2023碳之捕獲、儲存、再利用及環保科技論壇

2023 CCSU and Environmental Technology Forum

承辦單位:龍華科技大學
主辦單位:龍華科技大學、海外華人環境保護學會、台灣化工學會、台灣 $PM_{2.5}$監測與控制產業發展協會、台灣電力公司綜合研究所、一詮精密工業有限公司、台灣美聯生物科技有限公司、日友環保科技有限公司

論壇時間:2023/10/22
地點:龍華科技大學法民大樓

一、前言

國際淨零排放的路徑，大體上分為建物、交通、工業、電力四大方向。我國則提出四個戰略(能源、工業、生活及社會轉型)+兩項基礎(技術研發及氣候立法)以之因應，並定位為全民運動。然則，欲達到達淨零排放，必先推動碳中和。氣候變遷衍生的危機，也隨之帶來新的轉機。惟淨零排放議題，需長期投入方可為功，大學理應藉此契機，培育人才，為國所用。

本校對此議題相當重視，對於政府政策一向支持，除了努力推動 ESG 外，極力落實節水、節能、資源循環，也鼓勵學生成立「淨零減碳綠社團」，推動綠色校園，並透過國科會的補助編寫實務性之新能源教材。

然而要達到碳中和，綠電是重要關鍵之一。但是僅推動企業使用綠電，仍無法達到碳中和。綠電只能抵銷「用電產生」的碳排放，而公司的營業及生產活動相當複雜，其他來源的排放必須搭配負碳技術和循環經濟等其他政策工具來達成碳中和。如何做到負碳技術，則須進一步探討。碳捕獲是指以各種方式從發電或工業生產中捕獲 CO_2 從排放源中分離出來，由於 CO_2 捕獲後，後續須加以處理才有負碳效果；後續處理方式包括碳再利用納入循環概念，或將 CO_2 封存。使用再利用資源化或經過濃縮及壓縮後輸送封存，可避免直接排放到大氣中，降低大氣中 CO_2 的濃度。

本校與海外華人環境保護學會(OCEESA)、台灣 $PM_{2.5}$ 監測與控制產業發展協會及台灣化工學會，一向有良好之合作關係，乃邀請上述單位結合產、官、學、研專家學者，舉辦「碳捕獲、儲存、再利用及環保科技論壇(CCSU and Environmental Technology Forum)」，借此吸取更廣、更新的技術資訊與策略，同時希望結合國內各界的力量，共同為推動淨零排放而努力。謹此，論壇分設兩大議題，包括脫碳(Decarbonation, CCSU)及循環經濟、氣候變遷及再生能源(Circular Economy, Climate change, Renewable Energy)。

經 OCEESA 舉薦，本次論壇很榮幸邀請到三位美加專家做專題演講，分別是：美國能源研究重鎮、橡樹嶺國家實驗室(ORNL)副所長孫欣(Xin Sun)博士，美國環保署研究員馬新博士，和加拿大 Cantech Environmental 公司負責人巢志成博士。

孫欣博士所帶領之團隊對清潔能源(clean energy)、脫碳(de-carbonization)與環球安全(global security)方面之研究、領先國際，具有先導之作用，同時孫博士對於美國能源科技總局(ESTD)之運作，包括建物、交通、製造以及儲能與智慧電網等科技，具有先進之見解。其次，馬新博士長期從事整合型的水資源最佳化利用研究，對循環水經濟，包括能源、養料、物料和水的回收再利用，有獨到的經驗和見解，享譽國際。此外，目前擔任 116 年歷史 Air & Waste Management Association（A&WMA) 學術副主席的巢志成博士，具有環工學界與業界 40 年之經驗，其專長是循環經濟、零排放、永續環境、高價值材料之循環再利用、清潔生產等，主持過的大型計畫無數，著有績效，獲國際表彰。

為了增進國內外交流，本論壇也邀請到國內負碳專家談駿嵩教授、二氧化碳捕獲與再利用專家楊明偉博士、氫能與燃料電池專家陳立業教授等共襄盛舉。此外，論壇亦很榮幸地邀請到環境部化學署簡慧貞副署長代表大部演講致詞。另外，為了全面推動淨零排放及重要性認知，本論壇組委會亦同時舉辦高中職及大學生進行海報競賽，並提供獎金及獎狀，也邀請與本論壇相關之實務產品及廠商參展，使內容更加多采多姿。

相信為期一天之論壇、海報競賽及實體展示，結合了台灣、加拿大、美國、香港及大陸等專家，在本校、OCEESA、台灣化工學會、台灣 $PM_{2.5}$ 監測與控制產業發展協會及其他單位等產、官、學、研的共同努力下，能提供台灣各界有關淨零排放之卓越見解，進而與世界接軌，有助於長期減碳目標的達成。

二、舉辦目的

1. 透過本論壇與美國、加拿大、香港及大陸地區之專家更緊密的交流，互相學習相關技術，進一步合作。
2. 與 OCEESA、台灣化工學會、台灣 $PM_{2.5}$ 監測與控制產業發展協會建立減碳研究及教育平台，進而推動至台灣地區。
3. 分享技術、策略、方法給國內有關單位。
4. 推動校園內淨零排放觀念及重要性認知。

三、預期效益

1. 透過論壇將淨零排放的觀念推廣至學校或相關單位。
2. 引入美國及加拿大在去碳及循環經濟行動之經驗及新的技術及新的觀念。
3. 透過論壇提出未來綠能的發展趨勢與關鍵技術。
4. 對負碳技術及實施提供發展策略，有助於國內的發展。
5. 獲得潔能、脫碳及全球安全方面的發展策略，可供台灣參考。

四、議程

時間	主題	講者
08:30-09:00	報到	
09:00-09:10	致詞	龍華科技大學 葛自祥校長
09:10-09:15	致詞	海外華人環保學會 李森理事長
09:15-09:20	致詞	台中市環境局 陳宏益局長
	Plenary Session 1 Chairman: Tu Lee (李度)	
09:20-9:45	Clean Energy and Decarbonization Research at OAK Ridge National Laboratory	Dr. Xin Sun(孫欣) Associate Director, Oak Ridge Laboratory, USDOE, USA
9:45-10:10	Negative Emissions Technologies: CO_2 Capture, Storage and Utilization	Dr. Chung-Sung Tan (談駿嵩) 國科會負碳領域召集人
10:10-10:25	茶敘時間	
	Plenary Session 2 Chairman: Shan-Yuan Leu (呂紹元)	
10:25-10:40	CO_2 Capture in Taipower Company	Dr. Ming-Wei Yang (楊明偉) 台灣電公司綜合研究所化學與環境研究室資深研究員兼組長
10:40-10:55	Catalytic Processes for Converting CO_2 into Value-Added Products	Wen-Yueh Yu (游文岳) Associate Professor/ Department of Chemical Engineering, National Taiwan University
10:55-11:10	Recovering Critical Minerals From Coal Waste Streams	Dr. CHIN-MIN CHENG (鄭志民) Environmental Geochemist (1/2023-present) Leidos/National Energy Technology Laboratory-Pittsburgh, PA, USA
11:10-12:10	Panel discussion Topic: DECARBONIZATION (CCSU) 主持人:蔡春進 陽明交大環境工程研究所終身講座教授/台灣 $PM_{2.5}$監測與控制產業發展協榮譽理	Dr. Xin Sun (孫欣)/Dr. Chung-Sung Tan (談駿嵩)/Dr. Jason Cheng (鄭志民)/Dr. Shu-San Hsiau (蕭述三)/Dr. Hsiao-Kan Ma(馬

	事長	小康)/ Dr. Wen-Yueh Yu (游文岳)/Jason Wen (溫俊山)/ Dr. Ming-Wei Yang(楊明偉)
12:10-13:20	Luncheon Poster presentation /Physical display Dr. Tu Lee (李度)(台灣化工學會學生活動事務主任委員)	
	Plenary Session 3 Chairman: Anmin Liu (劉安民)	
13:20-13:35	永續發展之綠色化學實踐	環境部化學署 簡慧貞副署長
13:35-14:00	Climate Change Mitigation Through Circular Economy Actions	Dr. Chih C. Chao (巢志成) Principal, Cantech Environmental Service, Toronto, Canada
14:00-14:25	Transforming Urban Water Systems Towards a More Sustainable Future	Dr. Cissy Ma (馬新)/Environmental Engineer, USEPA, USA
14:25-14:40	茶敘時間	
	Plenary Session 4 Chairman: Jason Cheng (鄭志民)	
14:40-14:55	Developing Urban Biorefinery To Convert Municipal Waste Into Biofuels and Chemicals	Dr. Shan-Yuan Leu (呂紹元) Associate Professor, The Hong Kong Ploytechnic University
14:55-15:10	Hydrogen Technology Beyond the Fuel Cell Cars	Dr. Sammy Lap Ip Chan (陳立業) 國立中央大學化學工程與材料工程學系教授
15:10-15:25	Assessment of Bioenergy Potentials for Selected Countries	Dr. Jay Wu (吳知行) Director and Professor, Interdisciplinary Doctoral Program in Infrastructure and Environmental Systems, USA
15:25-16:20	Panel discussion Topic: CIRCULAR ECONOMY, CLIMATE CHANGE, RENEWAL ENERGY 主持人:潘偉平 西肯塔基大學 Sumpter 榮譽教授	Chih C. Chao (巢志成) / **Sammy** Lap Ip **Chan**(陳立業)/Anmin Liu (劉安民) /R. A. Doong (董瑞安)/Jay Wu (吳知行)/Sen Li (李森)/Shao-Yuan Leu (呂紹元)/Tien-Jin Chang(張添晉)
16:20-16:50	Awards Presentation /Photo Event	
17:30-19:30	Dinner	

五、主持人介紹

李度

國立中央大學教授，創立生物啟發材料與高速材料篩選實驗室，擔任台灣化工學會學生活動事務主任委員、亞洲結晶技術研討會委員與主席(2023)及15th International Workshop on Crystal Growth of Organic Materials Steering / Organizing Committee Member(CGOM15)(2024)

李度教授畢業於美國紐約大學化學系及美國柯柏高等科學藝術聯盟學院化工學士(1990)，之後獲得美國柯柏高等科學藝術聯盟學院化工碩士學位，2000年於美國普林斯頓大學獲得化工博士學位。李教授曾於美國必治妥施貴寶公司(Bristol-Myers Squibb)醫藥研究部門研究員(1999~2003)，於2004年至國立中央大學化學工程與材料工程學系任教，創立生物啟發材料與高速材料篩選實驗室，2011升等教授，擔任過系主任(2017~2020)。李教授的團隊的研究主軸為簡單有機分子、製藥工程及生物礦化的結晶，並運用下而上(bottom-up)的純化製造方法進行研究。特別著重於功能性結晶材料的附加價值提升、大規模量產製造及產品的再現性等議題，此外，透過生物啟發及建立一套工程參數的高速篩選平台，應用於(1)Bio-mineralization，(2)Chiral Resolution，(3)Circular Economy，(4)Co-crystallization，(5)Hydrothermal process，(6)Polymorphism，(7)Reaction crystallization，(8)Salt formation，(9)Spherical crystallization，及(10)Wet Granulation。李教授於20年內發過95篇論文，由於在學術領域活躍，擔任過化工會刊編輯、研討會籌備委員、研討會學術委員、研討會大會主席、學術研究傑出教授獎評審委員、美國紐約聖若望大學製藥科學系訪問教授(2016)、化學工程學門複審會委員、台灣化工學會學生活動事務主任委員、化學工程學會化工會刊編輯、TIChE 國際期刊副編輯及亞洲結晶技術研討會委員與主席等工作，與多家公司產學合作及擔任顧問，由於其優異的表現，國立中央大學服務優良教師獎(2006, 2007)、國立中央大學教師及研究人員服務優良獎(2010)、李謀偉福聚教育基金會學術研究傑出教授獎(2010)、國立中央大學教學優良教師獎(2009, 2013)、輸送現象及其應用專題研討會研究精湛獎(2013～2014)、國立中央大學績優專利獎(2012～2014)、國立中央大學資深優良教師獎(2014)、台灣化學工程學會傑出論文獎(2017)、國立中央大學學術研究傑出獎(2009～2023)。

蔡春進
國立陽明交通大學
環境工程研究所終身講座教授
台灣 $PM_{2.5}$ 監測與控制產業發展協榮譽理事長

蔡春進教授畢業於臺灣大學機械系，在美國明尼蘇達大學機械系的微粒實驗室完成碩士及博士學位。於 1990 年加入交通大學環境工程研究所，在過去近 33 年間在陽明交大建立了奈米微粒及空氣品質實驗室，從事 $PM_{2.5}$ 及氣膠採樣分析儀器、空氣污染控制技術及空氣品質的相關研究，研究成果有低臭氧靜電集塵控制技術、高效率酸鹼洗滌技術、溼式靜電集塵技術、$PM_{2.5}$ 檢測技術、$PM_{2.5}$ 酸鹼前趨氣體、水溶性離子自動監測技術及微粒分徑採樣技術等，將氣膠技術成功地應用於空氣污染監測及控制設備的改善。除了創新學術研究外，已獲國內外專利 67 項、技轉 28 項，對本國環保產業技術水準的提升有重大貢獻。2016 年起成立國科會「$PM_{2.5}$ 及奈米微粒監測與控制技術聯盟」(pm25.nycu.edu.tw)及 2018 年成立社團法人「$PM_{2.5}$ 監測與控制產業發展協會」(pmca.tw)，結合產官學研的力量協助空污環保業者提升技術，並擴大國內外市場，協助本國產業降低 $PM_{2.5}$ 的排放及改善 $PM_{2.5}$ 空氣品質。

蔡教授在國際學術領域上十分活躍，與國內學者共同創辦國際期刊 AAQR (Aerosol and Air Quality Research, aaqr.org, 2001)，在擔任主編期間推動國際化，申請 AAQR 成為亞洲第一個氣膠與空氣品質的專業 SCI 期刊(2008）。並曾擔任共同主編和主編11年，及現任編輯11年，成功的將 AAQR 提昇成為知名的國際期刊為最大的學術服務成就之一。曾獲國科會傑出研究獎三次(2016、2012、2004)、國科會產學績優聯盟獎二次(2018、2020）、特約研究計畫、傑出學者研究計畫、國家發明獎、未來科技突破獎(2018)及侯金堆傑出榮譽獎等獎項。由於在研究、技術發展和教育及服務上的傑出貢獻，因而獲得國科會110年度傑出特約研究員(2022)、國際氣膠研究學會會士獎(2006)、台灣氣膠研究學會會士(2012)及亞洲氣膠研究學會學士(2015)等獎項的肯定。由於蔡教授在國際學術及實務上的經驗與傑出成就，於2023年受國立陽明交通大學聘任為環境工程研究所終身講座教授。

潘偉平

ISCET Solutions 公司總裁、華北電力大學特聘教授、美國西肯塔基大學化學系 Sumpter 榮譽教授。曾任美國西肯塔基大學校長特別助理及燃燒科學與環境技術研究所創建人。

潘偉平教授畢業於中原大學化工系，在美國 Michigan 科技大學完成碩、博士學位。於1996年進入美國西肯塔基大學擔任教職，並創立燃燒與環保科技研究所(Institute for Combustion Science and Environmental Science Technology, ICSET)，聞名國際。目前擔任燃燒與環保科技研究所解決方案理事長、西肯塔基大學終身教授及任中國華北電力大學講座教授，在能源、電力及機械之工程上貢獻卓越。其主要專長是淨煤技術及碳的管理及控制。潘教授發表270篇論文，著作三本書，有兩項專利，著作之引用指標達9921，而 h-index 指標達52。由於其重要貢獻，有三項主要受獎，分別為 ICTAC(2021)、Mettler Award(2008)及西肯塔基大學千萬美元俱樂部成員。此外，潘教授擔任過海外華人環保學會理事長(OCEESA)及北美熱分析協會理事長。潘教授從美國 DOE、NSF、USDA、DOD、EPA 及其他項目獲得經費贊助，總計75個計劃，金款超過1700萬美元，與150個火力發電廠合作，並提出淨煤技術，其學術及實務工作經驗豐富。

六、演講者介紹

Xin Sun(孙欣)

Ph.D./ Barbour Scholarship for Oriental Women at University of Michigan (1993)
Associate Laboratory Director/ Oak Ridge National Laboratory (USA)

Experience:
1. Scientist and Management /US DOE National Laboratories,

Specialty:
Computational multi-physics and materials

Selected Publications and Patents:
1. Over 220 refereed journal articles, h-index=52;
2. 3 patents

Social Activities and Honors:
1. Fellow of ASME;
2. Editorial Board Member, Scientific Report, Springer, Nature.
3. Laboratory Director's Award for Exceptional Engineering Achievement (2008)

Chung-Sung Tan(談駿嵩)

Ph.D./University of California at Davis
Professor Emeritus/Tsinghua University(Taiwan)

Experience:
1. Department Head;
2. Associate Dean
3. Chairman /TCCSUA;
4. Chairman /Carbon Negative Technology for CCSU Working Team of National Development Council;
5. Vice President/ TSCFA
6. Chief planner/ National energy program
7. Chief planner/ University-Industry Collaboration Projects (Large Alliance)

Specialty:
1.Supercritical fluid technology
2.CO_2 capture and utilization
3.Chemical reaction engineering

Publications and Patents:
1.159 SCI refereed journal articles
2.57patents

Ming-Wei Yang(楊明偉)

E-mail：u620967@taipower.com.tw
Ph. D./Illinois Institute of Technology(2010)
Senior Researcher Specialist/ Group leader on CCS project
Taiwan Power Research Institute

Experience：

- 1992-present, Senior Researcher Specialist, Taiwan Power Research Institute.
- 2012-present, Assistant professor, NYCU, Biomedical Engineering,
- 2013-2019, Assistant professor, MCUT, Safety, Health and Environment Engineering

Specialty：

- Carbon capture process
- Carbon storage
- Hydrogen energy application

Wen-Yueh Yu (游文岳)

Ph.D./Chemical Engineering, University of Texas at Austin
Associate Professor/
National Taiwan University

Experience:

1. Assistant Professor/National Taiwan University
2. Postdoctoral Investigator/Swiss Federal Institute of Technology in Zürich
3. Research Assistant/Academia Sinica

Specialty:

1. Catalyst development for sustainable processes (CO_2 reutilization, biomass upgradation, NO_X removal)
2. Advanced surface characterizations

Publications and Patents:

46 SCI refereed journal articles
(H index: 23)

Social Activities and Honors:

- Outstanding Teaching Award, National Taiwan University (2021, 2023)
- Young Investigator Award, Taipei International Conference on Catalysis (2022)
- Best Paper Award, Catalysis Society of Taiwan (2021)
- Early Career Researcher Editorial Board of *Materials Today Sustainability* (2021)

- Chemical Engineering Excellence Award, Taiwan Institute of Chemical Engineers (2020)
- Advisor for College Student Research Creativity Award (2020)

CHIN-MIN CHENG(鄭志民)

Ph.D. /Civil Engineering - The Ohio State University, Columbus, Ohio

Senior Research Engineer, The Ohio State University
Environmental Geochemist
Leidos/National Energy Technology Laboratory-Pittsburgh, PA(USA)

Experience:

1. Senior Research Associate-Engineer/The Ohio State University - Columbus, OH
2. Research Scientist and Manager /ICSET- Bowling Green, KY

Specialty:

1. Geochemistry
2. Hydrogeology
3. Unit Operations
4. Mineral Separation

Selected Publications and Patents:

1. 20 articles in refereed journals
2. Over 100 magazine articles, proceedings papers, and technical reports
3. One patent

Social Activities and Honors:

1. American Society of Civil Engineers
2. Ohio Society of Professional Engineers

Registered Professional Engineer, State of Ohio (E-77445)

Chih C. Chao(巢志成)

Ph.D./Environmental Engineering

Principal/Cantech Environmental Service, Toronto(Canada)

Experience:

40+ years of consulting, research, academic and industrial experiences in circular economy, value-added recycling, sustainable materials management, materials/energy synergy, cleaner production, green engineering; Service area spanning Canada, USA, Taiwan, Singapore, Oman, EU, South Africa, China, etc.

Key positions:

1.Vice President/ Tunghai University(Taiwan)
2.Professor and Associate Director/ Sustainable Environment Research Laboratories, National Cheng Kung

University(Taiwan)
3.Fellow and Senior Director/ Green Technology Program, Industrial Technology Research Institute, Hsinchu(Taiwan)
4.Vice President/ China Ecotek Corporation (China Steel Group), Kaohsiung(Taiwan)
5.Process Engineering Manager/ Ontario Waste Management Corporation, Toronto (Canada)
6.Process/Environmental Group Supervisor, Bechtel Canada and Kilborn Engineering, Toronto(Canada)

Specialty:

1. Circular economy
2. Zero waste
3. Sustainable waste/Materials management
4. Value-added recycling

Selected Publications and Patents:

1.52nd Annual A&WMA Critical Review: Circular Economy for Clean Energy Technologies, Discussion Paper
2.115th A&WMA Annual Conference, San Francisco, USA, June 27-30, 2022
3.Decarbonization through Circular Economy Actions, University of Toronto
4.Climate Change Seminar, Toronto, Canada, December 14, 2021
5.Decarbonization via Sustainable Materials Management: Approaches and Benefit Analysis, 114th A&WAMA Annual Conference, Virtual, June 14-17, 2021.

Social Activities and Honors:

1. Chair/ International Affairs Committee, Air &Waste Management Association(USA)
2. Fellow/ Taiwan Association for Aerosol Research(Taiwan)
3. Outstanding Alumni Award/Tunghai University(Taiwan)
4. Editorial Member/ Studies in Science of Science(China)

Cissy Ma(馬新）

Ph.D./ Civil Engineering
University of Wisconsin(USA)
Research Environmental Engineer /US Environmental Protection Agency(USA)

Experience:

1. RESEARCH ENVIRONMENTAL ENGINEER /U.S. ENVIRONMENTAL PROTECTION AGENCY, Cincinnati, OH 2010–present
2. FEDERAL POSTDOCTORAL RESEARCHER /U.S. ENVIRONMENTAL PROTECTION AGENCY, Athens, GA 2007–2010
3. POSTDOCTORAL RESEARCH ASSOCIATE /University of Wisconsin – Madison, Madison, WI 2004–2007

Specialty:

1. water infrastructure carbon footprint,
2. greenhouse gas emission reduction,
3. water-energy-nutrient nexus, water reuse, resource recovery,
4. life cycle thinking,
5. infrastructure resilience,
6. climate change adaptation and mitigation,
7. integrated assessment metrics

Selected Publications and Patents:

- Sam Arden; Ben Morelli; Sarah Cashman; Michael Jahne; **Xin (Cissy) Ma***; Jay Garland. 2021. Onsite Non-potable Reuse for Large Buildings: Environmental and Economic Suitability as a Function of Building Characteristics and Location. *Water Research*, 191, 116635. doi:10.1016/j.watres.2020.116635.
- Ben Morelli, Sarah Cashman, **Xin (Cissy) Ma***, Jason Turgeon, Sam Arden, Jay Garland. Environmental and cost benefits

of co-digesting food waste at wastewater treatment facilities. 2020. *Water Science and Technology*. March 5. doi: 10.2166/wst.2020.104.

Social Activities and Honors:

1. Accolade letter from the White House's Office of
   Science and Technology Policy leadership and the assistant to the President for IPCC review and negotiation (2022)
2. US EPA ORD Sustainability Award(2021)

Shao-Yuan Leu(呂紹元)

Ph.D./Civil Engineering, University of California, Los Angeles (UCLA)
Associate Professor/ Civil & Environ. Engineering, The Hong Kong Polytechnic University(Hong Kong)

Experience:

1.Associate Professor/ Civil & Environ. Engineering

2.Assistant Professor/ Civil & Environ. Engineering

3.Postdoctoral Fellow/ Forest Service, Forest Produ
Laboratory

Specialty:

1.Biorefinery
2.Biological Process
3.Waste and Wastewater Treatment

Selected Publications and Patents:

4 SCI papers(2020-2022)

Social Activities and Honors:

1.Outstanding Reviewer Awards (2015) – Environmental Sci & Tech., American Chemical Society (ACS) & J. of the Taiwan Institute of Chemical Engineers, Elsevier

2.Licensed Professional Engineer – California, Civil #78220;

Sammy Lap Ip Chan (陳立業)

Experience:

1. Professor/Material Science and Engineering School, University of New South Wales (Australia)
2.Professor/Department of Materials Science and Engineering, National Taiwan University

Specialty:

1.Energy Materials

2.Hydrogen Storage Material
3.Battery Technology

Selected Publications and Patents:

Ph.D./Materials Sciences, University of Cambridge(UK)
Professor/ Department of Chemical and Materials Engineering, National Central University(Taiwan)
Honorary Professor/Material Science and Engineering School, University of New South Wales - (Australia)

Over 150 referred papers

10 Book chapters

Social Activities and Honors:

1. Fellow/Materials Research Society, Taiwan
2.Fellow/Institute of Materials, Mining and Minerals, UK
3.Fellow/ Australian Institute of Energy
4.Chartered Engineer/Engineering Council in UK
5.Chartered Scientist/British Science Council
6.Editor-in-Chief/International Journal(Materials Chemistry and Physics)
7.World's Top 2% Scientists (Lifetime Science Influence Ranking in 1960-2020)

Jy S. Wu(吳知行)

Ph.D./Chemical & Environmental Engineering, Rutgers-State University of New Jersey(USA)

Experience:

Professor/ Department of Civil and Environmental Engineering, University of North Carolina at Charlotte (current)

Specialty:

1. Energy Studies
2. Watershed Management
3. Environmental Systems

Selected Publications:

5 SCI potential papers (2013-2022)

Social Activities and Honors:

1. Fulbright Scholar – J.F. Kennedy

Chair in New Technology
2. OCEESA President - 2017
3. United Nations Speaker on Drought and Water Management at New York and Spain
4. Advised more than 65 M.S. and 15 doctoral students.
5. Received major grants from US Environmental Protection Agency, American Water Works Association Research Foundation, National Science Foundation, NC Division of Water Quality, NC Department of Transportation, and chemical industries.

七、小組成員(Panelist)

DECARBONIZATION (CCSU)

Shu-San Hsiau (蕭述三)

Email: sshsiau@cc.ncu.edu.tw
Ph.D./ Mechanical Engineering, California Institute of Technology (1993)
(美國加州理工大學機械博士)
Department of Mechanical Engineering, National Central University
(國立中央大學機械工程學系)
Chair Professor, Dean of College of Engineering
(講座教授兼工學院院長)

Experience (selected):

Chair Professor/Mechanical Engineering, National Central University
(2021/8 till now) (國立中央大學機械工程講座教授)
Dean, College of Engineering, NCU (2019.2 till now)
(國立中央大學工學院院長)
Director of Energy Program of MOST(2020.1 till now)
(科技部能源學門召集人)
PI of Sustainable Energy Cross-Domain Application Talent Cultivation Program of the MOE (2021.1 till now)
(教育部永續能源跨域應用人才培育計畫主持人)
Committee member of Petitions and Appeals Committee of MOEA(2016.1 till now)(經濟部訴願委員會委員)
Executive Director, Office of Higher Education Sprout Project,
NCU(2018.2-2019.1)(國立中央大學高等教育深耕計畫辦公室執行長)
Vice Dean of Engineering College, NCU)(2017.8-2019.1)
(國立中央大學研發事務副院長)
Associate Vice President for Research and Development, NCU(2014.2-2017.1)
(國立中央大學副研發長)
Director, Clean Coal Research Center, NCU(2014 till now)
(國立中央大學淨煤研究中心主任)
Director, Innovation & Incubation Center(2014.7-2015.12)
(國立中央大學創新育成中心主任)
Chairman, Department of Mechanical Engineering, NCU(2010-2013)
(國立中央大學機械系系主任)

Chairman, Institute of Energy Engineering, NCU(2008-2013)
(國立中央大學能源所所長)
Distinguished Professor, Department of Mechanical Engineering, NCU(2006/1-2021/7)(國立中央大學機械工程系所特聘一級教授)
Visiting Scholar, Mechanical Engineering, California Institute of Technology(2006-2007)(美國加州理工學院機械系訪問學者)
Visiting Scholar, Darmstadt University of Technology, German (2003)
(德國達母工業大學訪問學者)

Specialty:

- Energy Technology
- Thermal-Fluids
- Powder Technology
- Clean Coal Technology
- Biomass (Pyrolysis, Gasification)
- Metal Additive Manufacturing
- Modeling and Design of MOCVD
- Hot-Gas Cleanup
- Debris Flow and Avalanche
- Energy Education
- Creative Engineering Education

Selected Publications and Patents:

1. 30 selected papers in journals
2. 44 patents

Social Activities and Honors (selected):

1.109 年力學學會會士
2.109 年度科技部傑出研究獎
3.中華民國力學學會會士
4.108 年中國機械工程學會「會士」
5.107 年度中國工程師學會「傑出工程教授獎」
6.106 年度科技部傑出研究獎
7.2017 年 Advanced Powder Technology 期刊傑出論文獎
8.2017 年中央大學教學優良獎勵
9.2017 年中央大學服務傑出獎勵
10. 2016-2018 年中央大學特聘一級教授獎勵
11. 101 年度機械工程師學會「傑出工程教授獎」
12.中央大學特聘一級教授獎勵, 2013-2015
13.中央大學教學優良教師獎, 2012, 2013
14.中央大學特聘教授獎勵, 2010-2012
15.中央大學特聘教授獎勵, 2007-2009
16.中央大學研究傑出獎, 2006
17.中國工程師學會民國 98 年度工程論文獎, 2009
18.中央大學研究優良教師獎, 2005
19.指導大專學生參與國科會專題研究計畫獲得研究創作獎, 2005, 2006

20.重要項目評審委員
21.Alexander von Humboldt Foundation (德國鴻博基金會) 研究獎學金：Humboldt Research Fellowship, 2003
22.第三屆全國大專校院學生創意實作競賽指導獎, 2002
23.Travel Award from International Union Theoretical and Applied Mechanics (IUTAM)
24.主持教育部顧問室多媒體教材計畫，年度最優獎勵, 1998 and 2000
25.國科會研究優等獎：1997, 1999, 2000
26. Journal Reviewer: 18 important journals

Hsiao-Kan Ma(馬小康)

Email:skma@ntu.edu.tw
Ph.D./University of Illinois at Chicago(機械工程博士)
Department of Mechanical Engineering, National Taiwan University
(國立台灣大學機械工程學系)
Professor(教授)

Experience:
- 亞太地區燃燒能源與環境協會(PARCON)執行委員
- 亞太地區燃燒協會論文委員會委員

Specialty:
- Fluid mechanics
- Thermal sciences
- Combustion
- Air pollution control
- Fuel cell
- Formation of SiO_2 thin film

Selected Publications and Patents:
1. 76 selected articles in journals.
2. 10 patents

Social Activities and Honors:
1.J. of Material Cycles and Waste Management, Editorial Board (2008-Now)
2.J. of Thermal Science, Editorial Board (2001-Now)

3.Recycling Technology, Scientific Committee member, (2016-Now).
4.Semiconductor Thermal Measurement, Modeling and Management Symposium (SEMI-THERM): Asia Liaison, Committee member (2007-Now) http://WWW.SEMI- THERM.ORG/
5.International Electronics Recycling Congress (IERC): Committee member, International Steering Committee member(2007-Now) http://www.icm.ch/
6.Experts Meeting on Solid Waste Management in Asia and Pacific Islands (SWAPI): Advisory board member (2009-Now)SWAPI_SolidWasteManagementExpertsInAsia@yahoogroups.com
7.Asia-Pacific International Symposium on Combustion and Energy Utilization (APISCEU): Board member (2001-Now)
8.Organizer, 2016 Asia-Pacific International Symposium on Combustion and Energy Utilization Conference(2016 APISCEU), Taipei, Taiwan
9.The 10th Asia Pacific Conference on Combustion (2015ASPACC), Beijing, China. International Advisory Board member.
10.Hsiao-Kang Ma, Visiting Scholar, The Tin Ka Ping Education Fund, The Hong Kong Institute of Education, 2014.
11.協助工學院舉辦 2014 台日港國際能源論壇, 2014 年 4 月 28 日,國立台灣大學工學院
12.The 9th Asia Pacific Conference on Combustion (2013ASPACC), Gyeongju, South Korea. International Advisory Board member.
13.擔任專家:Asian Productivity Organizer (APO)
-Expert to India, 18-21 August , 2016
-Expert to India, 10-13 December, 2015
-Expert to Indonesia, 14-18 September, 2015
14.擔任台灣碳捕存再利用協會(TCCSUA)創會理事長(2014-Now)
-與日本興京都大學簽署碳捕存再利用技術合作
-參與聯合國組織 COOP 相關碳捕存再利用活動
-成為聯合國氣候變遷綱要公約 COP NGO 會員，出席 Cop22 Marrakech 議定書活動
15. 輔導學生獲得重要獎項:
2015 工業局輕金屬創新應用科技競賽(第一名)。
2015 東元國際比賽(ROHM 創新獎)。
2014 東元科技競賽(季軍獎)。
2013 國科會「創新創業激勵計畫」(傑出獎及 200 萬元創業獎金)。
2013 Acer ”Incredible Green Contest(Gold Medal and US$60,000 Award)。
2013 東元科技競賽(創新獎)。
2012 東元科技競賽(國內組冠軍、行銷獎，及 41 萬元獎金)。
2012 海峽杯兩岸大學生創業計劃邀請賽(冠軍金獎)。
行政院環保署 101 年環保創意徵選活動 Good Idea!(第一名及 10 萬元獎金)。
傳承 創新 發展 2012 海峽兩岸大學生科技與文化交流競賽(總冠軍)。
2012 年第七屆全國氫能與燃料電池術研討會論文競賽(論文佳作獎)。

Jason Wen (溫俊山)

Email: wen_jason@yahoo.com
Ph.D./Chemistry, University of California, San Diego(美國聖地牙哥加州大學)
P.E./California Registered Professional Engineer(美國加州註冊工程師)

Experience:

- Director, Department of Water Resources, City of Lakewood, California (2015 - 2021)
- Utilities Superintendent, City of Downey, California (2002 – 2015)
- Water Quality/Environmental Engineer, Golden State Water Co. (1997-2002)
- Engineer, CA Department of Health Services, Drinking Water Program (1994-1997)
- Environmental Consultant, HydroSearch, Inc., (1991-1994)
- Adjunct Professor of Environmental Management, and Advisor of California State University at Long Beach International Program 美國長灘加州州立大學兼職教授

Expertise:

- Water Resources Development and Management(水資源的開發和管理)
- Drinking Water and Wastewater Treatment (飲用水和汙水處理)
- Environmental Technology and Project Management(環境技術和項目管理)
- Municipal Government Operations and Management(美國市政運行和管理)
-

Social Activities and Honors 社團任職:

- CIE/USA National Council Chair (2014-15)
  (美洲中國工程師學會全國總會會長)
- President (2014), Overseas Chinese Environmental Engineers and Scientists Association (CIE-OCEESA) (美國海外華人環保學會會長)
- Chairman (2012-13), President (2011-12), Chinese American Engineers & Scientists Association of Southern California (CESASC)
  (美國南加州中華科工學會會長，理事長)
- President (2004-2005), Southern California Chinese American Environmental Protection Association (SCCAEPA) (美國南加州華人環保協會會長)
- Chair's Award (2003), American Water Works Association – California-Nevada Section (AWWA-CA/NV)(美洲供水協會加州和內華達州分會 會長獎)
- Chair (2002-2003), Environmental Compliance Committee – AWWA-CA/NV (美洲供水協會加州和內華達州分會環境委員會主席)
- Life-time Achievement Award (2022), Southern California Chinese American Environmental Protection Association (SCCAEPA)

CIRCULAR ECONOMY, CLIMATE CHANGE,

RENEWAL ENERGY

Anmin Liu (劉安民)

Email: anminliu1@gmail.com

M.S./Sanitary Engineering, Colorado State University (1970)

President, AML Environmental Consultants

Experience:

- Los Angeles Hyperion Wastewater Treatment Plant Engineering and Operations Manager
- Los Angeles City Environmental and Regulatory Affairs Manager

Specialty:

- Water and Wastewater Sustainability Management, Wastewater Treatment Plant
- Engineering Design and Operations. Broad aspects of Wastewater Treatment System
- Planning and Management.

Selected Publications:

- Manuel of Operations of Anaerobic Digestion Process (MOP11), Water and Environment Federation.
- The Philosophy of Computerization of Wastewater Treatment Plant Process Control,
- Pure Oxygen Waste Activated Sludge Process.

Award:

Project Leader of Hyperion: Secondary Treatment Conversion Project, awarded by the APWA(American Public Works Association) as one of the 10 Public Works Projects of the 20th Century

Social Activities and Honors:

(1)2017, Medal of Honor for Engineering Achievement at the CIE-USA Centennial celebration event in New York, USA.

(2) 1995-1996, President of Southern California Chinese-American Environmental Protection Association

(3)2002-2003, Overseas Chinese Environmental Engineers and Scientists Association.

Sen Li(李森)

Ph.D./Analytical Chemistry at Purdue University
President of OCEESA
Technology Manager of Care Solutions Technology and Business at Eastman Chemical Company (Tennessee)
Public Outreach Chair of Northeast Tennessee Section of American Chemical Society (NETS-ACS).

Specialty:

- Leadership and organizational growth
- Coaching and mentoring
- Corporate portfolio management
- Six Sigma processes
- Advanced analytical technology development
- Material innovation
- Manufacturing process improvements
- Greenhouse gas reduction and circular economics

Selected Publications and Patents:
Published more than 70 papers in Journals and Proceedings

Social Activities and Honors:

1. DuPont Innovation Award(2002)
2. American Institute of Chemist (AIC) Outstanding Graduate Student Award (2002), Carl P. McNally Fellowship (2002)
3. Purdue Outstanding Teaching Award (2004)
4. Top Three Best Papers at Pittsburg International Coal Conference (2006)
5. Thomas W. Keough Award (2007)
6. American Chemical Society Division Analytical Chemistry Award Honorable Mention (2007)
7. Federation of Analytical Chemistry and Spectroscopy Societies Student Award (2007)
8. AIC Fellow (2010)
9. IEEE Senior Member (2010)
10. ACS Local Section Distinguished Member Award (2017),

Ruei-An Dong(董瑞安)

Institute of Analytical and Environmental Sciences,
National Tsing Hua University
講座教授兼國際學院院長
能環中心主任
科技部環工學門召集人

Experience:

國立交通大學環境工程研究所教授,2015.08 ~ 迄今
國立清華大學原子科學院院長, 2011.08 ~ 2015.07
國立清華大學生醫工程與環境科學系系主任, 2008.08 ~ 2011.07
美國德拉瓦大學土木與環工系訪問教授, 2005.06 ~ 2005.09
國立清華大學原子科學系教授, 2003.08 ~ 2015.07
德國 Konstanz 大學生物系訪問教授, 2001.03 ~ 2003.12
國立清華大學原子科學系副教授, 1998.08 ~ 2003.07
國立清華大學原子科學系助理教授, 1994.08 ~ 1998.07

Specialty:

環境分子科學
環境復育 (Environmental Remediation)
生物感測器 (Biosensors)
環境奈米科技 (Environmental Nanotechnology)

Social Activities and Honors:

1.103年度科技部傑出研究獎
2.97年度行政院國家科學委員會傑出研究獎
3.2005年土壤與地下水研討會優秀論文獎
4.2004年土壤與地下水研討會優秀論文獎
5.2001年德國 Alexander von Humboldt-Stiftung Fellow
6.1998年中華民國環境工程學會學術論文獎
7.1995年國科會甲種研究獎助

Tien-Jin Chang(張添晉)

國立中央大學土木工程學系博士
Institute of Environmental Engineering and Management
National Taipei University of Technology
Distinguished Professor
台北科技大學環境工程與管理研究所特聘教授

Experience:

台北科技大學研發總中心主任
循環型環境研究中心主任
台灣水環境再生協會理事長

Specialty:

廢水高級處理
水再生利用
廢棄物資源化
有害物質管理

Selected Publications and Patents:

24 selected articles in journals.

演講摘要

Clean Energy and Decarbonization Research at Oak Ridge National Laboratory

X. Sun(孙欣)

Associate Laboratory Director, Energy Science and Technology Directorate, Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA, email: sunx1@ornl.gov

ABSTRACT

Oak Ridge National Laboratory (ORNL) is the largest US Department of Energy Office of Science Laboratory. Located in Oak Ridge, Tennessee, ORNL delivers scientific discoveries and technical breakthroughs that accelerate the development and deployment of solution for clean energy, decarbonization and global security. The Energy Science and Technology Directorate (ESTD) at ORNL leads transformational science and technology in enabling integrated, flexible, secure, and autonomous energy systems of the decarbonized energy infrastructure of the future. In this talk, ESTD's current research activities on clean energy and decarbonization will be reviewed in three key areas: buildings and transportation science, manufacturing science and technology, and energy storage and smart grid.

Buildings and transportation sectors combined consume 70% of raw energy in the US. In the transportation area, ORNL's research covers combustion, electric, and hybridized propulsion, vehicle and mobility systems research, and vehicle communications, systems integration, and decision science. ORNL's building technologies research focuses on accelerating the development and integration of advanced building equipment, novel dynamic envelope materials, as well as control systems to enable affordable, efficient, and resilient buildings.

ORNL's manufacturing science research focuses on the development and implementation of next-generation advanced manufacturing technologies through research and scale-up of new processes and technical capabilities enabling new materials, systems and products. Our research portfolio covers four primary focus areas: composite science and technology, energy and industrial decarbonization, precision manufacturing and machining, and secure and digital manufacturing.

ORNL's energy infrastructures research focuses on reducing the cost and improving the efficiencies of at-scale energy storage systems and the improvement of the reliability and sustainability of the electric grid in the areas of controls, and advanced power electronics.

***Keywords*: Clean energy, Decarbonization, Manufacturing, Transportation, Buildings, Grid**

Negative Emissions Technologies: CO_2 Capture, Storage and Utilization

Chung-Sung Tan (談駿嵩)

Professor Emeritus/Tsinghua University (Taiwan)
Chairman /Carbon Negative Technology for CCSU Working Team of National Development Council

ABSTRACT

This speech discusses the global CO_2 emission status, carbon reduction target and practice, capture technology, CO_2 storage, methods of CO_2 utilizations and technologies, and the issues of CCSU.

***Keywords*: CO_2 emission, Capture technology, CO_2 storage**

CO_2 Capture in Taipower Company

Ming-Wei Yang (楊明偉)

Senior Researcher Specialist / Taiwan Power Research Institute (Taiwan)

ABSTRACT

Taichung Carbon Capture, Utilization and Storage (CCUS) Campus Park is planned for the study of carbon capture and utilization technology applied on thermal power plants which is built next to coal-unit 9 and 10 of the Taichung Thermal Power Plant. The park will comprise four major areas, including a pilot scale carbon capture plant, a mini-tester region, an exhibition center and a plant factory.

Currently, two sets of carbon capture facilities, chemical absorption (CABS) and physical adsorption (VPSA) method have been set up in the mini-tester region. Each capture facility is designed as 20kg of CO_2 per day. The source for the CO_2 is directly drawn from the fuel gas of the coal-unit 9 and 10 stack. Flue gas clean unit (FGCU) is also set in the mini-tester region in order to serve as the pre-treatment process for carbon capture.

The exhibition center and plant factory are currently under construction. The history and the progress of Taipower for carbon capture technology will be displayed in the exhibition center. In the future, the plant factory will grow high economic value of crops with the captured carbon dioxide. The pilot capture plant is expected to capture 6 tons of carbon dioxide per day and is currently in the bidding process.

Keywords: Clean energy, Decarbonization, Carbon capture, Coal-fired unit

Catalytic Processes for Converting CO_2 into Value-Added Products

Wen-Yueh Yu (游文岳)

Associate Professor/Department of Chemical Engineering,
National Taiwan University, Taipei 106335, Taiwan
Email: wenyueh@ntu.edu.tw

ABSTRACT

The use of CO_2 as feedstock to manufacture green chemicals is an appealing approach to reutilize this abundant and renewable C1 resource to potentially replace the fossil resources. Nevertheless, the conversion of CO_2 into value-added products generally suffer challenges due to the inertness of CO_2 (kinetic limit) and low equilibrium constant of reaction (thermodynamic limit). Apart from these scientific difficulties, the catalytic processes for CO_2 conversion should be energy-efficient and cost-effective in order to provide sufficient economic incentives to substitute for the existed non-renewable processes. In this presentation, I will share our recent work on two CO_2-involved reactions, *i.e.*, (1) the non-reductive conversion of CO_2 with alcohols (*i.e.*, methanol, and 1,4-butanediol), a process to prepare value-added organic carbonates (*i.e.*, dimethyl carbonate, and poly(butylene carbonate)),[1-4] and (2) the one-pot degradation of poly(ethylene terephthalate) (PET) into dimethyl terephthalate (DMT) by methanol produced from CO_2 hydrogenation, a process to simultaneously valorize CO_2 and wasted PET.[5] These catalytic processes together with their catalyst development will be briefly introduced, and discussed their potentials in the CO_2 reutilization.

[1] "Direct copolymerization of carbon dioxide and 1,4-butanediol enhanced by ceria nanorod catalyst" Gong et al. *Appl. Catal. B* (2020) 265, 118524.
[2] "Conceptual design, environmental, and economic evaluation of direct copolymerization process of carbon dioxide and 1,4-butanediol" Yu et al. *J. Taiwan Inst. Chem. Eng.* (2020) 116, 36.
[3] "Facile reflux preparation of defective mesoporous ceria nanorod with superior catalytic activity for direct carbon dioxide conversion into dimethyl carbonate" Kuan et al. *Chem. Eng. J.* (2022) 430, 132941.
[4] "Activation of carbon dioxide with surface oxygen vacancy of ceria catalyst: An insight from in-situ x-ray absorption near edge structure analysis" Kuan et al. *Mater. Today Sustain.* (2023) 23, 100425.
[5] "One-pot methanolysis of poly(ethylene terephthalate) enabled by isopropanol-assisted CO_2 hydrogenation" Lin et al. *J. Taiwan Inst. Chem. Eng.* (2023) in press.

***Keywords*: CO_2 activation, catalysis, sustainable processes, organic carbonate, waste plastics.**

Recovering Critical Minerals from Coal Waste Streams

Chin-Min Cheng(鄭志民)
Leidos/National Energy Technology Laboratory
626 Cochran Mill Rd, Pittsburgh, PA 15236
emial:chin-min.cheng@netl.doe.gov

ABSTRACT

Critical minerals, including rare earth elements (REEs), is a group of 35 minerals identified by the United States' Executive Order 13817 that are critical to the nation's economic and national security interests. REEs, including scandium, yttrium and a group of 15 lanthanides, are critical in the production of emerging technologies. The United States has increased its domestic REE production more than 170% since 2018. However, it is highly dependent on imports and lacks processing options, which puts U.S. manufacturing capabilities and national security at risk. Finding alternative sources has become a critical issue. In the U.S., coal and coal wastes (including coal ash and coal mine drainage (CMD)) are considered potential alternative sources for critical minerals. Here we demonstrated an integrated process that effectively recovers REEs from CMD. The process uses environmentally benign industrial by-products and a naturally-occurring organic ligand to mitigate CMD and recover REEs. The engineering-economic costs and net energy, net CO_2 emissions, and water and other requirements were investigated to understand the economic and environmental implications of this process. The demonstrated process can be integrated with abandoned mine land reclamation to create a commercially viable approach that can provide reliable economic incentive to mitigate CMD and restore lands that are adversely impacted by historical mining.

Keywords: **Critical minerals, Rare earth elements, Coal mine drainage mitigation, Abandoned mine reclamation**

Climate Change Mitigation through Circular Economy Actions

Chih C. Chao(巢志成)

Principal, Cantech Environmental Service, Toronto, Canada
email: meister.chao@gmail.com

ABSTRACT

Climate change presents a serious threat and hence challenges to the sustainable

growth and survival of this planet. To combat the increasing climate change impact, governments, industries, and communities worldwide have engaged a wide spectrum of strategies and actions on mitigation, adaptation and resiliency measures, tailored to respective situations. Out of these measures, the plausible mitigation strategies include: cleaner production, zero waste, circular economy, sustainable materials management, low-carbon production and consumption, etc. To address the local and/or specific issues, however, a combination of strategies would need to be selected by responsible bodies and applied to individual cases, taking into account respective problem characteristics and affordability considerations.

Further, in order to achieve the objective of decarbonization towards carbon neutrality, the responsible bodies must take an integrated approach to tackle the multi-stakeholder issues, ranging from technological, regulatory, environmental, to economic and market solutions. As a result, a favorable solution approach may take the form of a prioritized choice of above-mentioned strategy options, with intention of coming up with a viable economic system that maximizes the total benefit of decarbonization while minimizing its overall impact to the environment.

It is noted that out of various mitigation strategy options, many regions or industries have taken circular economy actions and implemented such systems, which have proven to be effective in decarbonization and greenhouse gas reduction.

This paper will review the trend of climate change, its detrimental impact on the planet, and actions needed to mitigate its cause, that is, greenhouse gas emissions. It will further discuss the need for decarbonization, to curtail the global temperature rise. Means of decarbonization through circular economy actions will be presented. Its approach, methodology and implications will be examined with regard to greenhouse gas reductions and economic gains.

Needlessly to say, in planning and implementing the circular economy actions, various barriers of regulatory, partnership and economic nature do exist, which may jeopardize its progress and advancement. Likely challenges and plausible ways of innovative resolution will also be discussed. Case studies will be reviewed with intention of illustrating a sound decarbonization planning taking a balanced and overall life-cycle approach. It is expected this paper will stimulate further thoughts on advancing circular economy actions, aiming to help achieving carbon neutrality goals.

Keywords: **Climate change mitigation, Circular economy, Decarbonization, Economic gains**

Transforming Urban Water Systems towards a More Sustainable Future

Cissy Ma(馬新）
Research Environmental Engineer, US Environmental Protection Agency
email:ma.cissy@epa.gov

ABSTRACT

Human-environment coupled water systems are complex and dynamic, and management of these systems that requires a paradigm shift from the traditional "siloed" (drinking water, wastewater, storm water etc.) approach towards more holistic approaches to address multiple issues facing municipal water systems. The concepts of fit-for-purpose, resource recovery, and decentralization to maximize resource use (energy, nutrients, materials, and water) have been considered to provide more sustainable solutions to satisfy various water services. This presentation demonstrates how innovative technology and system designs can be substantially more efficient without shifting burdens and what integrated assessment metrics can be used to balance the economic trade-offs, environmental impacts such as greenhouse gas emission reduction, and system performances.

Keywords: **Municipal water systems, Resource recovery, Decentralization, Greenhouse gas**

Developing Urban Biorefinery to convert Municipal Waste into Biofuels and Chemicals

Jianyu Guan[1], Shao-Yuan Leu[1,2](呂紹元)

1. Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR, China;
2. Research Centre for Resources Engineering towards Carbon Neutrality (RCRE), The Hong Kong Polytechnic University

ABSTRACT

Developing biorefinery techniques to convert lignocellulosic biomass into bio-polymer products is an environmentally progressive way in mitigating global climate changes. In this practice, the "lignin-first" fractionation pretreatment approach has become a new target to obtain valuable lignin monomers. However, the reaction conditions applied in the process can lead into unwanted degradation and condensation reactions during the cleavage of the ether linkages among lignins,

resulting in formation of new phenolic hydroxyl groups and negatively impact the digestibility of the pretreated substrate. Our research aims to explore the potential of an alternative organosolv to isolate lignin without sacrificing its integrity. We demonstrated that diols pretreatment offers a reaction pathway to fractionate a new reactive lignin stream in the biorefinery. Diols acted as nucleophiles quenching the resonance stabilized benzyl carbocation and formed α-etherified lignin with hydroxyl tail. The hydroxyl tails improve the solubility of lignin in diols, preserving the β-O-4 linkage in lignin residue for future lignin valorization. Due to the high solubility of the pretreated lignin without the need of sophisticated process optimization, this pretreatment technology may be applicable to treating complex lignocellulosic biomass such as urban wastes or food processing residues.

***Keywords*: Lignin, Fractionation, Depolymerization, Urban biorefinery, Biofuel**

Hydrogen Technology beyond the Fuel Cell Cars

Sammy Lap Ip Chan(陳立業)
Department of Chemical and Materials Engineering, National Central University(Taiwan)
Honorary Professor/Material Science and Engineering School, University of New South Wales - (Australia)

ABSTRACT

In response to the drastic changes in the global climate and the impact of greenhouse effect, the general trend is to reduce our reliance on fossil fuel. Hydrogen fuel cell vehicles have been considered by some as an alternative to electric vehicles, both are designed to replace the gasoline- and diesel-powered vehicles down the road. However, hydrogen fuel cells also find applications as an energy storage solution for renewables such as solar and wind power used in microgrids, which are inherently intermittent and seasonal. Disconnected microgrids are presently the trend in developed countries to provide electricity to remote communities away from electricity grid. Micro-grids can also be connected to the main grid to enhance the electricity supply stability, to provide high efficiency, and to reduce transmission and distribution losses. Solar hydrogen system is a relatively new concept of energy storage in microgrid and remote area power supply. Here the solar hydrogen system uses surplus energy generated by the photovoltaic panels to produce hydrogen via a proton exchange membrane electrolyzer. The hydrogen is stored in hydrogen storage materials housed in a hydrogen tank. When there is insufficient solar power to supply the load, a fuel cell in the system will cover the deficiency by drawing hydrogen from storage. In this presentation, we cover several important solid-state hydrogen storage systems, their characteristics, advantages and

limitations in meeting the specific energy storage requirements of the solar hydrogen system in microgrids or independent remote area power applications. We advocate the application of AB_3 La-Mg-Ni hydrogen storage alloy as a starting material to blend with other alloy systems, so as to develop new high-performance, cost-effective hydrogen storage composite alloys for use in the solar-hydrogen system. Compared with other alloy systems, AB_3 La-Mg-Ni hydrogen storage alloy is more suitable for such an application, with a large amount of hydrogen stored, low working temperature and pressure. Several examples of the applications of the solar-hydrogen systems will be given in the presentation.

***Keywords*: Greenhouse effect, Hydrogen fuel cell, Solar and wind power, Microgrids, Solar-hydrogen systems**

Assessment of Bioenergy Potentials for Selected Countries

Jy S. Wu(吳知行)

Professor, Department of Civil and Environmental Engineering, University of North Carolina at Charlotte, USA.
emial:jwu@uncc.edu

ABSTRACT

The United States and China are two of the world's leading economies and the largest energy consumers. Taiwan is a small nation with a strong free-market economy and a per capita energy consumption midway between the U.S. and China. All three countries are grappling with a shortfall of fossil oil production relative to consumption. Global policy making is moving toward the development of renewable energy sources such as bioenergy in the form of biofuel. The role of bioenergy has unequivocally become a viable and immediate alternative to fossil fuels, particularly for the transportation sector. Substituting a fraction of motor gasoline with biofuel is viewed by the energy profession as part of the long-term strategic plan to reduce greenhouse gas emissions, conserve natural resources, and reduce dependence on imported energy. This research assesses the extent of marginal lands available in the southeast region of the U.S., China, and Taiwan to a limited extent, for their techno-economic potentials to produce cellulosic bioethanol. We evaluate the levelized cost of bioenergy production and compare this cost to the retail price of gasoline for market competitive analysis. Finally, we discuss relevant technology and energy policy options to promote the development of biofuel production.

***Keywords*: Bioenergy, Fossil Fuels, Biofuels, Levelized Cost of Energy, Energy Security**

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林如貞	副校長 教授	龍華科技大學
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劉安民	理事 AML Environmental Consultants	海外華人環境保護學會 總裁
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蕭瑞昌	副教授	龍華科技大學半導體工程系
陳寶祺	教授	龍華科技大學半導體工程系
陳軒嫿	USR 專案助理	龍華科技大學多媒體與遊戲發展科學系