

行政院所屬各機關因公出國人員出國報告書

(出國類別：研習)

「第 100 屆空氣及廢棄物管理協會年會」

出國報告書

服務機關：科學工業園區管理局

出國人 姓名職稱：鄧慧卿薦任技士、謝勝隆科長

出國地點：美國匹茲堡

出國時間：96 年 6 月 23 日至 6 月 30 日

報告日期：96 年 8 月 30 日

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壹、前言：

園區高科技產業發展迅速發展，有關空氣污染、溫室氣體及廢棄物處理問題日益複雜，擬藉由赴美國參加 2007 年第 100 屆空氣及廢棄物管理協會會議，觀摩美國空氣、廢棄物管理、清潔生產、溫室氣體管制政策與作法及國際環保管理趨勢，進行經驗交流分享，提供園區環境管理借鏡。

本次 AWMA 學會百週年研討會會議地點選擇在匹茲堡亦是別具深意，因匹茲堡昔日為美國鋼鐵之都，別稱“煙霧都市”，因早年煉鋼廠及運煤火車，均無污染防制設備，大量煤碳燃燒後的濃煙排出，空氣污染問題相當嚴重，影響日常生活及都市建築景觀，在產業經濟與環保意識興起過程，經由逐步立法管制與各界努力，不僅改善環境品質，都市風貌亦呈現戲劇化的轉變為閃亮的現代摩登都市，不僅完善保存百年歷史建築，並巧妙的與現代摩登商業大廈融合，展現別具風貌美麗的都市街景。

貳、出國行程：(時間：96/6/23- 96/6/30 共 8 天)

日期	地點	備註
6 月 23 日	桃園機場→美國彼茲堡	啟程
6 月 24 日	彼茲堡	啟程及夜宿彼茲堡
6 月 25 日至 6 月 28 日	彼茲堡	參加設備展覽及研討會
6 月 29 日	彼茲堡	參訪行程 (參觀 ALCOSAN 污水廠)
6 月 30 日	美國彼茲堡→桃園機場	回程

參、年會內容

一、儀器設備展(展覽期程為期 3 天，6/26 至 6/28)：

本次參展廠商約計 280 家，包含檢測儀器廠商、分析實驗室、污染防治設備儀器廠商、環境及能源政府部門(如加拿大、美國、台灣)、學術或技術研究單位等，名單詳見附件一。因參展攤位甚多，筆者無法一一瀏覽，

僅能就興趣或業務較相關攤位節錄部份加以較深入了解。



會場照片—展覽攤位鳥瞰

1、Bio-Reaction Industries

該公司主要設計及監造以生物膜技術處理揮發性有機物及臭味空氣污染防治設備，設備銷售遍及歐洲、美洲及亞洲各國，實廠經驗包含木製業、油漆業、造紙業、畜牧業、食品業、石化業、廢水處理廠及高科技業等，該公司聲稱防治設備具有設置成本及維護成本低廉、低耗能、使用少量化學藥劑、設置空間少及高處理效率等優點。(相關內容詳見該公司網址：<http://www.bioreaction.com>)



會場照片---- Bio-Reaction Industries 攤位

會場問答：

問：此套防治設備於晶圓製造或光電廠是否有設置運轉實例？

答：於美國是有高科技廠商將此套防治設施用於處理廢水處理場所產生之

臭味，因為生物膜對於含硫、含氮臭味物質具有很好去除效果，碳氫化合物經過生物分解後變成二氧化碳及水排放，另在台灣目前代理商與某晶圓廠商有進行製程尾氣模廠實驗，以尋求處理光阻劑尾氣操作條件。

2、FLIR Systems

FLIR Systems 為國際紅外線熱像儀製造廠，由 FSI 與 AGEMA 兩家紅外線熱像儀廠商整併而成，其後又合併了 Inframetrics、Indigo Systems 等公司，具有熱像儀感測器製造、電子控制模組、軍用與商用系統通路等特長，是目前全球最大的熱像儀製造供應商，該公司於會場介紹可用來偵測工廠 VOC 洩漏之紅外線影像氣體微漏偵測儀，該偵測器可用來遠距離遙測 VOC 洩漏，以減少工安意外及環境危害發生。(相關內容詳見該公司網址：<http://www.goinfrared.com>)

會場問答：

問：此偵測器對於工廠管線或儲槽 VOC 微量洩漏，其偵測極限為何？對於物種是否有限制？

答：GasFindIR 可掃描大片區域甚至幾公里長的管線，洩漏氣體在偵測器中顯示影像為「黑色煙霧」，因此如果在顯示螢幕上出現影像則表示有揮發性氣體存在。為適應產業作業場所環境，操作溫度設計範圍為- 15°C 到+50°C，也可承受 40G 振動，監測物種包含苯、乙烯、丁酮、辛烷、丙烯、丁烷、庚烷、甲烷、戊烷、甲苯、乙烷、己烷、甲醇、1-戊烷、二甲苯、乙苯、甲基酮、丙烷等。

3、Chemical substances(加拿大環境保護部門)

加拿大環境部於 1999 年立法通過加拿大環保法 (Canadian Environmental Protection Act, CEPA 1999)，其目的為透過各政府部門間的合作協調執行永續發展至污染預防，以保護環境、人類生活及健康，並減少

毒害物質的風險，以降低加國生態系統及生物多樣化的威脅。CEPA 的主要內容包括：管理組織、公眾參與、資料收集/目標/執行面、污染預防、控制毒性物質、動物產品及生物科技、控制污染及管理廢棄物、環境緊急應變、政府運作方法、執行（稽查及監測）、增補/申訴/可能納入推動的臨時條款等 12 章節。除此，該國認知需去除與減少環境難分解的毒性物質，以避免生物累積，由環境保護部與健康部共同發展管制毒害物質的法規，如聯邦有害控制產品法(PCPA)予以管制產品有害物質之使用。(相關內容詳見該國環境部網址：<http://www.chemicalsubstanceschimiques.gc.ca>)

會場問答：

問：貴國已列管多少化學物質，歐盟電子電機限用指令物種是否已有涵蓋？

答：目前已列管 3000 餘種化學物質，要求業者若列管物質重量達規定時，必須提報相關生產量、進出口量、使用量及質量平衡等資料，以供進一步評估是否屬毒性物質，決定是否需加以管制或限用。歐盟電子電機限用指令物種皆已涵蓋。



會場照片---- 加拿大環境保護部攤位

二、研討會議題(研討會為期 5 天，6/25 至 6/29)：

(一) 議題介紹

研討內容包括環境管理(溫室氣體管制及風險評估機制)、空氣污染防制與監測及廢棄物減量與處理三大主題，主題項下分列 36 項子題，每子題

有 6 至 70 篇論文發表，於此次會議中所發表的論文高達 500 多篇，發表者涵蓋亞洲、歐洲、澳洲及美洲等相關企業、大學或研究機構(論文篇名詳附件二)。



會場照片----研討會報到處

1、本次研討會中空氣類論文共計 300 餘篇，主題可概分為 7 類，分別為：

- (1) 空氣法令探討及未來挑戰。
- (2) 空氣污染物產生源及防制技術（含 MACT）探討。
- (3) 監測技術及數據品質探討。
- (4) 移動污染源對空氣品質影響之探討。
- (5) 空氣品質（室內及大氣）成份、模擬模式及風險評估方法研究。
- (6) 固定污染源微粒、VOCs、NO_x、SO_x 及其他污染物控制與監測研究。
- (7) 微粒物質管制法令及其探討。

2、本次研討會中廢棄物類論文共計 80 餘篇，主題可概分為 6 類，分別為：

- (1) 都市廢棄物及醫療廢棄物整合管理—處理/處置/回收技術、經濟及政策。
- (2) 有害廢棄物處理/去有害技術及管理。
- (3) 美國資源保育與回收法（RARC）法令回顧及未來展望。
- (4) 廢棄物減量、減積及再利用技術探討。
- (5) 電子產品廢棄物的回收再利用及管理。
- (6) 飛灰及灰渣之管理及再利用—技術、政策及應用。

3、溫室氣體環境管理類論文共計 40 餘篇，主題可概分為 3 類，分別為：

- (1) 溫室氣體對氣候影響及管理管制。
- (2) 溫室氣體盤查及減量（含碳捕捉）技術探討。
- (3) 清潔發展機制效益分析。

（二）論文內容摘譯與心得

因不同子題數十場會議同時發表，與會者僅可選擇參與其中一場，筆者選擇廢棄物及溫室氣體環境管理為主要參與主題。

1、 RCRA: The Past Quarter Century and the Next (addressing the past, present and future challenges of RCRA)

美國聯邦政府於 1976 年公告「資源保育與回收法」(RCRA)將有害廢棄物處理處置納入全國廢棄物處理體系，對美國廢棄物之處理處置產生重大影響；1984 年「有害與固體廢棄物修正案」(Hazardous and Solid Waste Amendments, HSWA)進一步擴大 RCRA 之適用範圍及法規要求；1992 年「聯邦設施遵守法」(Federal Facilities Compliance Act)明示聯邦機關與其所屬設施同受 RCRA 規範；1996 年「掩埋處置計畫彈性法」(Land Disposal Program Flexibility Act)對掩埋處置限制以及非有害掩埋場址地下水監測等規定略作放寬等。目前所稱之 RCRA，實際上是包含以上所有法律所構成。

RCRA 法律架構，包含總則、固體廢棄物管理公權力、有害廢棄物管理、州或區域固體廢棄物計畫、商務部長對資源與回收之責任、聯邦責任、附則、研究/發展/示範與資訊、地下貯存槽的規範及醫療廢棄物追蹤案之示範等 10 章節，其立法目的有二：(1)保護人民健康與環境；(2)減少廢棄物產生並保育自然資源。所採取之作法有三：

- (1) 將涉資源回收行為之物質自固體廢棄物定義中排除，使其不受規範。
- (2) 依有害廢棄物種類及資源回收行為，設定寬嚴不同之規範。
- (3) 另定授權法規以規範特定有害廢棄物之資源回收行為。

美國立法邏輯是於法律規定之上游端，亦即於定義部分，先訂出分類

架構，不同廢棄物分別適用不同之行政管制，再於此分類架構中，展開有利於資源回收再利用之微調，亦即在不威脅國民健康與環境情形下，依據資源回收物質性質及回收行為類別之不同，施以完全脫離規範或適度放寬規範之調整。近年來，則有另定授權法規以規範特定有害廢棄物資源回收行為之發展。美國採此立法邏輯之優點是思考方式簡單明確，然而困難處是，對於何者屬固體廢棄物，何者屬有害廢棄物之定義，必須巨細靡遺明訂，不可闕漏，當然，該等定義相對亦難脫繁瑣複雜之缺點。如能了解RCRA及相關授權法規之定義梗概，實際上已掌握該法律泰半規範內容了。



會場照片--- RCRA 會議會場

2、Challenges in Managing Used Electronic Waste

20世紀末，隨著IT產業的迅速發展、電子產品品種的增加、產品使用年限的縮短，電子廢棄物的種類越來越多，數量也越來越大，電子產品回收再生處理，將會是快速成長的一個領域。電子廢棄物處理的方法主要有典型的掩埋或焚燒，但焚燒卻會產生戴奧辛或夫南（Furan）等有毒物質，而掩埋的鉛、砷等有毒金屬則會滲出形成地下水受污染的原因。鑒於電子垃圾對環境所造成的越來越大的危害，各國政府陸續訂定電子廢棄物相關法規。

（1）美國加州的立法機構 2004 年通過了一項在美國首開先河的提案，要求顧客在購買新的電腦或電視機時，交納每件 10 美元的“電子廢棄物回收

費”，旨在為環保提供額外資金。環保組織和地方政府希望，這筆費用能用來幫助安全處理居民家中的電子廢棄物。

(2) 歐盟則做了“擴展的生產者責任”的嘗試。起草制定相關法律保證製造商對電腦的整個生命週期負責，並要求他們將回收電腦及配件的費用加到產品成本中。同時，製造商必須同意不添加任何有毒原料。從 2003 年 8 月 13 日起，每一件對歐盟退場門的電子電氣產品，都會被額外徵收一筆 10～22 歐元的費用，用來處理報廢的電子設備。歐盟對電子廢棄物的處理已經做出有關規定，要求有毒垃圾必須與普通垃圾分放，並要求所有成員國自 2005 年開始，人均至少分檢出 4 公斤電子廢棄物。這個數量不大，因為在許多家庭的地下室或閣樓上還有大量的電子廢棄物。歐盟還表示，消費者有義務將廢舊電器送往專門的電子廢棄物收集處。當然，將來的電子廢棄物將不再實行免費收集。

(3) 日本，2000 年頒布的《家用電器再生利用法》規定製造商和進口商負責自己生產和進口產品的回收和處理。

(4) 瑞典的法律規定處理費用由製造商和政府承擔。而法國更強調全社會共同盡責，規定每人每年要回收 4 公斤電子廢棄物。

(5) 德國根據歐盟指令著手制定本國的廢舊家電回收利用法。德國希望透過相關法律法規，進一步明確製造商對其設計、製造和銷售的家用電器和電子產品有義務進行收集、再使用和處置等，促使製造商開發綠色家電，即從電器的原材料選擇和產品設計開始，就為將來的使用和廢棄考慮，形成資源—產品—再生資源的良性循環，從根本上解決環境與發展的矛盾。

美國政府部門已積極訂定相關法令，相關環保組織亦投入相當人力進行宣傳教育活動，研究機構也深入參與科技研發，電子廢棄物資源化產業的發展自然離不開法律與政策的支持，雖然美國各個州頒佈實施的法律或管理辦法不盡相同，但是有 2 個中心內容基本是一致的，即為禁止焚燒電

子廢棄物與禁止把電子廢棄物作為普通生活垃圾掩埋。然電子廢棄物回收產業的興起與發展光靠企業是不夠的，必須全社會聯動，參與機構包括：

(1) 政府機構

美國 EPA 就電子廢棄物的回收利用提出了建議並發起了電子產品回收和資源化行動，國防部、能源部、郵政總局等部門建立並資助了一些研究項目和示範項目，所有這些為產業發展提供了法律和資金支持。部分州開始制定專項法律法規，在這種情勢下，電子廢棄物回收處理專業化公司開始出現，電子廢棄物資源化產業在美國進入了快速發展時期，該產業不僅創造巨額經濟效益和環境效益，也創造了許多新的就業機會。目前，電子廢棄物資源化產業在美國已經初具規模。

(2) 行業組織

國際電子廢棄物回收商協會（IAER）、電子工業聯盟（EIA）、全國回收商聯盟（NRC）等行業組織為電子廢棄物產業的發展做出了積極貢獻。他們舉辦“電子產品資源化高級會議”和“電子產品與環境國際研討會”等，為企業解決技術與發展問題。

(3) 研究機構

馬塞諸塞大學、杜克大學等研究單位就電子廢棄物的立法管理、收集方法、處理技術進行了大量研究，為人們深入了解和認識電子廢棄物提供了大量的信息，並且為電子廢棄物的產業化發展提供技術支持。

(4) 民間組織

矽谷毒性物質聯盟、巴塞爾行動網絡、綠色和平組織做了大量調查和宣傳教育活動。這些組織在促進公眾環境意識的提升，加快政府部門積極立法。

3、Conducting a Baseline GHG Inventory: Methodologies and Lessons Learned

自從工業革命以來，人類的經濟活動大量使用化石燃料，已造成大氣中二氧化碳等溫室氣體的濃度急速增加，產生愈來愈明顯的全球增溫、海平面

上升及全球氣候變遷加劇的現象，對水資源、農作物、自然生態系統及人類健康等各層面造成日益明顯的負面衝擊。為了抑制人為溫室氣體的排放，防制氣候變遷，聯合國於1992年地球高峰會舉辦之時，通過「聯合國氣候變化綱要公約 (United Nations Framework Convention on Climate Change, UNFCCC)」，對「人為溫室氣體」(Anthropogenic Greenhouse Gas)排放做出全球性管制的宣示。

對於溫室氣體排放必須透過建立GHG管理計畫，以盤查與驗證等程序，清查排放量後加以管制，溫室氣體盤查量化步驟主要依據WBCSD聯合各相關產業公會共同開發之溫室氣體盤查議定書(GHG Protocol)，以及甫於2006年7月所公告之ISO 14064-1標準內容，量化步驟如下：

(1) 步驟一：設定組織與營運邊界

營運邊界主要用於歸類各溫室氣體排放源，一般可依活動/設施之種類區分為三個範疇(詳表一)。範疇1係指直接溫室氣體排放，可再細分為能源、製程、運輸與逸散等4類型，其中運輸部分係指公司擁有控制權之運輸工具，如為租賃車輛則應歸類於範疇3類別；範疇2為能源間接溫室氣體排放，主要來自外購之電力、熱、蒸汽或其他化石燃料衍生能源產生之溫室氣體排放；範疇3則為其他間接溫室氣體排放，包括外包製造、員工通勤、委外運輸、廢棄物處理處置等項目。由於範疇3之控制權大多非屬公司所有，故通常僅定性描述溫室氣體排放情形，較難取得定量數據。

Table 1. Corning GHG Emission Source Categories

Source Category	GHGs	Description
Direct Stationary Combustion Emissions	CO ₂ , CH ₄ , N ₂ O	Fuel burning from combustion of fuels (natural gas, propane, diesel fuel, etc.)
Direct Mobile Combustion Emissions	CO ₂ , CH ₄ , N ₂ O	Fossil fuel burned from the operation of vehicles (and airplanes) owned or leased by Corning.
Direct Process Emissions	CO ₂	CO ₂ emissions from use of carbonate materials in Corning manufacturing processes
Direct Fugitive Emissions	HFCs and SF ₆	Hydrofluorocarbon (HFC) usage in refrigeration/cooling systems and process-related sulfur hexafluoride (SF ₆) usage
Indirect Purchased Electricity	CO ₂ , CH ₄ , N ₂ O	Electricity purchased for use by Corning facilities (including both buildings owned and leased by Corning)

(2) 步驟二：排放源鑑別

排放源鑑別工作重點為範疇別、排放源型式（能源、製程、運輸、逸散）與排放氣體總類之判定，各活動/設施之負責單位亦應註明，以便進行資料確認，同時授權負責後續溫室氣體減量工作之推動。由於不同部門可能擁有相同設施（如鍋爐、堆高機、滅火器等），為便於後續資料彙整，於排放源鑑別前先行統一共通設備之名稱。

(3) 步驟三：排放量計算/建立排放清冊與溫室氣體盤查報告書製作

由於各類溫室氣體對全球氣候變遷之影響各不相同，為求統一，乃以二氧化碳為基準，將各溫室氣體排放量乘以其全球暖化潛勢（Global warming Potential, GWP），以轉換成對應之二氧化碳排放當量，經加總後即可獲知該活動/設施所排放之溫室氣體總量，經過清查廠內相關活動或設施，並配合相關計算工具，即可彙整出廠內之溫室氣體總排放量。

(4) 步驟四：內部查證與管理階層審查



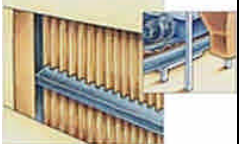





在取得獨立公正之外部第三者團體驗證前，組織可透過內部查證作業，瞭解企業本身溫室氣體盤查方式、數據品質、排放計量方法與文件管理程序之缺失，並進行必要之矯正預防措施。針對內部查證所見缺失應提出矯正與預防措施，並提交管理階層審查，以完成規劃、執行、檢查、改善之環境管理系統管理循環流程，達成持續改善之目的。








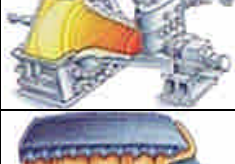


三、參訪行程：（6/29 RiverQuest and ALCOSAN）

本日安排 2 處環境生態與技術兼具之參訪行程，一為搭船導覽當地三河匯流區域之河川生態體系永續發展介紹及參訪位於河川邊之 ALCOSAN 都市污水處理廠，但搭船導覽（RiverQuest）行程因雨取消，直接至當地 Allegheny County Sanitary Authority (ALCOSAN)；Ohio Valley 最大的都市綜合污水處理廠參觀其污水與廢棄物處理作業。

當日參觀重點在其廠區內立體化設施及異味控制設計、處理設施效能。ALCOSAN 下水道系統服務範圍：收集 225 平方英里，90 萬人口，包含匹

茲堡及 Allegheny county 鄰近 82 個鄉鎮。廠內員工 300 人，污水之處理單元經初沈、接觸曝氣池處理有機質，經二級沈澱池後放流。廠區外觀整齊，草皮上可見綠頭野鴨，廠區之污泥脫水機房操作區有設透明隔離罩將人員與異味隔除，此外主要會產生異味設施均立體化加蓋，並設抽氣管將異味抽除以洗滌塔處理。另攔污柵、浮渣去除池產生嚴重異味之攔除浮渣、生物固體物，設置生物固體物混和槽，去除異味，後送廠內焚化爐處理去味、減積掩埋或當土壤改良用，該廠污水處理流程如下：

流程	圖示	流程說明
Interceptor Sewers		日常生活中，家戶使用過之廢水經由下水道系統收集至 Ohio River 河北岸之 ALCOSAN 污水處理廠處理。
Influent Wet Well and Main Influent Wet		進流水流入濕井後由進流抽水站啟動 2 個泵浦抽，每分鐘抽 128,000 gallons 到後續處理單元。
Bar Screens		移除固體物分類進焚化爐或填地。
Grit Chamber		石塊顆粒沈澱後自動化移除
Scum and Grease		移除浮渣及油脂
Primary Sedimentation Clarifier		初沈池移除有機質
Aeration Tanks		生物曝氣池，供養以微生物去除有機質。
Secondary Sedimentation Clarifiers		二級沈澱池

Chlorine Contact Tank		潔淨水加氯消毒後放流
Laboratory		每日測試水質潔淨度，確保品質。
Biosolids Mixing Tanks		設混和槽，去除生物固體物、浮渣等異味。
Dewatering Belt Press		帶濾式脫水機，污泥擠壓脫水至 75%
Air Purification		脫水處理程序空氣抽氣至洗滌塔洗滌過濾去除異味。
Heat Dryer		進一步將生物固體物乾燥減量。
Energy Recovery Facility		乾燥之固體物做為焚化爐燃料。
Generator		氣電共生，供廠內使用。
Post-Lime Treatment		致病菌去除
Alcsoil		生物固體物再使用做為土壤改良劑。

圖一、ALCOSAN 污水廠處理流程



污水廠大門



到處可見綠頭鴨



攔污柵



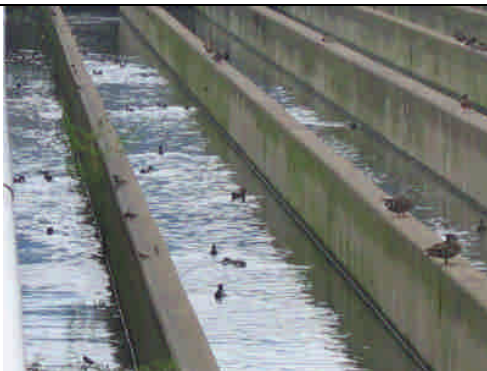
初沉池



活性污泥池



污泥離心脫水機



放流池



承受水體-RiverQuest

參訪照片---ALCOSAN污水廠

肆、心得及建議

面對全球化時代的來臨，世界潮流變化是遠超乎我們想像的，全球化後 WTO、APEC 經濟貿易、文化、環保各項議題，無一不深深衝擊地球村的每一份子。在「地球是平的」這本全球暢銷書中，作者 Thomas L. Friedman 將全球化劃分為三個階段。第 1 階段由 1492 年哥倫布發現"新大陸"開始自 1800 年，推動全球化進程的動力是勞動力，這期間世界從"大"變為"中等"。第 2 階段由 1800 年一直到 2000 年，工業革命各種發明和革新成為這次全球化的主要動力，世界從"中等"變"小"，而第 3 階段個人成為了主角，透過網路的串聯、傳播，膚色或文化差異不再是合作或競爭的障礙，因網路的普及，正在抹平一切疆界，世界變平了，從小縮成了微小。而彼得·杜拉克亦在其著作《下一個社會》中預言：「下一個社會是個競爭激烈的知識型社會，知識就是一切，知識工作者會成為主要的勞動力」。更顯示不論是個人、企業、組織、國家，面臨未來挑戰的要素在於"人材"，要有具備競爭力的知識工作者，國家才有競爭力，才有未來。

所謂「讀萬卷書，不如行萬里路」這句諺語其實是強調親身經歷用心體驗的重要，方能培養通透智慧。本次參與國際研討會，也印證了真是需要走出家門，才能體會世界的開闊，一場又一場各式議題，不同國家的經驗、現場互動與體驗更能加深思考深度，也自我期許努力提升個人專業知識與語文能力，進一步開闊視野、培養國際觀，能為國家社會有所貢獻。

參與此次會議國家包含亞洲、歐洲、澳洲及美洲等先進國家及開發中國家，所遇到環保問題雖不相同，但畢竟是地球村，各國所遭遇問題皆會相互影響，如氣候變遷、能資源耗用、環境污染等，此次年會研討議題即圍繞於探討以法令規定及技術方式解決目前全球所面臨各項危機。

台灣是世界上電腦的生產重地，電子產業的競爭力於國際間亦名列前茅，並為台灣主要的經濟來源，然而基於國際趨勢國內企業必須從產品設

計至生產過程皆對環境友善化，如此才能具有商機及永續發展之潛力，電子產業已非以價格及品質取勝，企業形象與其環境績效的重要性絕不亞於產品的品質或價格。因此，台灣電子產業應必須掌握市場面需求、加強內部管理改善、和放大經營遠景，才可促使企業因應國際間新的環保法令，提高國際市場競爭力，而政府部門則須在法令制定、資金融助、資訊交流及人才培育等方面更積極協助企業，如能以政府、人民、企業、環境四贏為目標，將會在環境永續發展下創造更多的綠色商機。

一、參展名單

Exhibitor Product Categories

Air Pollution Mobile Source Technologies:

Bio-Reaction Industries	Booth 721
Campbell Scientific, Inc.	Booth 213
Dekoron / Unitherm	Booth 429
Desert Research Institute	Booth 623
EKTO Manufacturing Corporation	Booth 517
Thermo Fisher Scientific	Booth 400
Wasson - ECE Instrumentation	Booth 216

Analytical/Laboratory Equipment:

Baseline - MOCON, Inc.	Booth 824
Centek Laboratories, LLC	Booth 422
EKTO Manufacturing Corporation	Booth 517
Envionics, Inc.	Booth 816
FLIR Systems	Booth 912
J.U.M. Engineering	Booth 117
Maxxam Analytics, Inc.	Booth 926
New Age Landmark, Inc.	Booth 729
Pollution Equipment News	Booth 121
Thermo Fisher Scientific	Booth 400
VOC Technologies	Booth 220
Wasson - ECE Instrumentation	Booth 216

Computer Hardware:

BEE-Line Software	Booth 305
EMC	Booth 423
Enwitch/DR DAS	Booth 723
TechniData America	Booth 928

Computer Software:

Chemical Material Tracking:	
EnvironMax, Inc.	Booth 627

Database:

Geotech Computer Systems, Inc.	Booth 106
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EH&S Software:

Perillon Software	Booth 310
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Environmental Compliance:

EnvironMax, Inc.	Booth 627
Nexus Solutions, Inc.	Booth 726

Hazardous Waste Tracking:

EnvironMax, Inc.	Booth 627
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MSDS Management:

EnvironMax, Inc.	Booth 627
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Consultants:

Air Management:	
AeroMet Engineering, Inc.	Booth 730
Air Quality Services, LLC	Booth 425
Air/Compliance Consultants, Inc.	Booth 325
AMEC Earth & Environmental, Inc.	Booth 321
ARCADIS U.S., Inc.	Booth 416
Barr Engineering Co.	Booth 810
BEE-Line Software	Booth 305
CH2M Hill	Booth 411
Civil & Environmental Consultants Inc. (CEC)	Booth 722
Earth Tech, Inc.	Booth 907
EMC	Booth 423
Environmental Chemistry Services, Inc.	Booth 917
Environmental Quality Management, Inc. (EQ)	Booth 713
ERM	Booth 306

ESS	Booth 210
GAI Consultants, Inc.	Booth 323
Golder Associates	Booth 528
Leak Surveys, Inc.	Booth 204
METCO Environmental	Booth 401
Michael Baker Jr., Inc.	Booth 930
N.A. Water Systems	Booth 113
RPT Environmental Associates, Inc.	Booth 417
Spectrum Environmental Sciences Inc.	Booth 618
TRC Environmental Corp.	Booth 801
Trinity Consultants	Booth 610
TVA Resource Management	Booth 717
URS Austin General Engineering	Booth 511
Weavertown Environmental Group	Booth 923
Weston Solutions, Inc.	Booth 525

Architecture & Engineering:

ARCADIS U.S., Inc.	Booth 416
Barr Engineering Co.	Booth 810
Civil & Environmental Consultants Inc. (CEC)	Booth 722
CPP, Inc.	Booth 223

Environmental Consulting:

AeroMet Engineering, Inc.	Booth 730
Air/Compliance Consultants, Inc.	Booth 325
AMEC Earth & Environmental, Inc.	Booth 321
ARCADIS U.S., Inc.	Booth 416
Barr Engineering Co.	Booth 810
BEE-Line Software	Booth 305
CH2M Hill	Booth 411
Civil & Environmental Consultants, Inc. (CEC)	Booth 722
CleanAir Engineering, Inc.	Booth 616
Compliance Assurance Associates, Inc.	Booth 828
CPP, Inc.	Booth 223
Earth Tech, Inc.	Booth 907
EM-Assist, Inc.	Booth 805
Enthalpy Analytical, Inc.	Booth 114
EnvironMax, Inc.	Booth 627
Environmental Quality Management, Inc.	Booth 713
ERM	Booth 306
ESS	Booth 210
GAI Consultants, Inc.	Booth 323
GE Energy	Booth 910
Golder Associates	Booth 528
hydroGEOPHYSICS	Booth 211
Lakes Environmental Software	Booth 420
Leak Surveys, Inc.	Booth 204
Locus Technologies	Booth 105
METCO Environmental	Booth 401
Michael Baker Jr., Inc.	Booth 930
N.A. Water Systems	Booth 113
QMI	Booth 900
RPT Environmental Associates, Inc.	Booth 417
SIR	Booth 626
Spectrum Environmental Sciences, Inc.	Booth 618
TRC Environmental Corp.	Booth 801
Trinity Consultants	Booth 610
URS Austin General Engineering	Booth 511
Weston Solutions, Inc.	Booth 525
WHTC Foundation-Environmental Technologies Program	Booth 806

Environmental Engineering:

AeroMet Engineering, Inc.	Booth 730
Air/Compliance Consultants, Inc.	Booth 325
AMEC Earth & Environmental, Inc.	Booth 321
ARCADIS U.S., Inc.	Booth 416
Barr Engineering Co.	Booth 810

CH2M Hill	Booth
Desert Research Institute	Booth
Durr Systems, Inc.	Booth
Earth Tech, Inc.	Booth
EM-Assist, Inc.	Booth
Environmental Quality Management, Inc. (EQ)	Booth
GAI Consultants, Inc.	Booth
Golder Associates	Booth
Kurtner North America	Booth
Locus Technologies	Booth
Michael Baker Jr., Inc.	Booth
N.A. Water Systems	Booth
SIR	Booth
TRC Environmental Corp.	Booth
Trinity Consultants	Booth
TVA Resource Management	Booth
URS Austin General Engineering	Booth

General Consulting:

Barr Engineering Co.	Booth
Compliance Assurance Associates, Inc.	Booth
Environmental Chemistry Services, Inc.	Booth
Spectrum Environmental Sciences, Inc.	Booth

Laboratory & Industrial Hygiene Services:

Air Toxics, Ltd.	Booth
Air/Compliance Consultants, Inc.	Booth
CPP, Inc.	Booth
Desert Research Institute	Booth
Enthalpy Analytical, Inc.	Booth
Environmental Chemistry Services, Inc.	Booth
GAI Consultants, Inc.	Booth
Maxxam Analytics, Inc.	Booth
Michael Baker Jr., Inc.	Booth
New Age Landmark, Inc.	Booth
Vista Analytical Laboratory	Booth

Surface Water & Groundwater:

AeroMet Engineering, Inc.	Booth 730
AMEC Earth & Environmental, Inc.	Booth 321
ARCADIS U.S., Inc.	Booth 416
Barr Engineering Co.	Booth 810
CH2M Hill	Booth 411
Civil & Environmental Consultants, Inc. (CEC)	Booth 722
Earth Tech, Inc.	Booth 907
Environmental Chemistry Services, Inc.	Booth 917
Environmental Quality Management, Inc. (EQ)	Booth 713
ERM	Booth 306
Geotech Computer Systems, Inc.	Booth 106
Golder Associates	Booth 528
hydroGEOPHYSICS	Booth 211
Michael Baker Jr., Inc.	Booth 930
TRC Environmental Corp.	Booth 801
URS Austin General Engineering	Booth 511
Weston Solutions, Inc.	Booth 525

Training & Education:

AeroMet Engineering, Inc.	Booth 730
BEE-Line Software	Booth 305
Compliance Assurance Associates, Inc.	Booth 828
EM-Assist, Inc.	Booth 805
ESS	Booth 210
Lakes Environmental Software	Booth 420
RPT Environmental Associates, Inc.	Booth 417

Exhibitor Product Categories (cont.)

Environmental
 Solutions, Inc. Booth 678
 Consultants Booth 679
 City of Denver Booth 427

Management

Earth & Environmental, Inc. Booth 321
 Engineering Co. Booth 816
 HSI Booth 411

Environmental

Consultants, Inc. (ECC) Booth 722
 Tech, Inc. Booth 607
 esult, Inc. Booth 808
 enMax, Inc. Booth 627

Environmental Quality

Management, Inc. Booth 713
 Booth 210
 Consultants, Inc. Booth 283
 Associates Booth 630
 State America Booth 688
 Environmental Corp. Booth 681
 Consultants Booth 670
 North General Engineering Booth 611
 Newtown Environmental Group Booth 625
 Solutions, Inc. Booth 626

Control Equipment

Activated Carbon

Carbon Corp. Booth 708
 North America Booth 728
 Airtech Booth 900
 Monitor Air Pollution
 Control, Inc. Booth 701

Accessories & Controls

North America Booth 728
 Pul Booth 527
 ECE Instrumentation Booth 216

Filter Systems

Monitor/DMM Corp. Booth 687
 Research Booth 683

Tag Systems & Accessories

North America Booth 728
 H-Jet, Inc. Booth 681
 ECE Instrumentation Booth 216

Wet/Dry Precipitators

Systems, Inc. Booth 611
 INGY Booth 610
 Technologies, LLC Booth 621
 AirClean, LLC Booth 611
 Tech, Inc. Booth 616
 Monitor Air Pollution
 Control, Inc. Booth 701

Filters

North America Booth 728
 AirClean, LLC Booth 611
 HJ Booth 627
 Monitor Air Pollution
 Control, Inc. Booth 701

Gas Suppliers

Process Combustion Corp. Booth 620

Monitors

Monitor/DMM Corp. Booth 687
 Research Booth 683

Inc. Booth 109
 407 Booth 670
 & Co. USA, Inc. Booth 622

Tech, Inc. Booth 624
 Thermo Fisher Scientific Booth 430
 TurboSonic, Inc. Booth 619
 Turner Environmental Booth 602
 Universal Analyzers, Inc. Booth 615
 Wheelabrator Air Pollution
 Control, Inc. Booth 701

Odor Control

BioSorb - MOCOP, Inc. Booth 624
 Bio-Reaction Industries Booth 721
 Chronostat Group Booth 623
 L&E America/DMM Corp. Booth 627
 Turner Environmental Booth 602

Other Absorption or Absorption Systems

PCE Research Booth 608
 Watson - ECE Instrumentation Booth 216

Other Equipment & Accessories

FLIR Systems Booth 672
 Indigo Technologies LLC Booth 621
 Sprays-Jet, Inc. Booth 681
 TurboSonic, Inc. Booth 619

RTD

Dan Systems, Inc. Booth 611
 L&E America/DMM Corp. Booth 627
 Model AirClean, LLC Booth 611
 Turner Environmental Booth 602

Scrubbers, Towers & Gas Cleanups

Atech Technology Systems, Inc. Booth 618
 Model AirClean, LLC Booth 611
 TurboSonic, Inc. Booth 619
 Turner Environmental Booth 602
 Wheelabrator Air Pollution
 Control, Inc. Booth 701

WOC Control

Bio-Reaction Industries Booth 721
 Oregon Carbon Corp. Booth 708
 Chronostat Group Booth 623
 Star Systems, Inc. Booth 611
 L&E America/DMM Corp. Booth 627
 Leak Surveys, Inc. Booth 204
 Model AirClean, LLC Booth 611
 Process Combustion Corp. Booth 620
 TurboSonic, Inc. Booth 619

Wastewater

Atech Technology Systems, Inc. Booth 618
 H.A. Meter Systems Booth 113
 Prodat, Inc. Booth 317

Water Treatment

Oregon Carbon Corp. Booth 708
 T&E Resource Management Booth 717

H₂S Treatment

Incinerators
 Bio-Reaction Industries Booth 721
 ORA Booth 606
 Neo-Sun Environmental Biotech
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Exhibitors

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 Geo-Cor Booth 208
 Statish Computer Systems, Inc. Booth 105
 Lucas Technologies Booth 106

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 Pollution Equipment News Booth 121
 TechData America Booth 626

Incineration/Thermal

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 Services, LLC Booth 111
 METCO Environmental Booth 421
 Process Combustion Corp. Booth 620

Pollution Prevention

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 Heritage Environmental
 Services, LLC Booth 111
 Lucas Technologies Booth 106
 TechData America Booth 626

Recycling & Resource Recovery

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 Heritage Environmental
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 Neo-Sun Environmental
 Biotech Co., Ltd. Booth 107

Refrigerators

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 EPA Booth 306
 Geo-Cor Booth 208
 Statish Computer Systems, Inc. Booth 106
 Lucas Technologies Booth 106
 Sprays-Jet, Inc. Booth 681
 Newtown Environmental Group Booth 625

Site Cleanup Services

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 Heritage Environmental
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 Lucas Technologies Booth 106

Soils

Geo-Cor Booth 208
 Lucas Technologies Booth 106

Source Reduction/Process Modification

Geo-Cor Booth 208

Underground Storage Tanks

Lucas Technologies Booth 106

Other

Bio-Reaction Industries Booth 721

Incinerators

Accessories & Controls
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 PCE Research Booth 608
 Process Combustion Corp. Booth 620

Flameless Thermal Oxidizer

PCE Research Booth 608

General Supplies

Air Techs, Ltd. Booth 612
 PCE Research Booth 608
 Process Combustion Corp. Booth 620



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Air:	
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Air Toxics, Ltd.	Booth 672
Bioscience - MDCOH, Inc.	Booth 624
Casnak Laboratories LLC	Booth 422
Chromatotec Group	Booth 625
Climetrics Corporation	Booth 599
EcoTech	Booth 626
EMC	Booth 423
Lukas Environmental Software	Booth 430
Met One Instruments, Inc.	Booth 670
Ogawa & Co., USA, Inc.	Booth 622
Opis, Inc.	Booth 617
Photovac, Inc.	Booth 134
Pollution Equipment News	Booth 121
Sable Instruments, Inc.	Booth 227
SIR	Booth 625
TechData America	Booth 625
Teledyne Monitor Labs, Inc.	Booth 621
Thermo Fisher Scientific	Booth 430
Tech Environmental, Inc.	Booth 621
Universal Analyzers, Inc.	Booth 616
Watson - ECE Instrumentation	Booth 216

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Air Toxics, Ltd.	Booth 672
Almetrix	Booth 612
Bioscience - MDCOH, Inc.	Booth 624
Campbell Scientific, Inc.	Booth 213
Casnak Laboratories LLC	Booth 422
Deconan / Unitherm	Booth 429
Enthropy Analytical, Inc.	Booth 114
EnviroNet, Inc.	Booth 616
FLIR Systems	Booth 612
J.E.M. Engineering	Booth 117
Microm Analytica, Inc.	Booth 625
METCO Environmental	Booth 431
Photovac, Inc.	Booth 134
VOC Technologies	Booth 220
Watson - ECE Instrumentation	Booth 216

Automotive Exhaust:

VOC Technologies	Booth 220
Watson - ECE Instrumentation	Booth 216

Calibration Equipment:

Alphas, Inc.	Booth 139
SGI Instruments	Booth 628
EuroTech	Booth 625
Electronics, Inc.	Booth 616
Opis, Inc.	Booth 617
Sable Instruments, Inc.	Booth 227
SIR	Booth 625
VOI Metrotronics, Inc.	Booth 212
Watson - ECE Instrumentation	Booth 216

Calibration Standards:

Alphas, Inc.	Booth 139
Proxit, Inc.	Booth 217
SPECTRA Gases, Inc.	Booth 213
VOI Metrotronics, Inc.	Booth 212
Watson - ECE Instrumentation	Booth 216

CEM:

Air Quality Analytical, Inc.	Booth 622
AMETEK Process Instruments	Booth 605
Airstead Technology Rentals	Booth 224
California Analytical Instruments	Booth 622
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EuroTech	Booth 625
EMC	Booth 423
Electronics, Inc.	Booth 616
Enviro Solutions, Inc.	Booth 726
Opis, Inc.	Booth 617

Proxit, Inc.	Booth 217
Pollution Equipment News	Booth 121
SICK Melsick, Inc.	Booth 328
Spectra Gases, Inc.	Booth 213
Teledyne Monitor Labs, Inc.	Booth 621
Thermo Fisher Scientific	Booth 430
TVA Resource Management	Booth 717
Universal Analyzers, Inc.	Booth 616

CE:

Almetrix	Booth 612
California Analytical Instruments	Booth 622
EcoTech	Booth 626
Sable Instruments, Inc.	Booth 227
Tests, Inc.	Booth 624
Thermo Fisher Scientific	Booth 430
Watson - ECE Instrumentation	Booth 216

CE:

AMETEK Process Instruments	Booth 605
California Analytical Instruments	Booth 622
EcoTech	Booth 626
SICK Melsick, Inc.	Booth 328
Teledyne Monitor Labs, Inc.	Booth 621
Tests, Inc.	Booth 624
Thermo Fisher Scientific	Booth 430
Watson - ECE Instrumentation	Booth 216

Combustion Gases:

Alphas, Inc.	Booth 139
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Airstead Technology Rentals	Booth 224
ClearAir Engineering, Inc.	Booth 616
Tests, Inc.	Booth 624
VOC Technologies	Booth 220
Watson - ECE Instrumentation	Booth 216

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Flow/Velocity:

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Watson - ECE Instrumentation	Booth 216

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Chromatotec Group	Booth 625
EcoTech	Booth 626
Sable Instruments, Inc.	Booth 227

Mercury:

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Alphas, Inc.	Booth 139
ClearAir Engineering, Inc.	Booth 616
Deconan / Unitherm	Booth 429
Milennium Instruments, Inc.	Booth 629
SICK Melsick, Inc.	Booth 328
Spectra Gases, Inc.	Booth 213
Thermo Fisher Scientific	Booth 430
TVA Resource Management	Booth 717
Universal Analyzers, Inc.	Booth 616
VOC Metrotronics, Inc.	Booth 612

Meteorological:

Atmospheric Systems Corp.	Booth
Campbell Scientific, Inc.	Booth
Climetrics Corporation	Booth
EMC	Booth
Linker Environmental Software	Booth
Met One Instruments, Inc.	Booth
R.M. Young Company	Booth
SIR	Booth

Meters & Recorders:

Campbell Scientific, Inc.	Booth
EnviroNet/DR DAS	Booth

NO_x:

Alphas, Inc.	Booth
California Analytical Instruments	Booth
EcoTech	Booth
Ogawa & Co., USA, Inc.	Booth
Opis, Inc.	Booth
Sable Instruments, Inc.	Booth
SICK Melsick, Inc.	Booth
Tests, Inc.	Booth
Thermo Fisher Scientific	Booth

O₃:

AMETEK Process Instruments	Booth
California Analytical Instruments	Booth
Proxit, Inc.	Booth
Sable Instruments, Inc.	Booth
Tests, Inc.	Booth

Other Instrument Supplies:

Alphas, Inc.	Booth
Airstead Technology Rentals	Booth
Sable Instruments, Inc.	Booth
Watson - ECE Instrumentation	Booth

Other Sampling Equipment:

Airstead Technology Rentals	Booth
Milennium Instruments, Inc.	Booth
Sable Instruments, Inc.	Booth
Watson - ECE Instrumentation	Booth

Other:

EcoTech	Booth
EnviroNet, Inc.	Booth
Ogawa & Co., USA, Inc.	Booth
Sable Instruments, Inc.	Booth
Thermo Fisher Scientific	Booth

Particulates:

Almetrix	Booth
SGI Instruments	Booth
Climetrics Corporation	Booth
EcoTech	Booth
GE Energy	Booth
Indigo Technologies, LLC	Booth
Met One Instruments, Inc.	Booth
Milennium Instruments, Inc.	Booth
Teledyne Monitor Labs, Inc.	Booth
Thermo Fisher Scientific	Booth
Tech Environmental, Inc.	Booth

Personal Monitors:

Air Quality Analytical, Inc.	Booth
Airstead Technology Rentals	Booth
SGI Instruments	Booth
Casnak Laboratories, LLC	Booth
Ogawa & Co., USA, Inc.	Booth
Thermo Fisher Scientific	Booth
VOI Metrotronics, Inc.	Booth

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 otronics, Inc. Booth 508
 otronics, Inc. Booth 505
 otronics, U.S. Booth 501
 otronics, Inc. Booth 510
 otronics, Inc. Booth 480
 otronics, Inc. Booth 541

O
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 otronics, Inc. Booth 508
 otronics, Inc. Booth 505
 otronics, U.S. Booth 501
 otronics, Inc. Booth 510
 otronics, Inc. Booth 480
 otronics, Inc. Booth 541

Other Accessories (pumps, bags, etc.)
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 otronics, Inc. Booth 515
 otronics, Inc. Booth 218

Other
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 otronics, Inc. Booth 423

O
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 otronics, Inc. Booth 526
 otronics, Inc. Booth 392
 otronics, Inc. Booth 817
 otronics, Inc. Booth 207
 otronics, Inc. Booth 801
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O & Stack Samples
 otronics, Inc. Booth 522
 otronics, Inc. Booth 515
 otronics, Inc. Booth 525
 otronics, Inc. Booth 117
 otronics, Inc. Booth 401
 otronics, Inc. Booth 529
 otronics, Inc. Booth 400
 otronics, Inc. Booth 529

Other
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 otronics, Inc. Booth 218

Other
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 otronics, Inc. Booth 526
 otronics, Inc. Booth 392
 otronics, Inc. Booth 817
 otronics, Inc. Booth 207
 otronics, Inc. Booth 801
 otronics, Inc. Booth 400
 otronics, Inc. Booth 529

Other
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Other
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 otronics, Inc. Booth 218

Materials:
 Activated Carbon:
 otronics, Inc. Booth 708
 otronics, Inc. Booth 218

Chemicals:
 otronics, Inc. Booth 217
 otronics, Inc. Booth 218

Publications:
 otronics, Inc. Booth 412
 otronics, Inc. Booth 902

Databases:
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 otronics, Inc. Booth 800
 otronics, Inc. Booth 518
 otronics, Inc. Booth 115

Environment Control:
 otronics, Inc. Booth 412
 otronics, Inc. Booth 800
 otronics, Inc. Booth 102

Environment:
 otronics, Inc. Booths 127
 otronics, Inc. Booth 115

Health & Safety:
 otronics, Inc. Booth 412
 otronics, Inc. Booth 800
 otronics, Inc. Booth 102

Periodicals:
 otronics, Inc. Booth 115

Publications:
 otronics, Inc. Booth 412
 otronics, Inc. Booth 913
 otronics, Inc. Booth 102
 otronics, Inc. Booth 115
 otronics, Inc. Booth 102

Regulatory Compliance:
 otronics, Inc. Booth 412
 otronics, Inc. Booth 510
 otronics, Inc. Booth 115
 otronics, Inc. Booth 102

Website:
 otronics, Inc. Booth 305
 otronics, Inc. Booth 412

Compliance Assurance:
 otronics, Inc. Booth 600
 otronics, Inc. Booth 700
 otronics, Inc. Booth 210
 otronics, Inc. Booth 910
 otronics, Inc. Booth 102

Services:
 Stack Testing:
 otronics, Inc. Booth 607
 otronics, Inc. Booth 425

Hg Monitoring & Testing:
 otronics, Inc. Booth 607
 otronics, Inc. Booth 425

Ambient Air Monitoring:
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Permitting:
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