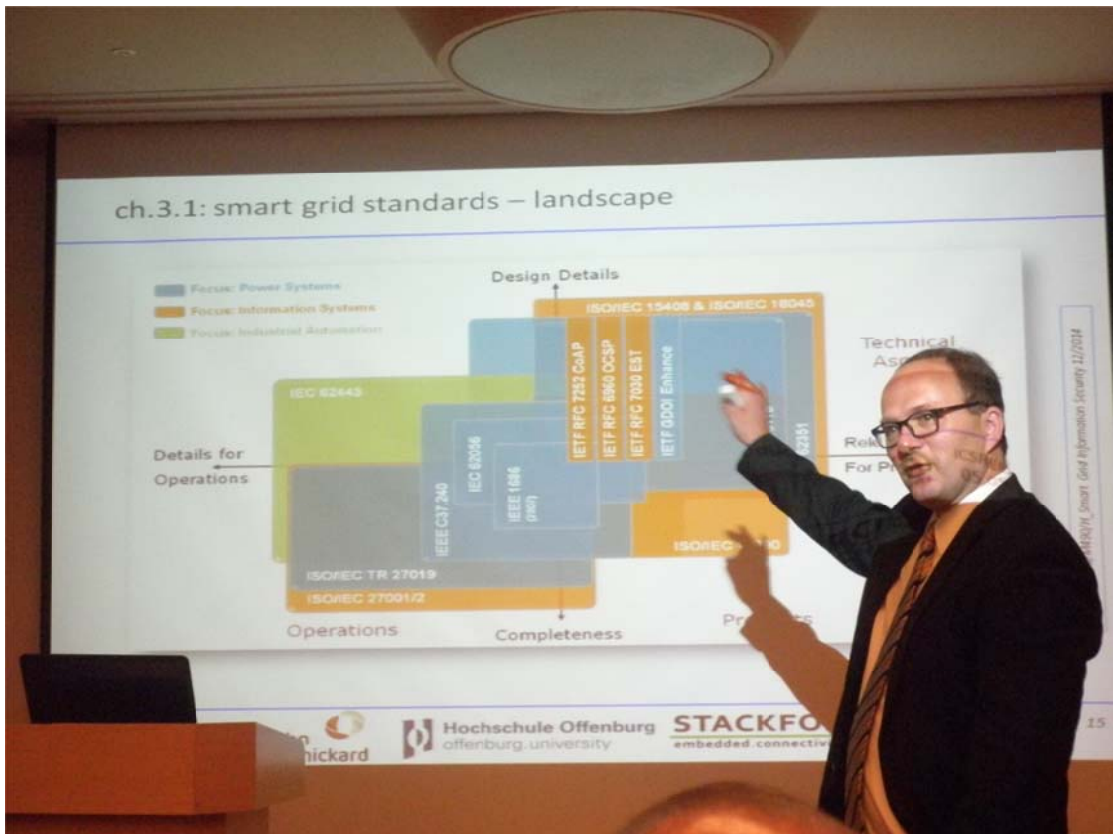
開幕儀式後緊接著介紹開幕專題演講的三位貴賓，Yanglong Hou 教授、Dennis Y. C. Leung 教授與 Dr.-Ing. Axel Sikora 教授分別進行開幕演講，主題分別為「Nanostructured Hybrid Materials for Lithium-based Batteries」（如圖四）、「Prospects and challenges of China in moving towards a sustainable energy future」(如圖五)與「Secure Communication for Smart Grid Systems」（如圖六），現場與會人士參與十分踴躍並提問。第一位 Yanglong Hou 教授演講之主題與鋰電池及奈米材料複合技術有關，部份演講摘錄於圖七與圖八。



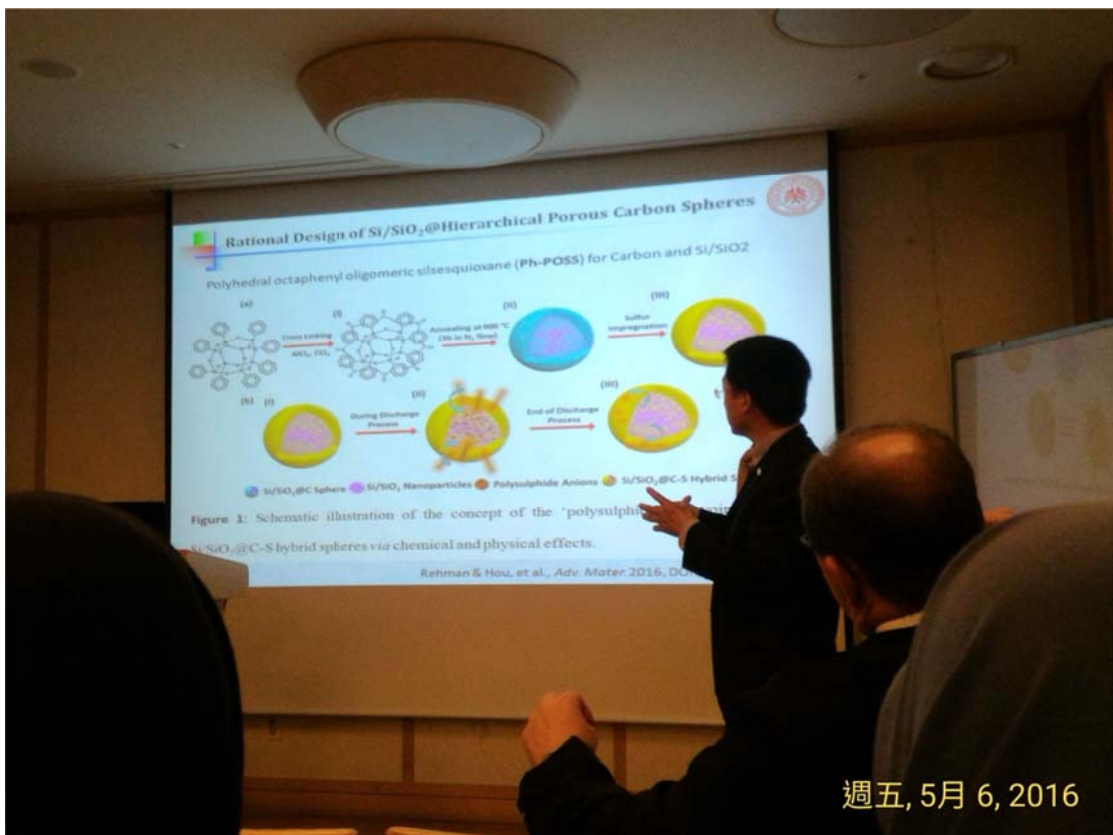
圖四 開幕演講 1



圖五 開幕演講 2



圖六 開幕演講 3



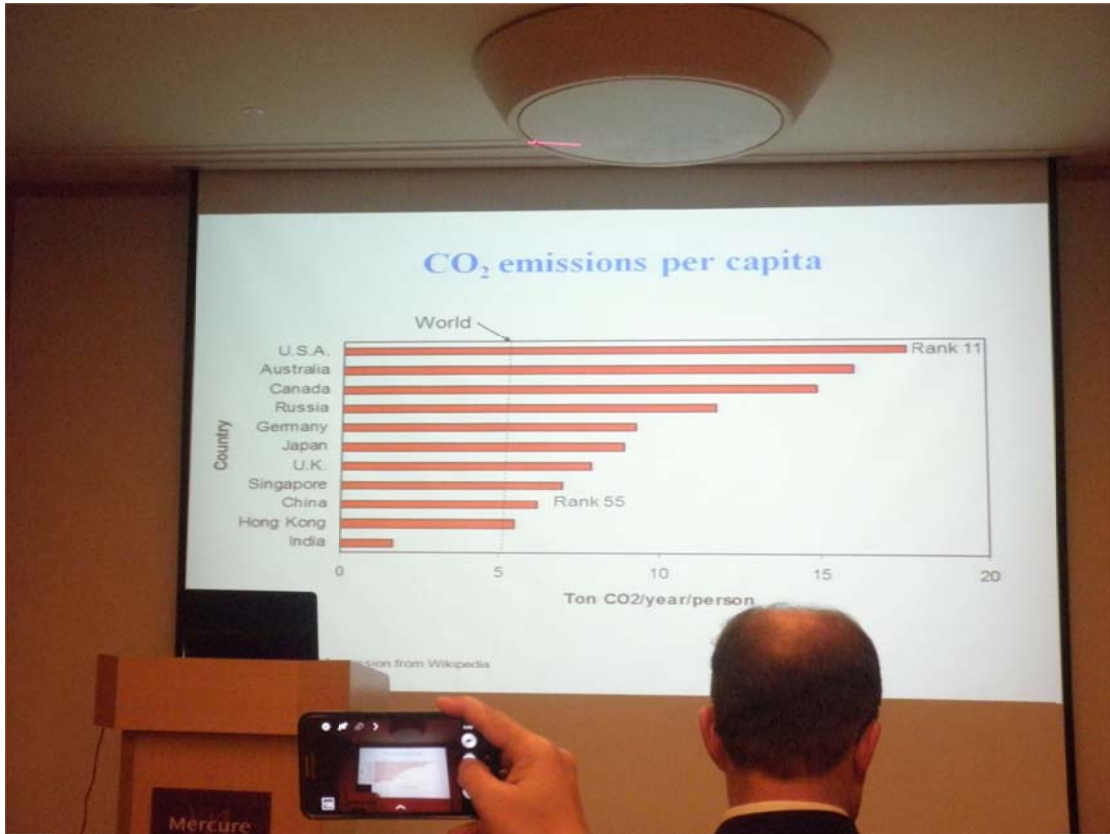
圖七 開幕演講 1 之節錄內容 1



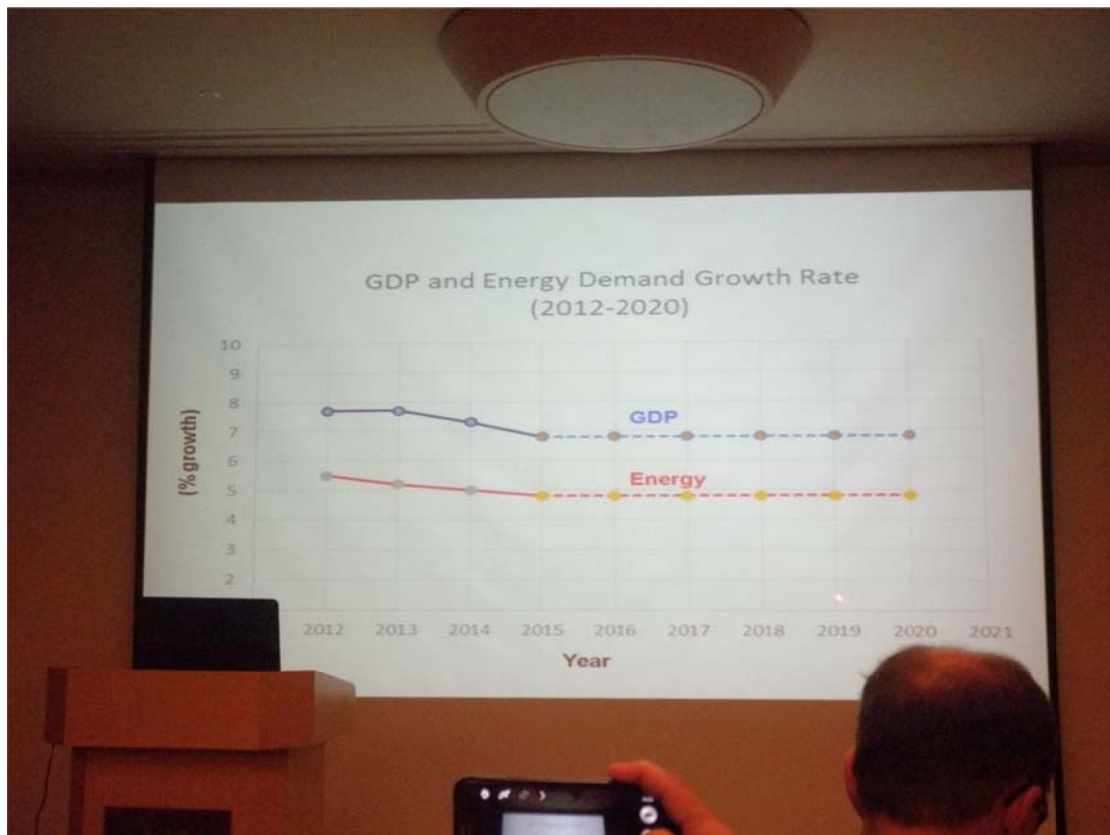
圖八 開幕演講 1 之節錄內容 2

第二位演講者由來自香港大學之 Dennis Y. C. Leung 教授就大陸地區發展永續與再生能源之觀點與挑戰進行說明，茲摘錄部份演講內容如圖九~二十所示。以排碳量而言，大陸地區之總量為全球第一。經濟發展與能源使用量之相關性目前呈現正相關，另言之，若為達到設定之減碳目標而抑制能量使用量，將可能導致經濟發展遭受不利之影響，因此如何於兩者間取得平衡，或使兩者之走勢脫勾，亦為一重要課題。目前大陸地區仍以煤碳為主要發電管道，但值得注意的是第二高的水力發電比重逐年降低，而其它項目包括風力與太陽能等再生能源之比重則逐年提高。而要達到設定之減碳目標之有效方法不外乎：(1)使用潔淨能源，(2)提高再生能源比例，(3)採用淨煤技術，(4)發展核電，(5)碳捕獲與封存，(6)提高能源轉換效能與節能等方法。其中核能部份，我國目前之發展走向還不明確，但其它提及之方法，包括使用潔淨能源、提高再生能源，淨煤技術、碳捕獲與封存等發展方向與本所目前進行當中之永續能源技術與策略發展應用計畫中之項目一致，顯示本所執行此計畫與國際趨勢一致，且突顯此計畫之重要性。而目前再生能源佔比除了加拿大高達 59%、而歐洲尚有 14%以外，其餘世界各國都明顯偏低。另外設定在約 2020~2024 年的目標大約在 15%~20%左右。而大陸地區在各

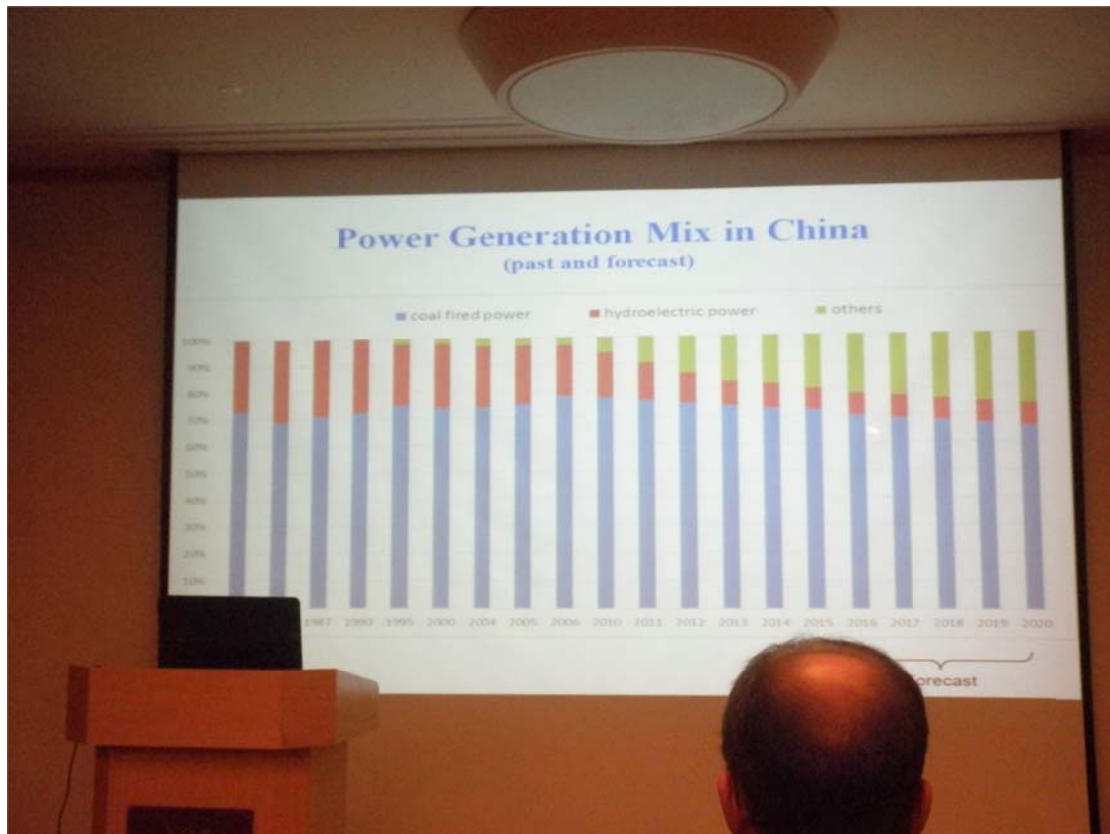
種再生能源的潛力方面，風能約有 1000 GW(陸域 250 GW，海域 750 GW)。太陽能則有 520 GW 左右。而在再生能源的發展目標方面，太陽能預定從 38 GW 提升至 100 GW，而風力則是從 100 GW 至 200 GW，其中離岸風力是從 5 GW 增加到 30 GW，因此在比重方面，陸域之風電仍是高於離岸風電，此是因為大陸有廣大的陸域面積可設置陸域風電，但我國陸域有限且幾近飽合，故目前正朝向發展離岸風電為主。就風力機安裝比例而言，大陸地區於 2014 年安裝量提高 23.2%高居全球第一，遠高於排名第二美國之 4.9%，因此大陸地區為近年來發展風電最主要的國家，其相關經驗亦可供我國發展風電之參考。而在成本部份，不同國家發展再生能源之成本亦有所不同，風力方面範圍約在 0.059~0.09 (US\$/kWh)，太陽能則是 0.12~0.19(US\$/kWh)，而水力約在 0.03~0.11(US\$/kWh)，歐洲地區發展水力發電成本較高，而生質能部份約在 0.05~0.08(US\$/kWh)，變動較小。但值得注意的是使用傳統的煤碳，其成本僅有 0.00265(US\$/kWh)，遠低於目前所有再生能源的成本。相較於大陸地區的風電而言，使用煤的成本只要其 4.5%，另言之，風電的成本比燃煤高出 20 倍有餘。此一價格差異實為發展再生能源與達到減碳目標之最大阻力。我國因 98.5%之能源仰賴進口，且主要仍是以燃煤為主，故煤之價格波動對我國之能源安全影響堪巨，而發展風電等再生能源則可降低此風險，因此我國應持續投入風力等再生能源之發展，並有效提高其比例。另外淨煤技術部份，目前光是大陸地區的煤礦存量就足夠使用最高達 100 年之久，因此低價煤勢必造成發展再生能源之阻力之一，所以可大幅減少排碳量之淨煤技術例如 IGCC 與 PFBC 等之長期發展亦為重要課題，此與本所之永續能源技術與策略發展應用計畫當中之淨煤技術觀點一致。而碳捕獲與封存亦為另一有效減碳之技術，我國先前亦積極進行此項技術之發展，並評估數個可能之封存地點與地質調查等工作。而大陸地區結合探油技術與封存之離岸設施之建立，包括各種海上工程與船運、港口等建設之經驗，於我國發展離岸風電所遭遇到之困境，或可供參考，我國應持續關注此方面的發展，並就技術層面進行適當的交流與學習。整體而言，為使經濟持續發展，能源之需求只會不斷提高，短期內較無減少之可能。因此目前世界各主要國家提出減碳之目標，是一項大挑戰，需同時進行各種有效的減碳措施方有機會達到設定的目標。目前已有之減碳技術可有效降低碳排放量，但成本仍然過高，導致推廣上的困難。長期而言，有效的能源管理與再生能源結構對於控制碳排放量之目標而言十分重要。



圖九 開幕演講 2 之節錄內容 1



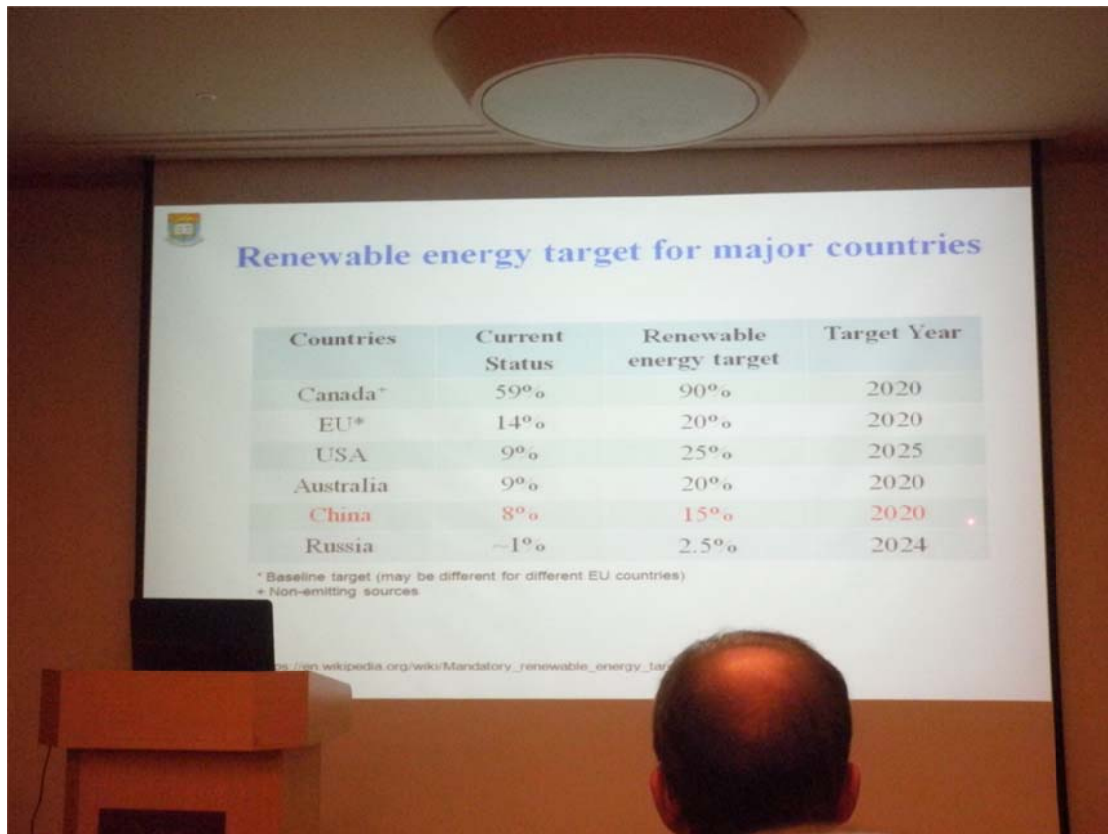
圖十 開幕演講 2 之節錄內容 2



圖十一 開幕演講 2 之節錄內容 3

- 
- Feasible approaches to reduce CO<sub>2</sub> emissions in China**
- A. Increase usage of cleaner fuels
  - B. Increase usage of renewable energy
  - C. Adopt clean coal technologies
  - D. Development of nuclear power
  - E. Carbon capture & storage
  - energy efficiency and conservation

圖十二 開幕演講 2 之節錄內容 4



圖十三 開幕演講 2 之節錄內容 5

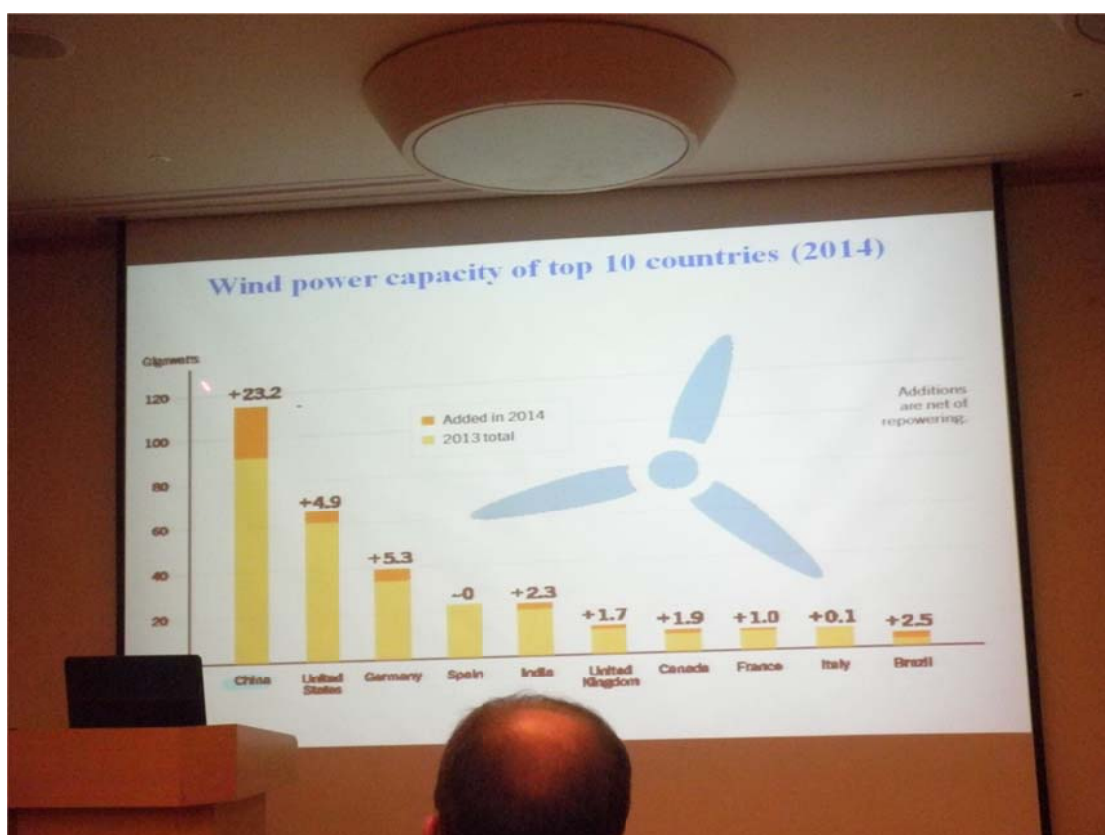


圖十四 開幕演講 2 之節錄內容 6





圖十五 開幕演講 2 之節錄內容 7

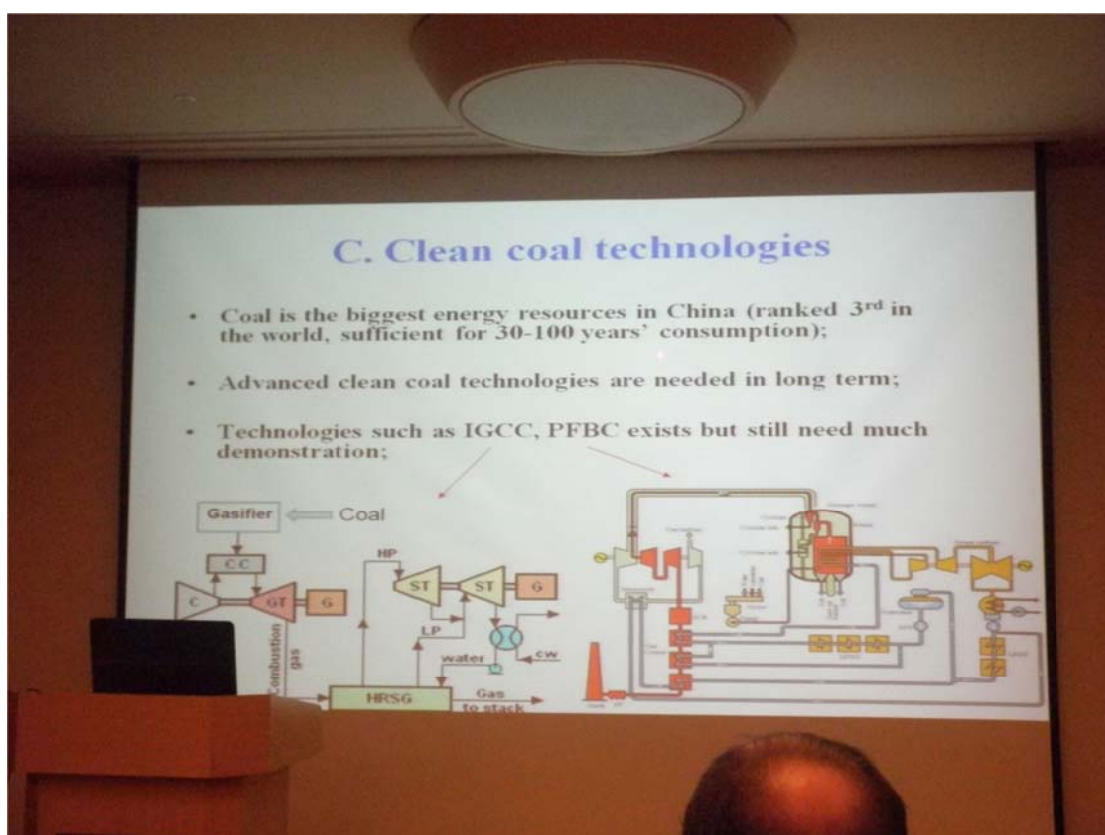


圖十六 開幕演講 2 之節錄內容 8

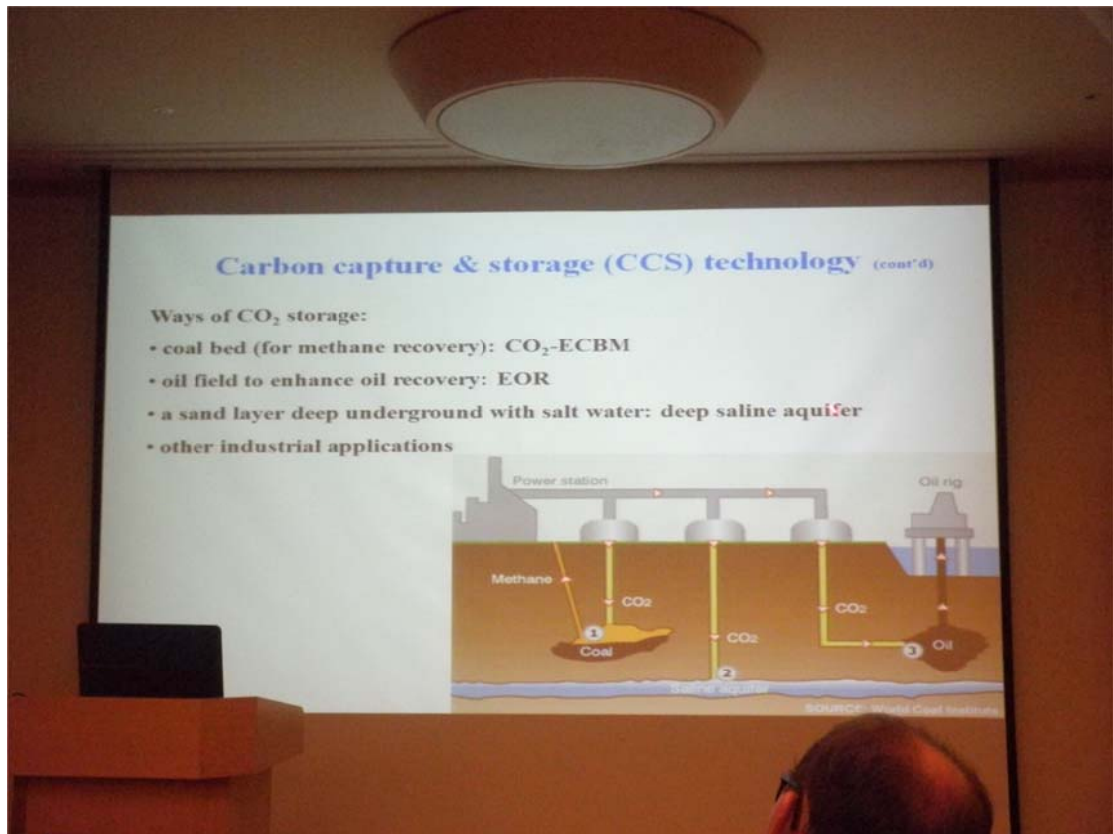
### Cost of different renewable energy (as at 2014)

	China (US\$/kWh)	USA (US\$/kWh)	Europe (US\$/kWh)	Africa (US\$/kWh)
Wind power	\$0.059	\$0.065 (North) \$0.09 (Central/ South)	\$0.075	\$0.09
Solar power	\$0.12	\$0.12	\$0.17	\$0.19
Hydro power	\$0.03	\$0.09	\$0.11	\$0.043
Biomass power	\$0.05	\$0.08	\$0.08	
	\$0.00265			

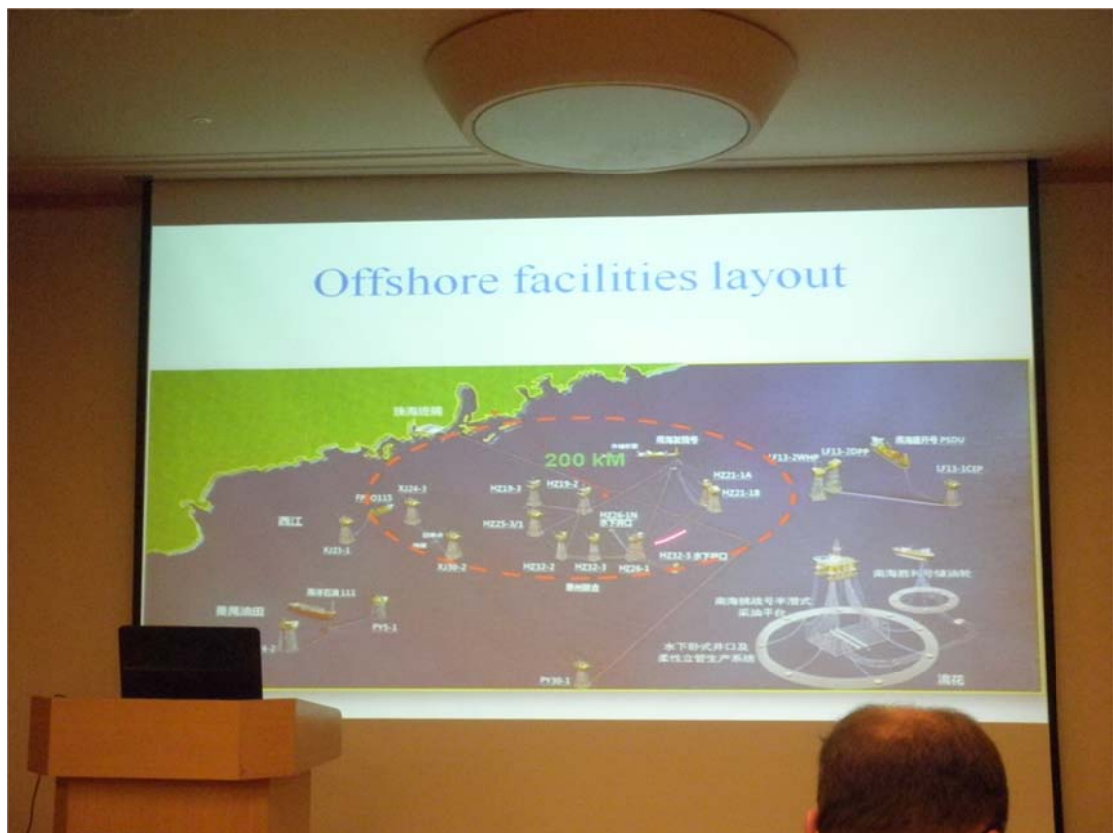
圖十七 開幕演講 2 之節錄內容 9



圖十八 開幕演講 2 之節錄內容 10

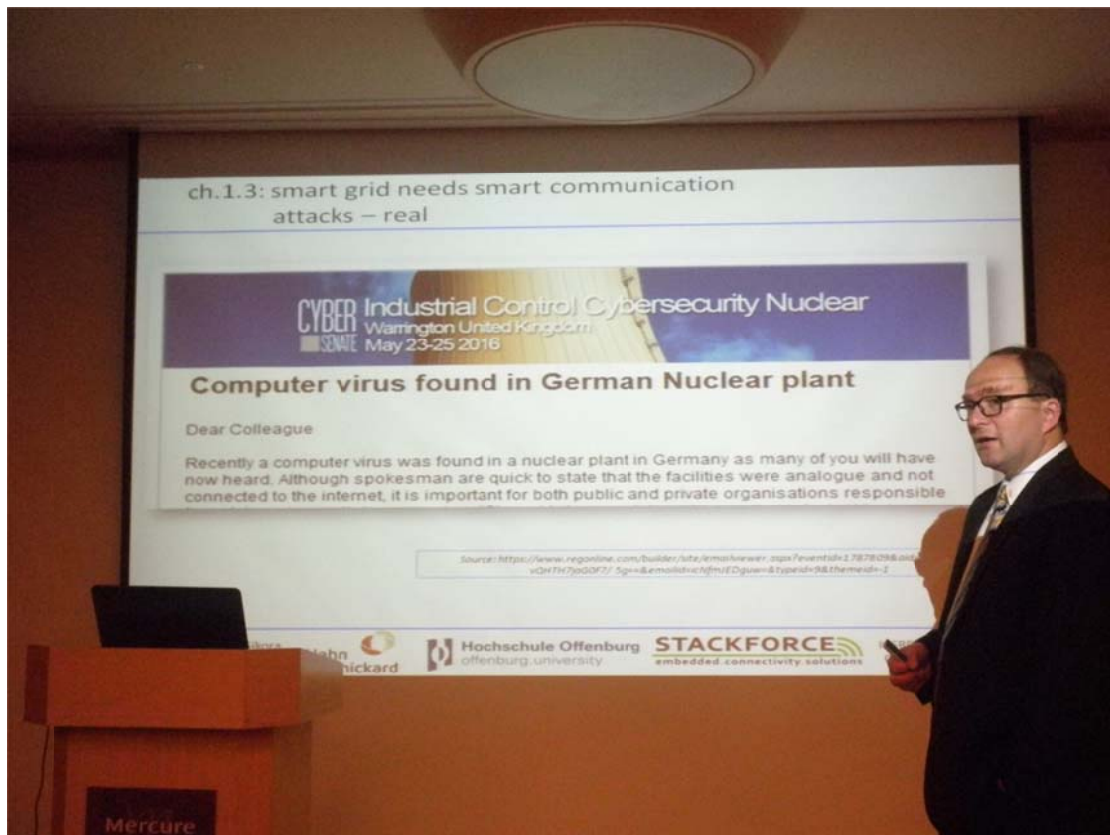


圖十九 開幕演講 2 之節錄內容 11

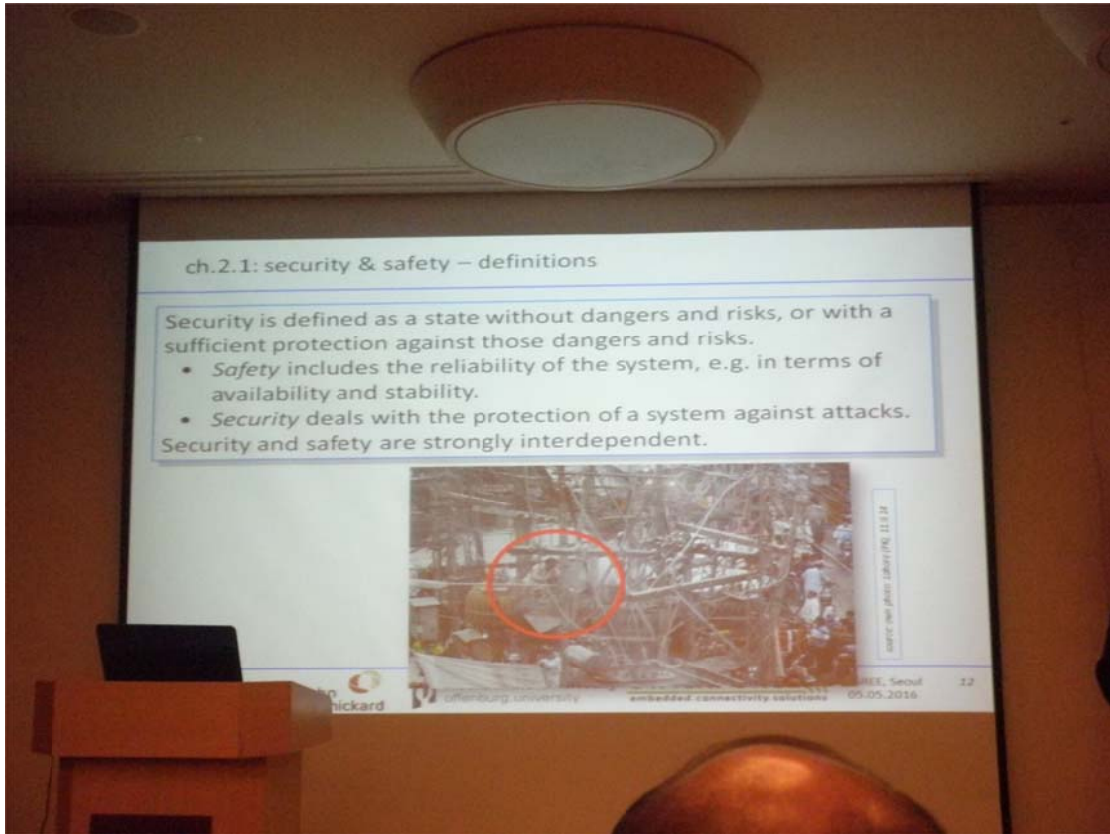


圖二十 開幕演講 2 之節錄內容 12

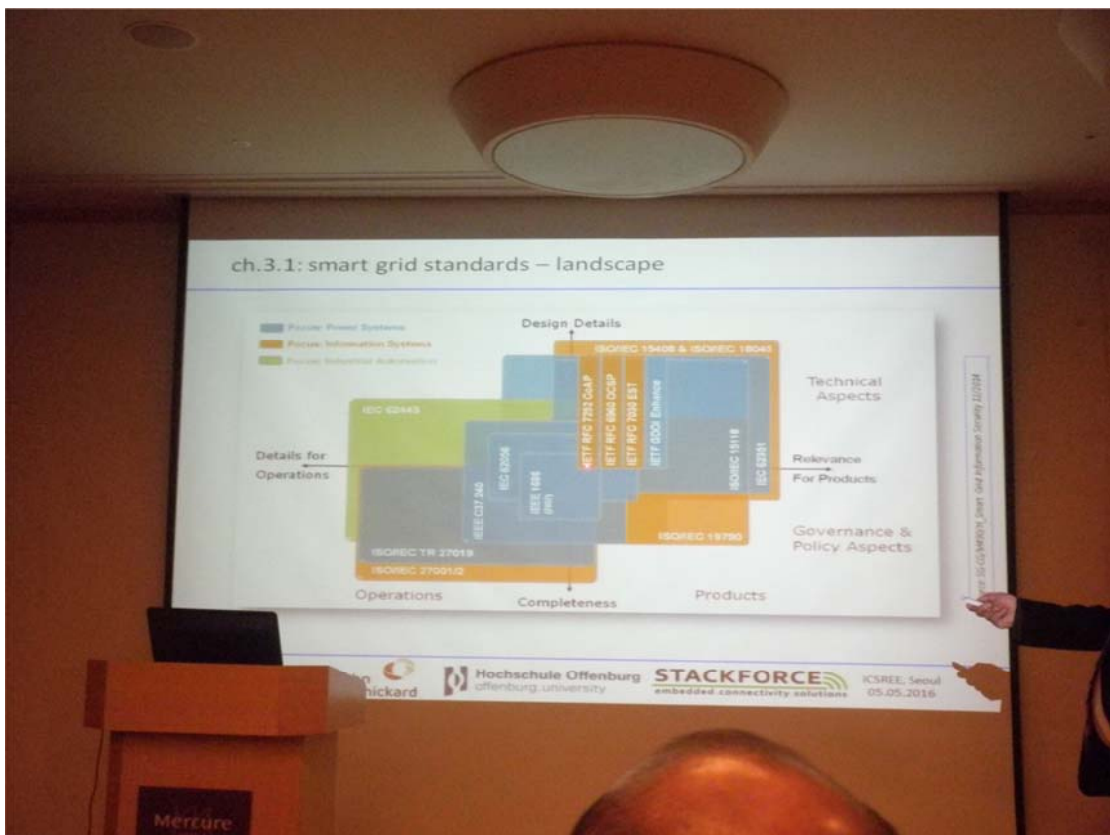
第三位來自德國之 Dr.-Ing. Axel Sikora 教授為電機領域之專家，其講題主要著重於智慧電網與安全性的議題，並提出實例說明安全性的重要性。另外亦提到，目前在安全性的發展方面，並是沒有規範，而是太多種規範，因此如何有效整合各種不同國家因不同考量而建立的不同規範，制定適合的本土化版為發展電網安全性的重要課題。目前本所風機分組主要採用 IEC 與 GL 之規範，較無此問題，但如何將本土化之各種負載，如颱風及地震等極端條件納入規範當中，應為需持續且積極進行之研究方向。部份內容摘錄如圖二十一~二十三所示。



圖二十一 開幕演講 3 之節錄內容 1



圖二十二 開幕演講 3 之節錄內容 2



圖二十三 開幕演講 3 之節錄內容 3

下午開始則分別在 2 個不同會場同時進行論文發表與討論，由下午 13:00 到 19:45，總計有 52 篇不同領域的論文發表，而海報發表亦有 5 篇。大會期間於會場與許多與會國內外學者專家交流，也包含來自台灣之教授也到此進行交流。相關之議程與論文發表如附錄一。職投稿於本次會議之論文場次安排於 5 月 6 日(五)下午之 Renewable Energy and Solar Energy Engineering 進行，每人發表時間約 15 分鐘，並包含問題討論。當日職於早上至會場，並繳交論文報告之相關資料。當日之會議論文發表，題目為「Hydrodynamic Analysis for a Jacket-type support structure of the offshore wind turbine」之論文，發表之投影片如附錄二；其主要內容為針對 Jacket 型式(Jacket Type)支撐結構進行水動力效應分析。離岸風機結構設計需同時考量風、波浪及海流等負載。本研究主要考量本土化水動力負載對於 Jacket 型式之支撐結構進行分析，針對 NREL 5MW 參考風機採用 Jacket 形式支撐結構建立數值模型，並以 Splash 3D 進行數值求解，此模型具有平行運算功能，可提高計算網格解析度，並縮短運算所需時間，提升分析的效能。在多相流部份採用 VOF(Volume of Fraction)進行模擬，而紊流則採用 LES(Large-Eddy-Simulation)進行運算。波浪之資料則是以中央氣象局在新竹外海於 2013~2014 年間量測之數據進行波浪參數設置，並用 IWMM(Internal wave maker module)模組進行造波，並採用規則波與不規則波進行分析，而流動方向採用 2 種不同角度，分別為 0 度與 45 度之入流方向進行探討。由結果可發現，在採用不規則波的情況下，平均之最大受力相對於規則波的情況下，會高出約 64%的受力，而比較單一最大受力值時，不規則波產生的最大受力為規則波的 2.25 倍。會後並由該場次的主持人 Dr. Erees Queen B. Macabebe 頒發一只發表證明並獲選為最佳論文，如圖二十四~二十六所示。



圖二十四 發表完成證明



圖二十五 獲頒最佳論文



圖二十六 大會頒發之最佳論文證明

於會議期間，職等除發表論文之外，亦參加其他領域之論文發表場次，聽取各國專家學者之研究成果。配合目前所執行的風能系統工程計畫需求及相關專長，在會議期間參與中小型風機與大型風機分析等議題並與國外風電技術相關領域



專家學者交換研究心得，了解國外於風機設計驗證相關技術，收穫豐碩。以下就針對參與重要相關之研究議題作一簡述及說明：

01. 「System Development and Performance Test of 5 kW Wind Turbine」：  
The paper presents development and performance of 5 kW wind turbine that already installed as one of renewable hybrid system in Tenjolaya village - subdistrict Malingping, Lebak - Banten Province. The renewable hybrid system consists of 5 kW wind turbine, 1 kW photovoltaic panels, water electrolizer and 300 W fuel cell. Monitoring and telemetry systems for measuring the performance of renewable energy generating equipment and energy consumption can monitor and record the performance of wind turbine in the field test . Data collection was performed with a range of every two seconds once and has done since June 2009, but data in June 2009 there is still much less than perfect because the data acquisition system has not been calibrated, whilst in July 2009 the data acquisition has gone well. In the case of wind power plants with capacity 5 kW, the observations in July 2009 produce data of wind speed on thre ranges 2-6 m/s, and generally only slightly above that reached more than 7 m/s. Correlation between wind speed turbine with output voltage, for the local wind speed 2-7 m/s, will produce the output voltage between 150-350 V. The above monitoring data will be used as a consideration in formulating the control system that will be designed. A concern in designing the control system because the output voltage of wind turbine fluctuative and has a very high range, i.e. between 0-400 V. From the monitoring result shows that the average wind speeds can reach 6.5 m/sec, and will produce a voltage of 340 V. Electric power generated will be used to charge the batteries by using a voltage of 130 -140 Vac (12 pieces serial batteries installed), so that the output voltage of the WT should be stabilized at a voltage of 130 - 140Vac. By installing the control system on WT output voltage can be obtained stable at 130-140Vac.

此篇研究主要建立包含 5 kW 風機、1 kW 太陽能水電解設施與 300 W 之燃料電池之複合式再生能源系統。其中風機部份，因風速變化較大，故產生之電池變化幅度亦較大，需以有效的控制策略將其降低到穩定之範圍，約在 130~140 Vac 左右。

02. 「Use of Hybrid PV and Wind Turbine - Grid Connected System in a Local Emirati Home in Dubai-UAE」： The Hybrid Optimization of Multiple Energy Resources (HOMER) software is used to assess the economics of

using a PV-Wind Turbine (PV-WT) system to provide clean and renewable energy for a typical local home in the UAE. The system is grid connected and thus contains no electricity storage facilities, e.g. batteries. The HOMER software was used to calculate the Cost of Electric (CoE) for different combinations of cost of grid electricity (CGE), interest rates and PV & wind turbine combinations. The results show that for interest rates of 4% and 6% a hybrid PV-WT system is economically viable for all four values of CGE studied. When the interest rate is raised to 8%, the hybrid PV-WT system is economically viable only viable a viable to the two highest CGE rates studied. The hybrid PV-WT system was not economically viable for all interest rates higher than 8%. This shows that lower interest rates are needed in order to promote the incorporation of renewable energy in UAE homes.

此篇則是針對在杜拜地區之一座民宅為對象，進行風力與太陽能等再生能源設備之經濟分析，並嘗試找出最佳之搭配組合，使民間廠家願意投資住宅用再生能源之技術。由其結果可發現，太陽能與風能所提供之電量仍舊偏低，而就投資報酬率而言，需搭配適合的借貸利率，才有可能使廠商有意願投資。因此本所之能源經濟模型團隊亦可就此類似之議題進行評估，選定具代表性的住宅，並試算出適用於我國最佳能源配比與合理之利率。

03. 「Modelling of a CFD Microscale Model and Its Application in Wind Energy Resource Assessment」: The prediction of a wind farm near the wind turbines has a significant effect on the safety as well as economy of wind power generation. To assess the wind resource distribution within a complex terrain, a computational fluid dynamics (CFD) based wind farm forecast microscale model is developed. The model uses the Reynolds Averaged Navier-Stokes (RANS) model to characterize the turbulence. By using the results of Weather Research and Forecasting (WRF) mesoscale weather forecast model as the input of the CFD model, a coupled model of CFD-WRF is established. A special method is used for the treatment of the information interchange on the lateral boundary between two models. This established coupled model is applied in predicting the wind farm near a wind turbine in Hong Gang-zi, Jilin, China. The results from this simulation are compared to real measured data. On this basis, the accuracy and efficiency of turbulence characterization schemes are discussed. It indicates that this coupling system is easy to implement and can make these two separate models work in parallel. The CFD model coupled with WRF has the advantage of high accuracy and fast speed, which makes it valid

for the wind power generation.

此篇研究則結合氣象預估模組與計算流體力學分析軟體，進行複雜地形之風力潛能評估分析。而此研究在紊流模型方面，選擇用 B-L 與 k-w SST 進行分析，誤差約在 1%~4% 左右。因紊流模型種類甚多，故職詢問主講者是否有考慮過其它種類的紊流模型，或者此兩種模型即具有代表性，而主講者表示，會選擇此兩種模型是因為考慮計算時間的關係，以此兩種模型進行計算，所需花費的時間約 3~5 天/case，若採用其它模型會需要更長的時間，但主講者也坦言，此兩種模型並不見得就是最適用的紊流模型，需要再進一步的分析與比對，才可找出最適之紊流模型。

04. 「Time series model of wind speed for multi wind turbines based on Mixed Copula」: Because wind power is intermittent, random and so on, large scale grid will directly affect the safe and stable operation of power grid. In order to make a quantitative study on the characteristics of the wind speed of wind turbine, the wind speed time series model of the multi wind turbine generator is constructed by using the mixed Copula-ARMA function in this paper, and a numerical example is also given. The research results show that the model can effectively predict the wind speed, ensure the efficient operation of the wind turbine, and provide theoretical basis for the stability of wind power grid connected operation.

此研究則是針對實際風場之風速歷程進行統計與分析，並建立時間序列之風速模型。模型與實際風速值之平均誤差約在 4% ~ 9% 之間。因此在風機運轉期間，搭配此模型，可有效調整風機運轉條件，達到最佳化之設定與控制策略，並進一步提高風機與電網之效能。

### (三) 5 月 8 日，回程

結束本次 ICSREE 2016 會議後，5/8 日於早上 8 點搭車前往仁川國際機場，並搭乘早上 12 點 35 分之飛機返回台灣，因時差關係，於台灣時間 14 點左右抵達桃園中正國際機場，順利圓滿結束本次公差行程。

### 三、心得

此次公差由 105 年 5 月 4 日至 5 月 8 日，共計 5 天。主要是參加在韓國首爾之 Mercure Ambassador Gangnan(江南國賓美居酒店)所舉辦的「2016 永續與再生能源工程國際研討會」，本次會議依據大會統計資料，總計有約 57 篇不同領域的論文發表。於會議期間，職等除發表論文之外，亦參加其他領域之論文發表場次，聽取各國專家學者之研究成果。配合目前所執行的風能系統工程計畫需求及相關專長，在會議期間參與中小型風機與大型風機分析等議題並與國外風電技術相關領域專家學者交換研究心得，了解國外於風機相關技術之發展情況。本所風機技術團隊發表 1 篇會議論文，除推廣核研所自製風機與研發技術外，並獲頒為最佳論文。本次公差除對於計畫績效有所貢獻外，並可聽取國外專家學者之研發成果，增進風能系統工程之研究議題之交流，提升我國於中小風機與大型風機之研發技術能量，與精進設計驗證相關之技術，收穫豐碩。

此次會議之心得列舉如下：

- (一) 經濟發展與能源使用量之相關性呈現正相關，另言之，若為達到設定之減碳目標而抑制能量使用量，將可能導致經濟發展遭受不利之影響，因此如何於兩者間取得平衡，或使兩者之走勢脫勾，為重要之課題。
- (二) 目前大陸地區仍以煤碳為主要發電管道，但值得注意的是第二高的水力發電比重逐年降低，而其它項目包括風力與太陽能等再生能源之比重則逐年提高，顯示風電等再生能源逐漸受到重視。
- (三) 要達到設定之減碳目標之有效方法不外乎：(1)使用潔淨能源，(2)提高再生能源比例，(3)採用淨煤技術，(4)發展核電，(5)碳捕獲與封存，(6)提高能源轉換效能與節能等方法。其中核能部份，我國目前之發展走向還不明確，但其它方法，包括使用潔淨能源、提高再生能源，淨煤技術、碳捕獲與封存等發展方向與本所目前進行當中之永續能源技術與策略發展應用計畫中之項目一致，顯示本所執行此計畫與國際趨勢一致，且突顯此計畫之重要性。
- (四) 而目前再生能源佔比除了加拿大高達 59%、而歐洲尚有 14%以外，

其餘世界各國都明顯偏低。另外設定在約 2020~2024 年的目標大約在 15%~20%左右。

- (五) 使用傳統的煤碳，其成本遠低於目前所有再生能源的成本，相較於大陸地區的風電而言，使用煤的成本只要其 4.5%，另言之，風電的成本比燃煤高出 20 倍有餘。此一價格差異實為發展再生能源與達到減碳目標之最大阻力。
- (六) 另外淨煤技術部份，目前光是大陸地區的煤礦存量就足夠使用最高達 100 年之久，因此低價煤勢必造成發展再生能源之阻力之一，所以可大幅減少污染之淨煤技術例如 IGCC 與 PFBC 等之長期發展亦為重要課題，此與本所之永續能源技術與策略發展應用計畫當中之淨煤技術觀點一致。
- (七) 整體而言，為使經濟持續發展，能源之需求只會提高，短期內無減少之可能。因此目前世界各主要國家提出減碳之目標，是一項大挑戰，需同時進行各種有效的減碳措施方有機會達到設定的目標。但目前已有之減碳技術雖可有效降低碳排放量，但成本仍然過高，導致推廣上的困難。長期而言，有效的能源管理與再生能源結構對於控制碳排放量之目標而言十分重要。
- (八) 風機因風速變化較大，故產生之電流之電壓變化幅度亦較大，就電網而言需要適當的處理方能有效利用，故需以有效的控制策略將其降低至穩定之範圍。
- (九) 風力與太陽能等再生能源設置於住宅之經濟分析之研究亦為重要課題，並嘗試找出最佳之搭配組合，使民間廠家願意投資住宅用再生能源之技術。然而太陽能與風能所提供之電量仍舊有偏低的問題，而就投資報酬率而言，需搭配適合的借貸利率，才可讓廠商願意投資。
- (十) 在風機運轉期間，搭配風場預估模型，可有效調整風機運轉條件，達到最佳化之設定與控制策略，並進一步提高風機與電網之效能。

## 四、建議事項

此次 2016 永續與再生能源工程國際研討會由於議題廣泛，職針對工作上與本所計畫相關研究領域，蒐集其專業技術資料，以利整理本所相關後續研發方向。綜合此次公差的心得，有如下建議。

- (一) 以大陸地區的風電發展目標而言，陸域之風電之比重高於離岸風電，此是因為大陸地區有廣大的陸域面積可設置陸域風電，但我國陸域有限，故我國應更積極朝向離岸風電之發展。
- (二) 就風力機安裝比例而言，大陸地區於 2014 年安裝量提高 23.2%高居全球第一，遠高於排名第二美國之 4.9%，因此大陸地區為近年來發展風電最主要的國家，其相關經驗亦可供我國發展風電之參考，我國應持續觀注其發展狀況，情況許可下與其適當交流學習。
- (三) 我國因 98.5%之能源仰賴進口，且目前主要仍是以燃煤之火力發電為主，故煤之價格波動對我國之能源安全影響堪巨，而發展風電等再生能源則可降低此風險，因此我國應持續投入風力等再生能源之發展，並有效提高其比例。
- (四) 離岸風電工程開發與建設涵蓋的領域相當廣且及技術甚為複雜，而大陸地區結合探油技術與封存之離岸設施之建立，包括各種海上工程與船運、港口等建設之經驗，於我國發展離岸風電所遭遇到之技術瓶頸，或可供參考，我國應持續觀注其發展，並就技術層面進行適當的交流與學習。
- (五) 智慧電網與安全性的議題方面，目前在安全性的發展方面，並是沒有規範，而是太多種規範，因此如何有效整合各種不同國家因不同考量而建立的不同規範，制定適合的本土化版為發展電網安全性的重要課題。
- (六) 目前本所風機分組主要採用 IEC 與 GL 之規範，但如何將本土化之各種負載，如颱風及地震等極端條件及軟弱海床等特性納入規範當中，應為需持續且積極進行之研究方向。
- (七) 本所之能源經濟模型分組可就風力與太陽能等再生能源設置於住

宅之經濟分析等議題進行評估，選定具代表性的住宅，並試算出適用於我國最佳能源配比與合理之利率，以提高國內產業投入此領域之誘因。

## 五、附 錄

附錄一 ICSREE 2016 議程與論文發表場次

2016 IACSIT SEOUL CONFERENCES

### Technical Program at a Glance

May 5	Lobby	10:00-17:00	Arrival, registration and conference materials collection		
May 6 9:00-11:30	Venus 1&2	9:00-9:10	Opening Remarks	Prof. Dennis Y.C. Leung	
		09:10-09:50	Keynote Speech	Prof. Yanglong Hou	
		09:50-10:10	Coffee Break & Group Photo		
		10:10-10:50	Keynote Speech	Prof. Dennis Y.C. Leung	
		10:50-11:30	Keynote Speech	Prof. Dr.-Ing. Axel Sikora	
May 6 11:30-13:00	Lunch @ SODOWE Restaurant				
May 6 13:30-19:15	Venus 1	13:00-15:30	Session I (Materials Science and Engineering)	10 Presentations	
		15:30-15:45	Coffee Break		
		15:45—17:30	Session III (Power Systems and Mechantronics)	7 Presentations	
			17:30-19:45	Session V (Renewable Energy and Solar Energy Engineering)	9 Presentations
	Venus 2	13:00-15:30	Session II (Materials Science and Engineering)	10 Presentations	
		15:30-15:45	Coffee Break		
		15:45—17:45	Session IV (Power systems and mechantronics)	8 Presentations	
		17:45-19:45	Session VI (Sustainable Development & Environment and Architecture)	8 Presentations	
May 6 20:00-21:30	Dinner@ SODOWE Restaurant				



# Session I

## Materials Science and Engineering

13:00-15:30

Location: Venus 1

*Chaired by Prof. Pavlo Selyshchev*

University of Pretoria, South Africa

Papers: EE020, EE022, EE027, EE046, CEM001, CEM1005, CEM025,  
CEM007, CEM1006, CEM1007

※Please arrive at the designated conference room 30 minutes earlier, in case some authors are not able to make the presentation on time.

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<p>EE020 13:00-13:15</p>	<p>Leaching Behaviour of Organic Materials in Reinforced Concrete Artificial Reef with RAC Noridah Mohamad, Abdul Aziz</p> <p><b>Noridah Mohamad</b>, Afif Iman, Hazel Monica, Josef Hadipramana and W.I. Goh</p> <p>Department of Structural and Material Engineering, Faculty of Civil and Environmental Engineering, Universiti Tun Hussein Onn, Malaysia, 86400 Batu Pahat, Johor, Malaysia</p> <p><i>Abstract</i>—This paper reports the leaching behaviour of pineapple skins incorporated in the artificial reef fabricated from recycle aggregate concrete. Pineapple skin was mixed with the concrete as added material which produce nutrients to attract fish habitat. Material test was conducted on the concrete reef specimens to determine its compressive strength. The nutrients dispersed were measured by using total phosphorus and nitrate test of the water sample collected from each of the artificial reef within the six days duration. Results showed the compression strength of the reef decreased with the increase of percentage pineapple skin used. However, it was found that the total phosphorus and nitrate leached from the reef increased gradually with time as the percentage of pineapple skin used increased.</p>
<p>EE022 13:15-13:30</p>	<p>Leaching Behaviour of Organic Materials in Reinforced Concrete Artificial Reef with RAC</p> <p>Noridah Mohamad, <b>Abdul Aziz Abdul Samad</b>, Afif Iman, Hazel Monica, Josef Hadipramana and W.I. Goh</p> <p>Department of Structural and Material Engineering, Faculty of Civil and Environmental Engineering, Universiti Tun Hussein Onn, Malaysia, 86400 Batu Pahat, Johor, Malaysia</p> <p><i>Abstract</i>— This paper reports the leaching behaviour of pineapple skins incorporated in the artificial reef fabricated from recycle aggregate concrete. Pineapple skin was mixed with the concrete as added material which produce nutrients to attract fish habitat. Material test was conducted on the concrete reef specimens to determine its compressive strength. The nutrients dispersed were</p>

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	<p>measured by using total phosphorus and nitrate test of the water sample collected from each of the artificial reef within the six days duration. Results showed the compression strength of the reef decreased with the increase of percentage pineapple skin used. However, it was found that the total phosphorus and nitrate leached from the reef increased gradually with time as the percentage of pineapple skin used increased.</p>
<p>EE027 13:30-13:45</p>	<p>Evaluation of fly ash based geopolymer stabilized recycled asphalt pavement as a sustainable pavement material.</p> <p><b>Menglim Hoy</b>, Suksun Horpibulsuk and Arul Arulrajah School of Civil Engineering, Suranaree University of Technology, Nakhon Ratchasima 30000, Thailand</p> <p><i>Abstract</i>—This study investigated the geotechnical and environmental characteristic of Fly Ash (FA) based geopolymer treated Recycled Asphalt Pavement (RAP) to be a sustainable pavement material. Liquid alkaline activator (L) is a mixture of NaOH and Na<sub>2</sub>SiO<sub>3</sub>, and FA is used as a precursor to synthesize the FA geopolymer. The critical 7-days strength of RAP-FA geopolymer and RAP-FA blend (without L) are measured by Unconfined Compression Strength (UCS) test and their microstructures are investigated via Scanning Electron Microscopy (SEM) analysis, while the leachability of the heavy metals are measured by Toxicity Characteristic Leaching Procedure (TCLP). Results show that the compacted RAP-FA blend can be used as a base course material, as its 7-days UCS meets the strength requirement. The UCS of RAP-FA geopolymers are higher than those of RAP-FA blend when the NaOH/Na<sub>2</sub>SiO<sub>3</sub> ratios are less than 90:10. SEM analyse of RAP-FA blend indicates the formation of C-S-(A)-H occurred due to the reaction between a high calcium in RAP and high silica and alumina in FA. Additionally, the geopolymerization products (N-A-S-H) in RAP-FA geopolymer were detected when Na<sub>2</sub>SiO<sub>3</sub> used in L. However, the slow geopolymerization reaction was observed when only NaOH is used as L, hence the 7-day UCS of RAP-FA geopolymer at NaOH/Na<sub>2</sub>SiO<sub>3</sub> = 100:0 is lower than that of RAP-FA blend. TCLP results were compared with environmental authorities' requirement and demonstrated that no environmental risk of using both RAP-FA blend and RAP-FA geopolymer. Moreover, the usage of FA-geopolymer indicated the effectiveness to reduce the leaching of heavy metal.</p>

providing stable power for energy converting devices. The use of hydrogen is essentially pollution-free with water being the only byproduct. Among the main challenges of contemporary hydrogen technologies, i.e. large-scale hydrogen production, hydrogen storage and delivery at near ambient conditions, low cost and hydrogen infrastructure, hydrogen storage technologies play a key enabling role in the incipient hydrogen economy. As a new liquid organic hydride, N-ethylcarbazole is widely studied with the high hydrogen storage capacity, and can be easily rehydrogenation. And finding some efficient and cheap catalysts on the catalytic hydrogenation is one of the most attracted research hotspot.

In this work, porous Mo-W oxides was prepared by hydrothermal method[1]. Noble metal Pd and Ru were loaded over the as-prepared materials via impregnation method[2], respectively, to form 0.5wt% Ru/Mo-W-O and 0.5wt% Pd/Mo-W-O catalysts. The hydrogenation of N-ethylcarbazole over Mo-W-O catalyst, 0.5wt% Ru/Mo-W-O catalyst and 0.5wt% Pd/Mo-W-O catalyst were studied and compared, respectively. The hydrogenation process was conducted at 180 °C, 8MPa with reaction time of 5 hours. Hydrogenation over Mo-W-O catalyst yeilds a product of 20% N-perhydroethylcarbazole, which indicates Mo-W oxides has certain catalytic activity. Nevertheless, hydrogenation over the 0.5wt% Ru/Mo-W-O catalyst yields a product of 53% N-perhydroethylcarbazole and the 0.5wt% Pd/Mo-W-O catalyst yields a product of 94% N-perhydroethylcarbazole, respectively. The result indicates that the catalytic performance of 0.5wt% Pd/Mo-W oxides catalyst is better than the 0.5wt% Ru/Mo-W oxides catalyst.



coffee break

**Coffee Break****15: 30--15: 45**

# Session II

## Materials Science and Engineering

13:00-15:30

Location: Venus 2

*Chaired by Dr. Hasnah Mohd Zaid*

Universiti Teknologi PETRONAS, 32610 Bandar Seri Iskandar Perak,  
MALAYSIA

Papers: CEM012, CEM014, CEM015, CEM018, CEM019, CEM023,  
CEM005, CEM028, CEM030, CEM024,

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CEM012 13:00-13:15	<p>The Effect of Calcination Temperature on Dielectric Properties of ZnO and Al<sub>2</sub>O<sub>3</sub> Nanoparticles at Radio Frequencies</p> <p><b>HASNAH Mohd Zaid</b>, MUHAMMAD Adil, and Lee Kean Chuan Universiti Teknologi PETRONAS32610 Bandar Seri Iskandar, Perak, MALAYSIA</p> <p><i>Abstract</i>—The dielectric properties of ZnO and Al<sub>2</sub>O<sub>3</sub> are dependent upon various factors such as chemical composition, method of synthesis, grain size, particle size distribution and porosity. A low dielectric constant is often desirable for several applications, whilst for enhanced oil recovery application, high loss dielectrics is required rendering the particles as surface-active agent. In this study, the dependence of the dielectric properties on the calcination temperature of ZnO and Al<sub>2</sub>O<sub>3</sub> nanoparticles is determined as a function of two applied radio frequencies of 18.82 MHz and 167.32 MHz. The experimental results indicate that the nanoparticles of different phases can significantly improve the densification and their dielectric properties. Detailed analysis of the results showed that rotational polarization is the major contributor to the enhanced dielectric behavior of the nanoparticles at the applied frequencies.</p>
CEM014 13:15-13:30	<p>Heat Transfer and Pressure Drop Characteristics of R-290 Refrigerant-Lubricant Mixtures during Evaporation in Micro-Fin Tube Containing Some Inserts</p> <p><b>Mao-Yu Wen</b>, Ching-Yen Ho and Wu-Chang Tsa Department of Mechanical Engineering, Cheng Shiu University, Kaohsiung 833, Taiwan, ROC</p> <p><i>Abstract</i>—This study reports an experimental investigation of heat transfer performance during evaporation of R-290 mixed with the lubricating oil (150SUS) in a smooth and micro-fin tube without / with four different inserts (twined coil, wire coil, twisted tape, and helical-coil). The test was conducted at a saturation temperature of 15 [°C], inlet oil concentration from 0 to 5 mass % oil, mass flux of 200 – 500 [kg/m<sup>2</sup>s] and heat flux of 10.24 [kW/m<sup>2</sup>]. The experimental results show the micro-fin tube with inserts has distinct heat transfer advantages over the smooth and the micro-fin tube without any insert, but the pressure drop was higher. The</p>

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	<p>enhancement factor (EFs) is larger for the lower oil concentration (at 1 %), while the ratios for the higher oil concentration (at 5%) are generally smaller than 1 and decreased rapidly as the oil concentration increased. Further, the values of PF (pressure drop penalty factor) are generally larger than 1 and rapidly increased as the oil concentration increased. In addition, new correlations to estimate the evaporation heat transfer coefficients for the R-290 mixed with the lubricating oil in micro-fin tube containing different inserts have been developed.</p>
<p>CEM015 13:30-13:45</p>	<p>Effects of Nb Promoter on the Properties of Cu/ZnO/SBA-15 Catalyst and Performance in Methanol Production</p> <p><b>Noor Asmawati Mohd Zabidi</b>, Sara Tasfy , and Maizatul Shima Shaharun Department of Fundamental and Applied Sciences, Universiti Teknologi PETRONAS, 32610 Seri Iskandar, Perak, Malaysia</p> <p><b>Abstract</b>—Hydrogenation of CO<sub>2</sub> provides an alternative route for methanol production and attractive option for CO<sub>2</sub> utilization. The present work investigates the synthesis of Cu-based catalyst on mesoporous silica (SBA-15) and promotion of the Cu-based catalyst with niobium (Nb). The addition of Nb promoter enhanced the reducibility and dispersion of the active sites as well as increased the BET and Cu surface areas. The performance of the synthesized catalyst in the hydrogenation of CO<sub>2</sub> was evaluated in a fixed-bed microreactor at 523K, 22.5bar and H<sub>2</sub>/CO<sub>2</sub> of 3. The CO<sub>2</sub> conversion using the Cu/ZnO/SBA-15 catalyst was 14.2 % and increased to 17.1% on the Nb-promoted catalyst. The yield of methanol obtained using the un-promoted Cu-based catalyst was 51.4 g/h.gcat and it increased to 143 g/h.gcat over the Nb-promoted catalyst.</p>
<p>CEM018 13:45-14:00</p>	<p>Structural and Magnetic Study on the Effect of Substitution of Cobalt by d-valent elements of Co<sub>2</sub>FeSi Heusler Alloy</p> <p>M.N.S. Saimin, <b>S.S.S.A. Aziz</b>, A.M.M. Ali1, O.H. Hassan, M.Z.A. Yahya, M.F.M. Taib *</p> <p>Faculty of Applied Sciences, Universiti Teknologi MARA, Tapah Campus, 35400 Tapah Road , Perak, Malaysia.</p> <p><b>Abstract</b>— In this paper, the effect of substitution of Co by d-valent elements such as Ag and Pt on electronic structure and magnetic properties of full Heusler type Co<sub>2</sub>FeSi alloys was investigated. Structural study reveals the presence of a small gap</p>

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	For the application of NCC in non-polar bionanocomposites, both OD-NCC and FD-NCC is recommended due to its relatively superior thermal stability and a higher crystallinity index.
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**Coffee Break**  
15: 30-15: 45



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# Session III

## Power Systems and Mechantronics

15:45-17:30

Location: Venus 1

*Chaired by Dr. Sunwoo Kim*

Department of Mechanical Engineering, University of Alaska  
Fairbanks, USA

Papers: EE010, EE013, EE015, EE006, EE009, EE011, EE026

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<p>EE010 15:45-16:00</p>	<p>Optimal Sizing of Decentralized Photovoltaic Generation and Energy Storage Units for Malaysia Residential Household using Iterative Method</p> <p><b>Dr. Hasimah Bt. Abdul Rahman</b>, and Nur Dalilah Nordin</p> <p>Centre of Electrical Energy Systems, Institute of Future Energy, Universiti Teknologi Malaysia, Johor, Malaysia.</p> <p>Faculty of Electrical Engineering, Universiti Teknologi Malaysia, Johor, Malaysia.</p> <p><i>Abstract</i>—World's fuel sources are decreasing, and global warming phenomena cause the necessity of urgent search for alternative energy sources. Photovoltaic generating system has a high potential, since it is clean, environmental friendly and secure energy sources. This paper presents an optimal sizing of decentralized photovoltaic system and electrical energy storage for a residential household using iterative method. The cost of energy, payback period, degree of autonomy and degree of own-consumption are defined as optimization parameters. A case study is conducted by employing Kuala Lumpur meteorological data, typical load profile from rural area in Malaysia, decentralized photovoltaic generation unit and electrical storage and it is analyzed in hourly basis. An iterative method is used with photovoltaic array variable from 0.1kW to 4.0 kW and storage system variable from 50 Ah to 400 Ah was performed to determine the optimal design for the proposed system.</p>
<p>EE013 16:00-16:15</p>	<p>Designation and Investigate of A Full-Wave Controller Rectifier (FWCR) for Effect source Inductance for Full Wave Rectifier.</p> <p><b>KHAIRUL KAMARUDIN BIN HASAN</b>, A.W.SitiSufiah, Razali,N. , S.A.Nordin Faculty of Electrical Engineering, Universiti Teknologi MARA, 81750 Masai, Johor, Malaysia.</p> <p><i>Abstract</i>—The full wave rectifier with RL load consists of all the SCRs as controlled devices. This full wave converter can operate in quadrants and output voltage can be negative in case of inductive loads. The power factor is poorer than a half converter, as the full bridge converter is primarily used to control the DC motor speed [1].The</p>

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	<p>purpose of this paper is to solve higher ripper power supply in a full wave controlled rectifier using an RL load of 240rms voltage, 50Hz with an attached source inductance, Ls of 10mH value. The average output voltage can be varied from 100-200VDC. The performance of a full wave rectifier with source inductance is to create conduction of four thyristor simultaneously with overlapping angle. The result obtained is with an efficiency of 50.18% at output RL Load.</p>
<p>EE015 16:15-16:30</p>	<p>Reducing Range Anxiety by Unifying Networks of Charging Stations</p> <p><b>Dr. Nazri Kama</b></p> <p>Advanced Informatics School, Universiti Teknologi Malaysia</p> <p><b>Abstract</b>—Availability of charging infrastructure is an important factor in penetration of electric vehicles into daily transportation system. Several factors in electric vehicle industry have caused range anxiety including insufficient charging stations, limited range of electric vehicles, long charging time, inaccurate estimation of available range, and energy consumption of auxiliary in-vehicle devices. However less attention has been paid to universality in charging station networks. This paper reviews the solutions to range anxiety. With regards to availability of charging station as one of the solutions, accessibility of charging stations by electric vehicle owners is also represented as another cause of range anxiety and a possible solution is provided.</p>
<p>EE006 16:30-16:45</p>	<p>A Survey on Particle Swarm Optimization for use in Distributed Generation Placement and Sizing</p> <p><b>Syed Muhammad Arif, Syed Ali Abbas Kazmi and Dong Ryeol Shin</b></p> <p>College of Information and Communication Engineering Sungkyunkwan University, Suwon, South Korea.</p> <p><b>Abstract</b>—This paper surveys the research and development of Particle Swarm Optimization (PSO) algorithm for use in selecting a suitable position for Distributed Generation (DG) units within a distribution network. Our discussion first covers the algorithm development of PSO and its use in neural networks. After establishing the foundations of PSO, we then explore its use in sizing and sitting of DG units in distribution network. Combining PSO with other optimization techniques for attaining better results is also discussed in this paper.</p>
<p>EE009 16:45-17:00</p>	<p>Variable Impact analysis of Linear Generator by using Response Surface Method</p> <p>Seong-Jin Cho, and <b>Sunwoo Kim</b>, Jin Ho Kim</p>

# Session IV

## Power Systems and Mechantronics

15:45-17:30

Location: Venus 2

*Chaired by Dr. Mohammad Yusri Hassan*

Centre of Electrical Energy Systems (CEES), Institute of Future  
Energy, Universiti Teknologi Malaysia, Malaysia

Papers: CEM303, CEM304, EE018, EE028, EE029, EE034, EE035,  
EE206,

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<p>CEM304 16:00-16:15</p>	<p style="text-align: center;"><b>System Development and Performance Test of 5 kW Wind Turbine</b></p> <p style="text-align: center;"><b>Sugiyatnoa</b>, Imam Djunaedia, Haifa Wahyu</p> <p style="text-align: center;">Research Centre for Electric Power and Mechatronics - Indonesian Institute of Sciences Kompleks LIPI, Jln. Sangkuriang 21/154D, Bandung 40135 - Indonesia</p> <p><i><b>Abstract</b></i>—The paper presents development and performance of 5 kW wind turbine that already installed as one of renewable hybrid system in Tenjolaya village – sub district Malingping, Lebak – Banten Province. The renewable hybrid system consists of 5 kW wind turbine, 1 kW photovoltaic panels, water electrolizer and 300 W fuel cell. Monitoring and telemetry systems for measuring the performance of renewable energy generating equipment and energy consumption can monitor and record the performance of wind turbine in the field test . Data collection was performed with a range of every two seconds once and has done since June 2009, but data in June 2009 there is still much less than perfect because the data acquisition system has not been calibrated, whilst in July 2009 the data acquisition has gone well. In the case of wind power plants with capacity 5 kW, the observations in July 2009 produce data of wind speed on thre ranges 2-6 m/s, and generally only slightly above that reached more than 7 m/s. Correlation between wind speed turbine with output voltage, for the local wind speed 2-7 m/s, will produce the output voltage between 150-350 V. The above monitoring data will be used as a consideration in formulating the control system that will be designed. A concern in designing the control system because the output voltage of wind turbine fluctuative and has a very high range, i.e. between 0-400 V. From the monitoring result shows that the average wind speeds can reach 6.5 m/sec, and will produce a voltage of 340 V. Electric power generated will be used to charge the batteries by using a voltage of 130 -140 Vac (12 pieces serial batteries installed), so that the output voltage of the WT should be stabilized at a voltage of 130 - 140Vac. By installing the control system on WT output voltage can be obtained stable at 130-140Vac.</p>
<p>EE018 16:15-16:30</p>	<p style="text-align: center;">Thermal Rating of Overhead Insulation-Covered Conductors in the Steady-State Regime</p> <p style="text-align: center;"><b>Evgenii Kuznetsov</b>, Vladimir Goryunov, Evgenii Kuznetsov, Elena Petrova, Anton</p>

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	<p style="text-align: center;">Bubenchikov, Dmitrii Batulko</p> <p style="text-align: center;">Omsk State Technical University, Energy Department, 644050 pr. Mira 11, Omsk, Russian Federation</p> <p><i>Abstract</i>—One can offer based on the solution of the heat equation and the heat balance equation a mathematical model of steady thermal regime of the conductor, which allows to determine the temperature of bare and insulation-covered conductors of overhead power lines, considering weather conditions, as well as to perform the calculation of electricity losses with conductors temperature. The expressions are for the gradient of temperature distribution in the current-carrying conductor, as well as conductor insulation with and without dielectric losses. The accuracy of the created model is checked when compared with the methods of CIGRE, IEEE and the Finite Element Method. High precision of matching results is achieved.</p>
<p>EE028 16:30-16:45</p>	<p style="text-align: center;">Analysis of Asymmetrical Modes in Medium Voltage Electrical Grids with Compensated Neutral</p> <p style="text-align: center;">Stanislav Girshin, Vladimir Goryunov, <b>Evgenii Kuznetsov</b>, Dmitrii Safonov, Elena Petrova</p> <p style="text-align: center;">Omsk State Technical University, Energy Department, 644050 pr. Mira 11, Omsk, Russian Federation</p> <p><i>Abstract</i>—A mathematical model of steady-state radial medium voltage electrical network with earthed neutral via arc-suppression coils has been carried out. A detailed equivalent circuit of the examined network using the completed equivalent circuit of phase coordinates methods and Kirchhoff's laws has been developed. The system of mathematical models equations has been completed. The advantage of the created mathematical model is the ability to increase the accuracy of the simulation by a detailed account of features of a network with arc-suppression coils. The mathematical model considers the load currents, the non-linear nature of consumers, the impact of the power lines asymmetry. Using the developed mathematical model there are presented results of the carried out researches of three power lines with different cross sections with neutral grounding via arc-suppression coils. The analysis of asymmetry parameters impact of power lines on the value of the neutral displacement voltage and on the voltage value at the end of the lines at different values of the reactor inductance has been completed. The conclusion about the model</p>

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	<p>The RMSE analysis showed an increase in performance accuracy of more than 5 percent when compared to other methods. The results in this study showed that the proposed method is proven to be effective and has great potential for accurate building load forecasting.</p>
<p>EE035 17:15-17:30</p>	<p>Rule-based Energy Management System in an Experimental Microgrid with the presence of Time of Use Tariffs</p> <p>Mojtaba Moghimi, Domagoj Leskarac, Christopher Bennett, Junwei Lu and <b>Sascha Stegen</b></p> <p>Griffith School of Engineering, Griffith University, Nathan Campus, 4111, Brisbane, Australia</p> <p><b>Abstract</b>— This paper aims to investigate a method of peak load shaving through the utilization of solar PV and battery energy storage whilst creating a cost effective Energy Management System (EMS). This is achieved by utilizing a rule-sets to manage and optimize a scheduling system with a forecasting algorithm. As Time of Use (ToU) tariffs change throughout the day, a cost benefit can be achieved when a smart energy storage system is appropriately employed. The EMS operation is tested on an experimental microgrid with commercial load considering payback period calculation</p>
<p>EE206 17:30-17:45</p>	<p>Use of Hybrid PV and Wind Turbine – Grid Connected System in a Local Emirati Home in Dubai-UAE</p> <p><b>Bassam Abu-Hijleh</b></p> <p>Faculty of Engineering and IT, the British University in Dubai, PO Box 345015 Dubai-UAE</p> <p><b>Abstract</b>—The Hybrid Optimization of Multiple Energy Resources (HOMER) software is used to assess the economics of using a PV-Wind Turbine (PV-WT) system to provide clean and renewable energy for a typical local home in the UAE. The system is grid connected and thus contains no electricity storage facilities, e.g. batteries. The HOMER software was used to calculate the Cost of Electric (CoE) for different combinations of cost of grid electricity (CGE), interest rates (i%) and PV &amp; wind turbine combinations. The results show that for interest rates of 4% and 6% a hybrid PV-WT system is economically viable for all four values of CGE studied. When the interest rate is raised to 8%, the hybrid PV-WT system is economically viable only viable a viable to the two highest CGE rates studied. The hybrid PV-WT</p>

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	system was not economically viable for all interest rates higher than 8%. This shows that lower interest rates are needed in order to promote the incorporation of renewable energy in UAE homes.
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# Session V

## Renewable Energy and Solar Energy Engineering

17:30-19:45

Location: Venus 1

*Chaired by Dr. Erees Queen B. Macabebe*

Ateneo de Manila University, Department of Electronics,  
Computer, and Communications Engineering, Quezon City 1108,  
Philippines

Papers: CEM031, CEM306, EE041, EE048, EE024, EE012, EE016,  
CEM027, EE023

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<p>CEM031 17:30-17:45</p>	<p>Use of Powdered Cordierite as a Transesterification Catalyst in Microwave Assisted Synthesis of Palm Biodiesel <b>Marwan</b> Department of Chemical Engineering, Syiah Kuala University Darussalam, Banda Aceh - 23111, Indonesia Abstract. An important phase of the MgO-SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub> system, cordierite was studied for its catalytic transesterification activity in preparing palm biodiesel. The transesterification was assisted by microwave irradiation in a batch mode reaction. It reveals that an enhanced yield of biodiesel was obtained, whereas the maximum yield was reached in less than 30 min. As a solid type catalyst, this result becomes a platform to develop the flow mode reaction unit using a cordierite based structured catalyst without modifying surface chemistry of cordierite.</p>
<p>CEM306 17:45-18:00</p>	<p>Hydrodynamics of Biomass Gasification in a Dual Chamber Circulating Fluidized Bed Reactor Dr. Haifa Wahyua, Ir. Imam Djunaedib, Ir. M. Affendib, Ir. Sugiyatno, MTb Research Centre for Electric Power and Mechatronics Indonesian Institute of Sciences - Lembaga Ilmu Pengetahuan Indonesia Abstract. This paper presents work on hydrodynamics of several types of biomass mixture in a dual chamber circulating fluidized bed. In designing the CFB reactor necessary to know the distribution of solid particles radially and axially influenced by fluidizing gas velocity, particle size, solid circulation flux, reactor diameter and height of the reactor. These factors will affect pressure drop along the riser of the reaction chamber. Pressure drop is an important factor in the study of hydrodynamics of particle flow. The pressure drop was measured using mathematical model compared to experimental results done on a cold mode. Since it was found that both results were consistent which means that the model can be used to predict the operating parameters of CFB design.</p>
<p>EE041 18:00-18:15</p>	<p>Modelling of a CFD Microscale Model and Its Application in Wind Energy Resource Assessment <b>Jie-shun Yue</b>, Song-ping Wu, and Fei-shi Xu School of Aeronautical Science and Engineering, Beihang University, 100083, China</p>

	<p><b>Abstract</b>—Parabolic trough systems are the most used concentrated solar power technology .When a parabolic trough solar collector (PTC) is not pointing directly at the sun, some of the energy that could be collected is being lost; how to automatically and accurately track the sun is a crucial task. In this paper, a programmable logic controller (PLC)-based automatic sun-tracking system for PTC is designed, the purpose is to improve the reliability and accuracy of tracking the sun. The PLC program was administered according to these calculated tracking angles, and by controlling the hydraulic drives of the parabolic trough solar collector with the rotary encoder signal, it was ensured that the PTC moves along one-axe, and maximum benefit was derived from solar energy by providing that the parabolic trough solar collector system are oriented at a right angle to the sun. Experiments were carried under 4 days in 2014. The results indicate that the tracking angle range of PTC reaches minimum in the winter solstice, but the change rate of tracking angle of PTC runs faster, and the fastest is at solar noon every day. The tracking error of the system is less than 0.6 °.</p>
<p>EE023 19:30-19:45</p>	<p>Hotspots detection in photovoltaic modules using infrared thermography  <b>April M. Salazar</b> and Erees Queen B. Macabebe                  Ateneo de Manila University, Department of Electronics, Computer, and Communications Engineering, Quezon City, Philippines</p> <p><b>Abstract</b>—An increased interest on generating power from renewable sources has led to an increase in solar photovoltaic (PV) system installations worldwide. Power generation of such systems is affected by factors that can be identified early on through efficient monitoring techniques. This study developed a non-invasive technique that can detect localized heating and quantify the area of the hotspots, a potential cause of degradation in photovoltaic systems. This is done by the use of infrared thermography, a well-accepted non-destructive evaluation technique that allows contactless, real-time inspection. In this approach, thermal images or thermograms of an operating PV module were taken using an infrared camera. These thermograms were analyzed by a Hotspot Detection algorithm implemented in MATLAB. Prior to image processing, images were converted to CIE L*a*b color space making k-means clustering implementation computationally efficient. K-means clustering is an iterative technique that segments data into k clusters which</p>

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# Session VI

## **Sustainable Development & Environment and Architecture**

17:45-19:45

Location: Venus 2

*Chaired by Dr. Mohamed Elkaftangui*

Abu Dhabi University, Department of Architecture, Al Ain road,  
Abu Dhabi, United Arab Emirates

Papers: EE302, EE003, EE004, EE036, EE051, EE052, EE033, EE050

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	<p>which has wide potential window, may support the reduction process. Moreover, the high stability and inert nature of BDD are expected for practical application. Because of the solubility of CO<sub>2</sub> in water solution is low, we propose amine solution (NH<sub>4</sub>OH(aq)), which has been known as one of CO<sub>2</sub> absorber in industrial capture gaseous stream. The reductions were carried out in two compartment cell separated by Nafion membrane during two hours in several potential from -1.2V to -1.5V vs. Ag/AgCl and produced methanol as main product. Maximum faradaic efficiency of methanol was 24.29% at potential -1.3V vs. Ag/AgCl (Fig 1). The faradaic efficiency of hydrogen formation was depressed under 2% at the same potential. Other products produced from this system are methane and carbon monoxide. However, very low faradaic efficiency of these gasses may prove the selectivity of the CO<sub>2</sub> reduction process. On the basis of this work, we successfully reduced CO<sub>2</sub> to methanol in amine solution on BDD electrode. Regarding to the contribution of adding the value from reducing CO<sub>2</sub> gas emission especially by industrial process will become a high opportunity in future application.</p>
<p>EE004 18:15-18:30</p>	<p>Technology's impact on carbon emissions of iron and steel industry in China  <b>Zhonglin Sheng</b>, Weida He and Yufei Xin          University of Science and Technology Beijing, Economics Department, 100083          Beijing, China  <i>Abstract</i>—This paper conducts an empirical analysis to explore the effects of the technology advance on carbon emissions in China adopting DEA Malmquist index that combines the iron and steel industry. The results indicate that the CO<sub>2</sub> emissions in China are positively related to the level of industrialization, technology innovation and economic scale. However, our findings also show that the technical progress has no significant effects on the improvement of environment quality in the short term.</p>
<p>EE036 18:30-18:45</p>	<p>Breaking through the Barriers to Green Building Movement in Indonesia: Insights from Building Occupants  <b>Mia Wimala</b>, Emma Akmalah and M. Rangga Sururi          Institut Teknologi Nasional, Civil Engineering Department, Jl. P.H.H Mustofa No. 23,          Bandung 40124, Indonesia  <i>Abstract</i>— As one of the biggest countries in the world and the 4th rank in construction industry in Asia, Indonesia is very far behind compared to some</p>

	<p>neighboring countries in terms of green building movement. It is confirmed by the fact that only 16 buildings in Indonesia that have been earned GREENSHIP, the certification issued by the Green Building Council Indonesia up to present. Therefore, the research was conducted to identify the barriers to green building movement in Indonesia from building occupants' point of view. The data presented in this paper are mainly derived from interviews and responses to a questionnaire which distributed randomly to building occupants who had experiences either in conventional or in green buildings around Jakarta and Bandung. Based on the findings from 75 respondents, it was identified that the barriers are: burdensome implementation, lack of supported atmospheres, inadequate knowledge and information, negligence, high cost of green building options, resistance to change, insufficient supervision, lack of awareness, low availability of green products on the market, and lack of building management role. The work concludes with recommendations of performance improvement strategies analyzed by SWOT method.</p>
<p>EE051 18:45-19:00</p>	<p>Removal of High C and N Contents in Synthetic Wastewater Using Internal Circulation of Anaerobic and Anoxic/Oxic Activated Sludge Processes</p> <p><b>Nittaya Boontiana</b></p> <p>School of Environmental Engineering, Institute of Engineering, Suranaree University of Technology</p> <p><b>Abstract</b>—Internal circulation (IC) of activated sludge anaerobic and anoxic/oxic processes was used to treat high carbon (C) and nitrogen (N) synthetic wastewater in order to achieve an effluent standard. The 1st &amp; 2nd internal circulation anoxic (ICA) has shown a great advantage. Because under anoxic conditions heterotrophs utilize organic matter (OM). OM and NO<sub>3</sub>--N are an electron donor and an electron donor, respectively. As a result, under conditions high carbon and NO<sub>3</sub>--N, N<sub>2</sub> production can generate higher than with 1st ICA BNR system only. Aerobic IC to anoxic, 1st ICA, and effluent IC to anoxic, 2nd ICA, could remove 100% of COD, 99.60% of TKN, and 99.90% of NH<sub>4</sub>+N. The organic loading rate and NH<sub>4</sub>+N loading rate are 68.38 kg-COD m<sup>-3</sup> d<sup>-1</sup> and 9.86 kg NH<sub>4</sub>+N m<sup>-3</sup> d<sup>-1</sup>, respectively in synthetic wastewater. Performance of these ICA activated sludge treatment was achieved the discharge standard with effluent COD less than 0 mg L<sup>-1</sup>, effluent NH<sub>4</sub>+N less than 4 mg NH<sub>4</sub>+N L<sup>-1</sup>, effluent NO<sub>2</sub>--N less than 0.1 mg NO<sub>2</sub>--N L<sup>-1</sup>, and NO<sub>3</sub>--N less</p>

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	<p>become a popular destination for local and foreigners. Considering the significance and the potential of the tourism industry for economic development of the society both locally and nationally, there is an urgency to establish competitiveness and attractiveness of destinations using effective and sustainable strategies based on the market conditions and preferences on one hand, and the other to balance the interests inside the destination. The aim of this study is to propose system thinking development for sustainable destination management in a tourist destinations as well as the opportunity to pursue strategic policies and conditions for constituting different types of management structures. The process includes the development of systems thinking approach that represents a holistic understanding of the interconnectedness and relationships between the various components that impact on sustainable development of tourism in Lake Toba. The paper as well intended to use this as a framework for decision making and capacity building by government and private stakeholders who share the responsibility in developing, managing and sustaining destination management in Lake Toba.</p>
<p>EE050 19:30-19:45</p>	<p>The Role of Higher Order Thinking Skills in Green Skill Development  <b>Yee Mei Heong</b>, Lai Chee Sern, Tee Tze Kiong and Mimi Mohaffyza Binti Mohamad          Universiti Tun Hussein Onn Malaysia, Faculty of Technical and Vocational Education, Department of Engineering Education, 86400 Parit Raja, Batu Pahat, Johor, Malaysia</p> <p><b>Abstract</b>—In the era of rapid development, industries sector will bring negative effect of environment. Therefore, green technologies should be exposed in education system for transforming economy model to greener economy modal. HOTS should be applied in green skill development in order to solve problems, generate new products and ideas. The application of HOTS can enhance someone in processing new information for various alternatives, ideas, actions, and design solutions to solve a problem. In this regard, a study on the role of Marzano HOTS in green skill development has been designed for the above purpose. This article suggests an initial idea of the study. The key elements identified in green skills development include green economy, green industry and green skills. Meanwhile, elements related to the Marzano HOTS is comparing, classifying, induction, deduction, error analysis, constructing support, abstracting and analyzing perspectives. As conclusion, HOTS</p>

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requires someone to critically evaluate information, make inferences, and make generalizations. With HOTS, we enable to apply knowledge, skills and values to make reasoning and reflection to solve problems, make decisions, innovate and strive to create something in green skills development.



*Dinner @ SODOWE Restaurant*  
**20:00-21:30**





# Hydrodynamic Analysis for a Jacket-type support structure of the offshore wind turbine

Ming-Hong Chen\*, Chin-Cheng Huang

Mechanical and System Engineering Program, Institute of Nuclear Energy Research

Chun-Wei Lin, Tso-Ren Wu

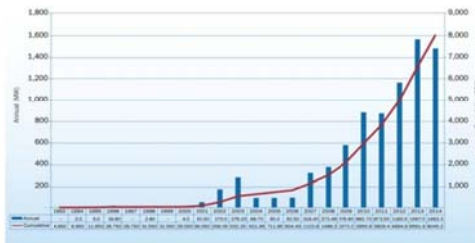
Graduate Institute of Hydrological and Oceanic Sciences, National Central University

2016 International Conference on Sustainable and Renewable Energy Engineering

May 5-7, 2016



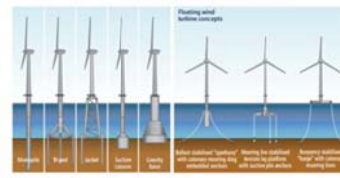
## Introduction



Country	BE	DE	DK	ES	FI	IE	NL	NO	PT	SE	UK	Total
No. of farms	5	16	12	1	2	1	5	1	1	6	24	74
No. of turbines	182	258	513	1	9	7	124	1	1	91	1,301	2,488
Capacity installed (MW)	712	1,048.9	1,271	5	26	25	247	2	2	212	4,494.4	8,045.3

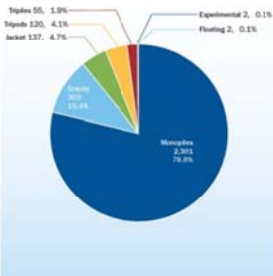
EWEA, The European offshore wind industry - key trends and statistics 2014, 2015.

Figure 17: Fixed-bottom foundation and floating offshore concepts



Source: White et al., 2011.

ALL P2012 design concepts are being tested for offshore turbines.



EWEA, The European offshore wind industry - key trends and statistics 2014, 2015.





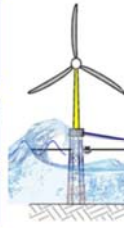
# R&D Progress in INER

- NTM
- ETM
- EWM
- EWS

$$H(u) = 0.0011u^4 - 0.0197u^2 + 0.224u$$

Wave  
 $H_{s1} = 4.09 \text{ m}$   
 $H_{s50} = 5.17 \text{ m}$

- NSS
  - SSS
  - SWH
- Currents



Wind and Wave directionality

$$u < 4, \Delta D = 180^\circ$$

$$4 \leq u \leq 13, \Delta D(u) = 0.728u^2 - 19.36u + 169.25$$

$$u > 13, \Delta D(13) = 40.602^\circ$$

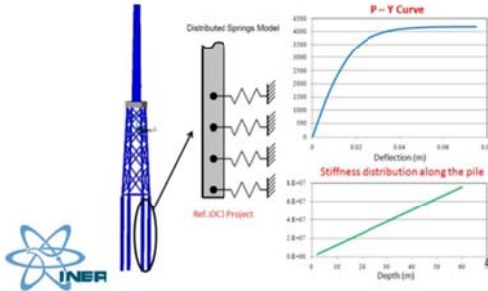
$$NWLR: 50 \pm 2.5$$

$$EWLR: 50 \pm 4$$

Water level



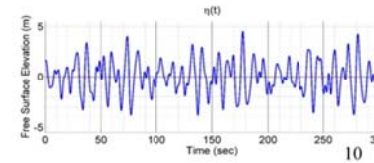
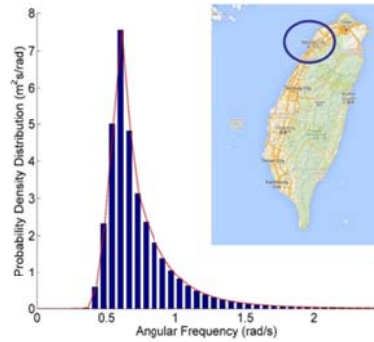
INER-P150II  
150 kW HAWT -2nd



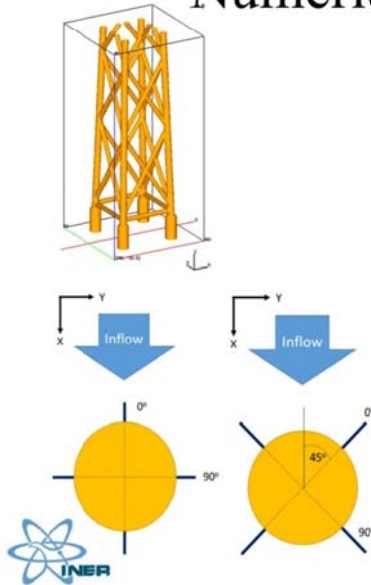
## Numerical model

### Wave model and input data

- The considered wave is generated based on the observed data
  - Central Weather Bureau of Taiwan
  - during 2013 and 2014 at considered locations
  - Samples were taken every 10 minutes
  - data were collected every hour
- Measurement was made
  - 0.03 to 0.4 Hz with 41 frequencies and resolution of 0.01 Hz
- Joint North Sea Wave Project (JONSWAP) spectrum is employed.
  - Significant wave height: 5.78 m
  - Significant wave period: 9.8 sec
  - Peak wave period: 10.45 sec
  - Angular frequency: 0.6013 rad/s
  - Average wave period: 7.5 sec
  - Probability density: 7 m<sup>2</sup>-s/rad
- Modified internal wave maker module is implemented to generate required wave as a site-specific load for the OWT



## Numerical Parameters



Parameter	Value
Significant wave height (m)	5.78
Significant wave period (sec)	9.8
Flow Velocity(m/s)	1.41
Finest Grid Resolution (m)	1.0
Residual for Convergence	1.0e-6
Mean Water Depth (m)	25.0
Courant Number	0.85

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## Conclusion (1/2)

- In the present study, the hydrodynamic load due to extreme external condition, such as typhoon, on the OWT has been investigated by the numerical simulations
  - Including the current, regular and irregular wave on the structure
  - Constant flow speed current and wave (regular and irregular)
  - Using Splash3D, a three-dimensional numerical model is developed for performing the force evaluation of the OWT
  - Multi-phase flow is evaluated by the VOF model, and the turbulent flow is described by the LES model
  - Different inflow directions (0 and 45 degree)



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## Conclusion (2/2)

- Comprehensive comparison for the maximum force
  - No significant variation among investigated cases for regular wave
  - Much larger max. force by irregular wave
- It can be deduced that using the regular wave as the hydrodynamic load for the evaluation of the OWT system will vanish some instantaneous extreme wave
- With such more practical hydrodynamic load
  - Average force is **64% larger** than regular wave
  - Maximum force is **2.25 times larger** than regular wave



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Thank you for your  
attention

