出國報告（出國類別：其他）

赴澳洲 IAEE 出國公差報告

服務機關：核能研究所
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派赴國家：澳洲柏斯
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摘　要

IAEE 會議邀請世界最有影響力的政府代表，企業和學術能源決策機構進行會議探討。會議的過程試圖解決政府和產業界極為關注和重視的問題。IAEE 通常每年舉行四次會議，分別為國際、美國、歐洲以及亞洲會議。IAEE 今年已在 2 月於日本京都舉行亞洲會議，歐洲研討會預計 9 月 9-12 號在義大利舉辦，北美 IAEE 研討會預計 11 月 4-7 號在美國德州舉辦。而在今年的國際 IAEE 研討會於 2012 年 6 月 24 日~27 日在澳洲柏斯舉辦。本次會議的大會主題為“全球二氧化碳減量下能源市場的評估:後京都議定時代與未來，涉及 6 個議題：二氧化碳排放模式、電力市場評估與清潔能源機制；能源市場與後福島核災；能源效率、發展與清潔發展機制；能源消費、經濟成長與碳價格；能源政策替代能源與能源安全；石油與天然氣市場與再生能源。

核研所目前正積極進行”我國能源科技及能源產業政策之長期規劃評估”，本次派遣卓金和副研發師與會並發表會議論文“Taiwan’s Baseload Power Option Analysis after the Fukushima Nuclear Accident”，並與國外能源學者專家討論分享核研所近年來在能源經濟的研究成果，藉以掌握相關能源議題之最新資訊與對策，拓展與國外研究單位之合作關係。

Abstract

The 2012 International Association for Energy Economics Conference was held in Perth, on June 24-27, 2012. Themes of the conference were Low-carbon society, economic restructuring and population urbanization” and involved: model of energy, economy and environment, energy policy, energy prices, energy systems and low-carbon economy in transition, energy security, energy markets and carbon trading, renewable energy development, environment and sustainable development, energy technology. Nearly two hundred experts and scholars attended the seminar and discussed lively. INER assigned Dr. Cho, Chin Ho to participate in the conference and published papers: Taiwan’s Baseload Power Option Analysis after the Fukushima Nuclear Accident. He also conducted extensive exchanges of views with the local researchers during the conference.

目　　次

一、 目 的

IAEE 會議邀請世界最有影響力的政府代表，企業和學術能源決策機構進行會議探討。 會議的過程試圖解決政府和產業界極為關注和重視的問題。IAEE 通常每年舉行四次會議，分別為國際、美國、歐洲以及亞洲會議。IAEE 今年已在 2 月於日本京都舉行亞洲會議，歐洲研討會預計 9 月 9-12 日在義大利舉辦，北美 IAEE 研討會預計 11 月 4-7 日在美國德州舉辦。而今年的國際 IAEE 研討會，於 2012 年 6 月 24 日~28 日在澳洲柏斯舉辦。

IAEE 於柏斯主辦第 35 屆 IAEE World 國際能源研討會，本次會議共收錄了論文 132 篇。核研所目前正積極進行「我國能源科技及能源產業政策之長期規劃評估計畫」，本次派遣卓金和博士與會並發表會議論文：“Taiwan’s Baseload Power Option Analysis after the Fukushima Nuclear Accident”，與國外能源學者專家討論分享核研所近年來在能源經濟的研究成果，並藉以掌握相關能源議題之最新看法與對策，拓展與國外研究單位之合作關係。

本次作者與會是希望藉由參加研討會，瞭解各國先進在能源模型領域的研究方法，如何設定模型與情境分析，並如何將其研究成果應用為政策依據與行動策略，由於與會者多為各國能源模型研究領域菁英，其中不乏是該國的政策幕僚機構或智庫。因此，此次參與研討會所獲良多。本次與會另外一個目的，是藉由發表論文讓與會專家學者知道台灣能源經濟模型的現況，並希望對於技術經濟模型提出建言，以及後續研究改進方向。更重要的是要讓各國學者知悉台灣要兼具節能減碳及經濟成長所面臨的困境，讓各國知道台灣在為對抗全球氣候變遷及邁向永續發展盡一份心力。

本次出國的另外一個任務是在研討會期間與日本能源經濟研究所(IEEJ)的研究團隊進行交流，並與 Yukari Yamashita (The institute of energy economics, Japan, Board member, director)等學者進行交流。會中並請教 Ms. Yamashita 日本能源經濟研究所的成功經驗，以做為成立核研所能源經濟及策略研究中心的借鏡。

二、過　程

項次	日期	地點		目的
		出發	抵達	
1	101 年 6 月 23 日	臺北	柏斯	報到
2	100 年 6 月 24 日 至 98 年 6 月 28 日	柏斯		蒐集整理資料、出席會議發表論文、研究心得交流
3	100 年 6 月 29 日	柏斯	臺北	回程

相關網站請參照圖 1。

三、心　得

本次 IAEE 研討會台灣方面計有 4 篇論文發表，參加的單位計有核研所副研發師卓金和，報告題目: Taiwan’s Baseload Power Option Analysis after the Fukushima Nuclear Accident；台灣電力公司處長鄭運和，論文題目:The setting and redesign of feed-in tariffs；中華經濟研究院研究員王京明，論文題目: Power “Smart Pricing” with and without Smart Meters；以及經濟建設委員會稽核楊達鑫。展現台灣學術界近期在能源經濟方面的研究方向與具體成果。另外，國外相關研究單位亦提出了超過 130 篇的論文，提供台灣的學者專家可以從不同的角度來看能源經濟問題，未來亦可驗證本身研究之見解在相異政經環境下的比較。

於會議上，核研所發表的 “Taiwan’s Baseload Power Option Analysis after the Fukushima Nuclear Accident’受到了學者的迴響。日本 Yukari Yamashita (The institute of energy economics, Japan, Board member, director)及美國 David Young (Electric power research institute)，對於本團隊技術經濟的模擬與碳價的課徵深感興趣，也對於在福島事件後台灣基載電力佔比變化感到好奇。此外，為配合政府正大力推動的節能減碳政策與國家型能源計畫，本報告另行彙整了相關大會主題報告及 6 篇會議論文（5 篇國外、1 篇台灣）之重要內容，作為未來研究的參考

<u>發表心得</u>

2012 國際能源經濟研討會(The International Association for Energy Economics)由科廷大學(Curtin University)及能源與礦產經濟研究中心(The Centre for Research in Energy and Minerals Economics (CREME)主辦，研討會的主講人為國際能源總署(International Energy Agency)執行董事 Richard H. Jones。Richard H. Jones 為前美國外交官，他曾擔任四個國家的大使：以色列（2005-2008 年），科威特（2001-2004 年），哈薩克（1998-2001 年）和黎巴嫩（1996-1998）。2005 年他還擔任美國國務院的高級顧問和伊拉克政策統籌局局長。目前擔任國際能源總署副執行主任，為國際能源署帶來了他三十多年的外交和政策經驗。其中包括中東的政治，貿易談判和能源安全問題等。

研討會地點位於澳洲的柏斯舉行。會議期間為期四天，從 2012 年 06 月 24 日至 27 日。此次會議舉行方式為單一場次 100 分鐘，每人報告時間為 20 分鐘，5 分鐘討論時間，各項議題皆有足夠的時間與各國與會者進行意見交換及充份交流。The International Association for Energy Economics 會議主題為檢視京都議定書與展望未來：油價變動、非傳統儲油、能源貧乏、二氧化碳限制下之區域成長，以及能源需求、核能、氣候變遷經濟、CCS、供給安全、再生能源技術之經濟可行性、綠色能源稅、能源技術之生命週期排放及淨煤轉換等。

而在這一次發表論文中本人發表的文章為「Taiwan´s Baseload Power Option Analysis after the Fukushima Nuclear Accident」。探討的內容為相對於美國與歐洲，台灣天然氣價格相對昂貴許

多；因此，使用燃煤 IGCC+CCS 在台灣將更具優勢。本研究採用 IEA 參數設定與美國、歐洲及台灣燃料價格，以 RETScreen 進行技術經濟分析，計算 2020 年 IGCC、IGCC+CC(S)與 NGCC 電廠之上網電價、最適碳價及經濟可行的時間。結果顯示 2020 年 NGCC 上網電價(146.70 美元/MWh)高於 IGCC+CC 電價(111.60 美元/MWh)與考慮碳運輸與儲存成本的 IGCC+CCS(127 美元/MWh)，其代表意含為儘管在沒有碳稅的前提下，IGCC+CCS 在台灣仍較具優勢。

相較之下，美國因為天然氣價格便宜，其 IGCC+CCS 在 2030-2035 年才有機會代替 NGCC。台灣實證也顯示當 CO_2 價格在 2020 年為 60-70 USD/t-CO_2，IGCC+CC 較 IGCC 加上碳交易划算；當考慮碳運輸與儲存成本後，CO_2 價格必須高達 90-100 USD/t-CO_2，IGCC+CCS 才划算。本研究建議：(1)將 CCS 技術納入台灣能源政策之低碳能源選項，(2)及早興建 CCS 示範電廠，(3)發展 IGCC+CCS 取代 NGCC。

報告結束後有兩位先進對本次報告提出問題:

（一） 第一個提問為 King Saud university 的教授 Carol A. Dahl，提問在本文中提到 IGCC+CC 及 IGCC+CCS 兩種計算均化成本的方式，其中最大的差異為何。筆者回應在過去國際能源總署計算碳捕獲與封存技術均化成本皆考慮用 IGCC+CC 來衡量，原因有三。首先是過去學者認為探運輸與儲存的成本不高，以至於忽略該成本。第二個解釋為運輸與封存的成本較難以衡量，所以在推估時並未將之考慮在內。第三個原因為運儲不屬電廠範圍，習慣上不列入發電成本，而在本文中由於我們獲得 GCCSI 推估的運輸與封存成本，故本研究將之納入分析。

（二） 第二個問題是 The institute of energy economics, Japan 的董事 Yukari Yamashita，問筆者對於未來天然氣價格的走勢如何評估。而筆者的回應為利用 IGCC 發電的過程會產生類似天然氣的氣體並可以用來發電，而此氣體的產生可能抑制天然氣價格上漲幅度，但目前就國際能源總署 2011 年出版的 World Energy Outlook 中，預測未來天然氣價格仍會向上攀升，因此，目前仍然未有這個現象產生。另外，一個關鍵則是頁岩氣(Shale gas)，當頁岩氣能大量開採時，供給增加將會降低天然氣價格的上漲。

<u>與會心得</u>

此次是筆者第一次參加大型能源經濟國際會議，在短短四天的會議期間，除了發表本研究團隊的論文之外，也聽到許多國外學者對於他們研究成果的發表，其中有許多值得筆者學習的觀念，這些都是在國內比較無法聽到的經濟現象，也讓筆者的視野更加的開闊。

而在這次的 2012 國際能源經濟研討會中，筆者的場次被排在第二天下午的第一個發表者，雖然心情非常緊張，但由於在出國前已經盡力將論文的內容反覆背誦，以至於報告的過程中非常順利，在報告結束後有幾位學者也提出他們對筆者這篇論文的意見和質疑，筆者也利用簡短的想法來回應他們，也從中獲得許多啟發和經驗。

本篇文章 Taiwan´s Baseload Power Option Analysis after the Fukushima Nuclear Accident 是大會中四篇由台灣人發表的文章其中一篇。本次發表的目的除了報告本所目前技術經濟的研究成果，也希望與會的專家先進能給予指導建議，更藉由本次的發表機會，告訴國際專家學者台灣也在為對抗全球氣候變遷及邁向低碳經濟盡一份心力。本次與會的國內專家，還有台電公司鄭運和處長、中經院王京明教授。研討會期間有幸能與多位學者進行交流，除了能多瞭解其他研究單位的研究方法與分析方向外，更藉此介紹核能所的能源模型與台灣目前能源使用概況，有多位學者對於台灣的資源與能源安全現況感到驚訝。再與國內學者交談時發現學者多有提到本所的葛復光先生，顯示本所近年來在能源模型領域耕耘已小有收穫。

此外，本次出國的另一任務，是在研討會期間與日本能源經濟研究所(The institute of energy economics, Japan)的研究團隊進行交流，並與 Yukari Yamashita (The institute of energy economics, Japan, Board member, director)等學者進行討論。會中並請教 Ms. Yamashita 日本能源經濟研究所的成功經驗做為成立核研所能源經濟及策略研究中心的借鏡。Ms. Yamashita 提到在日本能源經濟研究所與其他團隊合作的經驗，為每一年兩個不同的團隊會互相主辦研討會，透過研討會的交流來驗證彼此模型設計的參數設定及數值的正確性，並且透過這個研討會上級長官可以互相溝通及了解，進而創造雙贏的局面。其中，以日本能源經濟研究所及財團法人中央電力研究院(Central research institute of electric power industry)的互動最為密切。除了每年舉辦研究討論會議交換研究成果與觀點，負責人直接對話討論能源議題。在地球環境產業技術研究機構(Research Institute of Innovative Technology for the Earth)與日本應用能源研究所(Institute of Applied energy)，則透過共同舉辦研討會及合作執行日本經濟產業省所安排的工作

研討會心得

ELECTRICITY: SOME QUANTITATIVE REFLECTIONS ON POSSIBLE FUTURES

Enzo Di Giulio, 教授
Eni Corporate University

在這幾年歐洲制定了 20-20-20 的能源政策，所謂 20-20-20 是：指到 2020 年溫室氣體的排放量相對於 1990 年要減少 20%；2020 年再生能源的比例要到達 20%；2020 年利用提高能源效率減省 20%的能源消費。為了達到這個目的，核能成為義大利的的選項之一。儘管如此，義大利人對於核能表現出強烈的反對，尤其在 2011 年剛剛發生日本福島核災後，一次公投結果將禁止核能的發展。

在義大利的發電比例中，如圖 2 化石燃料佔總燃料的 79%，其中天然氣具有關鍵作用(57%)，煤燃料佔 16%。再生能源約占 22%，其中一半以上來自於水力發電，在未來歐盟提倡發展再生能源的前提下，未來再生能源的佔比會逐年增加，也將會左右義大利的發電佔比。

在表 1 中，可以看到義大利在發生福島核災前的能源配置規劃。根據表 1 可以發現未來的天然氣與煤的比例將逐年減少，其中再生能源將會從目前的 22%佔比提高至 32% (2020 年)，呈現穩定的成長。在核能的部分將在 2025 年提高至 14%，然而這種再生能源與核能擴張可能將導致能源的供給過剩，進而造成經濟的危害。因此，該篇文章最主要想要討論的是，電力的需求與供給可以均衡嗎?未來天然氣的角色?在這幾年頁岩氣的開採將會對於天然氣造成多大影響。

該研究利用的是 Electricity Generation in Italy 動態模型，其中考慮 2010-2030 年共 20 年資料以及九種發電種類，分別為煤炭，天然氣，石油，水能，風能，太陽能，生物質能和廢物，地熱，核能發電等選項。此外，透過成本效益計算不同燃料成本的均化成本，並利用三種情境:原始假設情境，傾向再生能源發展情境及傾向化石燃料情境，主要的差別在於成本的不同，當越偏好再生能源的情境時，政府會補助太陽能每度的成本。當越偏好化石燃料情境，政府也將補助化石燃料的成本。在圖 3 中顯示為原始架設情境下的均化成本，當均化成本越低時，代表這個燃料的競爭力越強。

由圖 3 發現天然氣石油以及煤炭的表現都良好，其中核能與地熱也呈現較低的均化成本，反之，在再生能源的部分則相對沒有競爭力。在圖 3 則顯示為二氧化碳價格的敏感度分析，價格分別為 30、70、130 美元/噸。結果顯示使用煤發電的均化成本隨著碳價格上升，上升幅度高於石油及天然氣，原因為煤的二氧化碳排放係數高於石油及天然氣。

在比較三種情境下在傾向再生能源情境下，水力擁有最低的均化成本，代表在這個情境下是最適合發展的。在化石燃料的情境下，天然氣的均化成本最低，隱含天然氣將最具優勢。

最後，在能源供給與需求模型，作者列出 GDP 一年成長 2%及 0.3%兩個範例，結果顯示於圖 4 與圖 5，在 GDP 成長率較大時能於會產生需求大於供給的現象，儘管將核能納入發電的選項仍無法造成能源供需平衡，再生能源與核能的佔比同時上升也難以達到對於能源的需求。

該模型的實證結果如下，在原始的情境下考慮未來經濟成長率為 2%時，未來再生能源與核能的佔比上升將造成義大利的能源供給過多。然而在 2011 福島核災後抑制了核能發展，控制了能源過度供給的現象，再加上受到歐債危機造成義大利未來經濟成長將可能衰退，能源供需較能維持平衡，因此，該作者提議政府不應再繼續發展核能發電佔比，以免產生太多的能源供給而造成經濟的危害。

在歐盟義大利的原始能源政策下，核能與再生能源都佔有非常重要的角色，為了達到歐盟 20-20-20 的政策，核能與再生能源的發展將帶動二氧化碳排放量減少，能源成本下降。然而在發生 2011 年日本福島核災後，義大利民眾開始舉辦公投反對核能的發展，也造成學者熱烈的討論，然而由於近年來歐洲經濟受到次貸及金融風暴的影響，國民生產毛額成長率一直位於低點，以至於不需要太多的能源供給。因此，該作者認為未來核能佔比的減少可以由再生能源的發展來替代。但相對於義大利或歐盟的國家，台灣的自然資源較匱乏，再生能源的佔比相對於義大利少，天然氣的價格也較昂貴，面對福島核災後的減核以及未來的減排情境下，基載電力佔比的問題將逐漸浮現，也將考驗著台灣政府的能源規劃。

WILL THE CARBON PRICE REDUCE AUSTRALIAN ELECTRICITY EMISSIONS?

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澳洲在這幾年提出一個能源政策，其主要的內容為將二氧化碳排放量在 2020 年減少至 2000 年還要少 5%。其中未來碳價格的波動或許是刺激二氧化碳排放量減少的一個好的誘因。因此，本篇文章利用碳價格高低觀察至 2050 年澳洲電力部門產業的減排效果。

首先該作者將資料區分為三種情境：高碳價格路徑、中碳價格路徑及低碳價格路徑。

這三個情境主要根據澳洲政府資料及 ETP 市場價格及每年 4%的成長率上升(如圖 5)。在這三個情境中，可以發現在高碳價格情境 2050 年碳價可高達$270 每噸，低碳價情境約在$50 每噸。

在接下來圖 6 為 2011-2050 年在碳價及中度能源需求的情境下能源配置為何。從圖中可以看到在碳價相對昂貴下，黑煤的發電佔比隨著時間持續的向下遞減，其中由於碳價格昂貴，複循環燃氣加上碳捕獲與封存技術佔比隨著時間成長快速，此外，不需要燃料的風力發電佔比也將日益增加。

在圖 7 中由於碳價格將便宜，碳捕獲與封存技術將沒有競爭力，以黑煤為發電燃料仍是普遍的現象，其他再生能源如風力與水力的佔比將維持不變。

在圖 8 中，為該作者以 LTIRP 模型模擬出高碳價格路徑、中碳價格路徑及低價格路徑的二氧化碳排量總量。根據過去資料，在澳洲 2000 年的二氧化碳排放量為 175kt，由此圖中可以看到低碳價格路徑，以及中碳價格路徑明顯無法達到 2000 年在低的二氧化碳排放量水準，只有碳價格在很低的情境下才能達到二氧化碳排放量在 2020 年減少至 2000 年還要少 5%。因此，該作者認為如澳洲政府所提出的燃煤關閉契約政策讓自願者關閉燃煤發電，才能達到澳洲政府所期望的目標。

由本篇文章我們可以了解該作者提到碳價格高低，對於發電佔比有相當重要的影響；當碳價格越高時，會產生高排放量的燃料將不會被使用，另外，碳捕捉與封存技術也將被運用在發電的過程中。另外，為了達到減排效應，除了碳價之外，政府的政策指引也十分重要。在台灣的部分由於台灣能源大多來自於進口，在未來天然氣、石油價格快速飆漲且核能不延役情況下，價格相對穩定且供給較不匱乏的煤，在未來發電上勢必仍將扮演重要的角色。由於煤的發電碳排放係數較高，在國際減碳壓力逐漸浮現後，台灣因為使用煤發電的外部成本將會大幅增加，出口貿易也將因商品碳足跡的關係而受到貿易限制，以上都會造成經濟體系的衝擊。因此，本研究建議將碳價及碳捕獲與封存技術，一併納入發電成本並進行基載電力規劃的檢討。

Adopting gasoline prices policy: Why is it easier for Brazil than China?

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自 2003 年以來，石油價格的持續上升成為許多國家必須迫切正視的問題，因此，在有限的時間下，這些國家通過對石油產品的補貼定價政策，特別是汽油和柴油，使其國內價格固定低於國外價格水平，這些政策的目的是為了減輕通貨膨脹的壓力。實際上，許多國家對燃料價格的補貼已經不是一個新現象。過去幾十年來特別是石油出口國，已利用補貼使其國內燃料價格低廉。然而由於最近石油價格節節攀升，這些政策的機會成本增加。舉例而言，印尼政府在國去幾十年來已經從一個石油出口國變成進口，面臨強大減少燃料補貼的壓力。另一方面，巴基斯坦和台灣最近成功減少補貼的措施。因此，本文的目的是要提出的主要客觀條件比較巴西和中國的油價補貼經驗。巴西這幾十年努力克服對石油進口的依賴，隨著時間增加石油產量，打破石油公司壟斷，並在去年年底實現自給自足的狀態(如圖 9)，這將確保為國內燃油價格將更具有靈活性。

相對於巴西，中國大陸的石油仍有賴於國外進口(如圖 10)。 石油的生產低於石油的消費，中間不足的部分將由進口來代替。另外，在圖 11 中可以發現中國大陸對於國內價格的管制情況仍高於其他國家。這個結果確定了兩個因素，使得中國政府在於控制汽油價格更加困難。首先，跟巴西不一樣的事，巴西國家國營石油公司擁有 99%的煉油能力。相形之下中國的私營煉油廠經擁有 15%的總煉油能力，然而其私營煉油廠必須從國外市場進口石油，這個結果可能會造成國際上的石油價格高於國內的石油價格，為了保證國內成品油供應，中國政府以補貼價格的方式出售原油，這將導致這些企業的虧損。 政府利用此方式來控制汽油價格低於國際市場價格水平的決定，必須意味著國有公司的虧損。相形之下，巴西自 2006 年以來的石油自給自足，以及大部分石油由國營企業精製，國內採用的定價政策並不一定意味著國內石油公司集團的損失。

Power “Smart Pricing” with and without Smart Meters

King Min Wang, 研究員

在這幾年台電公司推出幾個聰明的電價定價方式，去吸引民眾調整能源需求。其中要的方法為使用能源的時刻(Time of use, TOU)及能源需求減少的動機(Demand reduction incentive, DRI)。因此，本篇文章想要探討的是這兩種方法是否符合最有效的減碳及節省能源最好的方法。其中 TOU 模擬的計算方式為：

在夏季的計算方式為:R1xD1+R2x[(D3+D4)-(D1+D2)x0.5]

在非夏季的計算方式為:R3xD1+R4xD2+R5x[(D3+D4)-(D1+D2)x0.5]

其中 R1 為夏季一般費率，R2 為夏季離峰費率，R3 為非夏季一般費率，R4 為非夏季非費率，R5 為非夏季離峰費率，D1 為一般需求，D2 為非夏季需求，D3 為星期六尖峰需求，D4 為離峰需求。

在使用能源的時刻(Time of use)的模擬中(表 2)發現在夏季時台電公司用電尖峰時期的電價為 3.22 元，低於該作者模擬出的電價 3.68 元。在非夏季的部分台電公司用電尖峰時期的電價為 3.13 元，低於該作者模擬出的電價 3.43 元。在夏季中部分台電公司尖峰時期的電價為 2.26 元，高於該作者所模擬出的電價 1.82 元，此外，在非夏季電價的結果亦同。因此，該作者認為使用能源的時刻(Time of use)的政策中，對於尖峰電力使用的電價設定太低，在部分尖峰的電價則設的太高，可以經由調整而使政策效果更有效。

此外，該作者將能源需求減少的動機(Demand reduction incentive, DRI)，區分為基本稅率折扣(Basic tariff discount)及城市競爭稅率折扣(County competition tariff discount, CCTD)。這兩種方式的目的，在於利用稅率折扣的方式減少居民及學校的能源使用量。首先在基本稅率折扣(Basic tariff discount)的能源節省如表 3。

圖中顯示當電力消費的變動率介於 0 到-5%時，居民將會有 5%的稅率折扣，當電力消費漸少 10%以下，居民或學校可以獲得大約 20%的折扣。在城市競爭稅率折扣(County competition tariff discount)的部分可參考表 4。用城市競爭稅率折扣(County competition tariff discount)的居民為台灣 22 個城市中，能源減量成長率最高的三個城市。最優勝的城市可以獲得 15%的電力折扣，其次為 10%。台電公司最主要的目的，為提升公眾對於能源節約的重視及習慣。在基本稅率折扣(Basic tariff discount)的成本效益分析結果如下(圖 12)

首先在環境保護的部分節省了 2.79M ton 的二氧化碳排放量，台電公司的燃料成本可以節省 198 億。能源節省約 4.5TWh 且家計單位的能源支出將減少 15.3b。

在城市競爭稅率折扣(County competition tariff discount)的案例下(圖 13)，節約能源將達到460GWh，對於環境的危害也將減少二氧化碳排放量 257,000 噸。

在這幾年全球的趨勢為建立一個低碳的社會，為了創造它許多學者提出不同的定價方式來達到這個目的，其中學者提到利用 Time of use，以及 Demand reduction incentive 下的 Basic tariff discount 與 County competition tariff discount 來達到目的，就該作者的實證結果發現台電公司的 TOU 價格訂得較不適當，在電力使用尖峰時電力價格訂得太低，反之在電力使用為部分尖峰時電力價格訂得太高，消費者較沒有動機去調整他對於能源消費的數量。另外，再 Demand reduction incentive 的部分，居民可以因此獲得 10%-30%的優惠折價，然而這種方式似乎是利用台電公司的損失來回饋給民眾，當民眾能源越節省之下，台電公司的收益將日益減少，可能較不易由台電公司接受及符合合理性，因此，這兩種方式都可以再做一些調整，來刺激民眾減少能源使用量。

China’s Electricity Market Reform and Power Plants Efficiency

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在過去的三十年中，中國電力產業在經歷了一連串不同目的不同階段的監管與改革，在 2002 年，垂直整合的電力公營事業 - 國家電力公司（SPC）將發電部門，輸電和配電網絡區分開來，努力提高發電生產效率。因此，在該研究中，該作者利用資料包絡法研究改革後對於化石燃煤電廠效率的影響。

此外，該作者採用隨機追蹤資料迴歸(random panel regressions)估計(表 5)提高效率的措施如何變化變化，並如何影響 2002 年後獨立發電商和那些以前 SPC 的管理效率，除此之外，該作者同時控制了其他因素，如年齡，發電量及發電的時間長短。在該作者的實證結果中發現(圖 14，圖 15，圖 16)，中國大陸的總要素生產力在 2000-2008 呈現正向成長，該作者將之歸於技術進步所造成。另外，該作者發現的確在 2002 年，垂直整合的電力公營事業 - 國家電力公司將發電部門，輸電和配電網絡區分開來，努力提高發電生產效率後，國家電力公司的發電效率已大大改善，在考慮其他因素，如年齡、發電的電量及發電的時間長短，結果仍然呈現一致的現象。

IMPACT OF GREEN ENERGY POLICIES ON ELECTRICITY MARKET: AN ECONOMETRIC ANALYSIS

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為了達低碳經濟的目標，許多政府積極推動路能政策與綠能技術來減少二氧化碳排放量，其中歐洲對於綠能政策更是不遺餘力；因此，該作者利用 2001-2011 年月資料探討英國一些綠能政策對於電力價格的影響，包括再生能源義務 Renewable Obligation scheme，以及歐洲二氧化碳排放權價格 European Union CO2 Emissions Allowance Spot Price 等。首先研究的資料來源如表 6。

其中再生能源義務是英國支持再生能源發展主要的政策計畫之一，利用對於電力供應商課稅使其逐漸增加供給再生能源的責任，同時電力供應商也藉由提供綠色電力獲得「再生能源義務憑證」（Renewables Obligation Certificate），每一單位的憑證代表以再生能源方式，提供兆瓦小時的發電量。

在實證結果的部分(表 7)該作者利用頑強的標準誤修正迴歸式的異質性，第一條迴歸式試圖估計所有的變數，而第二條式子估計的是將石油及天然氣價格變數拿掉。從第一條及第二條式子，可以發現利用總變異除於可解釋變異的 R 平方值接近 0.84，代表模型結果配適的不錯，電力價格可以由這幾個變數來解釋。另外，在調整的 R 平方值從方程式一的 0.844 降至方程式二的 0.834，可見石油價格及天然氣價格對於解釋電力價格是有幫助。

在石油天然氣排放權價格(EAPrice)以及煤價格的係數皆為正，隱含當這些價格上升時會帶動電力價格上升。在再生能源義務價格則依開始呈現負向相關，隨著再生能源價格越來越高，再生能源價格及電力價格則呈現為正相關。

該作者利用 2001-2011 年資料估計能源政策對於電力價格的影響，實證的結果發現有些能源政策對於電力價格為負，其他則為正，呈現較不一致的現象。因此，綠色能源政策對於二氧化碳的排放量有正面的影響，對於電價的影響則有正有負。以再生能源義務為例，此變數在初期對於電價為負的效果，到某一個谷底後則會轉為正的效果，因此，較難判定再生能源義務對於電價的影響。所以，在未來台灣制訂綠色能源政策時，將有助於二氧化碳的排放，但有關於電價的波動可能還是要從其他面向來討論。

技術參訪

本次 IAEE 安排的技術參訪為 Kwinana Power Station，它是 Verve 城市中第二大的發電廠，位於澳洲柏斯南方約 40 公里；他最大的特色是能利用煤炭、天然氣及石油作為燃料發電，一年共生產 420 兆瓦的電力。為什麼會利用三種燃料進行發電呢?首先在 1972 年發生第一次石油危機時，石油燃料的短缺使其改變燃油發電而利用煤炭作為發電的主要燃料。而煤炭在澳洲的產量也相對豐富。在 1980 年代 Kwinana Power Station 開始利用天然氣作為主要的發電燃料。在 2005 年之後，利用石油作為燃料發電又重新被採用，因此，Kwinana Power Station 是一個非常獨特的發電廠。目前 Kwinana Power Station 正在加裝 2 座 100MW 裝置容量的燃氣渦輪機，所需要的成本為 2.63 億美元。而根據 Kwinana Power Station 的人員介紹這兩座 100MW 裝置容量的燃氣渦輪機，可利用石油及天然氣作為發電的燃料。此外，Verve Energy 公司透過這兩組高效率高穩定度，將可以提供西澳洲定期與穩定的電力(如圖 17)。

四、建 議 事 項

今年度作者發表的論文很榮幸可以被 IAEE 接受，並得以代表核研所參加此一盛會，覺得獲益良多，也希望未來能多多鼓勵與支持過內的學術界與研究界發表論文，參加此高水準的學術盛會。經過這次會議可發現，各國在能源領域的研究實力十分堅強，因此，要如何與國外學者的交流，瞭解到對於籌建國家級能源研究機構的需求。透過此次聆聽研討會，筆者得到許多新的想法可以應用在未來的研究改進方面，因此，對於未來的研究與發展我們建議如下：

（一） 能源政策對於電力價格的影響呈現較不一致的現象。因此，一個綠色能源政策可能只能影響二氧化碳的排放量，對於電價的影響較無法確定，然而民眾對於電力價格變動較為敏感，如果一個綠能政策造成電力價格大幅的上漲將無法被人民所接受。所以，在未來台灣制訂綠色能源政策時，要如何在降低二氧化碳的排放的前提下，兼顧電力價格的波動仍是一個重要的課題。

（二） 相較於義大利或是歐盟擁有較多的再生能源佔比(水力發電)，台灣的自然資源較匱乏，天然氣的價格也較昂貴，面對福島核災後的減核及未來的減排情境下，基載電力佔比的問題將逐漸浮現，也將考驗著台灣政府的能源規劃。因此，在政府穩定減核下找尋一個穩定供給的基載電力將十分重要，例如 CCS 技術等。

（三） 利用台電公司的損失來回饋給民眾，當民眾能源越節省之下，台電公司的收益將日益減少，可能較不易由台電公司接受及符合合理性，因此，利用台電公司補貼民眾減少電力消費可再做一些調整。例如由政府單位來進行補貼等。

（四） 台灣能源大多來自於進口，在未來天然氣、石油價格快速飆漲且核能不延役情況下，價格相對穩定且供給較不匱乏的煤，在未來發電上勢必仍將扮演重要的角色。然而由於煤的發電碳排放係數較高，在國際減碳壓力逐漸浮現後，台灣因為使用煤發電的外部成本將會大幅增加，出口貿易也將因商品碳足跡的關係而受到貿易限制，以上都會造成經濟體系的衝擊。因此，本研究建議將碳價及碳捕獲與封存技術，一併納入發電成本並進行基載電力規劃的檢討。

（五） 未來本所進入經能部後，仍應繼續以研究單位對研究單位的方式與國外能源相關單位、學術機構保持聯繫。透過它們的研究結果可以略知先進國家未來能源政策的方向，提供我國政府及早規劃因應。另外，在與其他國內機構合作時，可建立以雙方舉行研討會的方式來促進合作，並由兩造長官直接進行交流，建立雙方信任與溝通。


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Energy markets evolution under global carbon constraints
Curtin University
Centre for Research in Energy and Minerals Economics (CREME)
Perth, Australia June 24th – 27th 2012
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Conference Theme
Energy markets evolution under global carbon constraints: Assessing Kyoto and looking forward.
Objective and Aims
The objective of the conference is to examine the dynamism of the world energy sectors in the context of what effect the Kyoto Process, which ends in 2012, had on the energy markets, technologies, and systems of the world. Also of interest is what technological and market developments occurred in spite of the Process? In other words, will the energy world of 2012 and beyond be purely the product of reactions to the Kyoto Protocol, or were there strong undercurrents of change that flowed throughout the period that would have occurred regardless? And from this examination, what may we reasonably expect for the near- to intermediate-future? Plenary sessions will examine these questions from industry, government, and academic perspectives.
The conference will address the full range of energy issues that may be expected to be commanding the attention of industry, academics, analysts and policy-makers. In addition to all major fields of energy economics and policy typically covered, a list of topical areas of interest is contained in the Call for Papers.
We have a world class venue booked in our lovely and dynamic energy city - Perth is a member of the World Energy Cities Partnership - on the eastern shores of the Indian Ocean. I am sure you will enjoy your time in Perth and Western Australia every bit as much as we will enjoy your participation in the Conference. We are looking forward to greeting you in Perth in June 2012.

圖 1. 會議文宣網頁

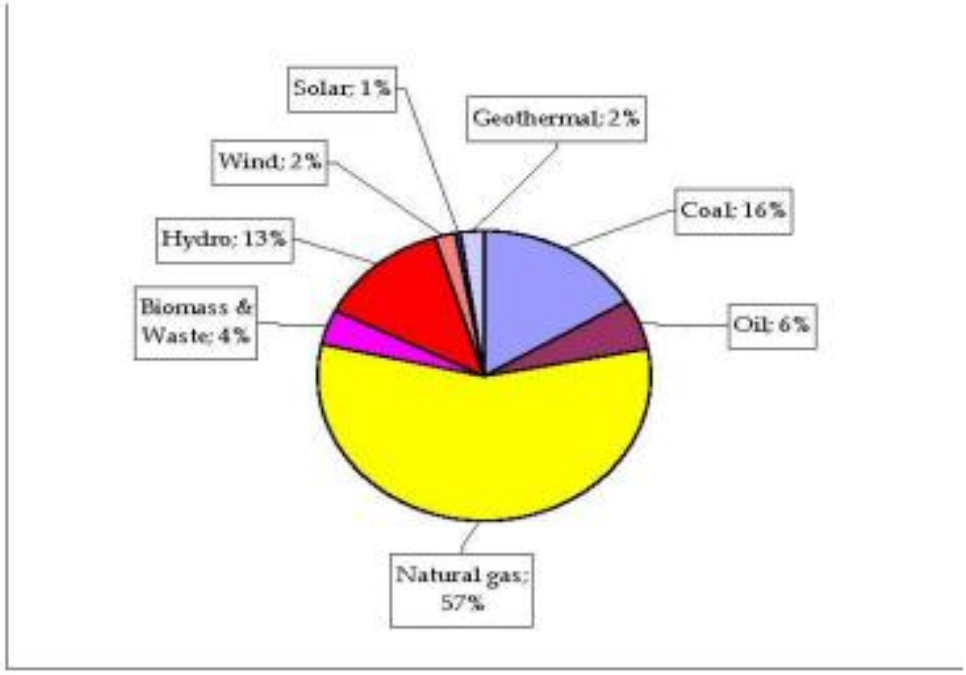


圖 2 再生能源佔比

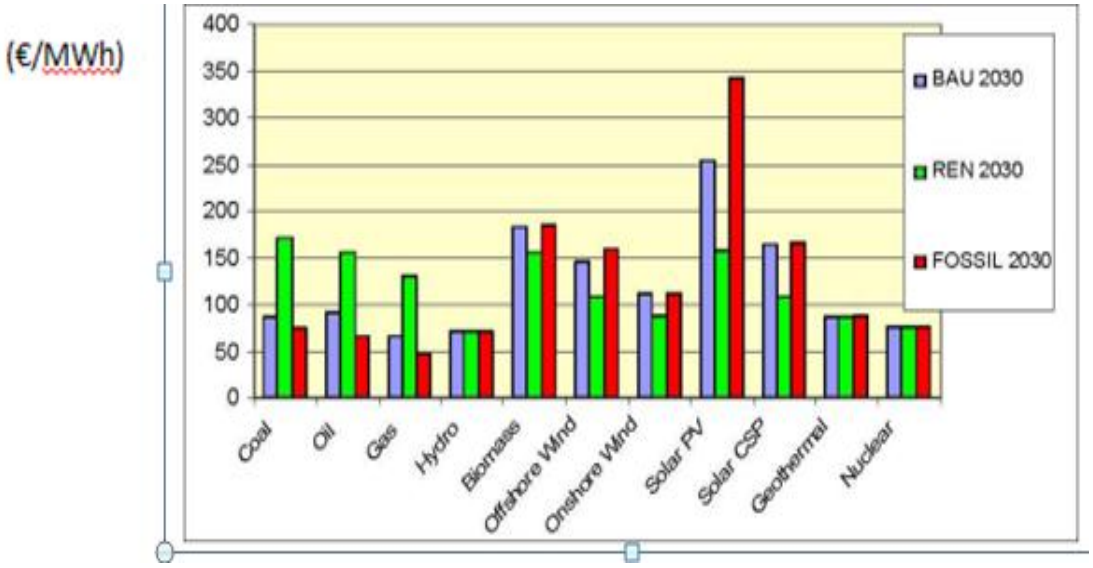


圖 3 中顯示為原始架設情境下的均化成本

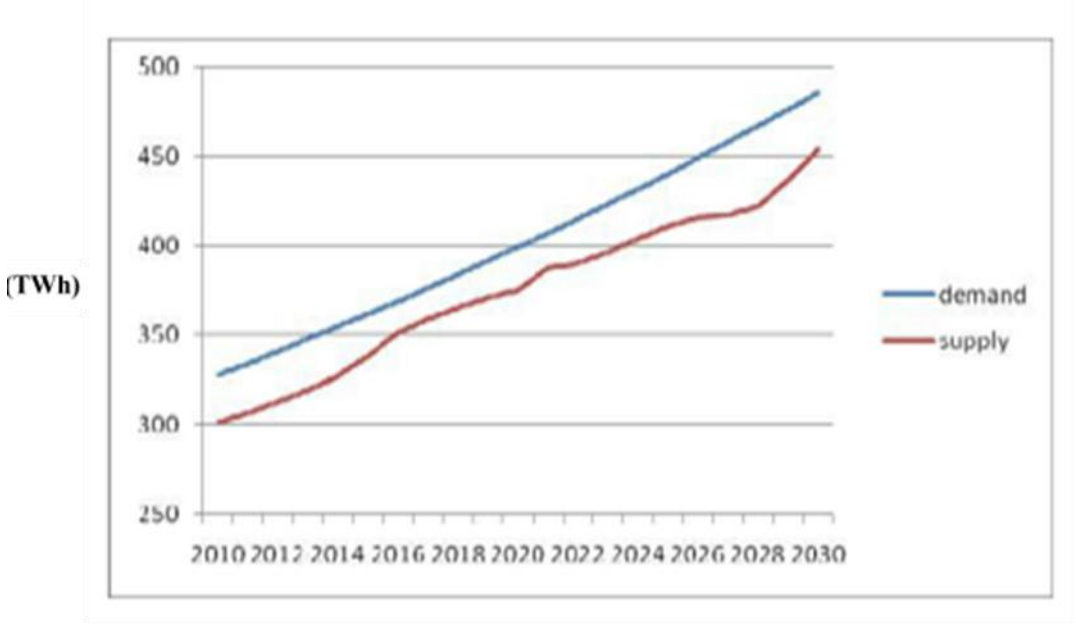


圖 4 能源供給與需求模型

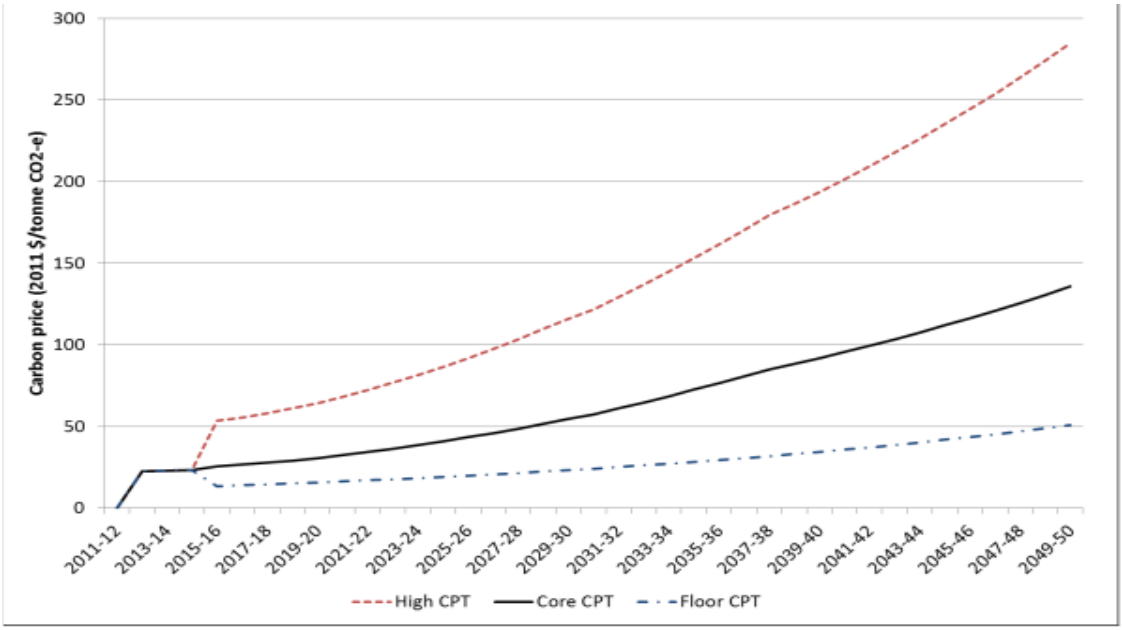


圖 5 能源供給與需求模型

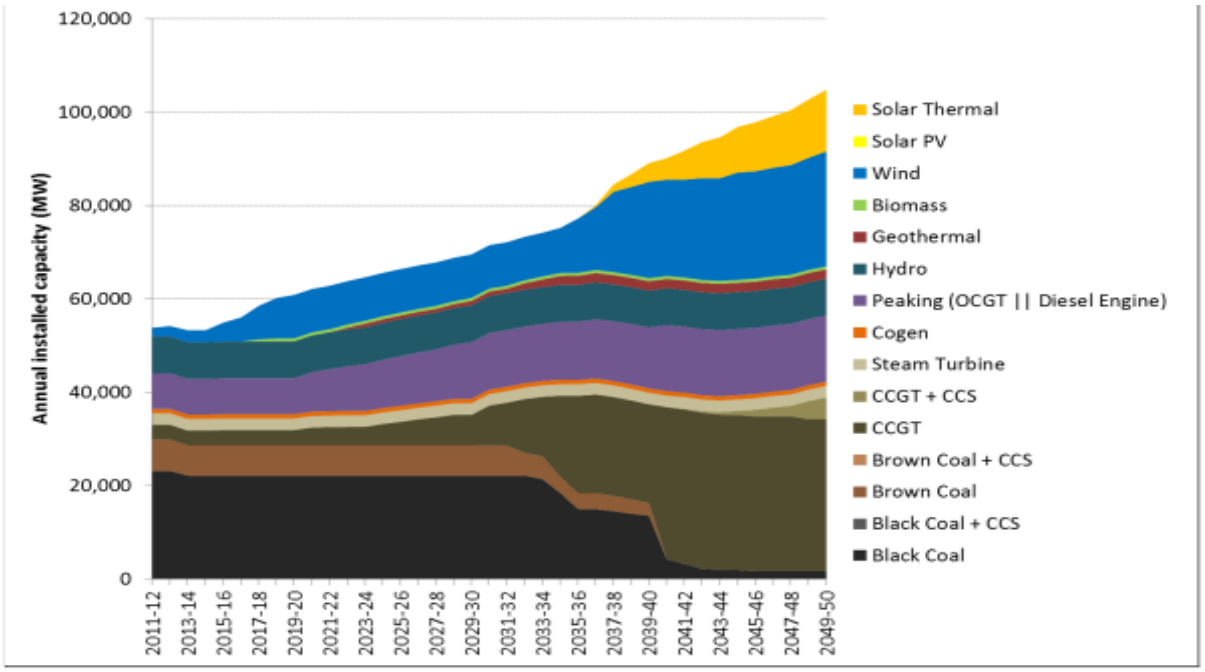


圖 6 碳價以及中度能源需求的情境下能源配置

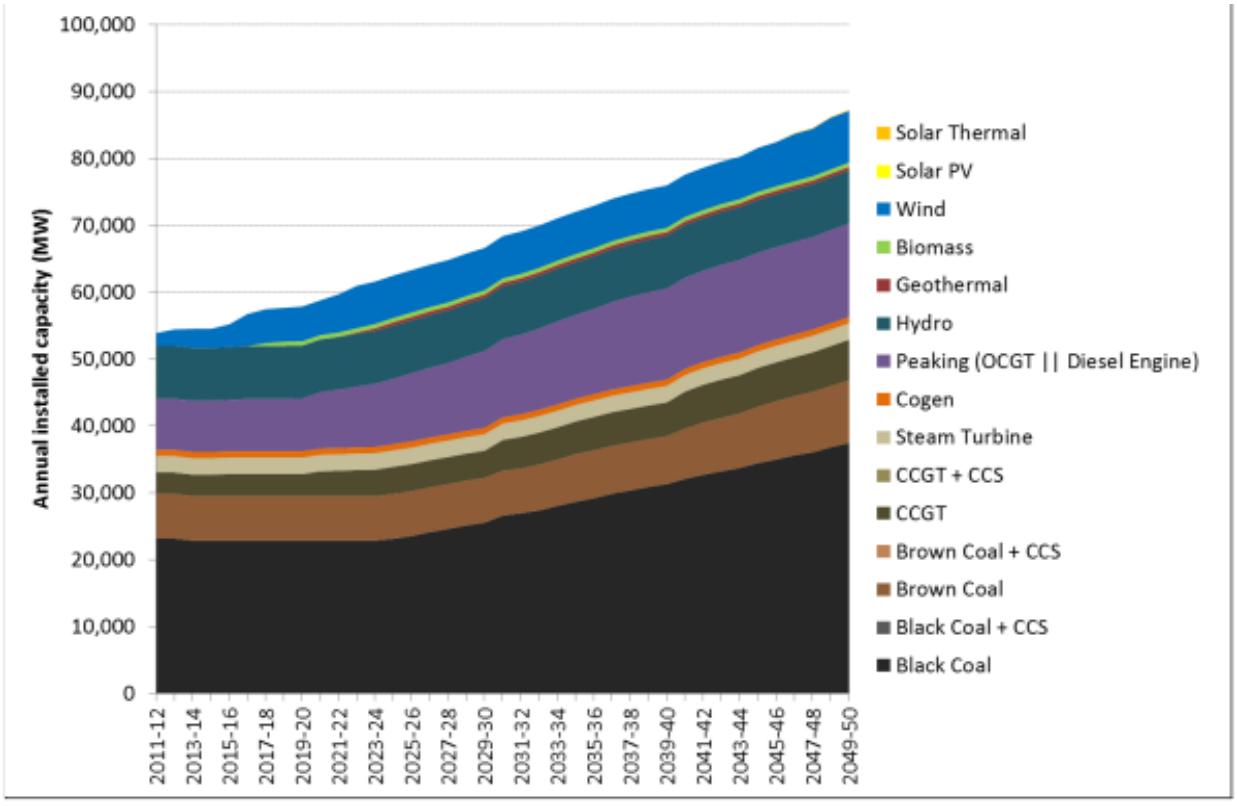


圖 7 低碳價以及中度能源需求的情境下能源配置

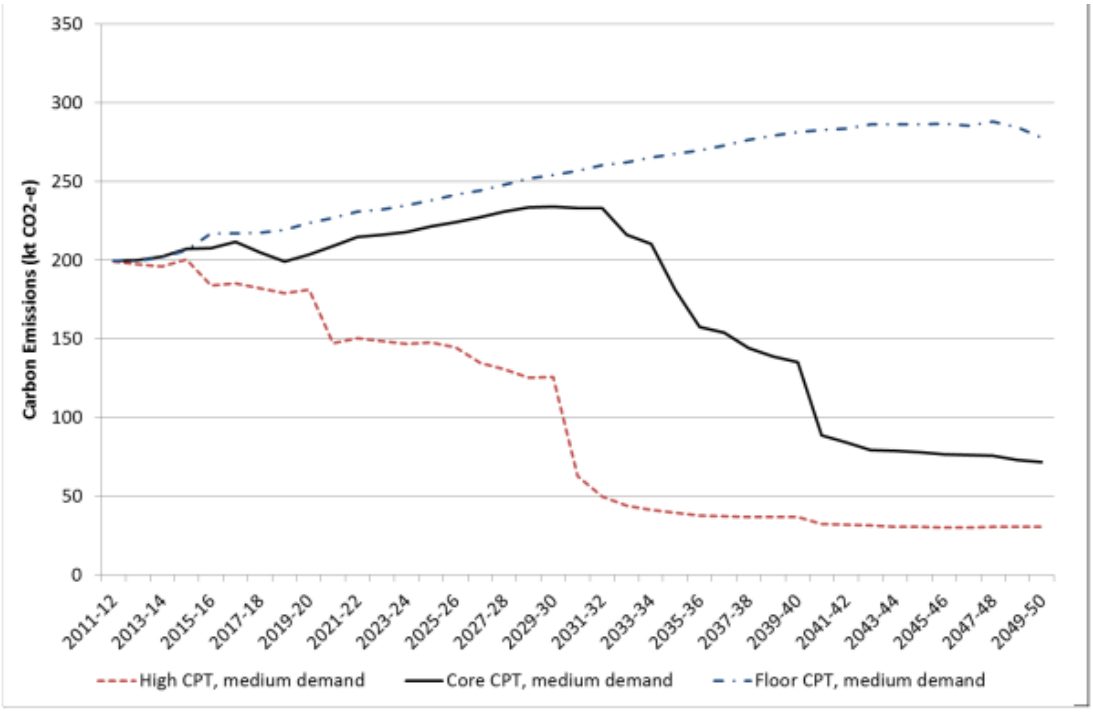
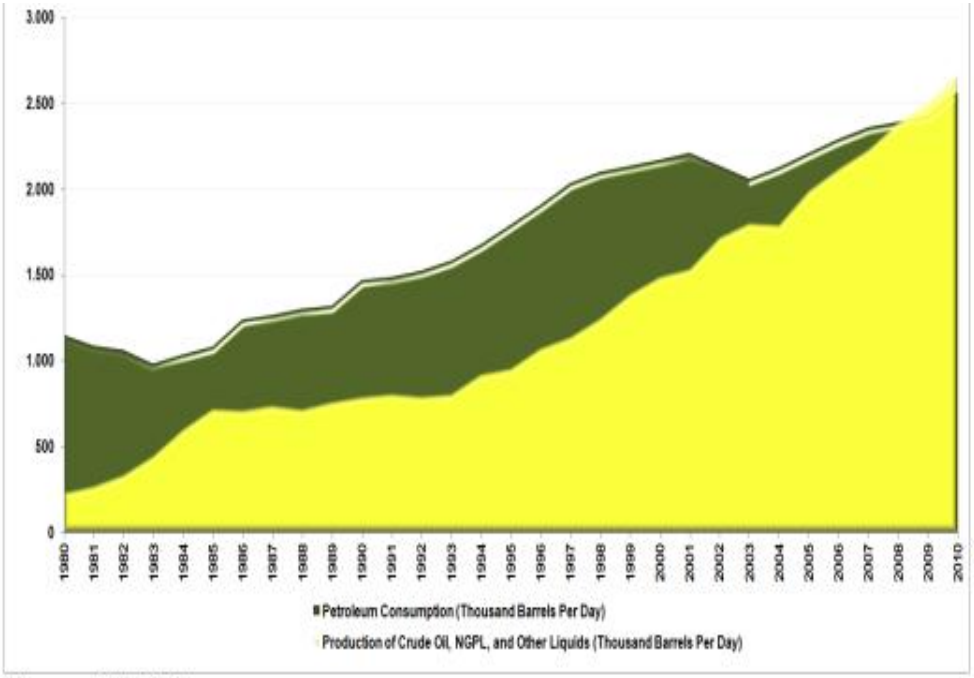
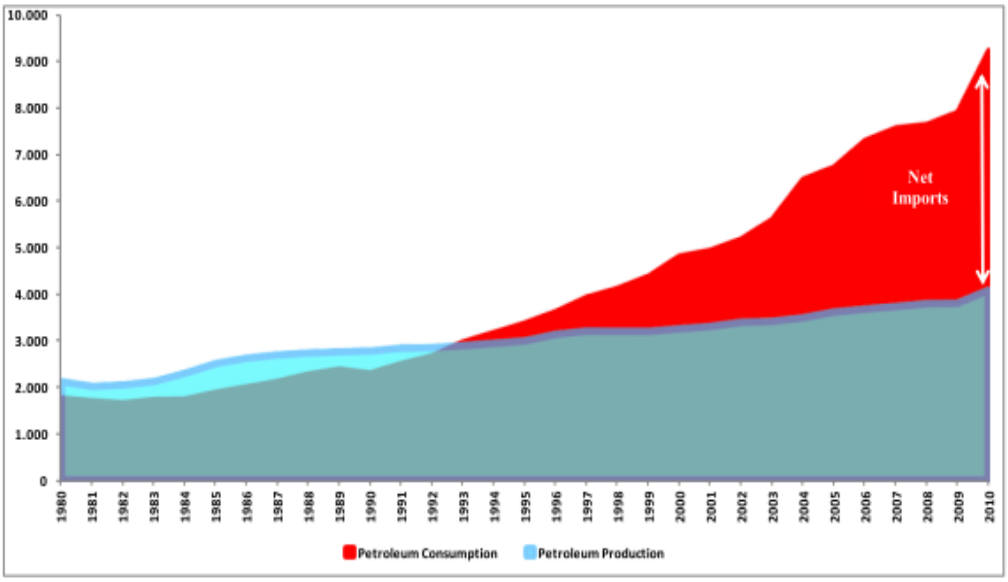


圖 8 LTIRP 模擬碳價路徑



Source: EIA/DOE

圖 9 巴西石油生產與消費



Source: Boletim Anual de Preços do Petróleo, Gás Natural e Biocombustíveis - ANP (2012)

圖 10 中國大陸的石油供需圖

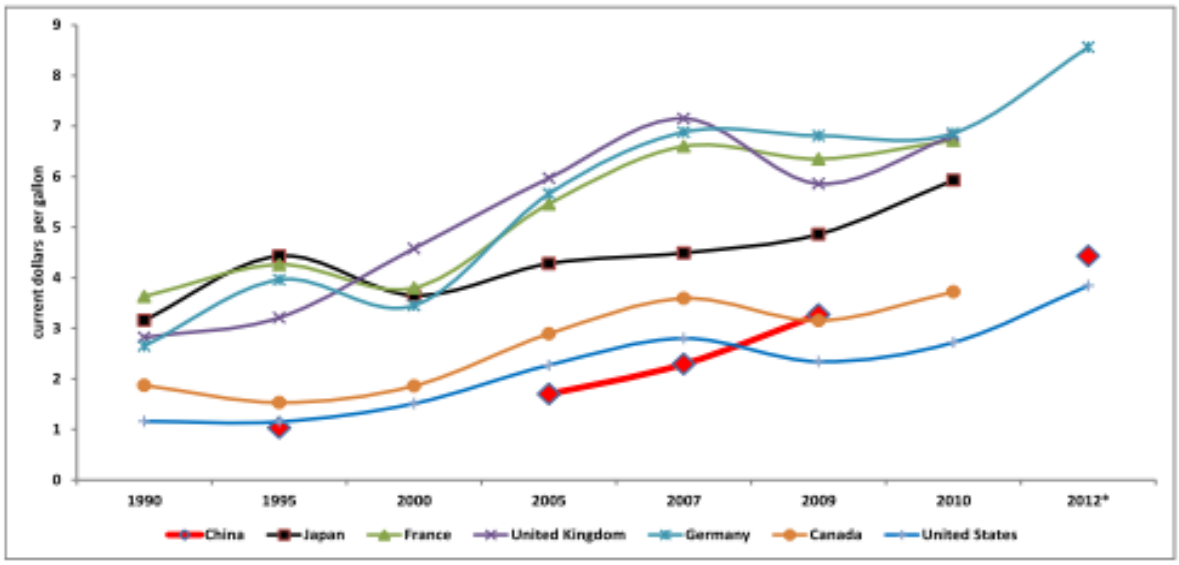


圖 11 各國天然氣價格

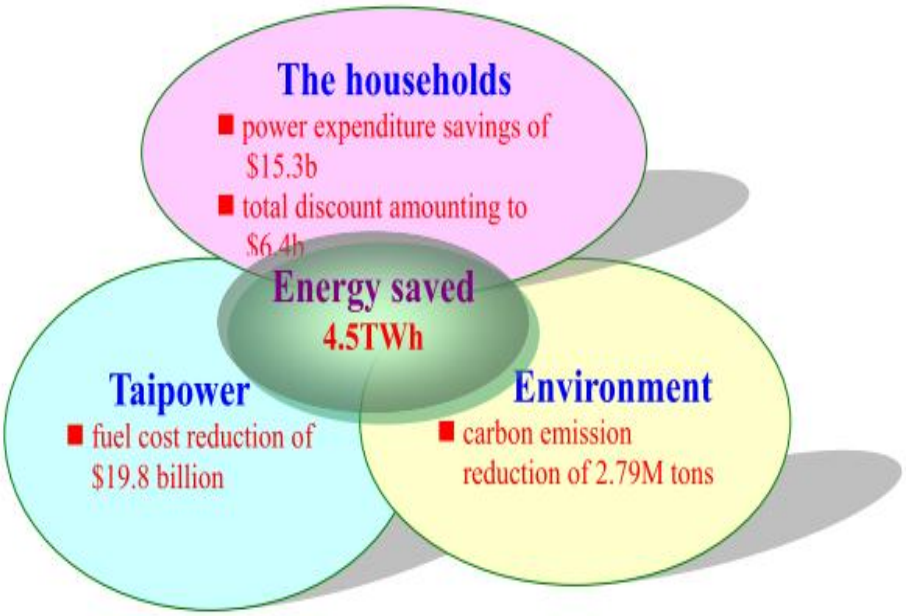


圖 12 基本稅率折扣(Basic tariff discount)的成本效益分析

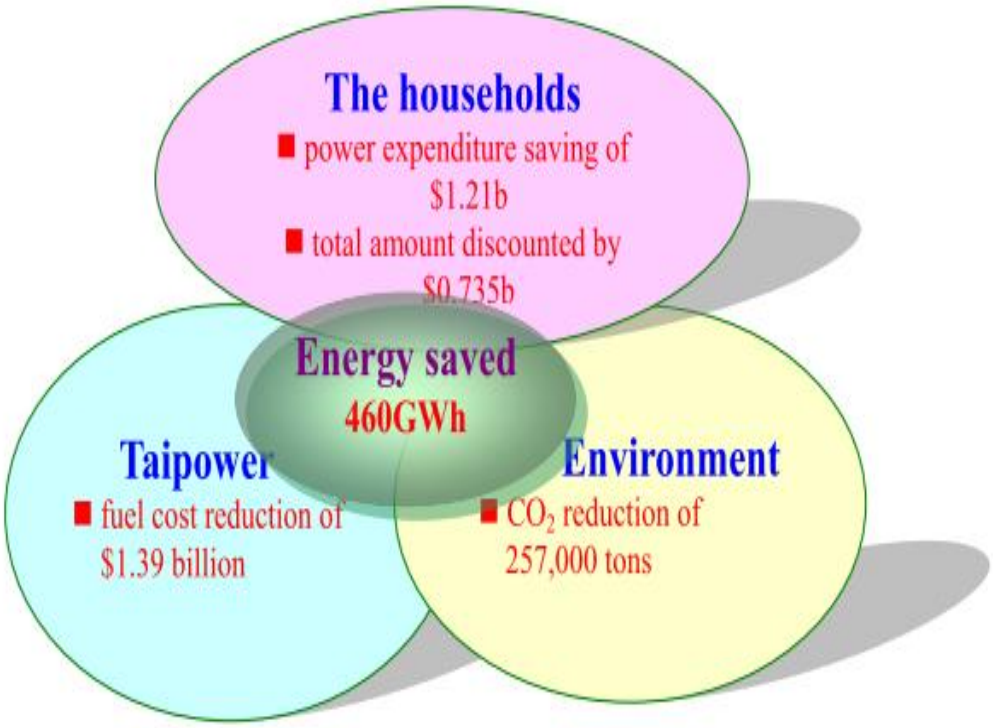
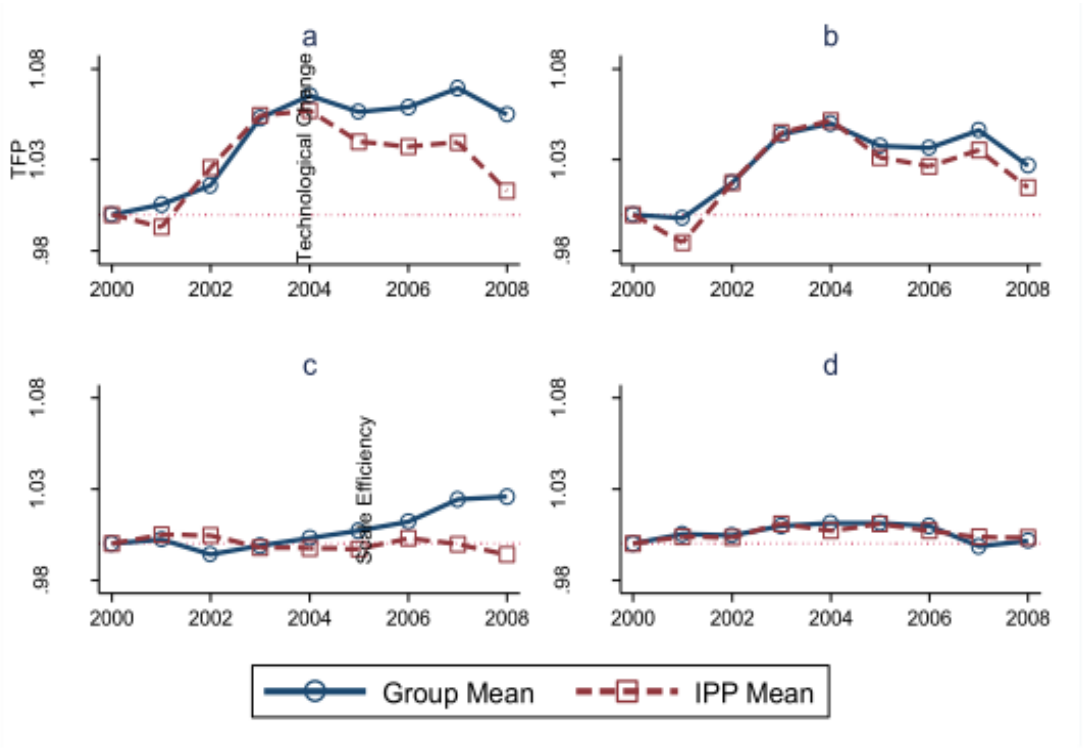
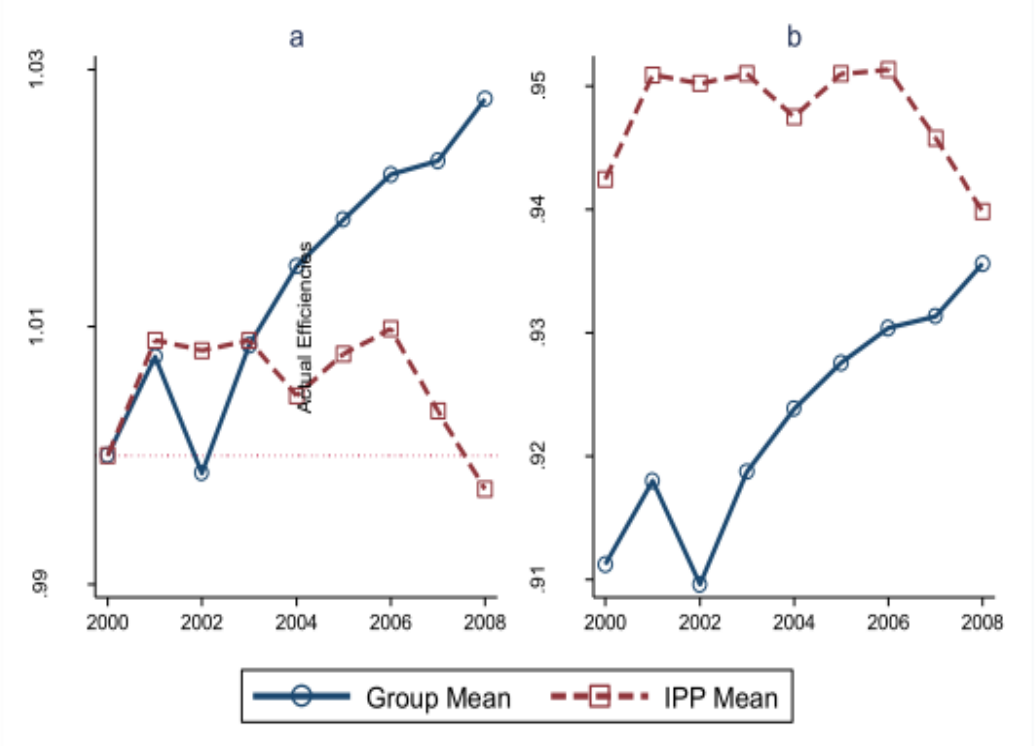


圖 13 城市競爭稅率折扣(County competition tariff discount))的成本效益分析



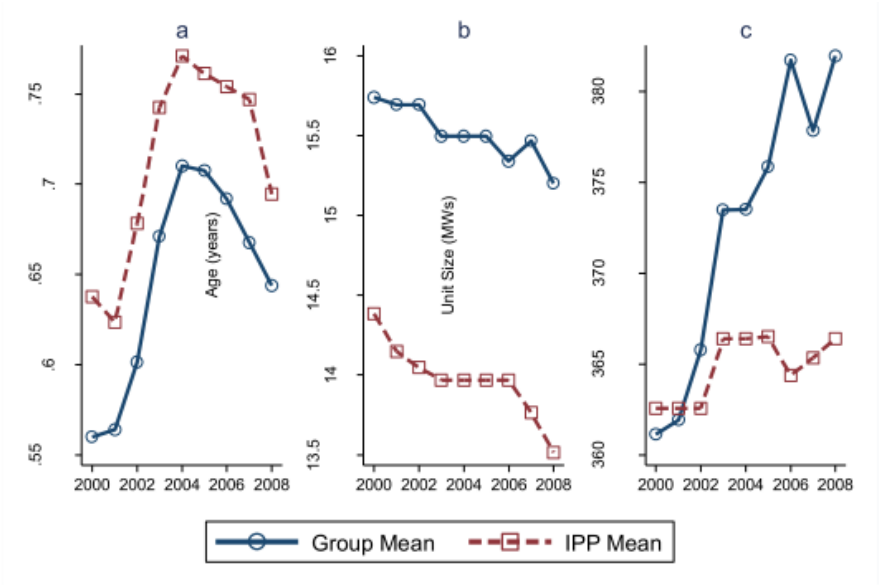
Source: Malmquist index calculation (The dotted line denotes the benchmark at the value of one).

圖 14 累積總要素生產力改變



Sources: Malmquist index and DEA calculations (The dotted line denotes the benchmark at the value of one).

圖 15 技術效率改變



Source: *Statistical Compilation of China's Electricity Industry* (CEC, 2000-2008); *A List of Running Desulfurization Facilities on Coal-fired Units* (MEP, 2011); websites of power plants; authors' calculation

圖 16 其他因子改變改變

圖 17 技術參訪

表 1 發生福島核災前的能源配置規劃

	2010	2015	2020	2025
Nuclear	0%	0%	4%	14%
Coal	16%	16%	14%	12%
Oil	6%	5%	0%	2%
Natural gas	57%	54%	49%	41%
Biomass & Waste	4%	5%	7%	7%
Hydro	13%	12%	11%	10%
Wind	2%	5%	10%	10%
Solar	1%	1%	2%	2%
Geothermal	2%	2%	2%	2%

表 2 使用能源的時刻(Time of use)的模擬

Period	Summer (Taipower) $/kWh	Summer (simulated) $/kWh	Non-Summer (Taipower) $/kWh	Non-Summer (simulated) $/kWh
Peak	3.22	3.68	3.13	3.43
Partial Peak	2.26	1.82	2.16	1.71
Off Peak	1.52	1.52	1.42	1.42

表 3　基本稅率折扣(Basic tariff discount, BTD)的能源節省

Growth rate of electricity consumption (X)	Incentive discounts
$-5\% < X \leqq 0$	5%
$-10\% < X \leqq -5\%$	10%
$X \leqq -10\%$	20%

Source: Taiwan Power Company

表 4 城市競爭稅率折扣

County Competition Results	Incentive discounts	Applicability
Gold Medal Prize	15%	The customers of the top three counties in the competition and already qualified for the Basic Tariff Discounts.
Silver Medal Prize	10%	
Bronze Medal Prize	5%	

Source: Taiwan Power Company

表 5 隨機效果追蹤資料迴歸

Dependent Variable : Technical Efficiency Score						
Independent Variables	Model A		Model B		Model C	
	Coefficient	P > |Z|	Coefficient	P > |Z|	Coefficient	P > |Z|
GROUP	-0.0392***	0.019	-0.0370***	0.003	-0.0400***	0.001
REFORM	-0.0015	0.758	-0.0130***	0.005	-0.0132***	0.004
*GROUP*REFORM*	0.0173***	0.004	0.0141***	0.010	0.0143***	0.009
UTILIZATION			0.1605***	0.000	0.1609***	0.000
AGE			-0.0038	0.212		
AGE Squared			-0.0001	0.176		
UNIT SIZE			-0.0028*	0.058	-0.0034**	0.014
UNIT SIZE Squared			-0.0001**	0.003	-0.0001***	0.000
CONSTANT	0.9528***	0.000	0.9773***	0.000	0.9919***	0.000
Sigma_u	0.048***	0.000	0.0314***	0.000	0.0313***	0.000
Wald Chi2	24.24***		145.54***		142.28***	
Log likelihood	645.402		691.7482		690.8215	
Observations	360					

*,**,*** refer to significance at 1%, 5% and 10% respectively.

表 6 資料來源

Name	Time series[1]	Frequency[2]	Units[3]	Data Source
Dependent Variable				
EPrice	PPP concatenated with RPD	Hourly	£/MWh	PPP: Statistical Digest at www.elecpool.com[4], RPD: Thomson Reuters DataStream Database.
Independent Variables				
CoalPrice	Average price of coal purchased by the major UK power producers	Quarterly	£/MWh	DECC Quarterly Energy Prices June 2011 at www.decc.gov.uk/statistics/publications/prices/
OilPrice	Average price of oil purchased by the major UK power producers	Quarterly	£/MWh	DECC Quarterly Energy Prices June 2011 at www.decc.gov.uk/statistics/publications/prices/
GasPrice	Average price of natural gas purchased by the major UK power producers	Quarterly	£/MWh	DECC Quarterly Energy Prices June 2011 at www.decc.gov.uk/statistics/publications/prices/
EAPrice	European Union CO2 Emissions Allowance Spot Price	Daily	£/metric tonne	Thomson Reuters DataStream Database.
ROCPrice	Renewable Obligation Certificates Auction Price	Quarterly	£/MWh	NFPA On-line ROC Auction Service at www.e-roc.co.uk
RO	Dummy Variable (April 2009 - June 2011)	Monthly	0,1	DECC Publications at www.decc.gov.uk/content/meeting_energy/renewable_ener/

表 7 實證結果

REGRESSION OUTPUT

VARIABLES	*(2)*	*(3)*
	EPrice	EPrice
ROCPrice	-153.345***	-158.815***
	(0.000)	(0.000)
ROCprice2	20.358***	21.029***
	(0.000)	(0.000)
EAPrice	0.041***	0.039***
	(0.000)	(0.000)
EAprice2	0.026***	0.028***
	(0.000)	(0.000)
CoalPrice	0.694***	1.014***
	(0.000)	(0.000)
OilPrice	0.310**	
	(0.029)	
GasPrice	0.019*	
	(0.057)	
RO	-0.357***	-0.305***
	(0.000)	(0.000)
ETax		
Constant	289.660***	301.329***
	(0.000)	(0.000)
Observations	76	76
R-squared	0.861	0.847
Adj. R-squared	0.844	0.834

Robust pval in parentheses
*** p < 0.01, ** p < 0.05, * p < 0.10

六、附　錄

（一） 會議報告投影片
（二） 論文集目錄
（三） 與日本能源經濟研究所往來書信
（四） 主要交流學者名冊

International Association for Energy Economics

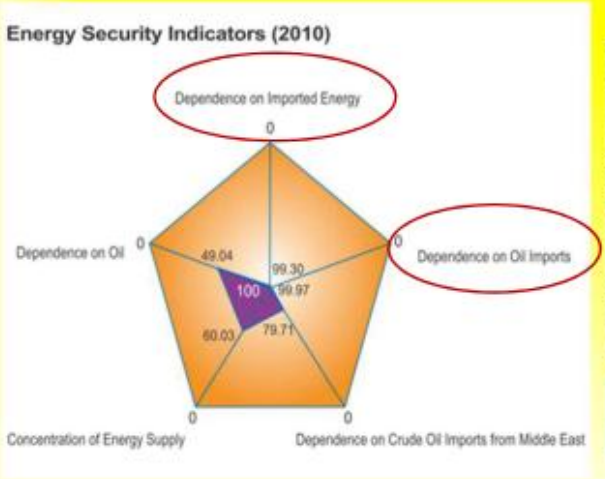
Taiwan´s Baseload Power Option Analysis after the Fukushima Nuclear Accident

Chin-Ho Cho
Fu-Kuang Ko
Institute of nuclear energy research
2012.06.25

Introduction

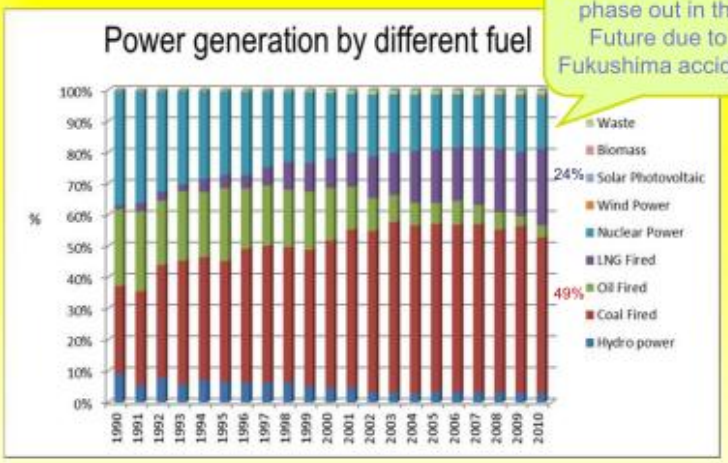
Carbon dioxide emissions
As industrialized countries have had to find ways of using
(1)Nuclear energy
(2)Renewable energy
(3)Nature gas energy

Energy security in Taiwan



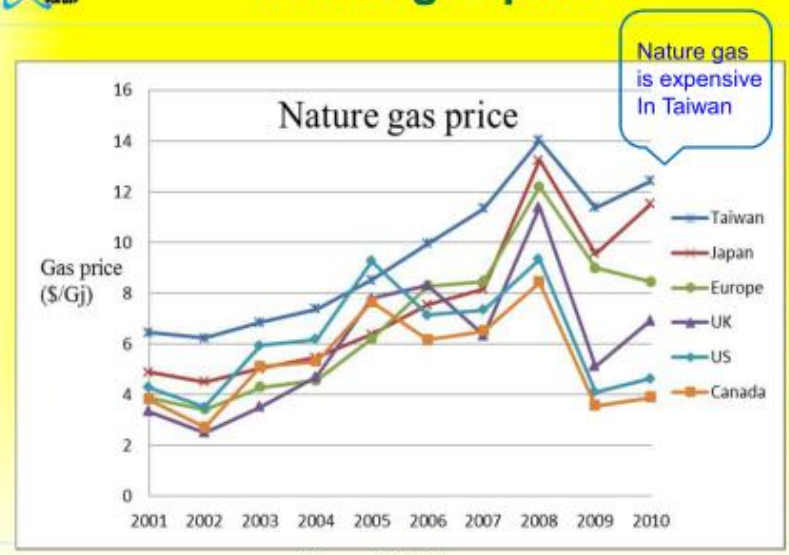
Power generation in Taiwan

Nuclear(16.85%)will phase out in the Future due to Fukushima accident



Thus, Nature gas combine cycle(NGCC) maybe a good baseload option in Taiwan

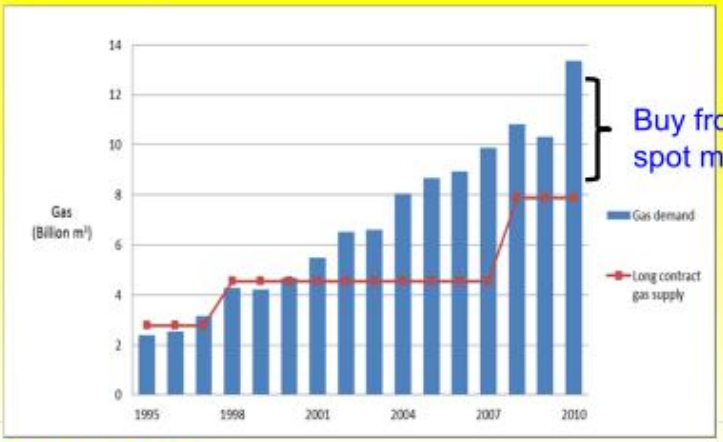
Nature gas price



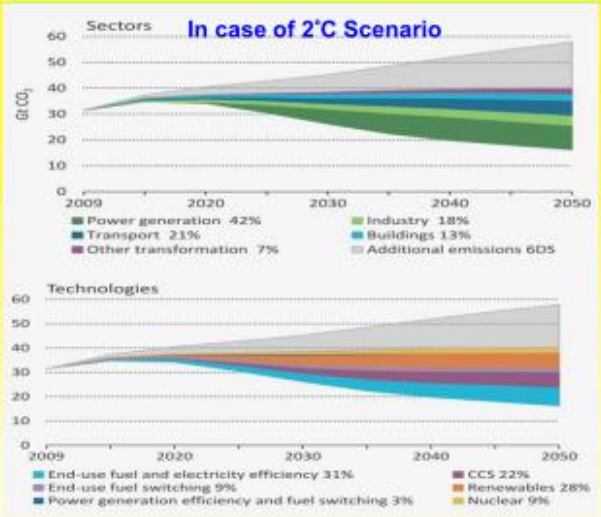
Source: BP, 2011

Nature gas supply and demand

- The cost of Nature gas import from national spot market is more expensive.



The important role of CCS



The CCS technology is first included in CDM in COP 17.

Source: ETP, 2012

CCS develop in several countries

EU:
1. CCS R&D support
2. Demostration support
3. A price limits on CO_2 emission that help to use CCS in power sectors.

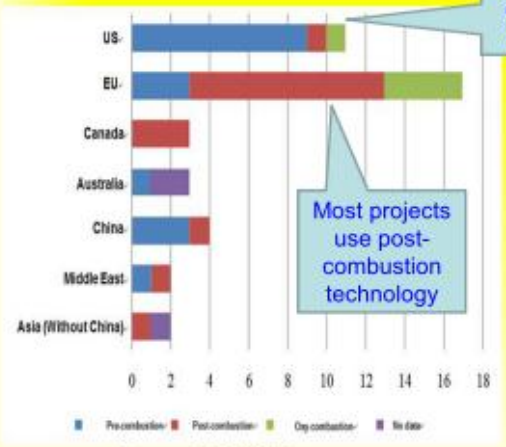
US: The CCS technology will help to generate 14.6% power without CO_2 emission until 2030.

Japan: The CCS technology will help to decrease 30% CO_2 emission until 2050.

Korea: The CCS technology will reduce 32 million CO_2 emission until 2030.

Source: ETP, 2012 and TIER(2012)

Large-scale CCS projects



Most projects use pre-combustion technology

Most projects use post-combustion technology

Source: GCCSI(2011)

The aim of this paper

- Is IGCC with CCS a feasible baseload option in Taiwan, US as well as EU?(replace NGCC or IGCC plus carbon exchange)
- Feasible year
- The role of carbon price in different projects

Techno-economic(TE) analysis

What is RETScreen?

- Provided free-of-charge by the Government of Canada
- World's clean energy decision-making software
- More than 186,000 users in 222 countries

Techno-economic analysis

Study	Country	Power generation type	Conclusion
Alonso- Tristan et al. (2011)	Spain	Small hydropower	Small hydropower still a feasible project for Spain even take sensitivity and risk analysis into account.
Gastli and Yassine (2011)	Oman	Solar water heating	Solar water heating is feasible plan for Oman and it should supply by Oman government.
Lubis L.I., et al. (2009)	Canada	hydrogen	Hydrogen technology for heating and power can reduce greenhouse gas emissions in Canada and its provinces.
Rodriguez, C.R., et al (2010)	Argentina	hydrogen	Automotive transportation could be supplied by hydrogen stemming from wind resources via electrolysis.
Mondal and Islam (2011)	Bangladesh	photovoltaic	PV technology can help Bangladesh to reduce 1423 tons of carbon emission.

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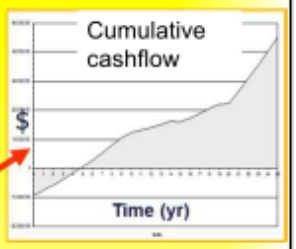
TE process

RETScreen® International www.retscreen.net

Cash Inflows
Profit from power generation
CO_2 payment
(negative)

Cash Outflows
Capital cost
Annual debt payment
O&M payment
Fuel payment



Financial indicate
IRR
Simple Payback

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TE process

Internal Rate of Return (IRR)

$$0 = \sum_{n=0}^{N} \frac{C_n}{(1+IRR)^n}$$

IRR≧ Investors target →Feasible

IRR≦ Investors target →Not Feasible

Accord to Wang(2007), it is a feasible project for Taipower company in Taiwan only when IRR≧3% and simple payment less than 20 years。

Data

Refer year:2020

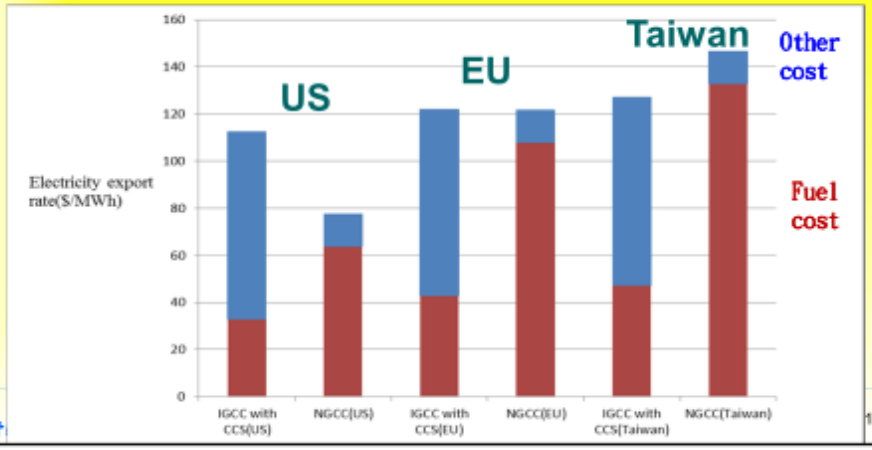
Parameter	NGCC	IGCC	IGCC with CCS
CF（%）	85	85	85
Fuel price ($/GJ)	19.14	3.37	3.37
HHV (%)	51.3	39	31.89
Inflation rate (%)	2	2	2
Project lift	32	40	40
Debt ratio (%)	70	70	70
Debt rate (%)	6	6	6
Debt term (yr)	10	15	15
Initial cost ($/kw)	962	3182	4770
Variable O&M ($/MWh)	3.37	6.79	8.83
Fixed O&M ($/kw)	14.22	58.52	68.47

Most data were obtained from EIA (2011). Moreover, growth rate of nature gas and coal price in US,EU and Taiwan were supplied by IEA (2011).

Empirical results

Electricity export rate (EER) in different fuel price

- We examine the costs among IGCC, NGCC and IGCC with CCS in 2020 by using different prices of fuel in US, EU as well as Taiwan.
- It shows that IGCC with carbon capture in 2020 will be more competitive than NGCC even without taking carbon price into account.



Feasible year (IGCC with CCS replace NGCC)

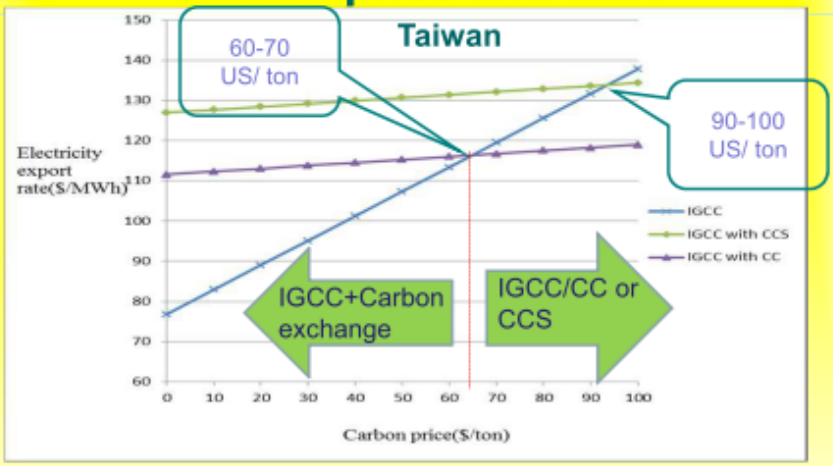
- fuel price ⬆
- capital cost ⬇

IGCC with CCS can instead of NGCC

Country	Taiwan	EU	US
year	2020	2020-2025	2030-2035

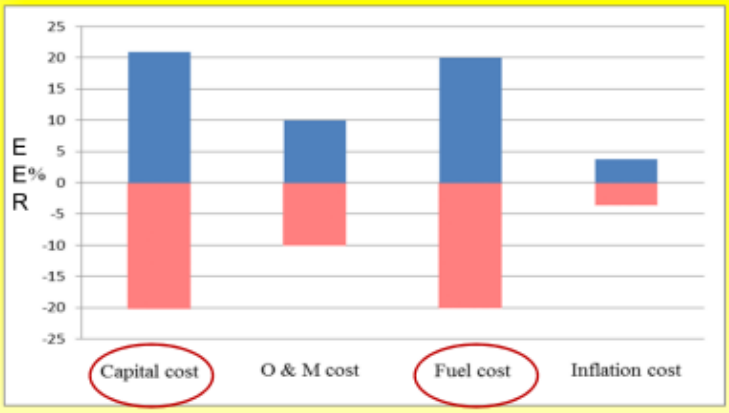
- It is feasible project for IGCC with CCS to replace NGCC from 2030-2035 in US.

The relationship between carbon price and EER



The results highlight the importance of pressure on carbon reduction when comparing IGCC and IGCC with carbon capture.

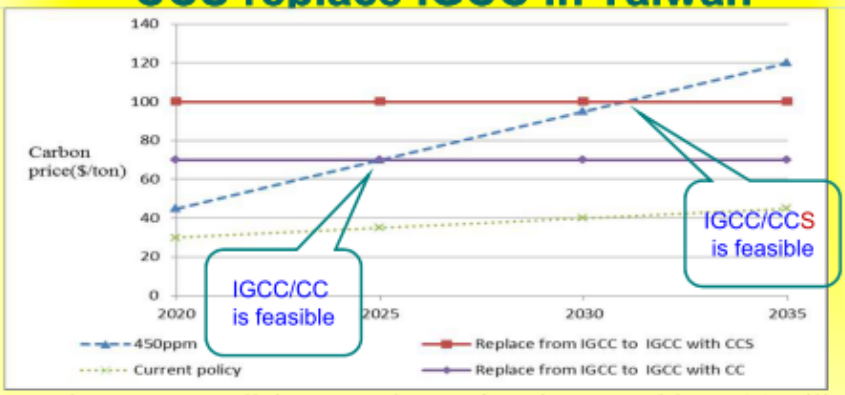
Sensitivity analysis



Thus, the uncertainty between capital and fuel cost in the future will strongly impact the electricity export rate

Source: INER

Feasible year for IGCC/CC or CCS replace IGCC in Taiwan



- In the 450ppm policies scenario, we found IGCC with CC(S) will become a feasible project in 2025(2030~2035).
- In the current policies scenario, we found IGCC with CC(S) will not become a feasible project.

Conclusion

1. Even without taking carbon tax into account, IGCC with CCS can replace NGCC in Taiwan in 2020 due to higher nature gas price.
2. The CCS is only feasible in US until 2030-2035 (Replace NGCC or IGCC).
3. In the 450ppm policies scenario, we found Taiwan's IGCC with CC(S) will become a feasible project (replace the IGCC) in 2025(2030~2035).In the current policies scenario, we found IGCC with CC(S) will not become a feasible project.

Thank you for you listening

35TH IAEE INTERNATIONAL CONFERENCE

Energy markets evolution under global carbon constraints: Assessing Kyoto and looking forward.

Perth, Western Australia June 24th – 27th 2012

IAEE INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS
WWW.IAEE.ORG

Curtin University

G'DAY MATES

Welcome to Perth!

Welcome to the 35th Annual IAEE International Conference. Our theme is Energy Markets Evolution Under Global Carbon Constraints: Assessing Kyoto and Looking Forward. Over the next several days we will examine, discuss, and debate a wide range of issues facing the world of energy. We will address questions around how the energy world has evolved in response to the Kyoto Protocol and the degree to which the Protocol has or has not influenced the path of energy markets and technology.

From the vantage point of Perth, we can observe the influence of the dynamic growth of China and India on the energy world and the ripple effects through resource rich economies like Australia feeding into this growth.

The reaction of governments around the world to the Fukushima tragedy, which clearly has had an impact in the short run on the growth path of nuclear energy development to help meet carbon dioxide emission goals as well as simply meeting energy demand growth, will surely be discussed in many contexts throughout the course of the conference. In addition, the dual impacts of the Fukushima tragedy and the unexpected change in the global natural gas balance brought on by the shale gas developments in the United States present us with a challenging future to formulate to assist policy makers and practitioners alike. Moreover, the expected significant increase in the availability of relatively low-cost natural gas will continue to put pressure on the commercial viability of a range of renewable energy technologies.

Continued technological advances, energy market restructuring, evolving regulation, and prices on carbon all add to the complexity of the markets we seek to model, forecast, and advise on. Our conference, with your participation, will once again provide a valuable forum to advance our understanding of these complex and dynamically evolving markets upon which the world's economies so critically rely.

However, we also hope that you will have the time to look around Perth and surrounding environs. Learn about the past, observe the present, and catch a glimpse of the future of our rapidly changing city and state.

The organizing committee and I wish you a warm welcome to Perth and the conference, and we hope to have an opportunity to meet with each of you at some point during our stimulating conference.

Ronald D. Ripple

Ronald D. Ripple
General Conference Chair

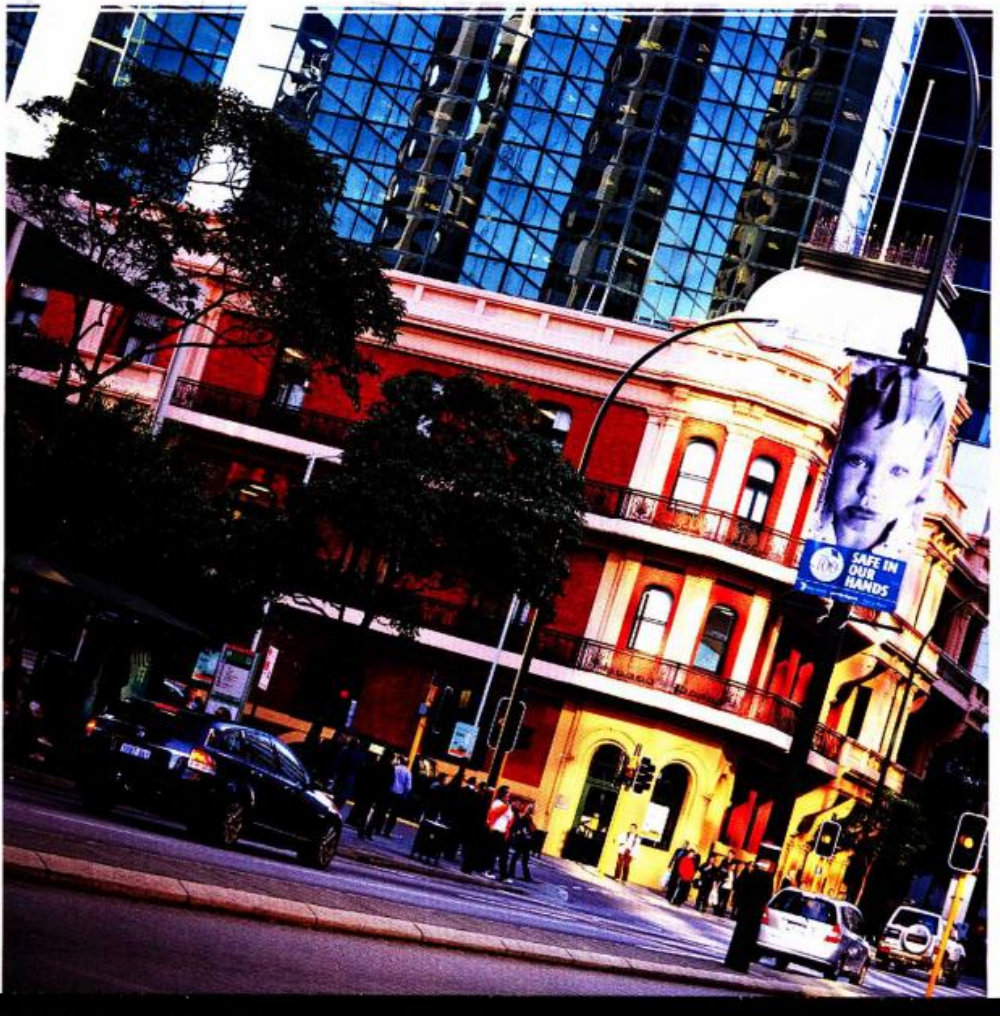
CONFERENCE COMMITTEE

Ronald Ripple Curtin Business School

Tony Owen UCL Australia

Daniel Packey Curtin Graduate School of Business

Helen Cabalu Curtin Business School



SUNDAY, JUNE 24

9:00 AM–5:00 PM – Meeting Room 12
IAEE Council Meeting

11:00 AM–5:00 PM – Foyer
Secretariat Open

12:00 PM–1:00 PM – Meeting Room 10
Council Lunch

6:00 PM–6:30 PM – Perth Town Hall,
corner Hay and Barrack Streets, Perth
Student Happy Hour

6:30 PM–8:30 PM – Perth Town Hall,
corner Hay and Barrack Streets, Perth
Welcome Reception

7:45 PM–10:45 PM – Bluewater Grill,
56 Duncraig Rd, Applecross
Council Dinner (by invitation only)
A coach will be leaving from Perth Town Hall,
corner Barrack and Hay Streets, at 7.30pm.
Return coach transfers will be available from 10.30pm.

MONDAY, JUNE 25

7:00 AM–7:00 PM – Foyer
Secretariat Open

7:30 AM–8:30 AM – Meeting Room 10
IAEE Affiliate Leaders Meeting

7:30 AM–8:30 AM – Northern Foyer
Light Breakfast

7:30 AM–8:30 AM – Meeting Room 12
Student Breakfast

8:45 AM–9:15 AM – Meeting Rooms 1-3
Grand Opening
Ron Ripple - CREME, Curtin University
Colin Stirling - DVC Academic Services,
Curtin University

Welcome to Country
Simon Forrest - Director,
Centre for Aboriginal Studies, Curtin University

Lars Bergman - Stockholm School of Economics
The Honourable Peter Collier - Western Australia
Minister of Energy

9:15 AM–10:45 AM – Meeting Rooms 1-3
Opening Plenary Session
Ambassador Richard Jones - Deputy Executive
Director, International Energy Agency

Fereidun Fesharaki - FACTS

Chair: Ron Ripple (Curtin University)

10:45 AM–11:15 AM – Northern Foyer
Coffee Break

11:15 AM–12:45 PM
Concurrent Sessions (1)
- Australian Emissions Policies – Meeting Room 1
- Evolving Electricity Markets – Meeting Room 2
- Clean Energy Policies in Electricity Markets
  Meeting Room 3
- Biofuels – Meeting Room 8
- Electricity Issues – Meeting Room 9
- Student Paper Session – Meeting Room 11

12:45 PM–2:45 PM – Riverview Rooms 4-5
Awards Lunch

2:45 PM–4:15 PM
Concurrent Sessions (2)
- Extended/Discussant I: Electricity:
  Contracts, Grids and Agents – Meeting Room 1
- Energy Issues I – Meeting Room 2
- Energy Markets – Meeting Room 3
- Nuclear Energy in a Post Fukushima World
  Meeting Room 8
- Oil Price – Meeting Room 9
- Energy Efficiency Writ Large – Meeting Room 11

4:15 PM–4:30 PM – Northern Foyer
Coffee Break

4:30 PM–6:00 PM – Meeting Rooms 1-3
Electricity Markets
Allan Dawson - CEO, Independent Market Operator, WA

Richard Green - Imperial College, London

David Newbery - Imperial College London and Director,
Electricity Policy Research Group, University of
Cambridge

Andrew Reeves - Chairman, Australian Energy Regulator

Chair: Perry Sioshansi (Menlo Energy Economics)

7:00 PM–10:00 PM – Riverview Rooms 4-5
Conference Banquet
Includes presentation of Best Student Paper Award.

TUESDAY, JUNE 26

7:00 AM–6:00 PM – Foyer
Secretariat Open

7:30 AM–8:30 AM – Meeting Room 12
2013 Daegu International Conference Planning Meeting

9:00 AM–10:30 AM – Meeting Rooms 1-3
Energy Technology Perspectives

Doug Buckley - Vice President Commercial, Shell Upstream International Australia
Peter Coppin - Stream Leader, Energy Storage for Renewables, CSIRO Energy Transformed Flagship
Laurence Mann - Research and IP Manager, Carnegie Wave Energy
Yukari Yamashita - Chief Economist and Director, Energy Data and Modelling Center, The Institute of Energy Economics, Japan
Chair: Tony Owen (UCL Australia)

10:30 AM–11:00 AM – Northern Foyer
Coffee Break

11:00 AM–12:30 PM
Concurrent Sessions (3)

- Energy and the Transportation Sector – Meeting Room 1
- Greenhouse Gas Policy after Kyoto – Meeting Room 2
- Energy Climate Change Policy – Meeting Room 3
- Issues in Renewables – Meeting Room 8
- Energy Efficiency and Conservation – Meeting Room 9
- Energy and Development – Meeting Room 11

12:30 PM–2:00 PM – Riverview Rooms 4-5
Lunch

BP Statistical Review of World Energy, June 2012 - Paul Appleby

2:00 PM–3:30 PM
Concurrent Sessions (4)

- Extended/Discussant II: Energy Consumption and Economic Growth – Meeting Room 1
- Price Risk in Energy Markets – Meeting Room 2
- Emission Issues – Meeting Room 3
- CO_2 Emissions, Carbon Price and Climate Change – Meeting Room 8
- Energy Modelling – Meeting Room 9
- Renewables and Energy – Meeting Room 11

3:30 PM–4:00 PM – Northern Foyer
Coffee Break

4:00 PM–5:30 PM – Meeting Rooms 1-3
International Oil & Gas Markets

Paul Appleby - Global Head of Energy Economics, BP Group
Tilak Doshi - National University of Singapore
Fereidun Fesharaki - FACTS
Peter Hartley and Ken Medlock - Rice University
Chair: John Felmy (American Petroleum Institute)

5:30PM–6:00 PM – Meeting Room 8
IAEE General Membership Meeting

7:00 PM–10:00 PM – Fremantle Prison
Cultural Event

WEDNESDAY, JUNE 27

7:00 AM–4:45 PM – Foyer
Secretariat Open

7:30 AM–8:30 AM – Meeting Room 10
Asian/Oceania Affiliate Leaders Meeting

9:00 AM–10:30 AM – Meeting Rooms 1-3
Financing of Energy Projects

Rob Koh - Head, Power and Utilities, ANZ Bank
Alan Langford - Chief Economist, Bankwest
Paul Simshauser - Chief Economist & Group Head of Corporate Affairs, AGL Energy Ltd
Chair: Hon Norman Moore MLC (Minister for Mines and Petroleum; Fisheries; Electoral Affairs)

10:30 AM–11:00 AM – Northern Foyer
Coffee Break

11:00 AM–12:30 PM
Concurrent Sessions (5)

- Extended/Discussant III: Energy Modelling and Risk Meeting Room 1
- Energy Policy – Meeting Room 2
- Energy Issues II – Meeting Room 3
- Regional NG Issues – Meeting Room 8
- Emission Policies, Fuel Substitution and Transportation Meeting Room 9
- Global Energy Issues – Meeting Room 11

12:30 PM–1:30 PM – Northern Foyer
Lunch

1:30 PM–3:00 PM
Concurrent Sessions (6)

- Oil Markets – Meeting Room 1
- Energy Issues III – Meeting Room 2
- Issues in the Natural Gas Markets – Meeting Room 3
- Electricity Markets – Meeting Room 8
- Biofuels II – Meeting Room 9
- Energy Market Models – Meeting Room 11

3:00 PM–4:30 PM – Meeting Rooms 1-3
Carbon Pricing across the Globe

Quentin Grafton - Executive Director and Chief Economist, BREE
Frank Jotzo - Director, Centre for Climate Economics & Policy, ANU
ZhongXiang Zhang - East-West Centre
Chair: Ron Ripple (Curtin University)

CONCURRENT SESSIONS (1) - 06

MONDAY, 11.15AM – 12.45PM

SESSION TITLE	PAPER TITLE
Australian Emissions Policies -Meeting Room 1-	Will the carbon price reduce Australian electricity emissions?
	Carbon price management with trading in volatile international emissions markets.
	Efficiency of emission reduction policies in presence of two-speed economy.
	Resilience lessons for Australian climate change mitigation policy.
Evolving Electricity Markets -Meeting Room 2-	World electricity co-operation and decarbonisation: the role of imports and exports in CO_2 reduction.
	China's electricity market reform and power plants efficiency.
	The effectiveness of energy storage to reduce peak demand on the Australian national electricity market.
	Electricity: Some quantitative reflections on possible futures.
Clean Energy Policies in Electricity Markets -Meeting Room 3-	The effect of environmental taxes on emissions from electricity generators in New South Wales.
	Perspectives for battery storage systems in the national Australian electricity market.
	Impact of green energy policies on electricity market: An econometric analysis.
	On the economics of photovoltaics vs nuclear in Europe between promises and fullfilments.
Biofuels I -Meeting Room 8-	Africa's case: Taking second generation biofuels from the laboratory to the market place.
	Ethanol as a destabilizing component for gasoline prices in Brazil.
	Australian national supply curves for biofuel production.
	On inter- and intra-generational equities in energy-climate policy modelling.
Electricity Issues -Meeting Room 9-	Trade liberalization, electricity prices and environmental quality: Evidence from South Africa.
	Power "Smart Pricing" with and without smart meters.
	Assessing competition benefits of new transmission interconnectors – established science or academic playground?
	Market power in Norwegian electricity market: Are the transmission bottlenecks truly exogenous?
Student Paper Session -Meeting Room 11-	An imperfectly competitive model of the world natural gas market.
	Evidence of market power in the Atlantic steam coal market using oligopoly models with a competitive fringe.
	Does the oil price adjust optimally to oil field discoveries?
	Can technological innovation help China take on its climate responsibility? An intertemporal general equilibrium analysis.

AUTHOR	CO-AUTHORS	INSTITUTE	SESSION CHAIR
Nicholas Cutler	Andrew Turley, Jenny Riesz, Ben Vanderwaal	ROAM Consulting	
Frank Jotzo	Steve Hatfield-Dodds	Australian National University	**Liam Wagner**
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Paul Twomey		UNSW	
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Clemens Haftendorn		DIW Berlin	
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Wei Jin		Australian National University	

CONCURRENT SESSIONS (2) - 08

MONDAY, 2.45PM – 4.15PM

SESSION TITLE	PAPER TITLE
Extended/ Discussant I: Electricity: Contracts, Grids and Agents -Meeting Room 1-	Flicking the switch: Retail demand side response under alternative electricity pricing contracts.
	Ready or not, here comes the smart grid.
	Can agent-based models forecast spot prices in electricity markets? Evidence from New Zealand.
Energy Issues I -Meeting Room 2-	Future investment costs of renewable energy technologies at volatile energy and raw material prices – an econometric assessment.
	Has liberalisation made European energy utility companies riskier?
	Adopting gasoline prices policy: Why is it easier for Brazil than China?
	The impacts of carbon sequestration on oil production projects decision-making: A real option valuation approach on different oil prices volatility scenarios.
Energy Markets -Meeting Room 3-	An integrated stochastic transport emissions policy model: Risks, opportunities and economics of U.S. greenhouse gas abatement in the near to mid term.
	Systematic risks and market changes in the Japanese electricity industry.
	International energy economics data: Sources, differences and their consequences.
	The influence of underlying fuels on electricity futures prices.
Nuclear Energy in a Post Fukushima World -Meeting Room 8-	Taiwan's baseload power option analysis after the Fukushima nuclear accident.
	Post Fukushima: Long-term role of the fusion power in Korea – a markal-times model approaches.
	Consequences of the Fukushima Daiichi nuclear crisis on the future of energy provision: Evidence from coal, gas and renewable markets.
	Kyoto, Fukushima and nuclear power.
Oil Price -Meeting Room 9-	WTI and Brent crude oil markets: A dynamic analysis of the price differential.
	The impact of oil prices in the process of financial integration in the GCC countries.
	Determinants of crude oil prices between 1997-2011.
	Forecasting crude oil price using soft-computing methods and google insight for searcher.
Energy Efficiency Writ Large -Meeting Room 11-	USA total energy demand and energy efficiency: A stochastic demand frontier approach.
	Portfolio optimization of new power plants with combinatorial auctions.
	Global and regional lifecycle energy efficiency of fossil-based primary energy sources: Trends and scenarios.
	Disinvestment effect of electricity efficiency improvements in an economy with energy price control and imperfect markets.

AUTHOR	CO-AUTHORS	INSTITUTE	SESSION CHAIR
Rimvydas Baltaduonis	Tihomir Ancev, Tim Capon, Taylor Smart	Gettysburg College / University of Sydney	
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D. Manzoor	I. Haqiqi, M. E. Aghababaei	Imam Sadiq University	

CONCURRENT SESSIONS (3) - 10

TUESDAY, 11.00AM – 12.30PM

SESSION TITLE	PAPER TITLE
Energy and the Transportation Sector -Meeting Room 1-	Forecasting market shares of environment-friendly vehicles by using a dynamic attribute based method.
	Establishing the potential grid benefits and detractions of the deployment of vehicles to grid electric vehicles.
	A dynamic panel data analysis of Chinese gasoline and diesel consumption.
	Gasoline prices, gasoline consumption, and new-vehicle fuel economy: Evidence for a large sample of countries.
Greenhouse Gas Policy after Kyoto -Meeting Room 2-	The EU emission trading scheme – sectoral allocation patterns and the effects of the economic crisis.
	Identifying optimal strategies to mitigate greenhouse gas emissions.
	Transition pathways to a low-carbon economy in Turkey: Technology, emissions and cost assessment under the times energy modelling framework.
	Improving the meaningfulness of measurements of greenhouse gas abatement potential: A transport case study.
Energy Climate Change Policy -Meeting Room 3-	CDM projects determinants: The role of host country characteristics.
	Renewable technologies and risk mitigation in small island developing states: Fiji's electricity sector.
	Transaction costs of low-carbon technologies: A review.
	Short-term impacts of a carbon tax on the European manufacturing industry including the CO_2 world supply chain.
Issues in Renewables -Meeting Room 8-	The implications of learning-by-doing on research and development of solar photovoltaic technology.
	Assessing the impact of wind turbines on property values in New York.
	Preliminary assessment of biomass energy potential in Asia using geo-referenced data.
	Persistent household energy dependence on biomass in Africa, the case of Uganda.
Energy Efficiency and Conservation -Meeting Room 9-	Suggestions from an empirical investigation on what should be fostered to improve energy efficiency in manufacturing smes.
	Trend breakout scenario impacts on the energy consumption of hospitals: Findings of a field survey.
	What are the greatest diffculties to improve industrial energy effciency in manufacturing SMEs?
	Estimating the future impact of automated control of air conditioners on reducing peak demand.
Energy and Development -Meeting Room 11-	Electrification, productivity growth and firm heterogeneity.
	Commodity speculation and price volatility.
	Electricity access and livelihoods in India: Quantifying the income impacts of chronic supply interruptions.

AUTHOR	CO-AUTHORS	INSTITUTE	SESSION CHAIR
Jeong Hwan Bae	Kyungsoo Cha	Department of Economics, Chonnam National University	
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Diego Silva Herran	Shuichi Ashina, Junichi Fujino	National Institute for Environmental Studies, Japan	**Seth Blumsack**
Lisa Yu-Ting Lee		United Nations University	
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Fourcroy Charlotte		EDF R&D and University Lille	
Andrea Trianni	Enrico Cagno, Ernst Worrell	Dept. of Management, Economics and Industrial Engineering, Politecnico di Milano, Copernicus Institute, Faculty of Geosciences, Utrecht University	**Jennifer Hayward**
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Narasimha D. Rao		International Institute for Applied Systems Analysis	

CONCURRENT SESSIONS (4) - 12

TUESDAY, 2.00PM – 3.30PM

SESSION TITLE	PAPER TITLE
Extended/ Discussant II: Energy Consumption and Economic Growth -Meeting Room 1-	Energy consumption and GDP casuality: New evidence from disaggregated data and panels of developed and developing countries.
	Energy consumption, energy R&D and economic growth in OECD economies.
Price Risk in Energy Markets -Meeting Room 2-	Contracting risks and design of optimal incentives in large energy infrastructure projects.
	The relationship between global and USA stock markets, USA financial risk ratings and the USA oil and gas market sector.
	The effect of the Fukushima nuclear accident on stock prices of electric power utilities.
	An options approach to UK energy futures.
Emission Issues -Meeting Room 3-	Diffusion of flexfuel cars in Brazil: Price response and impacts on CO_2 emissions.
	The duel benefits of global emission reduction scenarios: Reduced energy import volumes and reduced energy import values.
	Renewable and non-renewable energy consumption and CO_2 emissions: Evidence from OECD countries.
	Regional differences in the choice of energy technologies for long-term CO_2 emission reduction in Japan.
CO_2 Emissions, Carbon Price, and Climate Change -Meeting Room 8-	Evaluating carbon price induced inflation using the national accounts.
	Renewable support and CO_2 abatement in open economies – the role of price discrimination.
	China's methanol mirage: why methanol cannot help China's energy security and global climate change?
	Increased renewables in California: Impact on fossil fuel generation, levelized costs and grid CO_2 emissions.
Energy Modelling -Meeting Room 9-	The energy consumption-growth causality debate: Evidence from Asean +6 countries.
	Scenario analysis of future natural gas production using an agent-based model 'ACEGES'.
	Energy and economic growth: The stylized facts.
	Can declining energy intensity mitigate climate change? Decomposition and meta-regression results.
Renewables and Energy -Meeting Room 11-	Simulation analysis for massive deployment of variable renewables employing an optimal power generation mix model.
	Addressing a policy trilemma in promoting renewable energy in Indonesia.
	Dangers and unintended consequences of siloed renewable energy and energy efficiency policy making: Evidence from the UK.
	Different formulations of renewable energy experience curves in a global and local electricity model.

AUTHOR	CO-AUTHORS	INSTITUTE	SESSION CHAIR
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			Svetlana Maslyuk
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Cristina Alfonso		Curtin University	
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Andrew Warren	L. Sunderland, D. Croft	Association for the Conservation of Energy	
Jennifer Hayward	Paul Graham	CSIRO Energy Tranformed Flagship, Newcastle, Australia	

CONCURRENT SESSIONS (5) - 14

WEDNESDAY, 11.00AM – 12.30PM

SESSION TITLE	PAPER TITLE
Extended/ Discussant III: Energy Modelling and Risk -Meeting Room 1-	Can technological innovation help China take on its climate responsibility? An intertemporal general equilibrium analysis.
	Evidence of market power in the Atlantic steam coal market using oligopoly models with a competitive fringe.
Energy Policy -Meeting Room 2-	Does regulatory independence translate into a higher degree of liberalization? First evidence from EU energy regulators.
	Inter-regional financial flows of transfer payments under the German renewable energy sources act.
	The setting and redesign of feed-in tariffs
	Development of voluntary eco credit (environment value) markets in Japan.
Energy Issues II -Meeting Room 3-	Influence of interruption duration on direct and indirect outage costs in German households.
	Energy in mine planning: An operations research perspective.
	Modeling the uranium and enrichment markets, 2010-2030.
	An assessment of global hydrocarbon, nuclear and renewable potentials.
Regional NG Issues -Meeting Room 8-	Developments and perspectives of LNG trade in Asia.
	Merging regional natural gas markets: The case of Spain and Portugal.
	Exchange rate movements and natural gas trade in the Asia Pacific.
	A study of vertical integration in natural gas distribution utilities in Japan.
Emissions Policies, Fuel Substitution and Transportion -Meeting Room 9-	Electric-sector fuel switching under carbon constraints.
	Scenarios for the vertical integration model in the oil industry.
	Modelling the interaction between electricity and gas markets.
	Effective CO_2 reduction policies for passenger car transport based on evidence from selected OECD countries.
Global Energy Issues -Meeting Room 11-	Study on the inequality of global energy consumption based on the Zenga (2007) index.
	The uncertainty analysis of cross-market transmission among oil, gold, stock and exchange markets: Evidence from implied volatility indexes of CBOE.
	How dependent on foreign money? A cross country analisys on the oil external rents.
	Analysing the share composition of CO_2 emissions in Asian countries.

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Helen Cabalu	Julian Inchauspe, Paul Koshy	Curtin University	

CONCURRENT SESSIONS (6) - 16

WEDNESDAY, 1.30PM – 3.00PM

SESSION TITLE	PAPER TITLE
Oil Markets -Meeting Room 1-	Oil market dynamics.
	Cluster analysis of crude oil production: Is OPEC monthly production really that different from non-OPEC production?
	Media sentiment and the risk premium in the crude oil market.
	Evaluating chokepoints ratio in maritime transport.
Energy Issues III -Meeting Room 2-	Oil price shocks and macroeconomy in China and India: Insights from the energy sector.
	Technological regime and green innovation.
	Economic Location Price Signalling in a Future Carbon Constrained Australian National Electricity Market
	Innovation, renewable energy and macroeconomic growth.
Issues in the Natural Gas Markets -Meeting Room 3-	The future of the LNG market in South East Asia.
	Quantifying the volatility of energy prices using information theory: Natural gas markets.
	Opportunities and challenges for LNG in the golden age of gas.
	Share market reaction to the shale and tight gas investments.
Electricity Markets -Meeting Room 8-	Wind farms, power markets and market power in South Australia: observations, conclusions and implications
	Demand response to static time-of-use electricity pricing in Auckland.
	Electricity-economy nexus and assessment of macroeconomic impacts of market-oriented electricity reform.
	Market power in electricity markets? Evidence from New Zealand.
Biofuels II -Meeting Room 9-	The Brazilian experience with biodiesel blends in stability and handling issues.
	Is the ethanol market independent from the existing motor fuel and oil crop markets?
	Econometric study on Malaysia's palm oil position in the world market to 2035.
	Bioenergy innovation and the role of energy and climate policies.
Energy Market Models -Meeting Room 11-	Path creation – the case of Singapore.
	An imperfectly competitive model of the world natural gas market.
	Market fundamentals and co-variability of crude oil and natural gas prices.
	Forecasting short term electricity prices using multivariate time series models.

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To: yamashita@edmc.ieej.or.jp
Cc: 葛復光 Frank
Subject: Dear Ms. Yamashita

Dear Ms. Yamashita:
How are you going now?
I was impressed to discuss with you at 2012 IAEE global conference. Thank you for giving me many helpful suggestions. However, there some other questions after I discuss with my co-workers.

Our institute will rename as Institute of Energy Research, subordinate to Ministry of Economics and Energy next year. And the minister assign our institute to establish a new center, Energy Economics and Strategy Research Center. In Taiwan, there have been some think tanks for energy economics, but they are foundations, different from our public organization.

As I know, there are IEEJ and other think tanks in Japan. **How does IEEJ lead and operate joint programs, such as divide, cooperate and integrate, with other think tanks?** I hope we can refer to Japan successful experiences to design a win-win strategy for our center and other think tanks.

Could you share your insights and recommendations based onyou and IEEJ experts? **If possible, could you provide some materials (English or Japan) about my questions?**

Your helpful response would be appreciated!

Regards,
Cho, Chin-Ho
Institute of Nuclear Energy Research in Taiwan

Dear Mr. Cho,

Thank you very much for additional enquiry.
Please let me get back to you next week.
Let me see if there is anything we can contribute for your thinking.

Best regards,

Yukari Yamashita
IEEJ

Dear Ms. Yamashita:

Thank you very much for your helpful response and hope you have a nice weekend.

Regards,
Cho, Chin-Ho
Institute of Nuclear Energy Research in Taiwan

From: Yukari Yamashita [mailto:yamashita@edmc.ieej.or.jp]
Sent: Friday, July 06, 2012 11:35 AM
To: 卓金和
Cc: 葛復光 Frank
Subject: RE: Dear Ms. Yamashita

Dear Dr. Cho,

Thank you for waiting.
As I cannot think of a document which suits your interest, attached is some description of IEEJ's relationship with other research institutes.

Unfortunately, I cannot explain more clearly how we collaborate although we do collaborate very closely in many different projects and at many different meetings.
For example, we have good communication with RITE which develops similar but different energy modeling tools as IEEJ. Therefore, we often contact each other to compare our results using the same assumptions to see what brings differences and how we can explain, etc. for METI. Same with IAE. Some members of IEEJ sit on research planning meetings of mentioned think tanks and vice versa.

Please excuse me for insufficient information.

I wish you a successful inauguration of the new center.

Best regards,

Yukari Yamashita
The Institute of Energy Economics, Japan

Energy related think tanks in Japan and IEEJ’ s relationship.

Central Research Institute of Electric Power Industry (CRIEPI)
http://criepi.denken.or.jp/en/index.html

IEEJ and CRIEPI have mutual understanding of collaboration. We hold annual research exchange meeting to share researches and views. Our presidents contact each other regularly to discuss energy related issues.
We sometimes collaborate to conduct research together, co-host symposium for the public together and work together for METI or on our own budget.

Institute of Applied Energy (IAE)
http://www.iae.or.jp/e/index.html

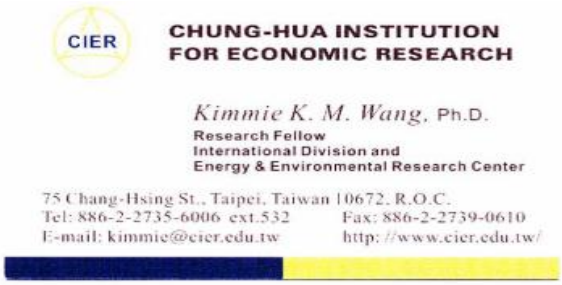
IEEJ and IAE have mutual understanding of collaboration. We sometimes collaborate to conduct research together, co-host symposium for the public together and work together for METI.

Research Institute of Innovative Technology for the Earth (RITE)
http://www.rite.or.jp/index_e.html

IEEJ and RITE sometimes collaborate to conduct research together, co-host symposium for the public together and work together for METI.

There are many other thinktanks with which IEEJ contact regularly.

附件四主要交流學者名冊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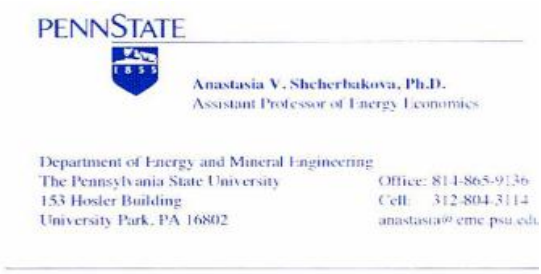
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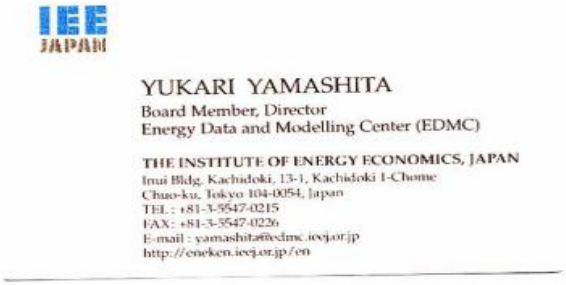
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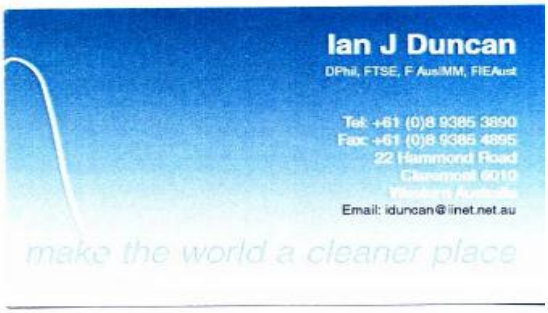
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