

出國報告（出國類別：會議）

出席 APEC 區域再生能源倍增利用
經驗與規劃會議報告

服務機構：經濟部能源局

姓名職稱：李君禮主任秘書

派赴國家：韓國大邱

出國期間：104 年 11 月 9 日~11 月 12 日

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出國地區：韓國大邱

分類號/關鍵詞：能源工作小組(Energy Working Group, 簡稱 EWG)；新及再生能源專家小組(Expert Group on New and Renewable Energy Technologies, 簡稱 EGNRET)；能源統計分析小組) (Expert Group on Energy Data Analysis, 簡稱 EGEDA) ；亞太能源研究中心(Asia Pacific Energy Research Centre, 簡稱 APERC)

內容摘要

亞太地區各國領袖於 2014 年領袖會議上宣示，希望亞太地區能在 2030 年達到再生能源使用量倍增之目標(以 2010 年為基準年)。此項宣示後，在能源工作組(EWG)、各專家小組(含新及再生能源專家小組 EGNRET 及能源統計分析小組 EGEDA)及亞太能源研究中心(APERC)，均投入資源進行各項分析，希望透過這樣的努力及合作為亞太地區朝向此項目標訂出可行之策略及作法。

美國政府為協助推動這項目標提出一項計畫「Workshop on Experiences and Plans to Double Renewable Energy Utilisation by 2030 in the APEC Region」，此項計畫獲得我國、菲律賓及泰國的共同支持，希望聚集亞太地區及國際間之專家，透過研討會之方式進行經驗及成功案例之分享，來擴散各國之成功經驗及技術交流，並進而協助領袖會議所宣示再生能源倍增目標之達成。

本次研討會共安排了七個 invited speech 及 10 個國家專家針對各國推動現況及展望進行報告(我國由職代表經濟部能源局報告「Strategy and Roadmap for Renewable Energy in Chinese Taipei」)；另我國工研院綠能所楊副所長以專家身分應邀進行專題演講，講題為「Carbon Technology for Green Energy Implementation」，介紹我國在綠色能源技術方面之研究重點及成果。

由各國之報告中可以發現，在面對全球環境變遷下，各國均投入新及再生能源之發展，然而因各國發展程度不同級環境之差異，因此有需要透過集體之合作，由已開發國家投入各項資源來協助開發中國家，以加速再生能源之推廣量。這樣之努力除了可協助發展中國家將有限的資源投入正確的項目，一方面又可減緩全球溫室氣體的排放；當然另一個重點則是協助改善這些國家或區域人民的生活環境和品質。

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壹、內容摘要

為了因應國際間推動節能減碳及發展低碳能源之需求，全球各國之作法上均是增加再生能源於電力系統上之應用，因此聯合國也透過永續能源倡議(SE4ALL)強調擴大再生能源之推廣應用；而亞太地區各國領袖也於2014年領袖會議上宣示，希望亞太地區能在2030年達到再生能源使用量倍增之目標(以2010年為基準年)。

亞太地區在領袖會議做此項宣示後，在能源工作組(EWG)、各專家小組(含新及再生能源專家小組EGNRET及能源統計分析小組EGEDA)及亞太能源研究中心(APERC)，均投入資源進行各項分析，其中包括再生能源的定義、各種再生能源或低碳技術的研究和應用、各國目前再生能源量之統計分析等，希望透過這樣的努力及合作為亞太地區朝向此項目標訂出可行之策略及作法。美國政府為協助推動這項目標亦提出一項計畫「Workshop on Experiences and Plans to Double Renewable Energy Utilisation by 2030 in the APEC Region」，此項計畫亦獲得我國、菲律賓及泰國的共同支持，也獲得亞太經合會(APEC)經費之支持；此項計畫希望聚集亞太地區及國際間之專家，透過研討會之方式進行經驗及成功案例之分享，來擴散各國之成功經驗及技術交流，並進而協助領袖會議所宣示再生能源倍增目標之達成。

這項研討會共安排了七個invited speech及10個國家專家針對各國推動現況及展望進行報告(含我國由職代表經濟部能源局報告「Strategy and Roadmap for Renewable Energy in Chinese Taipei」)；在完成所有報告後則是將所有參加人員分成三組進行專題討論，然後由各組分別說明各組討論之重要結論。分組討論之議題為：Current trends and barriers、Opportunities and strategies、Best practices等。

此外，工研院綠能所楊副所長秉純以專家身分在此項研討會針對低碳能源技術之發展進行專題演講，報告題目為「Low Carbon Technology for

Green Energy Implementation」，內容除了說明為促成低碳環境所可能採行之技術整合模式外，同時也介紹我國工業技術研究院在綠色能源技術方面之研究重點及成果；並主持各國報告中的其中一個 sessionr 及和美國專家 Mr. Nick Schlag 共同主持圓桌討論會議。

本報告針對此次參與研討會之過程進行說明，並對各國報告做重點式之說明，同時也將呈現圓桌討論之重要結果。

此次出國行程共計四天，如表一所示。

表一、出國行程表

日期	摘要
2015/11/09	去程
2015/11/11	參加「Workshop on Experiences and Plans to Double Renewable Energy Utilisation by 2030 in the APEC Region」，進行專題演講「Strategy and Roadmap for Renewable Energy in Chinsese Taipei」
2015/10/12	回程

貳、研討會之重要內容

此項研討會共計兩整天，詳細議程如表二所示。

表二、研討會議程表

Tuesday, 10 November 2015	
8:00 to 8:30	Registration
8:45 to 9:00	Opening Remarks and Workshop Expectations Anil Pahwa, Project Overseer
Session 1: Chair – Tom Key	
9:00 to 9:30	Global Status and Outlook on Renewable Energy Christine Lins, Executive Secretary, Renewable Energy Policy Network for the 21 st Century (REN21), France
9:30 to 10:00	APER Energy Demand and Supply Outlook 6 th Edition: Preview of High Renewable Scenario Cecilia Tam, Deputy Vice President, Asia Pacific Energy Research Centre (APEREC), Japan
10:00 to 10:30	Break
Session 2 : Chair – Christine Lins	
10:30 to 11:00	An Integrated Grid Path for Distributed Solar Tom Key, Senior Technical Executive, Electric Power Research Institute (EPRI), United States
11:00 to 11:30	Renewable Integration in the Western United States: Challenges and Opportunities Nick Schlag, Managing Consultant, Energy+Environmental Economics (E3), United States
11:30 to 12:00	Low Carbon Technology for Green Energy Implementation Bing-Chwen Yang, Division Director, Green Energy and Environment Research Laboratory, Industrial Technology Research Institute (ITRI), Chinese Taipei
12:00 to 1:30	Lunch Break
Session 3: Chair – Cecilia Tam	
1:30 to 2:00	Renewable Energy Utilization Towards Net Zero Energy Building Shicong Zhang, Deputy Director, Research Center for Development Strategy, China Academy of Building Research, Peoples Republic of China
2:00 to 2:30	The Future of Solar Dave Renne, President, International Solar Energy Society (ISES), Germany
2:30 to 3:00	Open Discussion
3:00 to 3:30	Break
Session 4: Sharing Experiences – Chair Nick Schlag	
3:30 to 3:50	Renewable Energy Experiences and Plans in China Peoples Republic of China - Yong Sun, Asia Pacific Sustainable Energy Research Center (APSEC)
3:50 to 4:10	Strategy and Roadmap for Renewable Energy in Chinese Taipei Chinese Taipei - Chnu-Li Lee, Bureau of Energy
4:10 to 4:30	Policy and Current Status of Renewable Energy in Japan

	Japan - Takao Ikeda, The Institute of Energy Economi
4:30 to 4:50	Energizing for Development – Implementing Renewable Energy Technology in Rural Peru Peru - Sol García-Belaúnde, Territory and Renewable Energies
4:50 to 5:00	First Day Wrap Up
Wednesday, 11 November 2015	
Session 5: Sharing Experiences – Chair - Bing-Chwen Yang	
9:00 to 9:20	Updates on Renewable Energy Development in Malaysia Malaysia - Azah Ahmad, Sustainable Energy Development Authority (SEDA)
9:20 to 9:40	Renewable Energy Development in Thailand Thailand - Karnnalin Theerarattananoon, Department of Alternative Energy Development and Efficiency (DEDE)
9:40 to 10:00	Country Report on Renewable Energy Viet Nam - Ninh Hai Nguyen, Ministry of Industry and Trade
10:00 to 10:30	Break
Session 6: Sharing Experiences – Chair – Shicong Zhang	
10:30 to 10:50	National Renewable Energy Program in Philippines The Philippines - Rico R. Velasco, Department of Energy
10:50 to 11:10	Sustaining the Development of Papua New Guinea’s Renewable Energy Sector – Opportunities and Challenges Papua New Guinea - Rebecca Kiage, Department of Public Enterprises
11:10 to 11:30	New and Renewable Energy in Korea – Best Practices in Policy and Development Republic of Korea - Sang-keun YU, Korea Energy Agency (KEA)
11:30 to 11:50	Open Discussion
11:50 to 1:30	Lunch Break
Session 7: Roundtable Discussion	
1:30 to 3:00	<ol style="list-style-type: none"> 1. Currents trends and barriers including policy, technical, and social to advancing renewable energy 2. Opportunities and strategies for strengthening renewable energy implementation: emerging technologies, innovative financing, public-private partnership, and business strategies 3. Best practices for advancing renewable energy: training for capacity building, reducing soft costs, resources for information sharing, stakeholder engagement <p>Group 1: Discussion Leaders: Christine Lins and Cecilia Tam Group 2: Discussion Leaders: Tom Key and Shicong Zhang Group 3: Discussion Leaders: Nick Schlag and Bing-Chwen Yang</p>
3:00 to 3:30	Break
3:30 to 4:15	Short reports on Group 1, 2, and 3 findings by group leaders
4:15 to 5:00	Brainstorming and Open Discussions to define a pathway for the future
5:00 to 5:10	Workshop Evaluation
5:10 to 5:20	Closing Remarks

此項研討會共安排七個專題演講及十個國家有關再生能源發展現況及未來趨勢之報告，以下將針對這七份專題報告做重點式及摘要之說明。至

於各經濟體之報告，因主要係在說明各經濟體推動再生能源之現況及未來規劃，因此也將報告重點摘要做些簡單之紀錄。

一、專題報告之簡要說明

1. Global Status and Outlook on Renewable Energy – Christine Lin

這是由 Renewable Energy Policy Network for the 21st Century (REN21) 執行秘書針對該組織所發行的「Renewables 2015 Global Status Report」進行內容之介紹。這份報告主要係由分散於各國約 500 位專家(含研究人員)提供資料或協助檢視而成，主要特色為全球性之評估、市場及產業趨勢分析、投資流向、政策環境、分散式再生能源、再生能源和環境變遷之關聯等；而報告內容則涵蓋再生能源技術、不同部門其再生能源之應用(含電力、冷暖房及交通)，同時亦觸及能源效率之關聯性。

以 2014 年為例，全球再生能源於電力和燃料應用方面的投資高達美金 2,700 億，而在電力系統方面其裝置容量達 1,712GW(如扣除水力則為 657GW)，約為全球電力系統總裝置容量之 27.7%，電力需求則約為 22.8%(但其中 16.6% 來自水力發電)。

REN21 並估算再生能源在 2013 年約占全球最終能源消費之 19.1%(其中 9% 為傳統之生質能)。報告中亦針對不同再生能源之過去及現況做簡要之說明。

在 REN21 這份全球報告中，除了針對電力系統進行報告及分析外，亦針對熱應用(冷暖房)及交通用途進行統計分析。當然以目前而言，全球在再生能源投資方面係以中國大陸居第一位，其次分別為美國、日本、英國及德國。整體而言，再生能源相關產業約提供全球 7,700 萬之就業機會；至於在投資方面則以太陽光電居首，其次則為風力。

值得一提的是，過去的經驗顯示，技術的發展往往超過人們的預期，因此也導致再生能源發展之速度遠超過人們的預估。

表三、2030 年全球再生能源裝置容量預估

Table 4: Global Renewable Power Capacity by 2030 in Recent Scenarios

	Hydro	Wind	Solar PV	CSP	Biomass	Geothermal	Ocean
	GW						
Actual 2006 Capacity for Comparison	–	74	8	0.4	45	9.5	0.3
Actual 2011 Capacity for Comparison	970	238	70	1.8	72	11	0.5
IEA WEO (2012) "New Policies"	1,580	920	490	40	210	40	10
IEA WEO (2012) "450"	1,740	1,340	720	110	260	50	10
IEA ETP (2012) "2DS"	1,640	1,400	700	140	340	50	20
BNEF GREMO (2011)	—	1,350	1,200	—	260	30	—
IEA RETD (2010) "ACES"	1,300	2,700	1,000	120	340	—	—
Greenpeace (2012)	1,350	2,900	1,750	700	60	170	180

Sources: See Annex 2. Actual 2006 and 2011 from REN21 (2008, 2012).

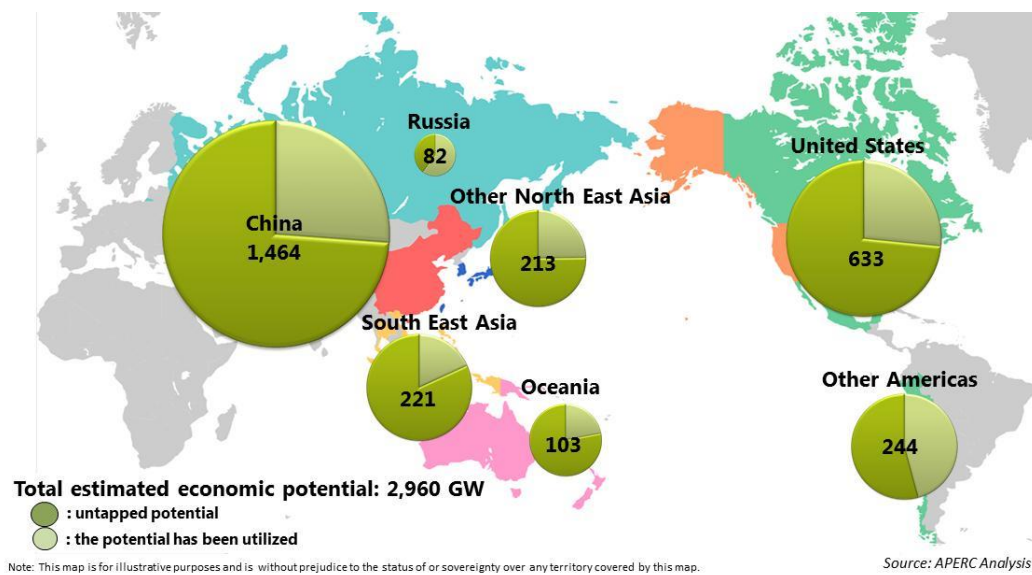
Notes: CSP stands for solar thermal power. Figures for 2030 are rounded to nearest 10 GW or 50 GW from original sources. Hydropower figure for 2011 excludes pure pumped hydro capacity; a comparable figure for 2006 is not available, see REN21 (2012), notes to Table R2, and note on hydropower on page 168.

Christine Lin 最後則強調，在 2014 年雖然全球能源需求量降低及石油價格之下跌，但再生能源之裝置量仍是增加的，這也是人類因應全球變遷所做的持續努力；而去(2014)年也是四十年來第一次經濟成長率和 CO₂ 排放量脫鉤。這在在顯示，人類努力推動再生能源已見初步成效。

2. APER Energy Demand and Supply Outlook 6th Edition: Preview of High Renewable Scenario – Cecilia Tam

「APEC Energy Demand and Supply Outlook」是 APERC(亞太能源研究中心)針對亞太地區各個國家能源供需每隔二~三年所發表之統計分析及預測資料，第六版預計在明(2016)年初發行。APERC 預估亞太地區由於交通部門能源需求的大量增加將導致整體能源需求在 2040 年較目前(2013 年)增加 33%，這些增加量約有 90%來自中國大陸及東南亞地區；然而值得慶幸的是化石能源之佔比將由 86% 降為 82%。如光以電力系統來看，再生能源將由 2010 年的 16% 提升至 27%；雖然這是很大的進步，但也意謂著亞太地區領袖們所宣示再生能源倍增之目標如依照自然發展趨勢是很難達成的。因此如要達成這項目標，勢必要有更強而有力的作為。

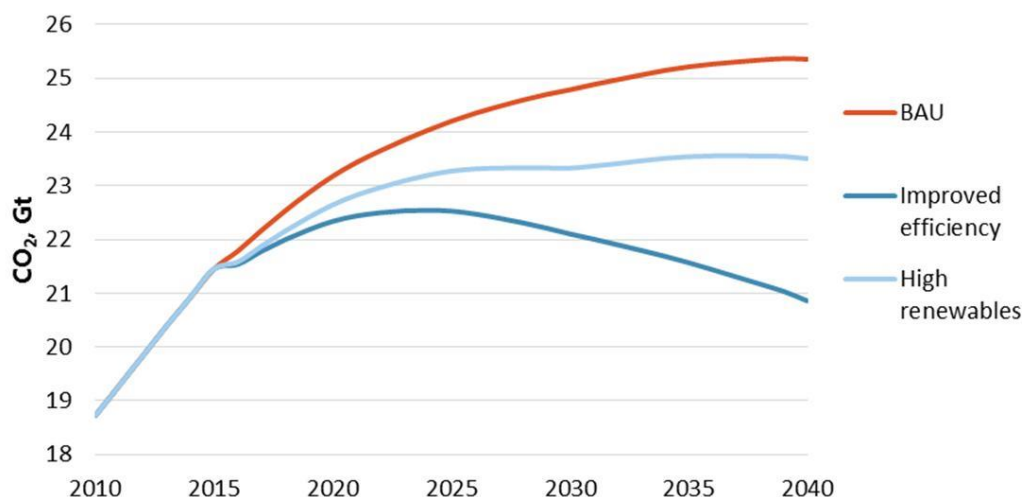
因此 APERC 在此版之能源供需報告中特別針對在電力系統中高再生能源之情境進行分析，其基本假設是各國政府均會達成其再生能源之設定目標，同時為滿足 APEC 再生能源倍增目標是在最低成本下之策略下來進行；而此項情境基於政府政策、目標、計畫等再加上可能之資源潛力進行推估，其潛力如圖一所示。



圖一、亞太地區再生能源潛力預估

在這項預估中，以太陽光電和風力成長最快，然而水力仍是最值得開發之再生能源；預估在 2040 年風力發電將達 2,359TWh，太陽光電則為 2,040TWh。至於整體再生能源量則將從 2013 年的 903 GW，成長至 2030 年的 2,684 GW 及 2040 年的 3,257 GW；而美國及中國大陸亦將占整個 APEC 地區的 70% (2030)及 71% (2040)。至於交通部門所需的生質燃料則是基於各國未能應用於糧食作物生產之農業用地轉為生產燃料用原料之最大化(當然這項假設係以不影響糧食作物生產為原則)，然而其發展及生產量仍然有限，甚至以最大化之潛力來推估生質酒精之供應量仍不敷 2020 年之需求量。

亞太區域內 CO₂ 的排放量在 BAU、能源效率改善及再生能源最大化等三種情境下則如圖二所示。



圖二、亞太地區不同情境下 CO₂ 排放量之變化趨勢

3. An Integrated Grid Path for Distributed Solar – Tom Key

由於愈來愈多之再生能源進入電力系統中，因此也逐漸改變電力網之運作及傳輸模式，如消費者亦成為電力生產者、負載成為互動式且動態變化、電力生產更加彈性化、電力傳輸及配送將更具可控性及彈性，未來亦有愈來愈多消費者採用分散式之能源資源(Distributed Energy Resources、DER)；因此 Tom 認為未來整合型的電力網應該具備：(1)電力網之現代化；(2)通訊標準及連結規範；(3)系統整合性之設計和運作；(4)完整之政策及法規/規範。

接下來，Tom 則是以太陽光電系統之增加從電力成本及供電穩定性來探討電力網是否足以支持這樣之成長，並從這些分析中歸納出電力網所潛在之問題。為了分析及探討這樣的問題，他們的研究系分成四個步驟進行從：首先是了解太陽光電系統的性能，其次則決定饋線的負載能力，再來則開發/改善分析的方法，最後才是進行變頻網路之佈建。

最後 Tom 則提出四點建議：

- Leveraging existing grid “hosting capacity” (matching solar to available capacity and energy demand)
- Changing requirements for DG to provide grid support, especially for island grids (Smart Inverters...optimal setting)
- Pinpointing distribution upgrades and reinforcements (AMI, smart protection and control, wires, see PVGrid)
- For the bulk two-way transmission grid, provide levers for operators (flexibility of resources, DG ride-thru requirements, forecasting, etc)

4. Renewable Integration in the Western United States: Challenges and Opportunities – Nick Schlag

Mr. Nick 強調在國際間推動減碳，電力部門應是所要探討的對象，而其努力方向有三，一為再生能源，二為二氧化碳捕獲及封存(CCS)，三為核能發電；然而再生能源卻因受外在環境而使輸出變化大、無法預測及輸出量的不確定性、再加上每天的輸出時間過於集中，因此電力系統就需要具備更大的彈性來因應這樣之變化；而其衝擊亦會隨這愈來愈多再生能源導入系統而愈來愈嚴重，因此電力系統的智慧化就成為選項之一。

以美國加州為例，係以 RPS(Renewables Portfolio Standards)來鼓勵再生能源之推廣，在 2013 年已達 23%，且相對 2005 年已減碳約 15%；預估 2020 年達 33%，減碳則為 20%，但也導致電價增加約 6~8%；預估在 2030 年則 RPS 將達 50%；這樣之目標對加州的電力系統來講將是一項嚴重的挑戰，因此亟需有工具來評估這樣之再生能源量對電力系統之即時影響，以提供因應之對策。Mr. Nick 則提出該公司所發展之 REFLEX 即是在建立這樣之模型以分析高佔比之再生能源量。該模型之功能為模擬每小時之電力調度需求、利用統計分析推估可運轉天數及條件、透過分析成本等因素來因應電力系統運轉之挑戰等。

尤其在 RPS 達到 50%時，因太陽光電的大量導入，因此如何平衡尖峰時段之過度發電量或因天候無法供電將是關鍵；所以在配置上如以燃煤發

電來搭配，如何兼顧快速反應或經常性的加卸載條件下，並不致於增加反覆運轉及維運之成本，更不會影響機組壽命將是重要的議題也是需克服之問題。因此加州設計了「低成本及最佳組合」之架構，已同時兼顧成本及價值。但這樣之成本及價值需要因應再生能源技術的演進、環境及財務之變化、及系統特性而作必要之調整。



圖三、成本計算之參數

最後，Mr. Nick 提出幾項建議來因應再生能源之導入電力系統，一為區域性之協調及整合，因為對小系統而言挑戰性高，對大系統則較容易因應；其次則重新思考導入再生能源之情境，這涵蓋兩個議題，一個為在滿足負載需求及系統彈性下可調度之負載有多少，另一則為在既有傳統能源及再生能源之特性下之較佳組合；再來則是探討提供最低成本可能之路徑(含天然氣、能源儲存、需求端管理、彈性負載及電價結構等)。他也強調加

州的做法並非在各地均適用，每一個國家或地區均應考慮區域特性而進行設計較佳之系統及機制。

5. Low Carbon Technology for Green Energy Implementation – Bing-Chwen Yang

這是作者報告的主題，主要是從綠色能源之角度來探討低碳技術之整合應用以實現永續發展的作法，然後介紹工研院在此方面之主要技術發展和進展；中間並以工研院 Green Campus 為案例來說明低碳技術整合應用之作法及效益。(詳細內容請見附件四)

6. Renewable Energy Utilization Towards Net Zero Energy Building - Zhang Shicong

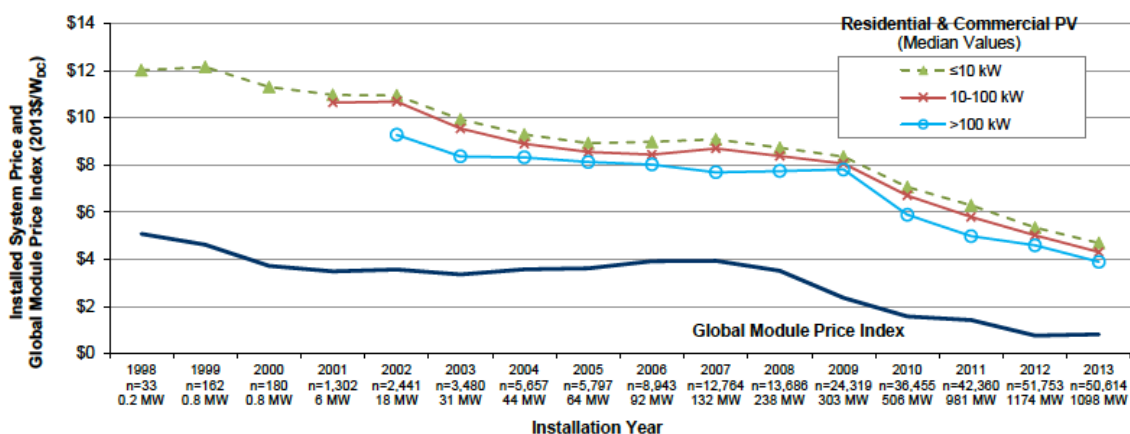
這一份報告係由大陸建築科學院執行一項 APEC 計畫的進度說明。Mr. Zhang 首先點出 2011 年全球能源消耗量約為 1999 年的 1.05 倍，而其中住商部門卻達 1.33 倍，工業部門系負成長僅為約 0.89 倍；至於住商部門內，商業部門的成長則較住宅部門成長更快。這計畫第一年主要是在調查亞太地區淨零耗能建築(Net Zero Energy Building)之發展現況及趨勢，重點項目為：淨零耗能建築(Net Zero Energy Building)之定義及政策、研究產出及技術發展里程、亞太地區主要推動計畫、相關推動組織及聯盟等。第二年則是以最佳案例之蒐集分析比較為主，並透過兩場研討會進行技術交流和分享。

7. The Future of Solar - Dave Renné

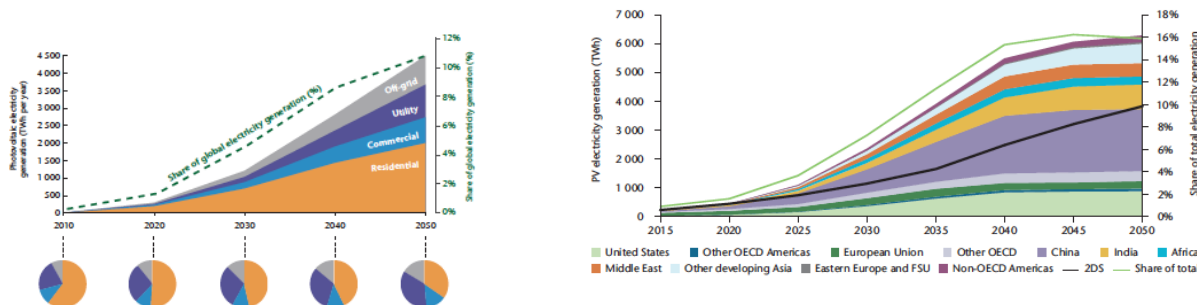
Mr. Dave 為國際太陽能學會之主席，此篇主要在談國際間太陽能之應用(含光電及熱能)現況。預估在今(2015)年底前太陽光電裝置量約可達 200GW，占全球電力供應量約 1%；其中超過 50MW 的大型太陽光電廠超過 70 座；此外偏遠地區無電力網可及地區、分散式太陽光電系統亦快速成長中。如果以 2013 年的產量來看太陽光電技術之發展，仍以矽晶太陽光電佔最大量(約 47GW)，其次則為薄膜太陽光電(約 4.9GW)，至於聚光型太陽

能發電系統則小於 0.2GW。至於太陽熱能之應用累積至 2013 年則達 374.7GWth，聚光型(CSP)則累積約為 4.4GW。

此外，太陽光電模組及系統之成本也將隨這是產量的增加而逐年下降，因此也大大推動太陽光電市場之快速成長並遠超過當初之預估值；根據能源總署(IEA)在 2011 預估，太陽光電在 2050 年將供應全球 11%之用電量，然而在 2014 年的預估，太陽光電系統在 2050 年的供電量已可大幅提升至 16%；這主要是因技術的進步及市場的快速成長而導致成本降低所致；而且是由住宅型之小型太陽光電系統移至大型的太陽光電系統(Solar Farm)



圖四、太陽光電成本及裝置量之變化



圖五、太陽光電系統之發電佔比(左)2010 年估算，(右)2014 年估算

因此在結論中，他特別強調再生能源百分百是有可能的，但須有多方面之配合，如政策推動以降低風險及不確定性、持續的研究發展以提升效

率及降低成本、資金的融資將是提升推廣的動力、技術人力的支援以支撐技術的進展等。當然其它如電力網...等的配合也是必要的，而這也將造成整個能源產業發展的巨大轉變。

二、各國報告重點及再生能源發展作法

1. 中國

中國再生能源之裝置量以水力佔最大宗，以 2014 年為例，總裝置量約 435GW 中，水力約為 301GW，其次則為風力及太陽光電；根據目標在 2030 年非化石能源將佔總初級能源供應量的 20%(相較於 2010 年則為 10%)。因此在作法上有三大策略，一為控制能源總需求量(尤其是降低對煤的依賴)；二為設定各項再生能源在 2020 年之目標(核能 53GW、風力 200GW、太陽光電 100GW、頁岩氣 300 億立方米、地熱 5000 萬噸標準煤)及最佳化能源組合(非化石能源超過 15%、天然氣超過 10%、煤低於 62%)；三則為能源市場及架構之改革(含價格機制、加速電力市場之改革，及推動供應者和消費者之直接交易)。

因此在作法上將透過將再生能源整合並進入供電網，並透過電力系統管理、能源儲存...等技術來強化再生能源在能源配比中之角色。

2. 台灣

主要談及我國再生能源政策及目標，並特別說明推動太陽光電及離岸風電之作法。

3. 日本

日本在 2015 年公布能源供需展望，預估在 2030 年再生能源佔比將達 22~24%，其中以水力佔比最高，依序則為太陽光電、生質能、風力及地熱。至於在推動作法上，在 2012 年前是以 RPS (Renewable Portfolio Standard)，之後則變更為 FIT；日本也因為 FIT 機制之導入，致使再生能源量大幅提升(尤其是太陽光電)；但也導致一個奇特的現象，每年提出太陽光電安裝申請量

卻遠超過實際的安裝量，這大概也反映了太陽光電成本之快速下降。也由於太陽光電安裝量的大幅增加，也對日本電力系統造成一些問題，如再生能源之推動太過於依賴太陽光電，其衍生之併網成本之增加，因此如何穩定及控制電力成本以避免政府財政負擔等將是要面對的問題。

4. 秘魯

秘魯最終能源消費以柴油(29%)、電力(19%)、天然氣(12%)、其他(40%)為主，如果以部門來分，則以交通部門佔 42%、住商 26%、工業 28%、其餘約 4%。如果以能源配比來看，水力約佔 40%，其餘 60%則為傳統之化石能源及生質能；至於再生能源利用則分為熱、電及機械能等三種不同型式。目前各種型式再生能源(含太陽能、風力、生質能，不含水力)約佔 2%之電力，預估在 2020 年可達 5%左右。

5. 馬來西亞

馬來西亞係在 2011 年正式通過再生能源法並以 FIT 機制來推動再生能源，而收購費用係由再生能源基金支付，該基金則來自電費之附加費，以 2%為原則(目前是 1.6%)，而這項額外費用也會影響 FIT 機制下再生能源之目標量；但以目前之附加費之機制及規模，預估在 2020 年僅能達成再生能源裝置目標值(2.08GW)之 72%。而在 FIT 機制中，不同的再生能源有不同之保證收購年限，此外針對採用當地產品則有額外的費用補貼；以太陽光電為例採用當地製造之模組或變壓器則有額外之補貼費用，因此這也產生推動地方產業之效益。然而目前在實際推動上卻受到諸多因素的影響，含技術、財務、環境...等，致使累計至 2015 年僅達成目標值得 32%左右。其中以太陽光電影響最大(主要係因再生能源基金的因素)，其 FIT 也僅適用至 2017 年，以將基金移至其他再生能源來擴大再生能源總裝置量；至於其他再生能源則維持至 2025 年。至於獲得延長適用 FIT 之太陽光電系統則包括兩類，一為淨能源量(Net Energy Metering、NEM)，預計從 2016 年起每年

100MW 至 2020 年止；另一則為系統級之太陽光電(Utility-Scale Solar、USS) ，預計從 2016 年起每年 200MW 至 2020 年止；兩者合計共 1,500MW 以彌補 2017 年停止太陽光電 FIT 後所造成再生能源推廣量不足的問題。

6. 泰國

泰國目前(2014 年)再生能源佔最終能源消費約 11.9%；而在最終能源消費中，工業部門已稍微超過運輸部門而成為最大消費部門，兩部門各約佔 36%左右。其主要再生能源可分為三大類：一為大自然能源，含太陽能、水力及風能；二為農業作物，含甘蔗、木薯及棕櫚樹；三為廢棄物，含農業廢棄物、工業廢棄物及都市固態廢棄物等。根據該國在 2015 年所公布之 ADEP2015 之規劃，預估在 2036 年再生能源將佔最終能源消費之 30%，而在估算上將分成電力(4.27%)、熱能(19.15%)及交通(6.65%)應用等三大領域。在推動作法上其中一項是將原先推動之 ADDER 機制改成 FIT 制度(但僅限於單一計畫小於 10MW 之系統)。至於在推動過程則由不同部會提供不同之激勵或補助措施，如進口設備或機器之免關稅、對銷售再生能源或節約能源提供稅務優惠 8 年、提供低風險貸款、ESCO 基金、信保、相關再生能源潛力之資訊、建立單一窗口之服務、推動 FIT 機制等。

7. 越南

越南目前電力系統總裝置容量達 34.6GW，其中約有 23GW 是在過去九年內完成，以因應經濟之快速起飛。其中再生能源裝置量不到 1%，並以水力發電為主。從越南政府在 2011 年所發布之政策來看，預估 2020 年再生能源發電裝置將達 4.5%，並在 2023 年達到 6%之目標；其中風力發電目標在 2020 及 2030 年分別為 1.0GW 及 6.2GW，生質能分別為 0.5GW 及 2.0GW；此外則希望利用再生能源對偏遠地區增加非電力網之供電系統，預估在 2020 年可以使 231,000 家戶能享受到電力之供應。基本上仍是以 FIT 機制為主來鼓勵再生能源之推動。

8. 菲律賓

菲律賓政府推動再生能源係以 NREP(National Renewable Energy Program)為依據，預估再生能源之裝置總量將從 2010 年的 5,369MW 成長至 2030 年的 15,236MW。推動上則有財務及非財務之誘因，非財務又因包括：

- Renewable Portfolio Standards (RPS) – on-grid “RE blend” obligation
- Off-grid RE Development - minimum “off-grid RE blend” obligation
- Net Metering – “consumer RE facility to offset electricity from grid”
- Feed-in Tariff (FIT) - “RE guaranteed fixed price for 20 years”
- Transmission and Distribution System Development – “RE connection facilities in the T/D Development Plan”
- Green Energy Option - “end-users option to choose RE as source of electricity”
- Adoption of Waste-to-Energy Technologies

財務誘因有：

- Income Tax Holiday and Low Income Tax Rate
- Reduced Government Share
- Duty-free Importation of Equipment and VAT-zero Rating
- Tax Credit on Domestic Capital Equipment
- Special Realty Tax Rate on Equipment and Machinery
- Cash Incentive for Missionary Electrification
- Exemption from Universal Charge
- Payment of Transmission Charges
- Tax Exemption on Carbon Credits

9. PNG

PNG 是一個正在開發中之國家，全國電力系統總裝置容量為 580MW，其中 300MW 為國營電廠，其餘為民營電廠(IPP)；而在這些電廠中，除 85MW 為天然氣外，其餘均為再生能源(含水力 432MW、地熱 56MW 及生質能 7MW)；

而在這樣短少之電力供應中，全國僅約 13%之人口有電力供應，但供電穩定性仍不足，其餘 87%仍無電力網路抵達；最近幾年由於天然氣之生產，因此發展較為快速，預估在 2030 年可達成全國 70%之人口均有電力可用。同時該國也預期在 2050 年時電力供應可達成百分百由再生能源或穩定且可持續之能源來供應，其碳排放量也將回到 1990 年的水準；因此將大力發展生質燃料已逐步取代化石燃料，以達到促進經濟發展及降低溫室氣體的排放量。

10. 韓國

韓國新及再生能源之發展目標，預估至 2035 年將佔初級能源供應量的 11% (2014~2035 能源需求之年增率為 0.7%，而新及再生能源之年增率為 6.3%)；而電力系統則為 13.4% (2014~2035 電力需求之年增率為 1.8%，而新及再生能源之年增率為 5.8%)。而整個新及再生能源的結構，將由現在以廢棄物為主而逐漸改變，預期廢棄物能源將從 2012 年約佔 68.4%，到 2035 年將縮小為 29.2%；而這期間太陽光電(2.7%到 14.1%)及風力(2.2%到 18.2%)將大幅成長，並填補廢棄物能源所減少了量。

至於韓國在推動新及再生能源方面則有三個不同之機制構成，針對電力部分係以 RPS(Renewable Portfolio Standard)，熱能部分係以 RHO(Renewable Heat Obligation)，交通部分則為 RFS(Renewable Fuel Standard)。

三、圓桌討論之內容及結論

此次討論共有三項議題，並將所有人分成三組同步討論此三個議題，然後在總結時由各議題主持人提出重點報告，然後在各組提出之重點中透過投票方式選出最重要之項目。我則和 Mr. Nick Schlag 共同擔任第三小組的主持人，這小組共包括中國、PNG、越南、韓國(二人)、馬來西亞、日本等國代表組成。

針對這三項議題，第三小組重要觀點則摘要如下：(其中具底線之紅色字體部分為第三小組成員認為較重要的觀點，並將列入總結會議上報告之項目)

1. Currents trends and barriers including policy, technical, and social to advancing renewable energy

- What are the policy barriers for advancing renewable energy?
- What the technical barriers for advancing renewable energy?
- What the social barriers for advancing renewable energy?

第三小組針對這項議題討論的重要觀點有：

(1) 政策缺乏延續性，常因執政者異動而改變，致使業者難以因應

(2) 中央及地方政府缺乏協調及一致性

(3) 能源價格的影響，含對消費者、投資者

(4) 缺乏對再生能源較明確的政策及策略

(5) 技術成熟度不足，同時對技術潛力及多樣性仍缺較明確的預估

(6) 財務的調度及融資對投資者仍不友善及缺乏誘因讓更多資金進入

(7) 透過 FIT 來引導不同再生能源之發展仍存在不同程度之挑戰

(8) 民眾對再生能源資訊仍不是很清楚，因此常產生無謂的紛爭

(9) 缺乏足夠的技術人力

(10) 無法從錯誤中學到教訓，主要是指亞太區域內之經驗交流仍然不足

(11) 需要有更多有關再生能源設備或系統之標準

2. Opportunities and strategies for strengthening renewable energy implementation: emerging technologies, innovative financing, public-private partnership, and business strategies

- What are the opportunities and strategies for strengthening renewable energy implementation?

- What are the emerging technologies for advancing renewable energy?
- What are the business strategies for innovative financing and public-private partnership for advancing renewable energy?

第三小組針對這項議題討論的重要觀點有：

- (1) 應該讓政策研擬者對技術的進展有充足的資訊及了解
- (2) 應該創造可以讓金融業願意貸款之計畫及信心，這可以透過成功案例來對金融業進行教育及宣導
- (3) 需要更多的技術訓練課程
- (4) 對即將成熟的技術及產品要有育成之計畫及作為
- (5) 架構智慧電表及電網以擴大再生能源併入電網的可能性
- (6) 擴大區域性生產鏈，以營造區域性特性及減少物流
- (7) 縮短供應端及需求端對再生能源認知的鴻溝

3. Best practices for advancing renewable energy: training for capacity building, reducing soft costs, resources for information sharing, stakeholder engagement

- What are the best practices for training and capacity building to advancing renewable energy?
- What are the best practices for reducing soft (non-hardware) costs for renewable energy?
- What are the best practices to build resources for information sharing?
- What are the best practices to improve stakeholder engagement?

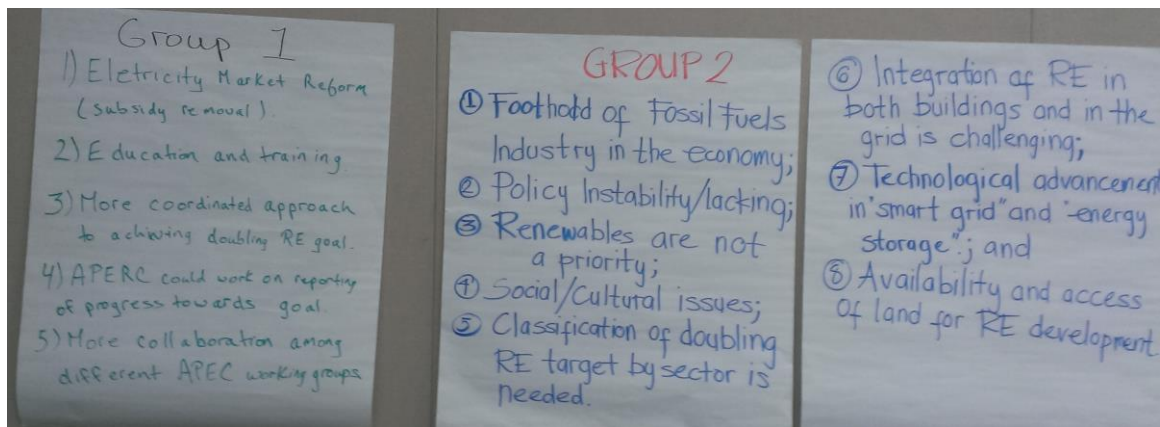
第三小組針對這項議題討論的重要觀點有：

- (1) 擴大國際間或區域間之各項資訊交流及分享，含技術、政策、教育宣導等
- (2) 強化對標準及證照方面之服務，以讓更多專業人力能進入此項市場
- (3) 發展及推動區域間的共通標準及測試準則，如電氣標準、電網規範、

測試程序...等

- (4) 透過創新技術及財務機制來降低投資再生能源之成本
- (5) 透過展示或教育宣導來改善公部門和民眾間之交流機制
- (6) 和相關利害關係者強化資訊之交流及溝通

至於第一及第二小組的總結報告重點則如圖六所示。



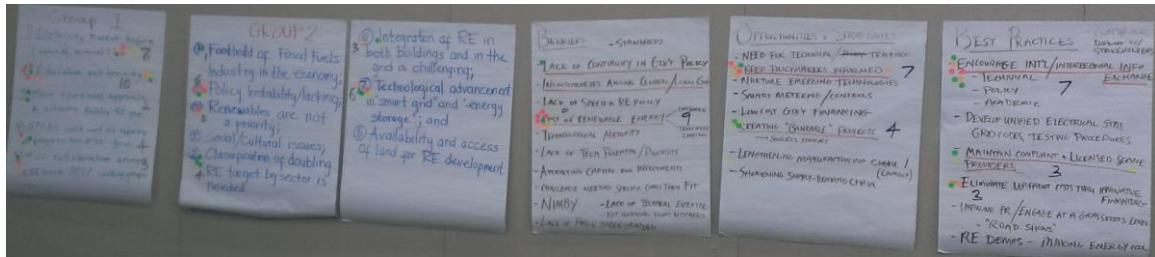
圖六、其餘兩個小組的總結報告

在經過各小組報告後，則由與會者針對這些重點項目進行投票，最後票選出來排名前六名的項目，其簡要說明如下：(詳細票選結果則如圖七所示)

- (1) 強化針對一般民眾之教育及專業人員之訓練，一方面可讓民眾對再生能源有正確的認識以減少推動之阻礙，另一方面可提供此項產業足夠的專業人力。
- (2) 降低能源價格的影響，含對消費者、投資者。
- (3) 架構合理之電力市場，如取消各項補貼；如此可讓不同供應端之能源能呈現正確之成本結構。
- (4) 應該讓政策研擬者對技術的進展有充足的資訊及了解，如此在研擬政策時才能真正因應技術及市場之發展需求。
- (5) 擴大國際間或區域間之各項資訊交流及分享，含技術、政策、教育宣導

等，如此方能有效縮短學習曲線而加速再生能源之發展。

(6) 投入資源加速前瞻性智慧電網及能源儲存技術之發展，如此才有機會將再生能源的不穩定性對電網之衝擊降到最低，也才有利於更多再生能源併入電網。



圖七、各小組重點報告票選結果

參、心得與建議

由於此項研討會係美國為因應亞太地區推動再生能源目標倍增之願景下而產生之一項計畫，同時亦配合國際太陽能學會(ISES)所舉辦的 Solar World Congress (2015 SWC)共同舉行，因此參加的人員除了亞太經合會(APEC)各國代表外，亦邀請國際間相關再生能源領域(尤其是太陽能)之單位派員出席及發表專題演講。所以參加此項會議，除了和亞太地區相關政府官員、專家及學者交流外，亦可和國際間重要推動組織進行經驗交換。透過這兩天的會議和細部討論，心得和建議如下：

1. 我國對亞太經合會相關事務或活動的參與是積極的，再加上在東南亞地區，我國各項技術或產業之發展相對進步，因此可以利用亞太經合會這個舞台來協助國內綠能產業之發展及對外擴展。
2. 因為亞太地區設定推動再生能源目標倍增之願景，因此從與會各國代表的報告中，可以理解到各國對推動此項願景的努力，而在不同再生能源中，太陽光電永遠有其角色；這對太陽光電技術及產業發展相對較早也較完整的我國而言是一個契機；關鍵在於我們如何把握這樣的一個機會，透過政府及民間的共同努力來掌握此項機會，突破目前我國太陽光電產業突破所面臨的困境。
3. 由於我國也是亞太經合會內「新及再生能源專家小組」的主席，因此應該更積極利用這樣之機會，以我國已建立推動再生能源之經驗及成果，再加上綠能相關產業之基礎，擴大我們在亞太區域之影響力；一方面強調我們對追求低碳永續發展之努力，一方面協助其它開發中國家架構再生能源之發展基礎。
4. 以美國為例，他們都積極申請 APEC 支持之計畫，並透過安排研討會等方式來協助各國進行技術及經驗之交流；何況我們身負「新及再生能源專家小組」主席的身分，更應積極協調國內學研單位透過「新及再生能源

專家小組」或能源工作組提出計畫，來彰顯我國在此方面對支持亞太領袖們所宣示再生能源目標倍增所作之努力及貢獻。

5. 由各國之報告中可以發現，在面對全球環境變遷下，各國也均會投入新及再生能源之發展，然而因各國發展程度不同級環境之差異，因此更有需要透過集體之合作，由已開發國家投入各項資源來協助開發中國家，以加速再生能源之推廣量。這樣之努力除了可協助發展中國家將有限的資源投入正確的項目，一方面又可減緩全球溫室氣體的排放；當然另一個重點則是協助改善這些國家或區域人民的生活環境和品質。
6. 面對今(2015)年底於法國巴黎召開的 COP21 會議，全球是否能在減碳及減緩溫室效應的壓力下達成共識來共同努力以降低溫室氣體的排放及維持環境的永續發展呢？各方都在期待；我國雖非聯合國的會員國，但在地球村的概念下，再加上我國是強烈依賴貿易之國家，因此也提出我們的自主減量承諾(INDC)，而此項承諾也和我國剛通過的溫室氣體管理法的減碳目標相互呼應及搭配；然而接下來如何落實才是真正挑戰的開始。因此我們更應該珍惜在 APEC 的舞台上展現我們的影響力，一方面促成自我減量，一方面協助其餘亞太地區國家減量。

肆、附件及參考資料

附件一、名片交換名單

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附件二、專題演講及報告人資料



Anil Pahwa is Professor and holds the Logan-Fetterhoof Chair in Electrical and Computer Engineering at Kansas State University, where he has worked for the past 32 years. His expertise lies in smart grid and renewable energy with a goal to make electric power systems more resilient and sustainable. He was Chair of Power and Energy Education Committee in 2012 and 2013, and presently he is an Editor of IEEE Transactions on Power Systems. He worked in the U.S. Department of State as a Jefferson Science Fellow for a year from 2014 to 2015 providing scientific support for international policies related to energy. His assignments in the Office of Economic Policy in the Bureau of East Asian and Pacific Affairs (EAP/EP) included energy issues, science and technology innovation, infrastructure financing, and urbanization mainly covering the APEC region.



Dr. Christine Lins was appointed as Executive Secretary of REN21, the Renewable Energy Policy Network of the 21st Century, in July 2011. REN21 is a global public-private multi-stakeholder network on

renewable energy regrouping international organizations, governments, industry associations, science and academia as well as NGOs working in the field of renewable energy. REN21 has its headquarters at UNEP, the United Nations Environment Programme in Paris/France. Between 2001 and 2011, Ms. Lins served as Secretary General of the European Renewable Energy Council. Previously, she worked in a regional energy agency in Austria promoting energy efficiency and renewable energy sources. Ms. Lins holds a Master's degree in international economics and applied languages. She has more than 19 years of working experience in the field of renewable energy sources.



Cecilia Tam joined the Asia Pacific Energy Research Centre (APEREC) as Deputy Vice President in March 2015 and is responsible for managing the research programme at APEREC. She is currently leading the development of the 6th edition of the APEC Energy Demand and Supply Outlook. Prior to joining APEREC, Cecilia was Head of the Energy Demand Technology Unit at the International Energy Agency (IEA), where she was also responsible for the IEA's Energy Technology Roadmaps Programme. Having joined the IEA in 2006 her work has covered technology roadmaps, finance, deployment and innovation, industry and energy efficiency. She has authored numerous IEA publications including Energy Technology Perspectives, Energy Technology Transitions for Industry, Transition to Sustainable Buildings, and a number of Technology Roadmaps. Cecilia was also a Senior Equity Research

Analyst with Dresdner Kleinwort Benson where she covered Latin American electricity companies, working on various privatisations and equity offerings.



Thomas Key is a Senior Technical Executive at EPRI and is currently responsible for EPRI’s research program for integration of distributed resources. He is a fellow of the IEEE for contributions in the area of power systems and power quality. He has also led programs on renewable and distributed generation, and has focused on beneficial integration of PV power systems including early pioneering in this area at Sandia National Laboratory in the 1980’s. During his career he has published more than 180 technical publications and reports.



Nick Schlag has worked as a consultant at E3 for six years. At E3, Nick works primarily on long-term resource planning and renewable integration in the electric sector. His work focuses on understanding how renewable policy goals and greenhouse gas reduction targets will affect the

electric sector, using scenario analysis to quantify impacts of high renewable penetrations upon electric system operations, supporting infrastructure investment, and retail rates in the future. Nick has contributed to a number of studies investigating the consequences of high renewable penetrations on system operations and the implications of these effects on the feasibility of achieving greenhouse gas reductions through investment in renewable energy.



Bing-Chwen Yang joined the ITRI in Chinese Taipei after he got his Ph.D. degree from the Department of Mechanical Engineering, Pennsylvania State University in 1992. He has accumulated lots of research experience in the field of energy conservation and environmental sustainability. He also led more than 10 big research projects in the area of heat transfer, heat exchanger design, HVAC&R system during his service in ITRI from 1992. During that period, he led the team to win two golden awards on “Major Contribution Award by the Achievement of Research” from ITRI. He also acts as one of the expert in the think tank of energy policy and strategy for BOE (Bureau of Energy), MOEA (Ministry of Economic Affairs) in Chinese Taipei. He has been the Deputy & Division Director of Residential & Commercial Energy Saving Division in Energy & Environment Research Laboratories from March, 2002 ~ June, 2010. He served as the executive assistant to the General Director of Green Energy & Environment Research Laboratories, ITRI before he moved to Asia Pacific Energy Research Center as a Team Leader in April, 2011. After service in APERC for one year and seven

months, he returned to ITRI and became the Division Director of Planning and Business Development division in Green Energy and Environment Research Laboratories from December, 2012 ~ December, 2013 and the Division Director of Green Energy Initiative Division from January 2014 ~ February 2015. Now he is the Deputy General Director of Green Energy and Environment Research Laboratories, ITRI.



Zhang Shicong is Director of China Academy of Building Research and Mayor in Green Building codes and standards, Building Energy Efficiency Codes and Standards, and Commercial Building Energy saving. He participated in several 10th ,11th ,12th Five Year Plan-Building Energy Efficiency Program of China. He is a member of the editorial board of *Design code for heating ventilation and air conditioning of civil buildings*, *International building energy codes comparison study*. He is a delegate of China in International Energy Agency-Energy Conservation through Energy Storage Implementing Agreement (IEA-ECES) and Program Overseer of APEC Nearly (Net) Zero Energy Program.



David S. Renné has been President of the International Solar Energy Society since 2010. He is also the Operating Agent of an International Energy Agency Solar Heating and Cooling Programme Task 46 titled “Solar Resource Assessment and Forecasting”. He continues to serve as an Associate Editor of the Solar Energy Journal in the field of solar resource assessment. Dr. Renné’s other current professional activities include a Senior Consultant to Clean Power Research, a small U.S. Company that develops resource assessment and analytical software tools to support large-scale grid connected solar energy systems, and a Consultant to the World Bank’s Energy Sector Management Assistance Program’s (ESMAP)’s Resource Mapping Project. From 1991 – until his retirement in 2012 Dr. Renné managed the solar resource assessment activities at the U.S. National Renewable Energy Laboratory (NREL). He also led and participated in a number of international programs. He still retains an Emeritus status at NREL.



Xu Zhao works at Asia Pacific Sustainable Energy Center (APSEC) as a research associate. He obtained his PhD in Civil Engineering from the University of Western Australia in 2014. His current research interests include “Developing Solar-Powered Emergency Shelter Solutions (SPESS) as an Energy-Resilience Tool for Natural Disaster Relief in APEC Community”.



Chun-Li Lee has worked for the MOEA for more than twenty years and is also familiar with Chinese Taipei’s power market, especially in the power market reform and renewable energy. He had participated in the first and second phases of deregulation on power plants, amended the Energy Management Law and promulgated the Renewable Energy Development Act in Chinese Taipei. Mr. Lee has served as the Secretary General, Bureau of Energy, Ministry of Economic Affairs and is responsible for the stabilization of energy supply and the improvement of energy security in Chinese Taipei. He is

currently Secretary General, Bureau of Energy, Ministry of Economic Affairs, Chinese Taipei. Prior to that he was Director of the Electricity Division, Bureau of Energy, Ministry of Economic Affairs from 2012 to 2015; Deputy Director of the Electricity Division, Bureau of Energy, Ministry of Economic Affairs from 2009 to 2012; and Specialist of the Energy Technology Division, Bureau of Energy, Ministry of Economic Affairs from 2007 to 2009. He has a Master's degree in economics from Department of Economics, Chinese Culture University, Chinese Taipei.



Takao Ikeda is Senior Economist in the New and Renewable Energy Group, New and Renewable Energy and International Cooperation Unit at the the Institute of Energy Economics, Japan (IEEJ). As a researcher of IEEJ, he has conducted policy research and current situation covering all renewable energy area and related technologies such as smart grid/smart communities. He also participated in APEC activities including APEC EGNRET and APEC Biofuel Taskforce. He holds the degrees of Bachelor of Engineering and Master of Engineering from Kyoto University, Japan.



Sang Keun Gavin Yu works at New & Renewable Energy Center(NREC) of Korea Energy Agency(KEA). He is in charge of international cooperation with agencies including IRENA, APEC, IPHE, IEA REWP and bilateral Cooperation since March 2011. He represents Korea in the APEC EGNRET (Expert Group on New & Renewable Energy Technologies) and he has been Vice Chair of EGNRET since 2013.

Azah Ahmad obtained her Bachelor of Science Degree in Electrical and Computer Engineering from the Ohio State University, USA 1998 and Master of Science in Energy Technology from UKM in 2004. She has extensive years of working experience in energy efficiency and renewable energy. She was the focal point representing Malaysia for the ASEAN Energy Efficiency & Sub-sector Network from 2003 to 2005 and a Technical Committee member on Performance of Household and Similar Electrical Appliances, SIRIM during her tenure with Pusat Tenaga Malaysia. In 2005, she joined the Malaysia Building Integrated Photovoltaic (MBIPV) Project, a project funded by the Government of Malaysia and UNDP/ GEF. She is a certified ISPQ PV installer by the International for Sustainable Power (ISP). In SEDA Malaysia, in charge of capacity and human capital development in RE as well as RE related projects. Support and facilitate R&D on RE within local research institutions and international organizations. A member of working group of solar PV Systems, appointed by Standards Malaysia since 2010. Serving as the Chairman for the ASEAN RE Awards since 2012.

Karnnalín Theerarattananon was awarded for the Golden Jubilee

Scholarship from the Royal Thai Government in 1998 to pursue her study from Bachelor degree up to Ph.D. She obtained the Bachelor of Applied Science degree in Chemical Engineering from University of Toronto, Canada in 2003; the Master of Science degree in Chemical Engineering from University of Saskatchewan, Canada in 2006; and the Ph.D in Biological and Agricultural Engineering from Kansas State University, U.S.A. in 2012. Her research interest was about bioprocessing production, such as cellulosic ethanol production. She was a member of the Honor Society of Phi Kappa Phi by Election of Chapter at Kansas State University in 2009, and was also a member of the Alpha Epsilon -Honor Society of Agricultural, Food, and Biological Engineering in 2009. Currently, she is working as an Engineer at the Bureau of Energy Research, Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy, Thailand. Her work responsibility involves promotion of renewable energy development in Thailand.



Nguyen Ninh Hai is Deputy Director of Renewable Energy Department under General Directorate of Energy under Ministry of Industry and Trade of Vietnam. Mr. Hai has been working in the renewable sector since 2008. He has been participating in drafting incentive mechanisms to promote development of renewable energy in Vietnam, such as FIT for wind power, biomass, and municipal waste to energy and solar. He has also worked on other policies related to renewable energy in Vietnam including National Strategy on promoting development of renewable energy, National Master Plan

on Renewable Energy. Mr. Hai is the lead person from Vietnam in the Renewable Energy Sub-Sector Network under ASEAN Energy Cooperation.



Rico R. Velasco is a Registered Electrical Engineer and currently working as a Science Research Specialist at the Department of Energy (DOE). Mr. Velasco developed an interest in Renewable Energy when he was assigned at DOE - Solar and Wind Energy Management Division. He is involved in the implementation of government-initiated and priority projects such as Household Electrification Program, which entails the provision of household lighting in off-grid areas using Renewable Energy Systems and Wind Resources Assessment Project, which aims to identify viable sites for wind power development in the country. Further, he is in charge in the administration of Renewable Energy Act of 2008 and all relevant laws, issuances, circular, and regulations particularly the technical evaluation and processing of applications for registration/accreditation of solar and wind (SW) Developers/Fabricators, Manufacturers & Suppliers as well as monitoring and evaluation of SW projects.



Rebecca Ogann Kiage is currently employed with the PNG National Department of Public Enterprise and State Investments (2014

– 2015) as the Assistant Secretary – Advisory overseeing the development of the first PNG National Energy Policy and National Energy Plan. Ms. Kiage’s area of research interest are in agriculture and renewable energy policy. Ms. Kiage also has extensive experience in PNG’s agriculture policy and has served with the PNG National Department of Agriculture and Livestock (2001 – 2009). Ms. Kiage holds a Master of Science: Energy & Resources; Policy & Practices from University College London, School of Energy & Resources –Australia, (2011), Master of Public Policy and Management from Monash University, Australia (2006) and a Bachelor Commerce, Business Economics from the PNG University of Technology (2000).



Sol García-Belaúnde Mora is the International Relations Coordinator for the Institute of Natural Sciences, Territory and Renewable Energies of the Pontifical Catholic University of Peru, INTE-PUCP. She acts as the liaison between INTE and other universities, institutes or research centers, aiming to create and strengthen cooperation opportunities in research and promotion of natural sciences, territory and renewable energies. Her work experience includes 7 years as the APEC Focal Point for the Ministry of Education of Peru; as part of her job, she organized the 2008 APEC Education Ministers Meeting and participated in several APEC-funded seminars, both as co-organizer and as speaker. She holds a B.A in Philosophy, studied International Cooperation for Development at the Diplomatic Academy of Peru and is enrolled in the Master’s on Public Policy at PUCP.

附件三、研討會過程照片



全體與會人員



作者進行專題演講



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經濟部能源局代表(作者)進行專題報告



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