

出國報告（出國類別：其他，參加國際會議）

赴瑞典

參加「斯德哥爾摩國際水週」活動

服務機關：經濟部水利署

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目錄

一、目的	1
二、斯德哥爾摩國際水週背景介紹與本屆探討範疇	2
2-1 背景介紹	2
2-2 本屆探討範疇	5
2-3 行程及參與場次	9
三、重點議題與心得	11
3-1 循環經濟(Circular Economy)	11
3-2 再生水運用於農業灌溉	14
3-3 再生水使用案例	16
四、心得與建議	22
五、參考文獻	25
附錄一、水週場地、活動照片	26
附錄二 水週完整議程	39

一、 目的

瑞典斯德哥爾摩水週(World Water Week in Stockholm)自1991年起每年舉辦，為現存歷史最悠久之水週活動。每年該水週會配合聯合國政策及全球關注焦點，擬訂主題，讓世界各國的組織及關心該主題之利害關係人，發表跟此主題相關的研究成果，並且結合專題研討、展覽以及會議的周邊活動，帮助大家更深入的探討這些議題，並彙整共識與結論。本(2017)年度主題為 Water and Waste: Reduce and Reuse.

近年來受到氣候變遷衝擊，我國水利單位穩定供水挑戰度越來越高。面對此挑戰，水利署提出水源多元化政策，以分散分險。其中再生水來源生活污水、工業廢水水量穩定，為多元化水資源之重要策略。我國再生水政策目標為於民國 120 年使用量達每日 120 萬噸(佔公共用水量 10%)，主要供工業使用，輔以生活次級與環境景觀使用。然本署推動過程中遭遇許多困難，如成本高於自來水水價使用端誘因不足、輸水管線長土地取得困難、廠商使用意願低媒合困難、生活污水廠處理升級用地取得困難等。

為了解各國水回收再利用之推動現況，借鏡其經驗，並知曉世界趨勢、聯合國推動方向，以協助國內廠商開發商機，爰參與該活動。

二、 斯德哥爾摩國際水週背景介紹與本屆探討範疇

2-1 背景介紹

目前國際上歷時較久之水週活動計有瑞典斯德哥爾摩水週、阿姆斯特丹水週及新加坡水週(比較表如下表 1)。其中，瑞典斯德哥爾摩世界水週活動(World Water Week in Stockholm) 是由斯德哥爾摩國際水資源研究中心(Stockholm International Water Institute, 簡稱 SIWI)舉辦的活動。本水週前身為自 1991 年開始每年舉辦之 Stockholm Water Symposium，2001 年起正式改名為 World Water Week in Stockholm，每年 8、9 月舉辦，提供學術界、商界、政府、聯合國下設組織及民間組織意見溝通及經驗交流平台。

表 1 國際水週活動比較

活動名稱	阿姆斯特丹國際水週 Amsterdam International Water Week (AIWW)	新加坡國際水週 Singapore International Water Week (SIWW)	斯德哥爾摩 國際水資源週 World Water Week in Stockholm (WWW)	
舉辦週期/起始年	每 2 年/ 2011 開始	每 2 年/ 2008 開始	每年/ 2001 開始 (2001 前稱為斯德哥爾摩水務座談會 Stockholm Water Symposium)	
參與人數	超過 19,000 人, 2015 (含 AquaTech 水展)	超過 21,000 人, 2016	超過 3,200 人, 2016	
主辦單位	荷蘭水務聯盟 (Netherlands Water Partnership, NWP) 等單位	新加坡環境與水源部等單位	斯德哥爾摩國際水研究院 (Stockholm International Water Institute, SIWI)	
活動內容	專業研討會	<ul style="list-style-type: none"> ● AIWW 研討會 ● 領導人會議 	<ul style="list-style-type: none"> ● 水務領袖峰會 ● 水務研討會議 ● 工業水處理解決方案論壇 	<ul style="list-style-type: none"> ● 主題研討會 ● 全體會議
	展覽	● 阿姆斯特丹水科技展	● 水博覽會	● 周邊展覽
	青年活動	● 青年學者交流	● 水務青年領袖會議	● 青年紀錄員
	水獎	● Sarphati 公共衛生獎	● 李光耀水獎	<ul style="list-style-type: none"> ● 斯德哥爾摩水獎 ● 斯德哥爾摩青年水獎
	現地導覽	● 現地導覽	● 現地導覽	● 導覽及參觀
	其他	<ul style="list-style-type: none"> ● 社交活動 ● 相關週邊活動 	● 水商務論壇	● 社交活動

每年世界水週會配合世界趨勢、聯合國政策訂出一個特定的主題，讓世界各國的組織能夠圍繞著這個主題，發表跟這個議題相關的研究成果，並且結合專題研討、展覽以及會議的周邊活動，帮助大家更深入的探討這些議題。近 10 年主題如下：

- 2008, Progress and Prospects on Water: For a Clean and Healthy World.
- 2009, Responding to Global Changes: Accessing Water for the Common Good with Special Focus on Transboundary Waters.
- 2010, Responding to Global Changes: the Water Quality Challenge—Prevention, Wise Use and Abatement.
- 2011, Responding to Global Changes: Water in an Urbanising World.
- 2012, Water and Food Security.
- 2013, Water Cooperation—Building Partnerships
- 2014, Energy and Water
- 2015, Water for Development
- 2016, Water for Sustainable Growth
- 2017(本年度), Water and Waste: Reduce and Reuse
- 2018(下年度，大會已公布), Water, Ecosystems and Human Development

整個水週的活動，非常多元，包括專題研討會、周邊活動、社交活動、展覽等等。

2-2 本屆探討範疇

本次水週主題為 **Water and Waste: Reduce and Reuse**，聚焦在達成永續發展指標(Sustainable Development Goals, SDG)SDG 6 目標 3 及 SDG 12 目標 5 之挑戰。

- *SDG6 target 3: “by 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.”*(藉由全球性共同降低污染、消除垃圾、最小化有害物質、減半未處理廢水排放及增加回收與安全的再利用，希望於2030年前讓水質全面提升)
- *SDG 12 target 5: “by 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse”.*(藉由預防、減少、回收及再利用，於2030年前大量降低廢棄物的產生)

2015年巴黎氣候變遷協定(Paris Agreement on climate change)及瑞士 Davos 世界經濟論壇(World Economic Forum)發表的年度全球風險報告(annual Global Risks Reports)中都強調將水及廢棄物視為經濟資產的循環經濟(circular economy)概念是達成此永續目標的重要方法，所以本次為期一周的活動全面性、系統性的探討水及廢水回收再利用這個主題。所謂全面性、系統性包含高、

中、低收入國家、所有與水相關部門(特別是食物與能源部分)、所有利害關係人(公、私、民間社團)、地理面向上、中、下游、從源頭到海洋。整周主題分以下面向探討:

- 水-廢棄物循環(the Water-waste cycle):完整的廢水管理循環，包含從水源到分配、廢水收集、處理、棄置到回收，必須考慮到水、能源、營養源的復原。聚焦在將廢棄物視為可再利用之資源，例如降低化學物質的使用、廢水回收再利用供農業灌溉及家用、營養源萃取再利用、廢水回收過程中產製能源、食物及其他產品的可能性。如何將廢棄物減量同時資源化之解方將從科技、機構合作、商業模式、決策機制等面向去探討。
- 驅動力(the drivers):人口增加、經濟成長、都市化、工業化、氣候變遷、天然災害增強等挑戰都是促使人們重視水-廢棄物循環之重要驅動力。面對這些挑戰需要更創新、進步的廢水處理、產品製造、回收再利用技術，也需要適當的政策及管理方式引導並改變製造流程及消費習慣。
- 水質管理(water quality management):在循環系統性的考量下，水質必須符合用水目的。除了傳統的生物及化學廢水處理外，水質標準必須考量新的污染物，(例如藥物殘留、奈米粒子、新陳代謝產物等)、熱污染、海淡廠廢排等。
- 健康及生物多樣性(Health and Biodiversity):人民健康及接受度是推動水-廢棄物循環理念很重要的面向。廢棄物污染不只影響人類，也影響到各陸地、海洋、水域生物，所以

生態系統及生物多樣性也必須納入考量。

- 都市面向(Urban dimension):城市規模從小城鎮到超大城市都將納入探討，特別針對都市規模及人口的動態成長、都市暴雨及水回收再利用的廢污水管理。並連結到空間規劃及機構間的合作、水-廢水-能源的網絡。
- 工業面向(Industry dimension):在全球水市場中，製造業用水成長最迅速。當很多產業不當的管理用水及廢棄物時，已經有些典範廠商以循環經濟的概念在製造鏈中有非常先進的做法，有些已經展現出 0 耗水、0 污染的回收再利用能力。
- 政策面向(Policy perspectives):水及廢水管理部門應該全面檢視包括污染物降低、更乾淨的生產、處理、再生流程、社經誘因等可加速廢污水永續經營管理之政策。另外值得討論的政策面向為將廢污水於農業之應用從小型、非正式提升到大型、正式的企業型態，包括私人投資、用水安全等。
- 經濟、財務面向(Economic and Financial perspectives):水安全的經濟可行性與明智的水資源及廢水管理息息相關。其中經濟誘因、有創意的投資模式、將廢污水轉換成財富的綠化行動都是永續廢污水管理的重要關鍵。
- 社會、機構及政府治理面向(Societal, Institutional and Governance perspectives):政策、法規、治理機制的發展及執行是推動良好水資源及廢水管理的基礎。在急速變遷的現

代世界，將風險納入政府治理機制是必須的。讓所有利害關係人參與，包含當地社群、不同性別、年輕人的參與，及社會、宗教對再生水使用的接受度等均需特別關注。

2-3 行程及參與場次

本次瑞典斯德哥爾摩水週活動時間為 106 年 8 月 27 日至 9 月 1 日，共計 6 日，228 場次(本屆完整議程詳附錄 2)。本人行程及參與場次如下：

表 2 參與行程及場次

日期	行程/參與場次
8/26(六)	啟程 桃園→荷蘭阿姆斯特丹→瑞典斯德哥爾摩
8/27(日)	1. Balancing competing interests and opportunities for better wastewater governance 2. Water in the circular economy: opportunities and challenges-I 3. Water in the circular economy: opportunities and challenges-II 4. Under the bridges of Stockholm- city tour
8/28(一)	1. Opening Plenary 2. Toward women – inclusive waer governance 3. Regligious jurisprunence related to reuse of water
8/29(二)	1. Harnessing opportunities for the safe reuse of wastewater in agriculture-I 2. Harnessing opportunities for the safe reuse of wastewater in agriculture-II 3. Harnessing opportunities for the safe reuse of wastewater in agriculture-III (excursion in the Sodertalje Municipality)

8/30(三)	<ol style="list-style-type: none"> 1. Eye on LAC (Latin America and the Caribbean)- Circular Economy in the Industry sector 2. Clean and Circular: the Future of Made in China Fashion 3. Circular Economy Cities: Transforming China and India's Urban Wastewater
8/31(四)	<ol style="list-style-type: none"> 1. Financing wastewater treatment and resource recovery 2. SIWISofa: Why should I change my water behavior? 3. The value of water: Aligning Perception with Reality 4. Designing for freshwater resilienc
9/1(五)	<ol style="list-style-type: none"> 1. Closing Plenary 2.Field visit- Ericsson ICT studio
9/2(六)-9/3(日)	<p>回程 瑞典斯德哥爾摩→荷蘭阿姆斯特丹→桃園</p>

三、 重點議題與心得

3-1 循環經濟(Circular Economy)

定義及背景

上一世紀的工業革命，帶領人類邁向經濟昌盛，但線性的資源利用及消費模式亦使得地球的資源入不敷出。目前大自然的資源一經開採，就注定了一條直線的「從搖籃到墳墓」(from cradle to grave)之路：開採 → 製造 → 銷售 → 使用 → 丟棄，而這條直通終點的路徑，就是所謂的「線性經濟」(如圖 1)。



圖 1 線性經濟示意圖 (圖片來源:地球公民基金會)

英國最著名提倡循環經濟的 Elle MacArthur Foundation 於 2012 年提出:「循環經濟具有可回復性和可再生性，其特性是透過新的設計，從一條完整價值鏈的系統，檢討各式各樣的經濟活動，建立資源循環圈(Loop)」。循環經濟揚棄傳統開採、製造、丟棄的線性經濟模式，在傳統廢棄物減量(Reduce)、回收(Recycle)、再利用(Reuse)的 3R 之外，加入重新定義(Redefine)與重新設計(Redesign)的 2R，後兩者所彰顯的不僅是產品與技術的重新出發，更是包含社會思維的再定義與再設計。

循環經濟正是想要改變線性經濟，重新建構一套「從搖籃到

搖籃」(from cradle to cradle)的新經濟模式(圖 2)。我們可以把所有廢棄物和污染當作是「資源錯置」的結果，由於經濟模式與產品設計不良，使得資源不能被充分利用和回收的結果。如果可以重新規劃原料開採、製程、使用、回收等流程，延長資源的生命週期，甚至不斷循環，就能徹底解決廢棄物、污染以及資源不足的問題。

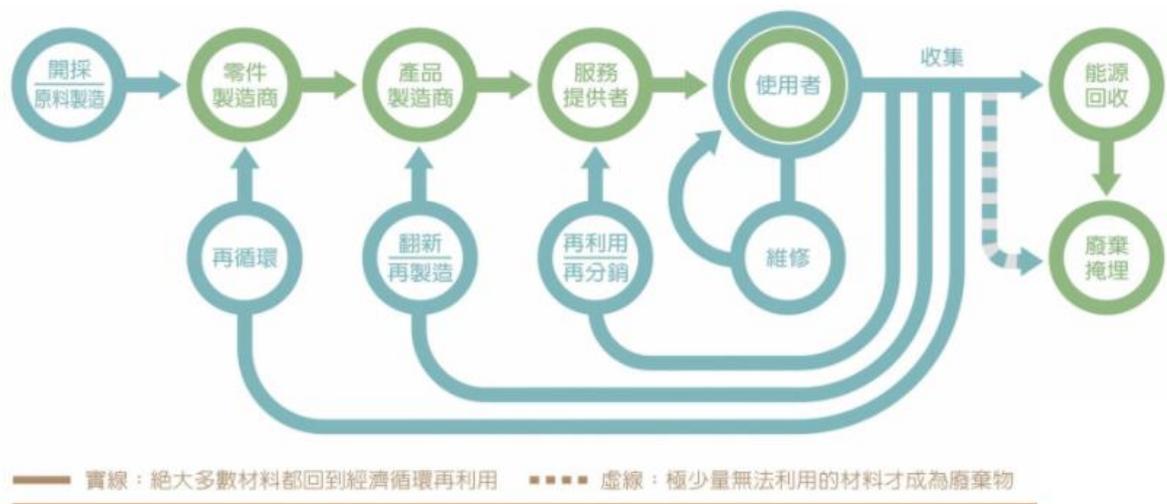


圖 2 循環經濟示意圖

要達成真正的「循環經濟」必須經過產品重新設計、製程重新設計、建立回收系統及商業模式重新設計四個途徑，方能達成零污染、零廢棄、零事故三大指標。

必要性及急迫性

循環經濟是近年國際環保倡議中非常流行的名詞，許多產業亦將循環經濟當作未來經濟的新動力，其中水資源扮演了關鍵性的角色。原因如下：

1. 依據推估，因為人口及經濟發展，全球用水需求及 CO₂排

放仍將持續大幅增加，但受到氣候變遷衝擊天然水資源之供給量將顯著減少。此供水缺口勢必必須由提高用水效率或尋求新水源補足。

2. 全世界有 80% 使用過的水未經處理即排入自然系統，此為龐大的可再利用資源。若能妥善利用，不僅能解決水污染問題，亦可增加新的水源。

3. 2015 年 12 月 12 日在聯合國氣候峰會中通過的巴黎氣候協議，目標是減少溫室氣體排放，讓地球暖化速度在 2100 年時，全球氣溫不會上升超過 2 度。欲達成此目標，光靠碳排放管制不足以達成，缺口由資源再生、利用補足。

循環經濟應用於水資源領域之挑戰

各場次討論期間，與會代表對於循環經濟概念運用於水資源領域多持正面態度，但也提出多項推動時可能面對之挑戰及建議，分述如下：

1. 可能遭遇之阻礙包括以下面向：

- 文化、社會及心理之接受度
- 政府政策、法規之支持度
- 經濟效益及可行性

2. 循環經濟的推動必須系統性、全面性的考慮整個水循環體系，且水為人類生活所必需，所以推動必須得到所有利害關係人的支持。

3. 目前提出之循環經濟應用內涵多為水再利用(reuse)，要達成零污染、零廢棄的目標仍有很大的空間。而且水再生利用目前仍為昂貴的技術，在水資源充沛的區域有推動的必要性嗎？

4. 水循環再利用應用在都會區應較適合、較有經濟誘因。示範場域必須考量規模(scale)、技術(technology)、維護管理(maintenance)、財務(financing)及政府政策(governance)。

5. 循環經濟的全面推動勢必改變用水行為及水體系，對傳統水權制度亦將造成衝擊。

3-2 再生水運用於農業灌溉

依據聯合國農糧組織在網站上揭露之訊息，農業用水約占全球取水量 70%、工業用水 19%、民生用水 11%。但全球約有 80% 的廢污水未經處理即排入自然體系，其中約有 10-15% 的農業灌溉用水使用間接或未經處理廢污水灌溉，引發糧食的安全疑慮；且僅 0.3% 使用再生水灌溉，故存在龐大再生水去化潛能。而要達到永續發展 6.3 指標 2030 年前將廢污水處理率提高到 50% 以上，故其處理容量仍有相當大的改善空間。與會者均認同要達到永續目標，必須讓廢污水處理增加更多的經濟誘因，觀念上也必須改變從以往的使用未處理廢污水，到將廢污水處理後再放流，進一步提升到以民眾健康為目標將廢污水視為一種資源妥善處理後再加以利用。

農業灌溉使用再生水之效益

1. 社會面向：

- 較使用未處理之廢污水更能保障民眾健康及生態環境，且增加營養源及提升食物安全。
- 穩定、可靠之水源，建構具氣候應變韌性之社區，

提升社區穩定度

- 增加農民收入及就業率

2. 經濟面向

- 回收水中含之氮、磷可增加農作物產量，並降低人工肥料之使用

- 保育及增加可供水量
- 預防枯旱之可靠替代水源，增加供水穩定度
- 對都會區綜合水資源調配、管理有助益
- 新的供水及廢棄物處理模式可解省經費，並將廢

污水中之水、能源、營養源、污泥等資源再復原利用

3. 環境面相

- 避免水體污染，保育原水水源
- 降低人工肥料之使用量
- 降低沙漠化及增加沙漠開墾
- 降低能源花費及溫室氣體排放

農業灌溉使用再生水之挑戰

- 再生水因含高營養源易孳生蟲害、農田易生雜草。

- 再生水中所含之高微生物及生物參數等，均超過美國、聯合國農糧組織(FAO)、世界衛生組織(WHO)等灌溉水源水質之規定標準。

- 民眾對於使用再生水有心裡的不適感
為更周延探討再生水使用，大會特別有一場次從宗教層面，

研究印度教、回教、及基督教之教義是否對再生水使用有特別的規定。其中印度教視河川為大地之母，信徒以花朵奉獻放入河中進行膜拜儀式，但反因此行為污染河川。因此目前印度有些環保團體與寺廟合作，將花朵撈起回收製作堆肥，供農民使用。而回教及基督教對於水均僅強調使用乾淨、清潔的水，未對使用再生水有所限制或規範。

3-3 再生水使用案例

案例 1. 約旦南部觀光鎮瓦迪穆薩(Wadi Musa)

佩特拉(Petrus)古城位於約旦南部，是聯合國教科文組織認定之世界文化遺產，阿拉伯傳統認為摩西出埃及後「點石出水」的地方，就是佩特拉。佩特拉被評為世界新七大奇蹟之後更具觀光吸引力，因古城內不能住宿，鄰近之瓦迪穆薩小鎮完全是為佩特拉觀光服務的，山上山下建有許多家酒店和餐廳、商店。

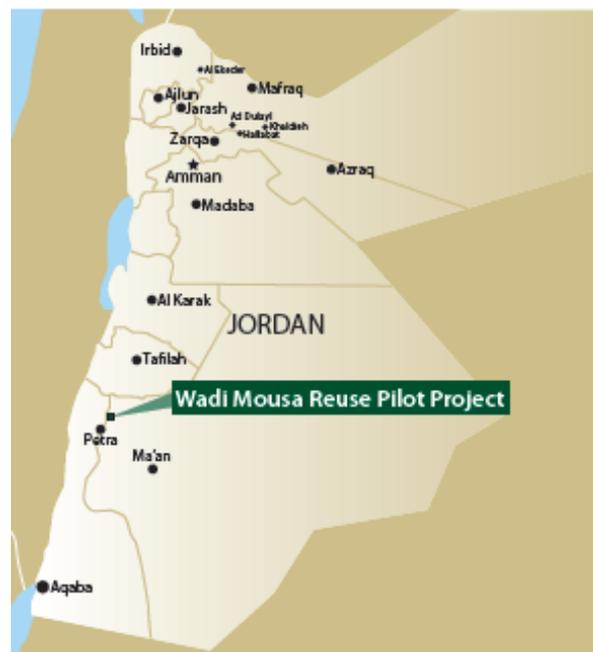


圖 3 瓦迪穆薩再生水示範計畫地理位置

該地區每年約有 2 億噸的供水缺口，而每年處理後之廢污水量約 1.4 億噸。美國國際開發署(USAID)自 2002 年起為改善當地生活環境，以該地區當作示範場域將再生水用作農業灌溉，主要作為動物食用牧草之栽種用，亦有部分灌溉蔬果。共計供給 100 公頃農田，80 農戶受益，農民無須負擔水費，但須負擔輸配水設備之維護管理費用。

經評估該示範計畫之效益如下：

- 保護該地區之觀光資源，免於水源污染
- 農作產量提升 20-30%
- 農民增加收入，且男、女均投入耕作。
- 遭遇之挑戰：
- 再生水鹽度高達 1000ppm
- 抽水站效益降低 10-20%
- 抽水設備昂貴，輸配水及灌溉系統因疏於維護而損壞。
- 探究農民願意採用再生水灌溉之因素：
- 該地區缺乏水源
- 因水源受到污染，農民無其他選擇
- 再生水含高營養源

該計畫經實施多年，農民多已能接受以再生水灌溉，且產品回銷入瓦迪穆薩之觀光旅館、餐廳等讓城鎮自我供給能力提高，降低外地輸入食品之時間、費用及依賴度。目前已有其他農民反應希望加入該計畫，獲取穩定之再生水水源。



圖 4 瓦迪穆薩使用再生水種植牧草情況

案例 2.瑞典 Holo 鎮之黑水回收再製肥料

在瑞典全國有將近 100 萬套私有之污水處理系統，其中約有 40% 系統或因系統老舊滲漏或管理不當處理效果不佳，衍生環境污染問題。除此之外，以目前開採速度全球磷預估將於 75 年內耗盡，而光在歐洲每年需要 160 萬噸磷製作肥料。所以瑞典政府訂定 2015 年前生活污水中至少 60% 之磷需回收做為肥料，回收之肥料至少需有 50% 回歸到農田。

在 Sodertalje 直轄市區域，私有污水系統排放大量營養源進入湖泊、水道，最終流入波羅地海之問題尤其嚴重，造成環境嚴重負擔。其中，Stavbofjarden 流域中的 Lillsjon 湖及 Kyrksjon 湖優養化最為嚴重。為配合瑞典國家磷回收政策並解決污染問題，當地環境委員會(Environmental Committee in Sodertalje)決定啟動一省水封閉處理系統(如圖 5)取代既有效果不彰之私人系統之試

驗計畫。

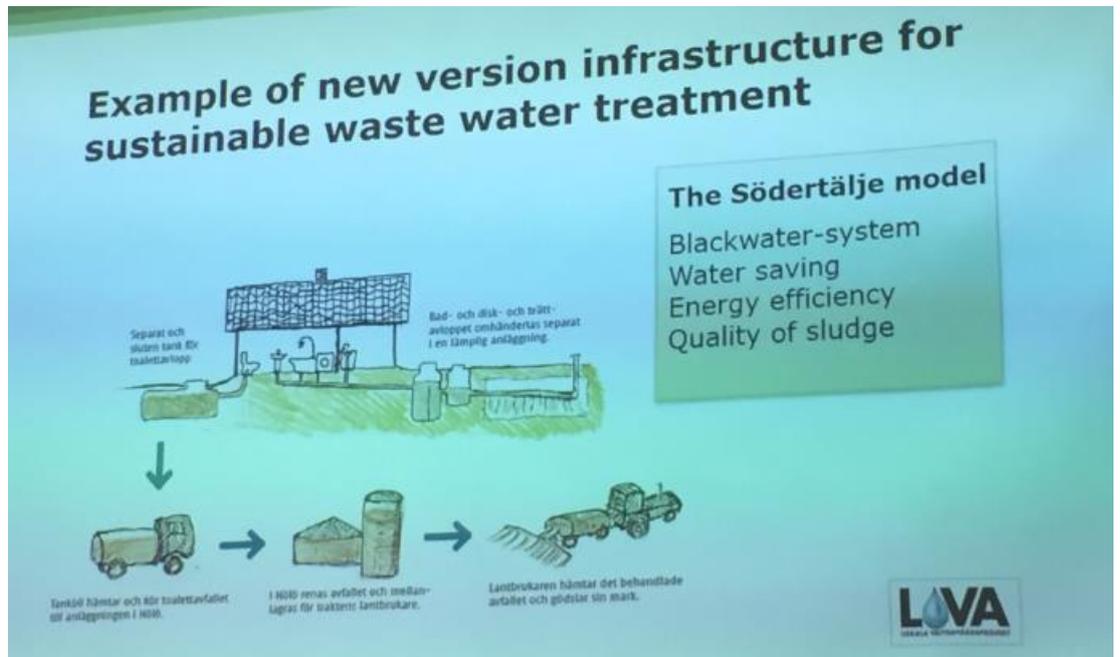


圖 5 Holo 鎮採用之省水封閉污水處理系統示意圖

(來源: Karl-Axel Reimer, Sodertalje Municipalty 簡報)

該封閉系統將含高營養源之廁所污水(以下簡稱黑水，該計畫將其稱為 Black Water)與其他生活污水分離，廁所污水存放於封閉系統，由封閉式卡車至各家戶蒐集後運送至處理場特別處理後產出含高營養源肥料，該肥料再免費提供該地區農民作為耕作肥料使用。黑水含水量越少、產出肥料效果愈佳。處理時以 wet-comosting process 加熱處理，過程中添加尿素提高 Ph 值去除不需要之微生物，產出具有高營養源、無致病菌之衛生肥料。

Holo 鎮之處理廠設立於 2012 年，蒐集 500-700 個黑水封閉桶，處理所得肥料提供給當地農民耕作使用，節省肥料採購及運輸之費用。



圖 6 黑水處理及肥料製造廠

該處理設備基本數據如下：

- 可處理 700 家戶之黑水，約 1500 每年立方公尺。
- 每年省下 6000 噸水資源。
- 回收肥料可施肥 375 噸穀物(含 8550 公斤氮、900 公斤磷、1800 公斤鉀)。
- 政府共投入 120 萬歐元建置，年度營運費越 3.8 萬歐元。

該試驗計畫效益如下：

- 避免營養源進入水體造成優養化及污染，並封閉植物營養源循環系統。

- 改變民眾對污水的觀感，創造市場價值同時節省能源及自然資源。
- 相較於既有農村分散式污水處理系統，經濟效益更佳。



圖 7 每人每年排放之黑水可提煉之穀物營養源量

四、心得與建議

1. 斯德哥爾摩世界水週有許多政府單位、聯合國組織與會，討論偏重政策面之趨勢與落實，有助本署政策與世界接軌、借鏡其他國家作法，值得持續關注、參與。明(2018)年主題為 Water, Ecosystems and Human Development.。
2. 依人口增加及經濟發展趨勢推估，溫室氣體排放量仍將大幅增加，欲達到 2100 全球增溫不超過 2^o C，光靠碳排放管制不足以達成，缺口必須由資源再生、利用補足。
3. 全球有超過八成使用過的水未經處理排放，此為龐大的可利用資源。若能妥善處理利用，不僅能解決水污染問題，亦可增加新的水源。要達成永續指標 6.3 之目標，必須讓再生水使用有更多的經濟誘因，觀念上也必須從舊有的使用未處理廢污水→廢污水處理後放流→將廢污水視為資源，妥善處理後加以利用。
4. 將循環經濟理念應用在廢污水回收再利用之技術已經存在，全面推展主要困難在於社會接受度低、法令限制、經費缺乏及專業人士不足。克服途徑：
 - 積極分享成功案例、知識、經驗
 - 即時水質監控資料可化解疑慮建立信心
 - 強化水的價值
 - 跨域合作，納入新的產業，如製藥、農用化學等
5. 農業用水約占全球取水量 70%，全球約有 10-15%之農業間接或直接使用未經處理之廢污水灌溉，引發糧食安全疑慮。

農業灌溉使用再生水除較廢污水水質佳外，生活污水回收之再生水具較高營養源可增加農作物產量，並降低人工肥料之使用。

6. 我國推動再生水政策主要訴求為供水穩定度高、不受天氣影響，主要媒合對象為工業用水。然因台灣近幾十年來並未發生嚴峻枯旱造成重大工業損失之事件，故該訴求誘因有限。本報告中所提 2 案例，約旦 Wadi Musa 因無其他水源、別無選擇，且使用污水回收之再生水增加農業收成，故該地區農民爭相取用；瑞典民眾高度重視環境保育及為下一代保有美好天然環境，故 Holo 鎮案例主要是為解決環境污染問題，並實驗氮、磷回收做為肥料之可行性，以達成 60%磷回收之長期政策目標。該 2 案例誘因契合當地民眾需求與文化。
7. 我國推動再生水政策或可重新檢視整體流程，與不同領域專家合作，找出契合台灣文化、需求之誘因，以利加速推動。本署或可考量與農業單位合作，挑選水源受污染地區做為示範場域，提供水質較佳之再生水灌溉，過程中檢視可回收之營養源、能源等，提高經濟誘因。
8. 本活動整體規劃細緻、辦理圓滿，以下特色值得我國辦理大型活動參考：
 - 議程主題規劃環環相扣、主軸明確，
 - 活動設計有許多巧思，例如會場座椅擺設(附錄一圖 12-圖 14)、閉幕結論以紅、綠卡片徵詢與會者認同與否(附

錄一圖 19),營造輕鬆氛圍、增加講者與參與者之互動。

- 座談會場次多達 228 場，大會 APP(附錄一圖 24)介面友善，除取代書面資料完整資訊外，亦方便與會者篩選有興趣之場次，並提供即時訊息及互動場域。
- 許多場次邀請業界分享其再生水使用經驗，除賦予業界企業責任外，亦可提供展現平台、鼓勵業界參與外。
- 遴選各國青年擔任紀錄員，除鼓勵青年關心水議題、了解青年想法外，亦可協助大會完整記錄各場次結論，並於閉幕式發表。

五、 參考文獻

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附錄一、水週場地、活動照片



圖 1. 活動會場- City Conference Centre- Norra Latin



圖 1. 活動會場- City Conference Centre- Flokets Hus



圖 2. 活動場地外圍廣場



圖 3. 活動場地外圍廣場



圖 4. 中場休息、午餐用餐等交流區



圖 5. 休息、用餐、展覽交流區



圖 6. 展覽空間



圖 7. 主辦單位 SIWI 攤位



圖 8 開幕式，參與踴躍



圖 9 開幕瑞典太空人 Prof. Christer Fugleasang 專題演講，
講題: Water-a spacewalk to understand our vital resource



圖 10 2017 Stockholm Water Prize 得主 Prof. Stephen McCaffrey，彰顯其在國際水法之成就與貢獻



圖 11 斯德哥爾摩市長 Karin Wanngard 開幕致歡迎詞



圖 12 座談會講者與與會者輕鬆互動



圖 13 座談會場地座椅擺設營造輕鬆、互動氛圍



圖 14 與會者出席踴躍、互動熱烈，輕鬆隨地而坐

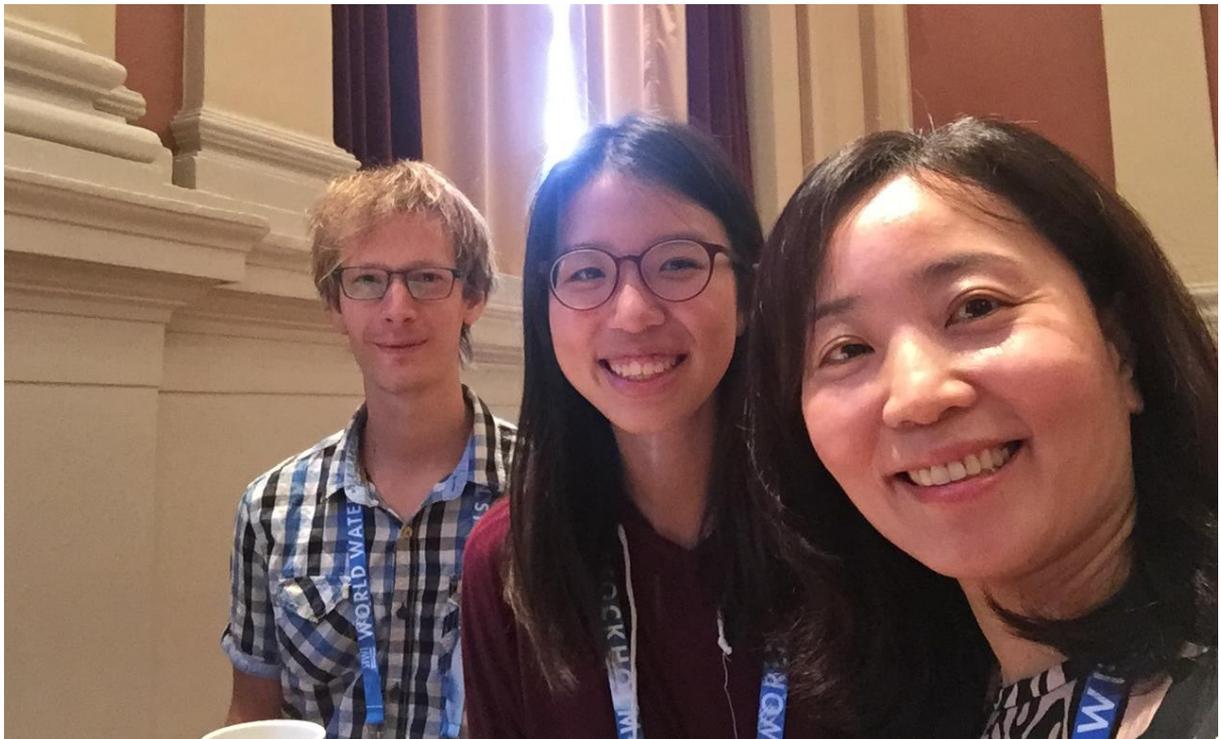


圖 15 水利署林惠芬(右一)、第四屆水青曾薇芯(中)、Koen van Gijn(左)



圖 16 閉幕式 SIWE 執行主席 Mr. Torgny Holmgren 致詞



圖 17 聯合國 Deputy Secretary-General Ms. Amina Mohammed 致詞



圖 18 水週科學委員會召集人 Dr. Torkil Jonch Clausen 報告會議結論



圖 19 重點結論徵詢與會者認同與否(同意綠牌、反對紅牌)



圖 20 青年紀錄員(Rapporteurs，分為三組 Social, Economic, Environmental)代表上台報告分組結論



圖 21 本署第四屆水青 Koen van Gijn(荷蘭籍)代表環境組報告結論



圖 22 參訪 Ericsson ICT Studio



圖 23 參訪 Ericsson ICT Studio

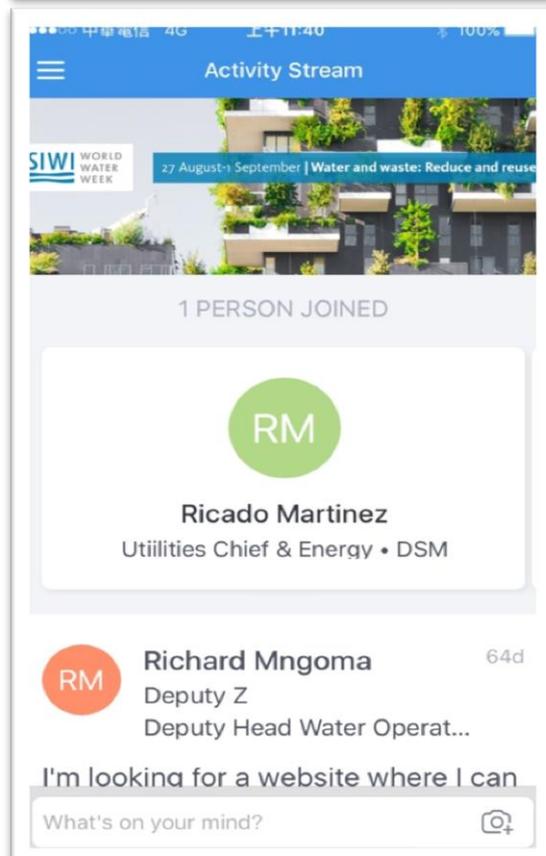
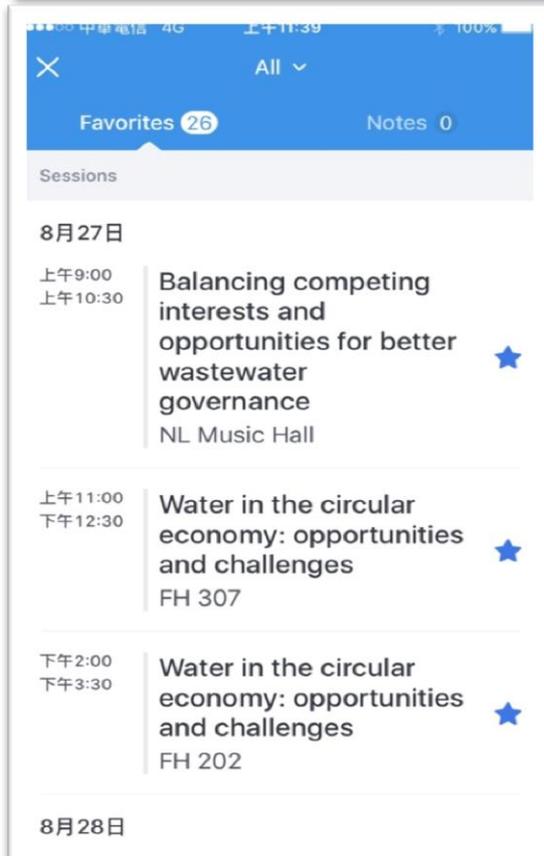
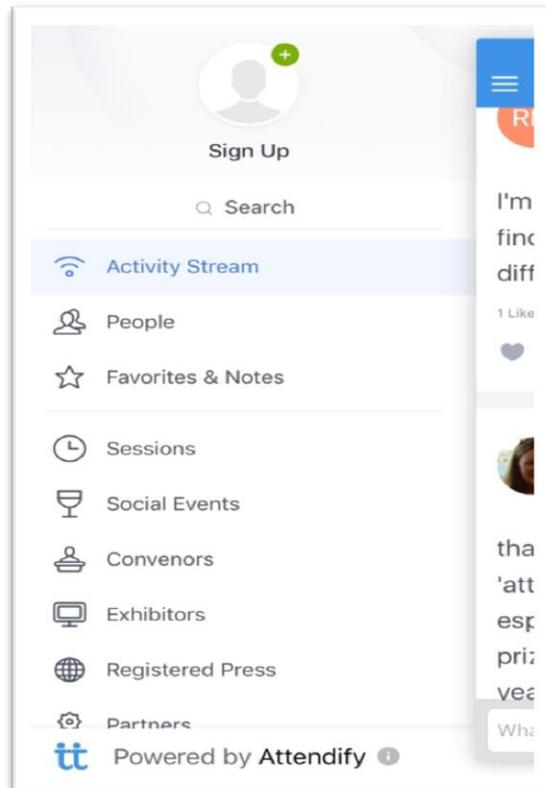
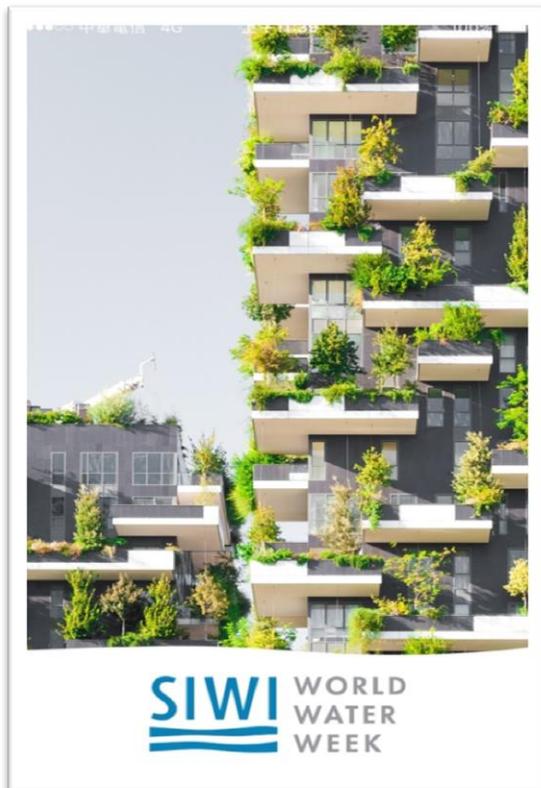


圖 24 大會提供之 APP，介面友善、資訊即時、可互動交流

附錄二 水週完整議程

Programme overview

EH = Exhibition Hall • FH = Folkets Hus • NL = Norra Latin • MH = Music Hall/Musiksalen • PH = Pillar Hall
 AU = Auditorium • LT = Little Theatre • CH = Congress Hall • ★ = Gold Star Event

SUNDAY 27 AUGUST			16:00-17:30		
	ROOM	PAGE		ROOM	PAGE
09:00-10:30			Showcase The freshwater health index: Participate in a mini assessment (16:00-16:45)	NL 253	18
Event A wasted potential: Bringing youth led solutions to scale ★	FH LT	2	Showcase An African response to agenda 2030	FH Cabaret	18
Event Balancing competing interests and opportunities for better wastewater governance	NL MH	2	Event Chain-reaction: Making corporate supply-chains work for WASH and the SDGs	NL PH	19
Event Data drought: An assessment of global hydrological monitoring systems	FH 300	3	Event From global policy to local project: Managing water through NDCs	NL AU	19
Showcase District-based initiative for SDG6: Building country systems, leveraging partnerships	NL 253	3	Event Implementation-monitoring of human rights to water and sanitation and SDG6 ★	FH LT	20
Event From practice to policy: Lessons from implementing sanitation safety plans	NL 357	4	Event Irrigating forests with wastewater- Natural and effective water treatment?	NL 357	20
Showcase Monitoring wastewater treatment sustainability: Learning from South Asia's small-scale systems	NL 353	4	Seminar Opportunities and limits to water pollution regulations	FH 300	21
Event Science faces practice: Benefits and risks of wastewater use	FH 202	5	Event Safely managed sanitation in small towns 2: Key challenges under scrutiny ★	FH 307	21
11:00-12:30			Event The groundwater paradox: A hidden challenge for society	NL 461	22
Event Accelerating actions for water and disasters in the next decade	NL PH	6	Seminar Understanding the gender dimension of water and waste	FH 202	22
Event Citizen observatories empowering people in integrated water and waste management	FH 202	6	Showcase Water and green growth: Just a concept or reality?	NL 353	23
Showcase Global framework on water scarcity in agriculture	NL 353	7	Seminar Water in the circular economy: Opportunities and challenges	NL MH	23
Showcase Global water solidarity: Promoting decentralized solidarity in WASH sector	NL 253	7	Showcase "Wastewater, the untapped resource": UN World Water Development Report 2017 (17:00-17:45)	NL 253	24
Seminar Opportunities and limits to water pollution regulations	FH 300	8	Young professionals mingle (18:00-21:00)	Boqueria	24
Event Sustainable withdrawals: How do you know?	NL MH	8	Under the bridges (18:45-21:00)	Ström-kajen	25
Event The state of the evidence base for WASH microfinance	NL 461	9	MONDAY 28 AUGUST		
Seminar Understanding the gender dimension of water and waste	NL 357	9	09:00-12:00		
Showcase Urban lessons from Japan: Technical exchange on water and waste	FH Cabaret	10	Opening plenary	FH CH ABC	27
Seminar Water in the circular economy: Opportunities and challenges	FH 307	10	13:30-14:00		
Event WWW2017 Debate: Is water reuse the solution to water scarcity? ★	FH LT	11	SIWI Sofa Rethink water. Reinvent business. (13:30-14:00)	EH	28
14:00-15:30			14:00-15:30		
Showcase 2030 WRG country Initiative: Blending partnerships and finance for water security	FH Cabaret	12	Showcase Why women? Why water? The GAP Inc. and USAID alliance (14:00-14:45)	NL 253	29
Showcase A second sanitary revolution supporting The New Urban Agenda	NL 353	12	Event 21st century technology: Bridging the gap to wastewater reuse	NL PH	29
Event Falkenmark Symposium - Achieving SDG in Africa: Scaling green-blue revolution	NL MH	13	Event Antimicrobial resistance putting sustainable development at risk: Drivers, impacts, solutions. ★	FH CH C	30
Showcase How water utilities can contribute to climate mitigation solutions	NL 253	13	Showcase Food retailers' freshwater strategies: Enhancing stewardship through supply chain co-operation	FH Cabaret	30
Event Innovations for the SDGs: The Young Professional's role ★	FH LT	14	Event How to empower stakeholders reducing and reusing water; Collaborative modelling	FH 307	31
Event Monitoring transboundary water cooperation: How the dedicated SDG indicator helps	NL AU	14	Event Inclusive revenue models: Give a boost to sanitation entrepreneurs!	FH LT	31
Seminar Opportunities and limits to water pollution regulations	FH 300	15	Event Overcoming water scarcity and drought: Reduce, re-use and replenish	FH CH A	32
Event Plastic soup and dead zones: Source prevention for cleaner seas	NL PH	15	Event Protection of the sacred: Wastewater management and indigenous realities	NL MH	32
Event Safely managed sanitation in small towns 1: Lessons from recent experiences ★	FH 307	16	Event Reaching millions: Future capacity development for the sanitation sector	FH 202	33
Event Towards universal access to drinking water in fragile contexts: DRC	NL 461	16	Event SDG-synergies: Countries link WASH and nutrition to reduce malnutrition	NL 357	33
Seminar Understanding the gender dimension of water and waste	NL 357	17	Event Toward women-inclusive water governance ★	FH 300	34
Seminar Water in the circular economy: Opportunities and challenges	FH 202	17	Showcase Unravelling the MagiCube: Kenya's approach to up-scaling water and sanitation	NL 353	34

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MONDAY 28 AUGUST (CONTINUED)		
	ROOM	PAGE
SIWI Sofa Global framework on water scarcity in agriculture (14:30-15:00)	EH	35
Showcase The Colorado River Basin Study: Collaborative solutions to water sustainability (15:00-15:45)	NL 253	35
15:30-16:00		
SIWI Sofa Supplying rural areas with water and electricity simultaneously	EH	36
16:00-17:30		
Event Accountability in WASH: From emergency to development	FH 307	37
Showcase Australian water tools: Linking information and modelling to support decision-making	NL 253	37
Event Experience different perspectives on the urban water-energy nexus! ★	NL 357	38
Event Increasing impact through donor-supported advocacy for water supply and sanitation	FH CH C	38
Event Is wastewater a She? Linking SDG6.3 (wastewater) and SDG5 (gender)	FH 300	39
Showcase Join SIWI's journey towards strengthened water governance	NL 353	39
Event Operationalizing citywide inclusive sanitation: Right tools? Right use?	NL MH	40
Event Religious jurisprudence related to reuse of water	FH LT	40
Event Rethink water. Reinvent business. Reframing the way businesses value water	FH CH A	41
Event Snow Leopards: A surprising solution to water and climate security?	FH 202	41
Event The roundtable on financing water	NL PH	42
Showcase Wastewater treatment needs skilled staff: German approaches and experiences	FH Cabaret	42
SIWI Sofa Latin America and the Caribbean: Water water everywhere? (16:30-17:00)	EH	43
City of Stockholm cocktail reception (19:30-21:30)	City Hall	43

TUESDAY 29 AUGUST		
	ROOM	PAGE
09:00-10:30		
Showcase Call to action: Radically shifting mindsets for citywide inclusive sanitation	NL 253	45
Event Eye on LAC - Fostering a wastewater treatment revolution	FH CH A	45
Seminar Harnessing opportunities for the safe reuse of wastewater in agriculture	FH CH C	46
Event Harnessing water risk tools: Expanding our understanding of water waste	FH 300	46
Event MENA Focus - Water security and water integrity challenges	NL PH	47
Event Powering the wastewater renaissance: Emissions reduction in wastewater management ★	FH LT	47
Event Smart regulation to reduce faecal contamination of urban water resources	FH 307	48
Showcase The value of collective local action-creating the shared water plan	FH Cabaret	48
Event UN-Water stakeholder dialogue	NL AU	49
Showcase Water pricing: Finding the right price in developing countries	NL 353	49
Event Water resources (in-)security and conflict: Exploring inter-linkages	FH 202	50
Seminar Water, pollution and systemic challenges: The case of the textile-industry	NL MH	50
SIWI Sofa WASH at the workplace: What does leadership look like? (10:00-10:30)	EH	51

	ROOM	PAGE
11:00-12:30		
SIWI Sofa The AgWater challenge: Corporate progress and learnings (11:00-11:30)	EH	51
Showcase Sustainable tariffs: Achieving fair and equitable water management in Sweden (11:00-11:45)	FH Cabaret	52
Event Eye on LAC - Before/after the toilet: Sewer connectivity and fecal-sludge management	FH CH A	52
Event From data to decision: Monitoring water quality at scale	FH 300	53
Event Gender and the sanitation market ★	NL 461	53
Seminar Harnessing opportunities for the safe reuse of wastewater in agriculture	FH 202	54
Event MENA Focus - Investment potential in wastewater treatment and reuse	NL PH	54
Showcase Protecting the most vulnerable: Legal frameworks for community freshwater rights	NL 253	55
Event Scaling up social accountability for water and waste	FH 307	55
Showcase The Africa EU Water Partnership Project: Unlocking investments through development	NL 353	56
Event The role of green infrastructure investments in meeting global commitments	FH CH C	56
Event WASH4Work: Mobilizing business action on water, sanitation, and hygiene	NL 357	57
Seminar Water, pollution and systemic challenges: The case of the textile-industry	NL MH	57
Showcase Climate adaptation with growing glaciers and ice stupas (12:00-12:45)	FH Cabaret	58
12:30-14:00		
SIWI Sofa Microplastics in the freshwater environment: An issue of concern (12:30-13:00)	EH	58
SIWI Sofa New business from disruptive innovation in water and energy (13:30-14:00)	EH	59
Seminar/Field visit Harnessing opportunities for the safe reuse of wastewater in agriculture (13:45-17:00)	FH Entrance	59
14:00-15:30		
Event Addressing conflict risks in climate adaptation and mitigation efforts	FH 300	60
Event AFRICA Focus - Innovative approaches to improved water quality through wastewater management	FH CH A	60
Event ASIA Focus - Sustainable wastewater and fecal sludge management: Fit-for-purpose solutions	FH CH C	61
Event Contributions of earth observations and models for improved water sustainability	NL 357	61
Event Gender and water: Framing the relationship	NL PH	62
Event Governing the paracommons: The case of Palestinian water ★	FH 202	62
Event Safe water enterprises: The opportunity to reach a billion people?	FH LT	63
Event Solving the plastic waste crisis in urban waterways	FH 307	63
Showcase Strengthening national processes for achieving SDG6: SWA's country engagement experience	NL 353	64
Showcase The Stockholm action plan for good water status	FH Cabaret	64
Showcase Water scarcity in Egypt; Facing challenges	NL 253	65
Seminar Water, pollution, and systemic challenges: The case of the textile-industry	NL MH	65
SIWI Sofa Manos al agua: Integrated water management for sustainable coffee (14:30-15:00)	EH	66
15:30-16:00		
SIWI Sofa Capacity development in the use of new technologies (15:30-16:00)	EH	66

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 AU = Auditorium • LT = Little Theatre • CH = Congress Hall • ★ = Gold Star Event

16:00-17:30	ROOM	PAGE
Showcase Launch of Rising to the challenge: WASH poverty diagnostic initiative (16:00-16:45)	NL 253	67
Event AFRICA Focus - Waste for food and energy security	FH CH A	67
Showcase Argentina's roadmap for sustainable water resources management	NL 353	68
Event ASIA Focus - Building cities of the future through high-performing water utilities	FH CH C	68
Event Fully engaging the disenfranchised society in water governance	NL 357	69
Event Journey to a world free of untreated wastewater ★	FH 300	69
Event Lessons from the 2017 Integrated Baseline process for SDG6 monitoring	NL AU	70
Showcase Toilet Board Coalition business approaches to waste to resource models	FH Cabaret	70
Event Valuing water: Towards common principles and political enthusiasm	NL PH	71
Event Water and sanitation: Innovative mobile solutions to improve service delivery	FH 307	71
Event Water security in fragile contexts	FH 202	72
Event Water to mitigate climate change: Beyond the obvious	NL MH	72
Showcase Launch Water Security Journal; Panel discussion on sanitation and health (17:00-17:45)	NL 253	73
Stockholm Junior Water Prize (17:45-21:30)	Grand Hotel	73

WEDNESDAY 30 AUGUST

09:00-10:30	ROOM	PAGE
SIWI Sofa Pharmaceuticals in the aquatic environment in the Baltic Sea (09:00-09:30)	EH	75
Event AFRICA Focus - Waste to benefits: From policy to action	NL AU	75
Event ASIA Focus - Towards a healthy Ganges	NL MH	76
Event Dealing with the sanitation nexus: The need for disruption	FH 307	76
Showcase Empowering local communities with social accountability tools	NL 353	77
Event Eye on LAC - Circular economies in the industry sector	FH CH A	77
Showcase Improving emergency wastewater management: Compendium of sanitation technologies in emergencies	NL 253	78
Event Improving our waters: How innovation in textiles is reducing pollution	FH 202	78
Event MENA Focus - Adapting to climate change: Assessment, vulnerability & action	FH LT	79
Seminar Smart solutions in water and waste management for liveable cities	NL 357	79
Seminar Wastewater and health: Setting the scene	FH 300	80
Showcase Water and faith: Building partnerships to achieve the SDGs	FH Cabaret	80
Event Stockholm Water Prize Symposium: International water law	NL PH	81
SIWI Sofa Water, sustainable business and China's Belt and Road Initiative(10:00-10:30)	EH	82
11:00-12:30	ROOM	PAGE
SIWI Sofa Meet the SJWP winner & founding sponsor Xylem CEO (11:00-11:30)	EH	82
Showcase WASH and nutrition nexus: An effective approach to stop stunting (11:00-11:45)	NL 253	83
Event AFRICA Focus - High level ministerial panel: Waste to benefits	NL AU	83
Event Clean and circular: The future of made in China fashion ★	NL MH	84

Event Eye on LAC - What is new on wastewater reuse financing?	FH CH A	84
Showcase Join us on the road to Brasilia 2018	FH Cabaret	85
Event MENA Focus - MENA water world café 2017	FH LT	85
Showcase Results-based financing & WatSan: Improving systems & accountability	NL 353	86
Event Scaling-up wastewater treatment and management from source to sea	FH 307	86
Seminar Smart solutions in water and waste management for liveable cities	FH 202	87
Seminar Wastewater and health: Microbes: Research, methods, and tools	FH 300	87
Event Water Stewardship: Different ways but same objectives?	NL 357	88
Showcase HEPI: Supporting WASH actors get ready for the next outbreak (12:00-12:45)	NL 253	88
12:30-14:00	ROOM	PAGE
SIWI Sofa Power of pride: Social norms for community-based watershed management (12:30-13:00)	EH	89
SIWI Sofa Innovative sustainable water solutions for coffee processing (13:30-14:00)	EH	89
14:00-15:30	ROOM	PAGE
Event African smallholder irrigation: Double yields with half the water!	NL 357	90
Showcase Building Africa's leadership in sanitation: USAID, Gates Foundation/IHE Delft, AMCOW Innovations	NL 253	90
Event Circular economy cities: Transforming China and India's urban wastewater	NL MH	91
Showcase Financing the SDGs: The Ghana Water Trust and attracting private investment	NL 353	91
Event High level panel on water	NL PH	92
Event Open government and water: A new governance paradigm	FH 300	92
Showcase Re:use, re:make, re:think fashion	FH Cabaret	93
Seminar Smart solutions in water and waste management for liveable cities	NL 461	93
Event Subsidies revisited: Supporting the poorest and most vulnerable in CLTS	FH LT	94
Event Unlocking finance for urban water reuse and resilience ★	FH 307	94
Seminar Wastewater and health: Implementing target 6.3: Investing in health!	FH CH A	95
16:00-17:30	ROOM	PAGE
Showcase Advancing water innovation in Europe, China and globally	NL 253	96
Event Complexities associated with climate change, water, and agriculture	FH 307	96
Event Contaminants of emerging concern: A challenge for waste water reuse?	FH 300	97
Event Integrated urban water management: Challenges and opportunities	FH 202	97
Showcase Scaling wastewater services: Reconciling change and organizational health	NL 353	98
Event SDG6: Searching for universal sustainability metrics for rural water services	NL PH	98
Showcase The HSBC Water Programme: Transforming lives in the Ganga	FH Cabaret	99
Event Water in the circular economy: Progress, potential and financing	FH LT	99
Event Water scarce cities: Towards urban water security under scarcity	NL MH	100
Stockholm Water Prize Ceremony & Royal Banquet (16:30-23:00)	City Hall	100

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THURSDAY 31 AUGUST			ROOM	PAGE
09:00-10:30				
SIWI Sofa Nestlé Waters pioneering water stewardship towards a systematic approach (09:00-09:30)	EH	102		
Event Bioenergy, water and SDG implementation: Experiences and linkages	FH 300	102		
Event Building a resilient future through water (I)	AU	103		
Showcase Diplomacy on the Yarmouk, the Jordan River's forgotten tributary	FH Cabaret	104		
Event Ensuring adaptation through insurance: Mainstreaming resilient nature-based water management	FH 307	104		
Seminar Financing wastewater treatment and resource recovery	NL MH	105		
Seminar Governance of water and waste: A key to sustainable development?	FH 202	105		
Showcase Implementing integrated urban water management: Tools, approaches, real world experiences	NL 253	106		
Event International water law assists transboundary water cooperation: Years of patience "paying-off"	FH CH A	106		
Event Liquid manure and pesticides: Water quality challenges of agriculture	FH LT	107		
Event Sanitation in Europe: From access to pollution reduction and reuse	NL PH	107		
Showcase WADA: Achievements from Coca-Cola and USAID's Global Community Water Partnership	NL 353	108		
SIWI Sofa Practical collective action case studies addressing water challenges (10:00-10:30)	EH	108		
11:00-12:30			ROOM	PAGE
SIWI Sofa Why should I change my water behavior? (11:00-11:30)	EH	109		
Showcase Wings: Developing non-grid water and sanitation solutions for urban areas (11:00-11:45)	NL 253	109		
Event Building a resilient future through water (II)	NL AU	110		
Event Ecosystems, water and health: The multiple dimensions of natural infrastructure	FH 307	111		
Event Emerging pollutants in water reuse: Addressing knowledge and policy gaps	NL PH	111		
Seminar Financing wastewater treatment and resource recovery	NL MH	112		
Seminar Governance of water and waste: A key to sustainable development?	FH 202	112		
Event Private finance and equitable delivery of WASH services	FH 300	113		
Event Solid fuel from sludge: Resource recovery worth getting heated about	FH LT	113		
Showcase Tackling WASH inequalities in the Era of the SDGs	FH Cabaret	114		
Showcase WASHaholics Anonymous: The first step on the road to recovery	NL 353	114		
Event Waste, water and undernutrition: Evidence and policy perspectives	NL 357	115		
Showcase Water solutions for remote areas: From water generation to wastewater (12:00-12:45)	NL 253	115		
12:30-14:00			ROOM	PAGE
SIWI Sofa Transforming the textile sector towards a sustainable future (12:30-13:00)	EH	116		
SIWI Sofa Pathways for water diplomacy and policy impact (13:30-14:00)	EH	116		
14:00-15:30			ROOM	PAGE
Showcase NDC Explorer: Water in 163 climate plans and selected cases (14:00-14:45)	NL 253	117		
Event Don't neglect maintainers: Don't waste investments for WASH in schools	FH LT	118		
Seminar Financing wastewater treatment and resource recovery	NL MH	118		
Seminar Governance of water and waste: A key to sustainable development?	FH 202	119		
Event Industrial water re-use: A step towards a circular economy	NL 461	119		
Showcase Nature for water: World Water Day 2018	FH Cabaret	120		
Event Operationalizing resilience within water security	NL PH	120		
Event Public-private partnerships in urban sanitation: Why, when, how	FH 300	121		
Event Reducing waste in efficient irrigation: What pathways and who gains?	NL 357	121		
Event The value of water: Aligning perception with reality	FH 307	122		
SIWI Sofa Involving local communities to water management (14:30-15:00)	EH	122		
Showcase Showcasing business best practice for climate adaption and water stewardship (15:00-15:45)	NL 253	123		
15:30-16:00			ROOM	PAGE
SIWI Sofa Re-integration of CA water science into global sustainable development (15:30-16:00)	EH	123		
16:00-17:30			ROOM	PAGE
Showcase Designing for freshwater resilience	NL 353	124		
Event Pathogen flows: Applying public health principles to urban sanitation	NL MH	124		
Event Providing safe water, sanitation and hygiene in health care facilities	NL PH	125		
Event Scaling up private sector investment in water and waste	FH 300	125		
Event Six critical components for SDG 6.3: Does your country count? ★	FH 202	126		
Showcase Sustainable water partnership: Delivering stability and benefits through water security	FH Cabaret	126		
Event Tapping capital markets to finance WASH investments	FH 307	127		
Showcase Water innovation engine: Catalysing change and partnerships through the HLPW	NL 253	127		
Mingle & dance (19:00 -00:00)	Vasa Theatre	128		
FRIDAY 1 SEPTEMBER				
09:00-18:00			Room	Page
Closing plenary (09:00-12:00)			NL AU	
Field visit Hammarby Sjöstadverket (12:45-16:00)			FH Entrance	
Field visit Ericsson ICT studio (12:45-17:00)			FH Entrance	
Field visit AstraZeneca's wastewater treatment Plant in Södertälje (12:45-18:00)			FH Entrance	