



GLOBAL WtERT COUNCIL

Research, education, and information
for sustainable waste management

Summary Report of 2017 Activities of National Members of GWC

This Report is a summary of the research and education activities of the sister WtERT organizations around the world. This is the first time we have put together such a report. The objective is to show the breadth and depth of the research, education, and information dissemination activities of the organizations affiliated with the Global WtERT Council; and to encourage the formation of research partnerships. We thank all who have submitted or contributed to these reports. The order of presentation is shown below:

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WTERT-Brazil activities in 2017

By Dr. Sergio Guerreiro Ribeiro, Presidente, WTERT-Brasil (sergiog@wtert.com.br)

1. WTERT- Asia Inaugural Meeting

The formation of the Asian Chapter of WTERT took place in Nanjing, China in April and WTERT Brasil presented the waste management status in the Country. Besides Brazil and most Asian Countries we had Colombia, USA, Spain and Germany representatives of their respective WTERT organizations. Everbright International, sponsor of the meeting, organized a perfect program that included three days of presentations, exhibitions, technical visits and profitable technical discussions between all sister WTERT organizations. Everbright has shown strong interest in Brazil WM situation and WTERT Brasil has committed to disclose the most impressive Chinese WTE developments,, in the past 15 years, in Brazil. A complete report on the visit was published in the Brazilian home page <http://wtert.com.br/site/wp-content/uploads/2017/11/WTERT-ASIA.pdf>

2. Political Activities aiming to Improve WM Legislation in Brazil

The new Brazilian Law on Waste Management was published in 2010 and has been criticized by WTERT Brasil from the very beginning. The reason was the Law does not establish any restrictions on waste disposal in landfills stating that landfills are an environmental sound solution. Although this seems correct, in Brazil there are no directives, similar to European 1999/31/EC, restricting organic waste disposal, leachate treatment, biogas capture, closure cost and many others. The new “sanitary landfills” have been built without any environmental protections including leakage of untreated leachate to the rivers and ocean. WTERT Brasil declared a “war” against this policy and was joined by a very important institution The Lawyer Bar Association of Brasilia the Capital of the Country. WTERT Brasil made a 90 minutes presentation for some high authorities in Brasilia which was professionally filmed and posted at the home page and YouTube.

<https://www.youtube.com/watch?v=G7ClhSOshpU>

Another important article was published for Canal Energia, the most important online media about energy in Brasil:

https://drive.google.com/file/d/1_8T7KIQZbn6dhERNI7DcTOtIIX7ldHKw/view?usp=sharing

Also a printed and online magazine interviewed WTERT Brasil and made an article comparing China and Brazil on WM activities

https://drive.google.com/file/d/1Fbo1KVM8E9co_cQqIHp3FFWEGo9OIMih/view?usp=sharing

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3. WTERT Participating with CONCREMAT in a 2 years IDB Project to Bring WTE to the State of São Paulo

IDB has launched a 2 years research project grant to study ways to improve the feasibility of WTE plants in São Paulo. Concremat, a large contractor firm based in Rio de Janeiro, made a partnership with WTERT Brasil and we have been shortlisted to get the project. The results should be available early next year (2018)

<https://renewablesnow.com/news/to-the-point-idb-brazils-sao-paulo-to-partner-up-for-green-projects-581698/>

4. Three-day Mini Course given at SABESP (Sanitation Company of São Paulo State)

SABESP, formerly a water and sewage treatment company will be in charge of helping to improve the WM situation in São Paulo State. They are creating an Energy Branch to act as an interface between the WTE plant and the municipalities using the huge network they have to collect the tipping fee together with the water/sewage fees they already charge the houses. WTERT Brasil is engaged in helping them to learn about WTE technologies.

5. Hybrid Cycles (Biomass/MSW/Natural Gas) Applications – GasBrasilano/WTERT Project

This research partnership with *GasBrasiliano*, the natural gas distributor in West São

Paulo State, started in 2015 <http://www.gasbrasiliano.com.br/noticias/saiu-na-midia/gasbrasiliano/> and has been recently renewed. So far five major ethanol mills were studied and the results indicate a small amount of natural gas can double the net energy export of the cogeneration plant. The main client is RAIZEN, a Shell Company, with USD 23 billion gross income in 2016. The same solution can be applied to WTE plants in Brazil and it will be considered in the IDB project described in item 3.

6. Partnership between WTERT Brasil and PUC- RJ

Catholic University at Rio de Janeiro (PUC-RJ <http://www.puc-rio.br/english/>), a private Jesuit school and one of the most prestigious in Brazil. WTERT president, who obtained his BS in Mechanical Engineering there, is co-advisor of a Master Thesis on hybrid cycles applications in biomass and MSW. There are several students working on WTE and we are discussing how PUC-RJ and Columbia University can establish some type of cooperation on WM technologies.



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WtERT-China activities in 2017

By Prof. Qunxing Huang, Vice Director, [Institute for Thermal Power Engineering](#) State Key Laboratory of Clean Energy Utilization, Zhejiang University

1. Establishment of National engineering laboratory for waste incineration technology and equipment development.

After oral defense and expert evaluating, ITPE of Zhejiang university won the bidding for building this unique national engineering laboratory for **waste incineration technology and equipment**. This lab was supported by national development and reform commission of China and on May 11, the opening ceremony was hold in ZJU. Members of this lab include China Everbright International, Jinjiang company, Nantong Boiler, Powerchina Ltd. and others. Prof. Jianhua Yan, the vice president of Zhejiang university, has been nominated as the first director of this lab.

2. Participation in inaugural meeting of the WtERT-Asia regional organization

The inaugural meeting was held in Nanjing China (April 25-27) and was sponsored by China Everbright International. Zhejiang University made a presentation on current state of waste management in China, the major WTE company in China. Prof. Kefa Cen of ZJU was elected Vice Chair of WtERT-Asia.



3. WtERT-China organized the 2017 WTE training workshop for developing countries

ITPE of Zhejiang University representing WtERT-China has organized the second international training workshop of waste-to-energy. Over 20 government officers and engineers respectively from Vietnam, Thailand, Pakistan, Malaysia, Indonesia et.al. have attended this workshop. The workshop was supported by the minister of science and technology of China and it is an important part of the “*One Belt One Road Initiative*”.



4. Exchange of scholars: Doctoral student Peng Lu of Zhejiang University started 6-month internship at Columbia University (Advisors: A.C. Bourtsalas, N.J. Themelis).

5. Publications

Recycling and WTE Volume: Prof. Qunxing Huang, submitted an essay on Circulating Fluid Bed Combustion of MSW.

‘Experimental research of basic properties and reactivity of waste derived chars’, Peng Lu, Qunxing Huang, AC Thanos Bourtsalas, Yong Chi, Jianhua Yan, *Applied Thermal Engineering*

‘Effect of chlorine on the structure and reactivity of char derived from solid waste’, Binhang Hu, Qunxing Huang, Athanasios C Bourtsalas, Mujahid Ali, Yong Chi, Jianhua Yan, *Energy & Fuels*

‘Effect of Operating Conditions on Coke Formation and Nickel Catalyst Performance During Cracking of Tar’, Peng Lu, Qunxing Huang, Athanasios C Bourtsalas, Yong Chi, Jianhua Yan, *Waste and Biomass Valorization*

‘Co-pyrolysis characteristics and kinetic analysis of organic food waste and plastic’, Tang Yijing, Huang Qunxing, Sun Kai, Chi Yong, Yan Jianhua. *BIORESOURCETECHNOLOGY*, 2017, 249:16-23.

‘Co-gasification of municipal solid waste with high alkali coal char in a three-stage gasifier’, Binhang Hu, Qunxing Huang, Alfons Buekens, Yong Chi, Jianhua Yan. *ENERGY CONVERSION AND MANAGEMENT*. 2017, 153: 473-481.

‘Coking and Regeneration of Nickel Catalyst for the Cracking of Toluene as a Tar Model Compound’, Lu Peng, Huang Qunxing, Chi Yong, Yan Jianhua, *ENERGY & FUELS*, 2017,31:8283-8290

‘Comparison of the waste-to-energy (WTE) moving grate and circulating fluidized bed technologies, as applied in China’, submitted to *Waste and Biomass Valorization* journal (by A.C. Bourtsalas, Qunxing Huang, Hanwei Zhang, N.J. Themelis..

WtERT- France Activities in 2017

By Prof. Ange Nzihou, Ecole des Mines Albi

AWARDS

Prof Ange Nzihou, head of WtERT-France received the insignia of Chevalier de l'Ordre National du Mérite (Knight of National Order of Merit). Bestowed by the President of France, the award was given in recognition of 15 years of outstanding contribution in the field of Energy and Environmental Transition. This award recognizes the creation of building blocks, not only in an individual's career, but in enabling others to advance their own research.

COLABORATIONS/PARTNERSHIPS

WtERT France contributed to the 9th International Conference of the African Materials Research Society (AMRS2017) held in Gaborone, Botswana 11-14 December 2017. The Botswana AMRS2017 had gathered 500 participants from around the world. At its heart, the AMRS series of conferences allows the scientific and research communities to build knowledge, foster relationships and promote action for further understanding and collaborations in the broad fields associated with materials science and technology. The themes of AMRS2017 reflect both the needs of the global research community

such as energy and health, as well as the needs that are specific to Africa. **Waste to Energy and Added Value Materials, and Waste Management** in particular have been among the key theme of this conference.

In 2017, WtERT-France was supported by the World Bank, the USA NSF and ACS, the RUK Royal Society of Chemistry, The MRS (Material Research Society), Botswana Government. WtERT France will stay very active in this network in contributing and emphasizing actions in Francophone African countries

INTERNATIONAL NETWORKING AND CONFERENCE



WasteEng conference Series in collaboration WtERT France and WtERT Global Council will organize the WasteEng2018 conference in Prague (Czech Republic) from July 2 to 5, 2018. WasteEng Conference Series has reached an outstanding international recognition with participants from over 50 Countries for each issue during the last 10 years. Following the event WasteEng2014 held in Rio de Janeiro (Brazil) in August 2014, WasteEng2016 in Albi (France) in May 2016, we are happy to announce the WasteEng2018Conference to be held from July 2 to 5, 2016 in the cultural city of Prague a UNESCO World heritage site. 500 abstracts from 61 countries will be presented at this 7th issue of the WasteEng Conference Series that will feature cutting-edge R&D and address barriers related to the Conversion of Biomass and Waste to Energy to Added-Value Materials. The conference will emphasize life cycle assessment and technologies/processes/practices that reduce emissions.

WASTE AND BIOMASS VALORIZATION Journal



Worldwide and renowned research teams in the field of Waste to Energy and Added Value Materials in *Waste and biomass Valorization* (<http://www.springer.com/engineering/journal/12649>).

This journal is gaining an outstanding reputation. 12 issues/year will be published from 2018 (in 2017) and the number of manuscripts submitted is doubling each year since 2015.

WtERT France in collaboration with the WasteEng Conference Series have brought together 10 prominent academics on a review of recent progress and prospects in the field of biomass and waste to energy and added-value materials. This paper has been published in *Waste and Biomass Valorization*.

Progress and Prospects in the Field of Biomass and Waste to Energy and Added-Value Materials

M. Castaldi, J. van Deventer, J. M. Lavoie, J. Legrand, A. Nzihou, Y. Pontikes, X. Py, C. Vandecasteele, P. T. Vasudevan, W. Verstraete

This article has been assembled through the contributions of the attendees of the WasteEng2016 Conference who participated in the three Panel Discussions during the conference. The attendees represented a global spectrum of location and socioeconomic position.

PUBLICATIONS IN PEER REVIEWED INTERNATIONAL JOURNALS

WTERT France researchers at IMT-Mines Albi published papers in renowned peer reviewed journal. A selection of 2017 papers is shown below:

- 1) M. Castaldi, J. van Deventer, J. M. Lavoie, J. Legrand, A. Nzihou, Y. Pontikes, X. Py, C. Vandecasteele, P. T. Vasudevan, W. Verstraete. Progress and Prospects in the Field of Biomass and Waste to Energy and Added-Value Materials. *Waste and Biomass Valorization*, 8 (6), pp 1875–1884, 2017
- 2) J. Dong, NZIHOU A., Y. Chi, E. Weiss-Hortala, M. Ni, N. Lyczko, Y. Tang, M. Ducouso, Hydrogen-rich gas production from steam catalytic gasification of bio-char. *Waste and Biomass Valorization*, 8 (8), pp 1875–1884, 2017
- 3) M. Said, L. Cassayre, J.-L. Dirion, X. Joulia, A. Nzihou; Effect of Nickel Impregnation on Wood Gasification Mechanism. *Waste and Biomass Valorization*, 8(8), pp 2843-2852, 2017
- 4) R. Sani, A. Nzihou. Production of clay ceramics using agricultural wastes: study of properties, energy savings and environmental indicators. *Applied Clay Science*, 146, 106-114. 2017
- 5) L.M. Romero Millan, A. Nzihou, F.E. Sierra Vargas. Kinetic analysis of tropical lignocellulosic agrowastes pyrolysis. *BioEnergy Research*, 10, 832-845, 2017
- 6) B. Stanmore, A. NZIHOU. Can biomass be satisfactorily gasified under pressure using an aqueous slurry feed: Examination by simulation. *Biomass and Bioenergy*, 97, 108-115, 2017
- 7) O. W. Awe, Y. Zhao, A. Nzihou, D. Pham Minh, N. Lyczko. A Review of Biogas Utilisation, Purification and Upgrading Technologies. *Waste and Biomass Valorization*, 8 (2), 267–283, 2017
- 8) M. Hervy, S. Berhanu, E. Weiss-Hortala, A. Chesnaud, C. Gérente, A. Villot, D. Pham Minh, A. Thorel, L. Le Coq, A. Nzihou. Multi-scale characterisation of chars mineral species for tar cracking, *Fuel*, 189, 88-97, 2017
- 9) K. Zeng, D. Gauthier, D. Pham Minh, E. Weiss-Hortala, A. Nzihou, G. Flamant, Characterization of solar fuels obtained from beech wood solar pyrolysis, *Fuel*, 188, 285-293, 2017
- 10) T. Son Phan, A. R. Sane, B. Rêgo de Vasconcelos, D. Pham Minh, P. Sharrock, D. Grouset, A. Nzihou. Hydroxyapatite supported bimetallic cobalt and nickel catalysts for syngas production from dry reforming of methane. *Accepted in Applied Catalysis B*, 224? 310-321? 2018.

PLENARY AND KEYNOTE LECTURES AT INTERNATIONAL CONFERENCES

Prof. Ange Nzihou has been invited to deliver plenary lectures and keynotes in international conferences on the field of interest for WtERT.

- 1) Nzihou A., "Biowaste as a source for nutrients, micro-elements and sustainable fertilizers (biofertilizers)", 9th Intern. Conf. of the African Materials Research Society (AMRS2017), Gaborone, Botswana, December 11-14, **2017**
- 2) Nzihou A., « An overview and challenges on alternative fuels and renewables », Invited talk- Université de Sherbrooke- Département de génie chimique et des biotechnologies, Sherbrooke- Canada- October 5, **2017**
- 3) Nzihou A., « Innovative Catalysts for the Conversion of greenhouse gases (CO₂ and CH₄) from biowastes to energy and chemical », 7th International Congress on Biofuels and Bioenergy, Toronto, Canada, October 2-4, 2017
- 4) Nzihou A., "Conversion of greenhouse gases (CO₂ and CH₄) from biowastes to energy and chemical using innovative calcium phosphates catalysts"; 15th International Conference on Environmental Science and Technology, 31 August to 2 September, Rhodes, Greece, **2017**
- 5) Nzihou A., "Syngas production in dry reforming of methane using phosphate-based and conventional catalysts"; 5th International Conference on Sustainable Solid Waste Management, June 21-24, Athens, Greece, **2017**
- 6) Nzihou A., "An overview on alternative fuels and renewables"; Solvay company Soda Ash Brainstorming session on Alternative Fuels; June 2, Paris, France **2017**
- 7) Nzihou A., "Calcium phosphates versus conventional catalysts: Case study of dry reforming of methane", Catalysis and Chemical Engineering. February 22-24, Baltimore, USA, **2017**

WtERT- Germany Activities in 2017

By: Hedwig Vielreicher, Manager WtERT-Germany

WtERT-Germany was assigned by the Global WtERT Council (GWC) to collect and showcase all data (expert profiles, scientific papers, news, case studies on WtE solutions etc.) from all WtERT organization. In 2017 WtERT Germany developed the **WtE Decision Support System** now available at www.wtert.net.

The **WtE Decision Support System** provides a platform to stakeholders from all over the world to:

- get informed and inform about state of the art methods and technologies for sustainable waste management,
- inform about the waste management methods in their country and learn about solutions in neighboring and other countries toward approaching sustainable waste management,

- to provide a database of realized solutions by means of case studies from all over the world,
- to get in contact with scientists, local decision makers, associations and companies who may assist with implementation of the needed technology.

The **WtE Decision Support System (WTE-DST)** provides information classified by

- technical terms, see: http://www.wtert.net/Biomass_to_Energy.html
- countries, <http://www.wtert.net/China.html>

The **WTE-DST** database includes

- experts, <http://www.wtert.net/Experts>
- partner institutions like companies, associations, municipalities and universities <http://www.wtert.net/Partners.html>
- case studies, e.g. <http://www.wtert.net/bestpractice/52/MBT-Jiangsu-High-Tech-Waste-Processing-for-China.html>
- abstracts and links to scientific papers, e.g. <http://www.wtert.net/paper/3917/Study-on-Achievements-and-Perspectives-towardsa-Green-Economy-and-Sustainable-Growth-in-Serbia.html>
- articles about the current state of waste management in different countries, <http://www.wtert.net/paper/3819/Current-State-of-Waste-Management-in-Brazil.html>
- news http://www.wtert.net/Latest_News.html and
- events http://www.wtert.net/Upcoming_Events.html

The WTE-DST and www.wtert.net were first introduced at the WTERT-Asia Inaugural Meeting in Nanjing, China (May 2017), After that, they were promoted by Werner Bauer and Hedwig Vielreicher at numerous technical events in Germany, Austria, Luxembourg, Ukraine, Turkey and Bosnia Herzegovina.

Please contribute your data to wtert.net by e-mailing to Hedwig Vielreicher, vielreicher@wtert.net



WtERT- Greece activities in 2017

By: Prof. Kostas Aravossis, National Technical University of Athens; President WtERT-Greece

WTERT Greece – SYNERGIA has collaborated, participated and been represented successfully through its members and representatives who continued to support our work in Greek and European level for the 9th year since its establishment in 2008. We wish to all of you a happy and fruitful 2018.

PRESENTATIONS

WTERT Greece and WtE strategy, guidelines and studies have been represented in International Exhibitions through roundtables and presentations in several cases in the past year.

1. Prof. Konstantin Aravossis coordinated the roundtable on “Implementation of Regional Waste Plans (PEDSA), first tenders and financing” that took place during the “**Waste management, The next day**” conference, (Hilton, Athens, 09/01/2017)
2. Prof. K. Aravossis, as the Chair of WTERT Greece made a presentation “Possibilities of waste recovery to energy and Biogas Combustion Plants” at the **International Exhibition “Verde.Tec” Forum**, (Mediterranean Exhibition Centre, Athens, 2-5/03/2017)
3. Prof. K. Aravossis made a presentation on “Business opportunities within circular economy driven by EU Directives” on the **Conference of Chemical Industries Association of Europe**, (Bratislava, 08/04/2017)
4. Prof. K. Aravossis presented “Greece’s energy mixture and development perspectives in the EU - the role of WtE” during the 2nd **International Petroleum Conference**, (Athens, 09/06/2017)
5. WTERT sponsored the **5th International Conference on Sustainable Solid Waste Management**. Global WTERT Head Prof. Themelis chaired and coordinated with Prof. K. Aravossis, Head of the Greek WTERT Branch a special session on 'Waste to Energy' as part of the Conference, including 19 specialized presentations of best practices from 15 countries of the world. (Athens, 23/06/2017)
6. WTERT Greece participated **at the 6th International Conference on Environmental Management, Engineering, Planning and Economics (CEMEPE)** and **SECOTOX** Conference,

(Thessaloniki, 25 – 30/06/2017) Two Greek presentations regarding WtE matters have been presented by:

- a. Prof. C.S. Psomopoulos (WTERT Greece partner) *“Current state of the Waste-to-Energy industry globally”*, and
- b. Prof. K. Aravossis, *“A municipal solid waste management assessment guide for waste management plans and reporting”*

7. WTERT sponsored the **18th European Roundtable for Sustainable Consumption and Production**, - ERSCP 2017, “Towards a Greener Challenge & Evolution in the Framework of the Circular Economy”. Prof. Carlo Vandecasteele, KU Leuven, as a Keynote Speaker invited by WTERT Greece, presented “The role of waste to energy, WTE in the circular economy”. Prof. C.S. Psomopoulos during the Energy, Environment and Economic Session, discussed the “Potential contribution of Waste to Energy as part of the effort for the economic recovery of Greece”. (Skiathos, 1-5/10/2017)

8. Prof. Aravossis, as Head of the Scientific Committee of the conference and chair of WTERT Greece, organized, chaired and coordinated the roundtable on “Energy Recovery from waste” (combustion, energy from biogas, anaerobic digestion) during the **5th International Conference on «Solid Waste Management and its Contribution to Circular Economy»** held by the Hellenic Solid Waste Management Association, in collaboration with ISWA (Athens, 14-15/12/2017).

The discussion panel was composed by members of leading companies the Greek waste management Industry.

COLABORATIONS/PARTNERSHIPS

- WTERT Greece, contributed to the creation of WTERT Southeast Europe, welcoming already the first participating country, Serbia, and the WTERT Serbia branch.
- HELEKTOR has become a WTERT Greece sponsor, with further discussions of cooperation with Global WTERT.
- WTERT Greece has become a member of DEPAN, from April 2017, a network that promotes entrepreneurship and services for the benefit of Greek municipalities and citizens.

PUBLICATIONS

WTERT Greece researchers published, presented and participated in several national and international meetings and conferences. You can below find a list of the most significant publications:

- **Kungolos A., Laspidou C., Aravossis K., Samaras P., Schramm K.W., Marnellos G.**
"Proceedings of the 6th International Conference on Environmental Management Engineering, Planning and Economics (CEMEPE) & SECOTOX Conference"
pages: 1278 GRAFIMA Publ., **2017**
- **Strantzali E., Aravossis K., Livanos A.**
"Evaluation of Future Sustainable Electricity Generation Alternatives: The case of a Greek Island"
Renewable & Sustainable Energy Reviews Journal [Volume 76](#), September 2017, Pages: 775–787, **2017**
- **Mitsikas A., Aravossis K.,**
"A Municipal Solid Waste Management Assessment Guide for Waste Management Plans and Reporting".
Proceedings of the 6th International Conference on Environmental Management, Engineering, Planning & Economics, Thessaloniki, Greece, 25 – 30/06/2017, pp 466-475.
- **Mitsikas A., Aravossis K.,**
"A techno-economic Assessment of Waste Management Scenarios in Attica - Greece"
18th European Roundtable for Sustainable Consumption and Production - ERSCP 2017, Skiathos, 1-5/10/2017.
- **Kyriakopoulos G., Kapsalis V., Aravossis K.**
"Investigation of Environmental Services Valuation towards inter-organizational system frameworks of circular economy" 18th European Roundtable for Sustainable Consumption and Production - ERSCP 2017, Skiathos, 1-5/10/2017. Greece, Volume: Session 13: Resource Efficiency and Resources, pp. 565–573. ISBN: 978-618-5271-24-4
- **Aravossis K.**
"Possibilities of waste recovery to energy and Biogas Combustion Plants", VERDETEC FORUM, 1st International Exhibition VEREDETC, MEC Paiania, Athens, 05/03/2017
- **Aravossis K.**
"Greece's energy mixture and development perspectives in the EU - the role of WtE",
2nd International Petroleum Conference, 09/06/2017
- **Patsiouras K., Psomopoulos C.S., and N. J. Themelis**
Current state of the Waste-to-Energy industry globally.
6th International Conference on Environmental Management Engineering, Planning and Economics (CEMEPE) & SECOTOX Conference
- **Triantafyllou V., Bourtsala A.C. (Thanos)**
The role of Waste to Energy (WTE) in a circular economy society.

18th European Roundtable for Sustainable Consumption and Production, -
ERSCP 2017

- **Sakalis A. and Kalogirou E.N.**

Waste-to-Energy Implementation and other Investment Opportunities in the
Greek Waste Management Sector. WTERT Greece

<http://www.wtert.eu/Greece.html>

Prof. Aravossis has also published articles on the Greek press, about “Environmental Protection, Investments and development” and “Environmental Protection, a growth leverage”, highlighting the importance of heading towards Waste To Energy solutions and the opportunities energy recovery could bring to the Greek market.

WtERT- India Activities in 2017



Waste to Energy Research & Technology Council
(WTERT-India)

Elanza Building, Room No.1, 1st Khed Lane,
Off Sayani Road, Prabhadevi,
Mumbai – 400 025. Phone no- 022-65616261
Email id: info@wtert.in

1.0 About WTERT-India

Waste to Energy Research and Technology Council (WTERT)–India co-founded with the Memorandum of Understanding between CSIR- (NEERI) National Environmental Engineering Research Institute and the Earth Engineering Centre (EEC) of Columbia University, New York, brings out solutions and understanding of the current challenges in sustainable waste management through conferences and workshops since the inception of WTERT-India in 2011.

WTERT-India is focusing on the industries, government agencies which are implementing technologies to reduce the public health impacts of improper solid waste management in India and increase the recovery of materials and energy from the used solids, by means of recycling, composting, and waste to energy and sanitary land filling with landfill gas utilization. The guiding principal of WTERT - India is to have an effective responsible management of waste which could be cost effective in a shortest time.

2.0 Organizational Set up:

In 2015, the following members were selected for the various posts for an initial tenure of one year and have been continued with extensions with the concurrence of the trustees:

Shri. D. M. Shrotriya, President

Post	Name
Vice President	Mr. K. S. Rao

Secretary	Dr. Sunil Kumar
Treasurer	Miss Geetanjali Pawar

Prof. (Dr.) Arun D. Sawant, one of the Trustees of WTERT-India was appointed as Project Director from 1st July, 2016 for the Research Centre set up at Surat, conference related work, convenor for conferences and certificate course including any other project related work.

The details of different members and staff are shown in Appendix 1.

3.0 Principal activities of WTERT-India

3.1 Seminar Organized

In order to understand Air & Water pollution issue of the MIDC areas and to create awareness and identifying problems faced by the Industries and Industrial areas, WTERT– India had taken an initiative to conduct program for a period of 6 months with the support of MPCB and MIDC in 5 MIDC industrial areas. WTERT-India accordingly organized three Seminars on “Solution Based Awareness on Air and Water Quality for MIDC Industries and Industrial Areas” at Dombivali, Talaja and Tarapur during the period March 2017 to June 2017. Through these Seminars, WTERT-India has highlighted the current scenario of each area with an emphasis towards estimating the water, air and energy footprint in industry and industrial areas with remedial measures to reduce the emissions & discharges which would benefit the Industries and help for sustainable development. We received good response from the industries and the participants attended the seminars. The Outcome of the Seminars have been sent to the concerned MIDC areas and uploaded on WTERT-IndiaWebsite.

3.2 Conference Organized:

WTERT-India in 2017, organized one National Level Summit on “Waste to Energy Technology Plants & Equipment Providers” at Hyderabad on 3rd Feb. 2017



National Level Summit held at Hyderabad on 3rd Feb. 2017

In these brainstorming workshops/seminars, it was found that the challenges related to Waste Management are sector and locality specific. Each Municipal Corporation, ULBs has their unique problems and challenges ranging from collection and storage, segregation, transportation leading to processing and disposal issues. Mostly in these conferences, it was discussed and

debated about the challenges faced by Urban Local Bodies, service providers, manufacturers, and researchers in selecting appropriate technology for SWM. Mostly, they considered the factors such as waste segregation, easy operation and maintenance strategies, valuable product, low manpower and maintenance requirement etc.

4.0 Way forward and future work:

Based on the experiences in past two years, WTERT-India is focusing on capacity development and knowledge support from Municipal bodies, ULBs, Govt. authorities etc. Some of the upcoming projects are:

1. Waste Characterization Study of Bhopal and Indore City through the developer agency for which we have already submitted the proposals.
2. Waste Characterization Study of Amritsar, Pimpri-Chinchwad through the developer agency for which we have already submitted the proposals.
3. Waste Characterization Study of Machhalipatnam, Tadepalligudem and Vizianagaram through the developer agency for which we have already submitted the proposals.
4. Proposed one day Seminar on “Solution Based Awareness on Air and Water Quality for MIDC Industries and Industrial Areas” at Additional Ambarnath MIDC, Badlapur MIDC and in the months of January, 2018.
5. The work started for the project on “Baseline status of Ambient Air quality in & around dumping sites with emphasize on odorous Compounds” for The Mumbai Metropolitan Region – Environment Improvement Society (MMR-EIS). Four sites have been selected for the study i.e. Deonar & Gorai of Mumbai, Thane & Navi Mumbai of MMR respectively. Deonar and Thane are the open dumping sites whereas Navi Mumbai site is scientific landfill site and Gorai site is closed one. Currently, a Preliminary Site visits are arranged for the collection of the Primary data of the dumping sites from the respective municipal corporations, identifying the sampling locations and carrying odour perception surveys for the identified locations.
6. We have submitted a proposal to Thane Municipal Corporation for providing **Advisory Services** for closure of dumping site at Diva-Khardi site.

Appendix 1. List of Members of WTERT-India

Board Members and Trustees

Mr. D.M. Shrotriya, President Mr. K. S. Rao, Vice-President
Dr. Sunil Kumar, Secretary Miss Geetanjali Pawar, Treasurer

Other Trustees

Dr. Rakesh Kumar, Prof. (Dr.) Aurn D. Sawant Dr. Vijay Kulkarni

Other Members: Mr. Ranjit Anepu Mr. Avick Sil

Staff of WTERT-India: Ms. Geetanjali Pawar, Project Manager ; Mr. Sumith Shetty, Technical Assistant; Miss. Prachi Padave, Field Assistant

WtERT- Italy (MatER) activities in 2017

By Prof. Stefano Consonni, Politecnico di Milano: Director of MatER

The MatER Study Center, sister organization of the Global WTERT Council, wishes you a Happy and Successful 2018. The past year has been for sure a rich year, full of



Materia & Energia da Rifiuti
Materials & Energy from Refuse

novelties and original content in the history of our study center since its beginning in 2011. This could be represented most of all from two key events: the 3rd edition of the MatER Meeting and the launch of the new MatER website, completely refurbished as in the graphic as in the overall structure.

On May 22nd - 23rd the MatER Meeting 2017 took place at the Piacenza Campus of the Politecnico di Milano over ***“Innovation & Trends in Waste Management”***.

This biannual conference arises from the fundamental goal of MatER that is providing a thorough, objective representation of technologies and policies for **material and energy recovery from waste**, covering the regulatory, strategic and technical scientific aspects of sustainable waste management. The event has been organized with the scientific support of DICA (Department of Civil and Environmental Engineering) and Energy Department of the Politecnico di Milano.

For the first time the collection of the works has been managed entirely through a call for-abstracts and their evaluation has been undertaken by a scientific committee according to their quality, innovation and relevance of the subject, together with the need to preserve a balance of topics within the sessions.

We decided to implement for the first time a registration form to manage all the applications totally on-line, developing also a dedicated website for the event using the platform *EasyChair* that we have been using to collect at the same time the works of the authors.

The detailed program, together with the short abstract descriptions, can still be consulted at [the dedicated page of the event](#).

Some works have been illustrated during the oral sessions and the rest have been presented in 4 poster sessions, distributed among the 2 days.

The focus of the 4 oral sessions have been:

- 1. Strategies and perceptions on waste management;*
- 2. Closing the loop: potential and critical issues;*
- 3. Processes and technologies for energy recovery;*
- 4. Processes and technologies for material recovery.*

Furthermore, during the afternoon of May 22nd we introduced a special panel session concerning the economic regulation of waste management, which is becoming a relevant topic especially in Italy. After an overview concerning the regulation of waste management tariffs, a round table with institutional guests of the AGCM (Italian

Competition Authority), the AEEGSI (Italian Regulatory Authority for Electricity Gas and Water), UTILITALIA, ATERSIR Emilia Romagna, HERAMBIENTE and CONAI have been set up. At the end of the round table, we had the pleasure and the honor to host the **Italian Minister of the Environment**, Gian Luca Galletti, who gave the closing speech of the economic session.

The conference offered a broad overview on the waste management situation in Italy with the possibility to compare it as well with some other countries. The speakers outlined the main technological, environmental and economical challenges that are going to be faced to improve the sustainability of the waste management system and some proposal on how to tackle them.

Finally, another novelty of the 3rd edition has been the introduction of the technical visit of a waste treatment facility, hosted this year on May 24th at the WtE plant of Piacenza of IREN Ambiente.

Here are in summary some of the **MatER 2017** numbers:

- *~130 participants, over 8 nations and different professional realities (university, industry, public administrations, etc.)*
- *24 presentations over 2 days*
- *13 Poster presentations*
- *4 international Keynote lectures*
- *1 round table with institutional guests*

[Some pictures with the highlights of the event can be seen in our website at **this link**.](#)

We really would like to thank all the WtERT network participants that took part to the event and gave a significant contribution to make this event successful with us. It has been a pleasure to share this important moment with all of you and we really hope to see you again (and many more!) for the 4th edition in 2019.

The second great change that made this year remarkable for our study center involved the communication aspect. In 2017 in fact we completed the making of and the activation of our new website, completely refurbished not just esthetically but also in the concept in order to offer a more immediate and comprehensive explanation over the recovery of material and energy from waste.

An analysis and planning of the digital strategy of MatER had been previously done by Quaerys Srl, which is an innovative start-up operating in the fields of social media monitoring and big data content analysis. As we wanted to pay a special attention to our communication side, we then received the support from Quaerys to define our communication strategy and the redesign of the MatER website.

We decided to implement it in Wordpress, a free and open-source content management system, but very common in modern websites. It took us quite a significant time to get familiar with this new tool, but although some work and improvements still have to be done, we are very satisfied with **our new communication channel**.

We are also very glad to announce that in 2017 we renovated the partnership with the six waste management companies (A2A, Brianza Energia e Ambiente, HERA Ambiente, IREN Ambiente, Linea Group Holding, Hest Ambiente), members of the MatER

Coordinating Committee, that continue to support our work, guaranteeing the necessary funding to go further with our research activities. Moreover it's a pleasure to report you that in 2017 we signed the collaboration with a new industrial partner, represented by SILEA Spa (Società Intercomunale Lecchese per l'Ecologia e l'Ambiente per Azioni), a waste management company based in Valmadrera, province of Lecco, in the northern part of Italy.

On the academic side, in the second half of 2017, we also had the possibility to truly materialize our collaboration inside the Global WTER Network hosting as a **visiting researcher Demetra Tsiamis**, Associate Director of the Earth Engineering Center at the City College of New York. It has been a pleasure for all of us hosting Demetra throughout our facilities at LEAP for the last 6 months as an occasion of professional enrichment, knowledge transfer and scientific exchange. In particular Demetra, who directly collaborates with Prof. Marco Castaldi in the USA, carried out a meticulous work over the municipal waste comparison between the EU and the US, trying to deeply understand the waste statistics methodologies underneath.

Concerning our projects, in 2017 our research activities addressed as usual issues raised by private companies and public authorities. Here is a short list of the **most important areas of investigation**, but we are attaching to this report a document with a more detailed description of them:

- *Modeling of WtE plants and assessment of their performance;*
- *Environmental evaluation of Construction & Demolition Waste management;*
- *Recovery of Bottom Ash from Waste Incineration;*
- *High-Temperature measurements in WtE plants;*
- *Measurement of Ultrafine and Nanoparticles Emissions;*
- *Technical and economic assessment of novel technologies for the thermal treatment of waste.*

A further activity concerns the renewal of the collaboration with Lombardy Region, regarding the evaluations of innovative plants, the environmental assessment of the regional C&D waste management system, the organization of workshops over the energy balance of incinerators and other topics of interest, considerations and proposals over the EU guidelines in the field of BREF revision, etc.

During this year, we constantly monitored and analyzed the most important Italian and international updates on waste management (you can find all of them on our website, in the "News&Events" section). Our MatER researchers published various international papers about waste management, recovery and LCA activities: a list of them can be found on the "Our Study" section of the website.

As an example, Mario Grosso and Lucia Rigamonti, members of the scientific committee of the MatER Study Center, cured the editorial of *WASTE MANAGEMENT & RESEARCH* of August 2017, entitled "*Circular economy, permanent materials and limitations to recycling: Where do we stand and what is the way forward?*".

As part of our work, our MatER researchers constantly took part all over the year to many national and international **meetings**, with **oral presentations**, posters and related

full paper available in the meeting records. Here below is a short list of the most significant ones with the name of the speakers and title of the work:

11th European Conference on Industrial Furnaces and Boilers (April 2017 - Algarve, Portugal): "An Optimal Algorithm to assess the compliance with the T2s requirement of Waste-to-Energy facilities" (F. Viganò)

4th International VDI Conference (May 2017 – Copenhagen, Denmark): "Materials and energy from waste – experiences from Italy" (M. Grosso)

PREWIN Network Meeting 2017 (June 2017 - Copenhagen, Denmark): "Has the increased fraction of industrial waste in WtE plants an effect on the emissions?" (F. Viganò)

Joint Conference ISIE and ISSST (June 2017 – Chicago, USA): "C&D Waste Management in Lombardy Region" (L. Rigamonti) .

- ‡ *IRRC - International Recycling and Recovery Congress (September 2017 – Vienna, Austria): "Impact of the increased fraction of industrial waste on the emissions from waste-to-energy plants" (F. Viganò);*
- ‡ *SARDINIA 2017 (October 2017 – Cagliari, Italy): "C&D Waste Management in Lombardy Region" (L. Rigamonti)*
- ‡ *4th International Conference on Final Sinks (October 2017 – Kyoto, Japan): Keynote Speech "Waste prevention and re-use: experiences, environmental assessment and challenges" (M. Grosso);*
- ‡ *CEWEP STAC Meeting (November 2017 – Paris, France): "Optimization of IWMSs: Methodology and preliminary findings" (S. Consonni).*

in 2018, Our Best Wishes for a Fruitful New Year to all WTERT sister organizations!

WtERT- Republic of Korea activities in 2017

By Prof. Yong-Chil Seo, Director of WTERT-Korea and BK+21 Program; and Prof. Hang-Seok Choi, Head of Dept. of Environmental Eng., Yonsei University

Center for WTE: Post Graduate Programs for Waste to Energy and Related R&Ds for Process Technology of Combustible and Organic Waste to Energy

Through the Human Resources Development program of the Korea Institute of Energy Technology Evaluation and Planning, Ministry of Industry and Commerce, R.O. Korea, we concentrate on the development of the combustible/organic wastes energy process system technology and fostering trained manpower, especially post graduate level. To cultivate internationally competent professionals, Yonsei University specializes in educational programs such as establishing curriculum for the field of the combustible/organic wastes energy process system, performing an internship and holding a related seminar. Also, we hold a Korea-China-Japan Joint Symposium on waste energy technology every year with Dalian University of Technology(DIT), China and Tokyo Institute of Technology(TITech), Japan. As related post graduate program for energy, material cycle and environment, the department got granted BK21+ project from 2014 until 2020. With the operation of these human resource development programs, the total grant was around US\$ 1 million/year for supporting post graduate research.

Established Gangwon Provincial WTE Council

In order to promote community development and regional specialization, competitiveness in Waste to Energy, we organized the Gang-won Waste Resource and Energy Council, which includes local governments and local communities in the province of Gangwon. Major activities include joint researches performed with region- and central-based companies, academia and local government, joint development of basic research and commercialization technologies, specialized graduate school curriculum, and human resource development program, etc.

R&Ds granted in 2017

1. Technology of thermal energy production and solid refuse fuel using mixing waste of low calorific value, KETEP, *74 thousand dollars/year*(2015-2018)
2. Development of economical & eco-friendly crematory system, MSS, *46 thousand dollars/year* (2015-2017)
3. Development of high quality syngas production technology for MSW fluff SRF by mixed oxidants gasification, KEITI, *123 thousand dollars/year*(2013-2018)
4. The Development of Innovative Gasification Technology with Tar Free and Purified Producer Gas for MSW-SRF, KIST, *140 thousand dollars/year* (2015-2017)
5. Commercialization of 0.5 TPD-class process for mercury harmless and recovery from mercury wastes, KEITI, *34 thousand dollars/year*(2016-2018)
6. Estimation on natural emission of long range transported mercury and assessment of contributions by anthropogenic emissions between surrounding nations, KEITI, *290 thousand dollars/year* (2015-2018)
7. Identification and estimation of air borne pollutants having potential carcinogenic effects along with atmospheric dispersion of mercury and its toxicity study in Seoul, South Korea, NRF, *28 thousand dollars/year*(2016-2017)
8. Development of the Integrated Treatment Technology for High Mercury Contents, KEITI, *332 thousand dollars/year* (2014-2017)
9. Development of integrated electro-mechanical actuator (300g weight class) for aircraft of operational ceiling height 60,000ft (18.3km), KEIT, *105 thousand dollars/year* (2017-2020)
10. Advanced Graduate Program in Process System Technology of Combustible/Organic Waste to Energy, KETEP, *457 thousand dollars/year* (2017-2021)
11. Production of high-grade biofuel from by-products of domestic timber industry and evaluation its practical use as heating fuel, KFS, *93 thousand dollars/year* (2017-2019)
12. Development of integrated production process and scale-up optimum design technology of high-calorific fuel and hydrocarbon material based on polymer waste, NRF, *93 thousand dollars/year* (2017-2020)
13. Development of APAC (Advanced Process Analysis Combined with CFD) process simulation technology using CFD Library for the next generation waste biomass fast pyrolysis plant, NRF, *92 thousand dollars/year*(2014-2017)
14. Knowledge-based Environmental Service Human Resource Development Project, KEITI, *211 thousand dollars/year* (2015-2018)

15. Development of High Value Added Heat Recovery Technology for Waste Tire Using Speed-Dissipation Heat Recovery Reactor, TIPA, *100 thousand dollars/year* (2016-2017)

16. Development of Transportation Fuelization Technology by Stabilizing the Use of Agricultural Spread By production Oil and Upgrading of Dedication Oxygen, KETEP, *218 thousand dollars/year* (2014-2017)

17. Development of 20T/D pyrolysis oil production demonstration and utilization technology, KETEP, *69 thousand dollars/year* (2017-2021)

PhD and MS dissertations supervised by WTERT-Korea (2017)

1. **Seung-Ki Back:** PhD, Development and Application of Mercury Recovery System for Wastes Generated from Various Industries using Roasting Technologies

2. **Won-Seok Yang:** PhD, Assessment of Available Technologies and Gasification Characteristics for Various Wastes: Waste Urethane, Automobile Shredder Residue, Solid Refuse Fuel Residue

3. **Ho-Seong Yoo:** MS, A study on characteristics of torrefaction of EFB (Empty Fruit Bunch) and fast pyrolysis of EFB

4. **Won-Jun Jang:** MS, A Study on Supported Nickel Catalysts for Reforming of Methane and Glycerol

5. **Jae-Oh Shim:** PhD, A Study on Deoxygenation Catalyst for Biodiesel Production from Oleic Acid

6. **Min-Jae Kim:** MS, A Study on Catalytic Decomposition of N₂O over Cobalt Based Catalysts: The Role of Additives

7. **Da-We Lee:** MS, A study on Pd based Catalysts for the Deoxygenation of Oleic Acid

Education and information dissemination activities

Prof. Seo participated and presented at the WtERT-Asia inaugural meeting in China (April 2017), and designated as a vice president of WTERT Asia. He has attended and presented various topics in WtE and environment in the 3Rincs conference in Mumbai, India (March, 2017), the 8th International Conference on Chemical, Agricultural, Biological and Environmental Sciences in Singapore (August, 2017), the 11th International Conference on Chemical, Agricultural, Biological, Healthcare and Environmental Sciences (CABHES) in Indonesia (August, 2017) and the 7th International Conference on Solid Waste Management in India (December, 2017). He has also designated as an International Advisory Board Member of National Institute of Environmental Studies of Japan for 5 years term (2017-2022).

Prof. Seo continued to experiment at mercury emission inventory and removal in South Korea anthropogenic sources during 15 years. The results were published about 30 papers in various SCI journals. As in 2013 and 2017, UNEP invited Prof. Seo to mercury expert for making "Technical Background Report for the Global Mercury Assessment 2013 and 2017".

China-Japan-Korea Joint Symposium on Energy and Environment has been held every year between 3 countries WtE academic institutes (Yonsei, DIT, TIT) by sharing R&D performances with the attendance of 20-30 graduate students from each country. This year it was held at Dalian Institute of Technology (DIT), China, on Oct. 26-28, 2017.

There were some awards of presentations in the symposium by Korean students as follow;

- Oral: A Study on Characteristics of Pilot-Scale Gasification Process for Solid Refuse Fuel (Se-Won Park)
- Oral: Studies on Gasification Characteristics Using Solid Refuse Fuel Residue Treated by Mechanical Biological Treatment Process (Sang-Yeop Lee)
- Poster: Gasification Characteristics of Fluff Type Solid Refuse Fuel in Downdraft Fixed Bed and Bubbling Fluidized Bed Reactors (Yeon-Ouk Jeong)



Publications (2017)

1. Yoo, H. M., Seo, Y. C., Park, S. W., Kang, J. J., Choi, H. S., & Oh, C. H. (2017). **Removal Effect of Ash and Metallic Species by Washing from Empty Fruit Bunch Byproducts in Palm Mills on Pyrolytic Characteristics to Produce Bio-Crude Oil.** *Waste and Biomass Valorization*, 1-12.
2. Back, S. K., Sung, J. H., Moon, Y. H., Kim, Y. H., Seok, K. S., Song, G. J., & Seo, Y. C. (2017). **Mercury distribution characteristics in primary manganese smelting plants.** *Environmental Pollution*, 227, 357-363.
3. Pudasainee, D., Seo, Y. C., Sung, J. H., Jang, H. N., & Gupta, R. (2017). **Mercury co-beneficial capture in air pollution control devices of coal-fired power plants.** *International Journal of Coal Geology*, 170, 48-53.
4. Sung, J. H., Back, S. K., Jung, B. M., Kang, Y. S., Lee, C. G., Jang, H. N., & Seo, Y. C. (2017). **Speciation and capture performance of mercury by a hybrid filter in a coal-fired power plant.** *International Journal of Coal Geology*, 170, 35-40.
5. Jang, H. N., Back, S. K., Sung, J. H., Jeong, B. M., Kang, Y. S., Lee, C. K., ... & Seo, Y. C. (2017). **Adsorption and kinetics of elemental mercury vapor on activated carbons impregnated with potassium iodide, hydrogen chloride, and sulfur.** *Korean Journal of Chemical Engineering*, 34(3), 806-813.
6. Roy, D., Seo, Y. C., Sinha, S., Bhattacharya, A., Singh, G., & Biswas, P. K. (2017). **Human health risk exposure with respect to particulate-bound polycyclic aromatic hydrocarbons at mine fire-affected coal mining complex.** *Environmental Science and Pollution Research*, 1-17.

7. Upadhyay, M., Park, H. C., Hwang, J. G., Choi, H. S., Jang, H. N., & Seo, Y. C. (2017). **Computational particle-fluid dynamics simulation of gas-solid flow in a circulating fluidized bed with air or O₂/CO₂ as fluidizing gas.** *Powder Technology*.
8. Park, H. C., Choi, H. S., & Kwak, Y. H. (2017). **Numerical study of heat transfer characteristics of char from waste tire pyrolysis.** *Journal of Material Cycles and Waste Management*, 1-8.
9. Parthasarathy, P., Choi, H. S., Hwang, J. G., & Park, H. C. (2017). **Determination of thermal decomposition kinetics of low grade coal employing thermogravimetric analysis.** *Korean Journal of Chemical Engineering*, 1-15.
10. Park, H. C., Lee, B. K., Yoo, H. S., & Choi, H. S. (2017). **[TC2015] fast pyrolysis characteristics of biomass in a conical spouted bed reactor.** *Environmental Progress & Sustainable Energy*, 36(3), 685-689.
11. Lee, J. E., Park, H. C., & Choi, H. S. (2017). **Numerical Study on Fast Pyrolysis of Lignocellulosic Biomass with Varying Column Size of Bubbling Fluidized Bed.** *ACS Sustainable Chemistry & Engineering*, 5(3), 2196-2204.
12. Jha, A., Lee, Y. L., Jang, W. J., Shim, J. O., Jeon, K. W., Na, H. S., ... & Na, J. G. (2017). **Effect of the redox properties of support oxide over cobalt-based catalysts in high temperature water-gas shift reaction.** *Molecular Catalysis*, 433, 145-152.
13. Na, H. S., Shim, J. O., Jang, W. J., Jeon, K. W., Kim, H. M., Lee, Y. L., ... & Roh, H. S. (2017). **The effect of titration time on the catalytic performance of Cu/CeO₂ catalysts for water-gas shift reaction.** *Catalysis Today*.
14. Lee, Y. L., Jha, A., Jang, W. J., Shim, J. O., Jeon, K. W., Na, H. S., ... & Bae, J. W. (2017). **Optimization of Cobalt Loading in Co–CeO₂ Catalyst for the High Temperature Water–Gas Shift Reaction.** *Topics in Catalysis*, 1-6.
15. Salama, E. S., Jeon, B. H., Chang, S. W., Lee, S. H., Roh, H. S., Yang, I. S., ... & Kim, S. (2017). **Interactive effect of indole-3-acetic acid and diethyl amino ethyl hexanoate on the growth and fatty acid content of some microalgae for biodiesel production.** *Journal of Cleaner Production*, 168, 1017-1024.
16. Jang, W. J., Kim, H. M., Shim, J. O., Yoo, S. Y., Jeon, K. W., Na, H. S., ... & Yoon, W. L. (2017). **Deactivation of SiO₂ supported Ni catalysts by structural change in the direct internal reforming reaction of molten carbonate fuel cell.** *Catalysis Communications*, 101, 44-47.
17. Park, K. S., Kim, J. H., Park, S. H., Moon, D. J., Roh, H. S., Chung, C. H., ... & Bae, J. W. (2017). **Direct activation of CH₄ to oxygenates and unsaturated hydrocarbons using N₂O on Fe-modified zeolites.** *Journal of Molecular Catalysis A: Chemical*, 426, 130-140.

18. Jang, W. J., Hong, Y. J., Kim, H. M., Shim, J. O., Roh, H. S., & Kang, Y. C. (2017). **Alkali resistant Ni-loaded yolk-shell catalysts for direct internal reforming in molten carbonate fuel cells.** *Journal of Power Sources*, 352, 1-8.
19. Kim, M. J., Lee, S. J., Ryu, I. S., Jeon, M. W., Moon, S. H., Roh, H. S., & Jeon, S. G. (2017). **Catalytic decomposition of N₂O over cobalt based spinel oxides: The role of additives.** *Molecular Catalysis*.
20. Xiong, J. Q., Kurade, M. B., Kim, J. R., Roh, H. S., & Jeon, B. H. (2017). **Ciprofloxacin toxicity and its co-metabolic removal by a freshwater microalga**

Chlamydomonas mexicana. *Journal of hazardous materials*, 323, 212-219.

21. Date, N. S., Chikate, R. C., Roh, H. S., & Rode, C. V. (2017). **Bifunctional role of Pd/MMT-K10 catalyst in direct transformation of furfural to 1, 2-pentanediol.** *Catalysis Today*.

Imperial College
London

WtERT- U.K. activities in 2017



By: Dr. Costas Velis, University of Leeds and Prof. Chris Cheeseman, Imperial College London

We are delighted to report that we have had another successful year in the UK and we would like to share with you a few selected updates. Professor Cheeseman of Imperial College London (Chair) and Dr Velis of University of Leeds (Vice Chair) met often to discuss developments in the UK sector.

We have recently appointed a **new administrator for WtERT-UK: Ms Spyridoula (aka: Loula) Gerasimidou**, is a PhD candidate in the University of Leeds, researching on advanced novel thermogravimetric methods for the characterisation of solid recovered fuels (SRF). Loula will take care of the day-to day operation of WtERT-UK, such as answering to queries submitted to the web-site. She has completed a basic review of key academic peer reviewed publications that appeared in the last 3 years and soon we will update the relevant content of our web-site. The **web-site** is for another year very well noticed, with **over 34,000 visits** to it. Its content is organised as a simplified entry point information for generic lay audiences, rather than technical experts, and therefore it appeals to anyone interested to know more about sound sustainable waste and resources management and in particular the role of thermal processing in it. In the course of 2008 we will consider a revamping, to accommodate its appearance in smartphones and tablets, accommodating the fast developments in that area.



Dr Costas Velis, Vice-Chair of the WtERT UK was invited to a high level panel on energy from waste (EfW Theatre Panel) in the landmark annual event for the sector, at **RWM in Birmingham** in September. He shared insights on the prospects of the thermal recovery in the

UK, in the light of Brexit, explaining the opportunities and challenges around the EC Circular Economy Package, and the targets to eliminate MSW landfill disposal in Europe.



Dr Velis contributed also as member of the Scientific Committee of the conference IRRC – Waste to Energy on in September 2017 in Vienna, Austria – a conference specialised in thermal processing, bringing industry and academia together.

WtERT-UK obtains regular **insights on the latest international and national trends** by its active participation in the ISWA Energy Recovery Working Group and the CIWM Thelma Treatment Special Interest Group. As part of the ISWA series of meeting we have visited the state of the art new EfW plant in Copenhagen – the ski slope still to be developed this year! **Contact with other WtERT organisations around the world** continued on an ad-hoc basis and were very fruitful: In Spring 2017, Dr Velis delivered a keynote in the Italian counterpart organisation Mater at LEAP, Politecnico di Milano, invited by Prof Consonni, where he had the opportunity to exchange experiences with their excellent academic and consultancy team in Piacenza (see photo of Prof Themelis presenting there). A series of meetings also occurred on the side of the UN Oceans Conference in New York in June – Prof Castaldi hosted us to the excellent setting and historic premises of the City College of New York (see photos) and ISWA World Congress / SWANA 2017 in Baltimore in late September with the Global WtERT colleagues (Dr Vourtsalas).





As an example of active **international research collaboration** between WtERT members, a research proposal in a BBSRC call for biotechnological processing of waste in India was put forward on advanced thermal/ bioengineering processing led by the University of Leeds with the great support of WtERT-India colleagues of NEERI, and is currently under evaluation. Both Universities kept publishing intensively on relevant matters – you can find the relevant publications in the Universities web-pages below.

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<http://www.imperial.ac.uk/people/c.cheeseman>

Dr Costas Velis, University of Leeds, Vice Chair WtERT-UK: c.velis@leeds.ac.uk
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WtERT- U.S.A. activities in 2017

USA-1) 2017 activities at Earth Engineering Center at City College of New York

By: Marco J. Castaldi, Director and Demetra Tsiamis, Associate Director EEC|CCNY

The Earth Engineering Center at City College of New York (EEC|CCNY) had a number of activities and productive collaborations that will continue into 2018. We produced

eight journal publications on sustainable MSW management ranging from recycling to landfill operations. We also published a textbook on gasification and pyrolysis of MSW. These publications are listed below:

- a) 1. Ciuta, Simona, Tsiamis, Demetra, and Castaldi, Marco J. *Gasification of Waste Materials*. 1st ed., Elsevier, 2018. ISBN 9780128127162.
- b) 2. Morton A. Barlaz, Craig H. Benson, Marco J. Castaldi, Scott Luetlich. " *Spatial and temporal characteristics of elevated temperatures in municipal solid waste landfills*, Navid H. Jafari, Timothy D. Stark, and Todd Thalhamer, Waste Management, 2017, Vol. 59, p. 286 – 301.
- c) 3. Hao, Zisu, Mei Sun, Joel J. Ducoste, Craig H. Benson, Scott Luetlich, Marco J. Castaldi, and Morton A. Barlaz. " *Heat Generation and Accumulation in Municipal Solid Waste Landfills.*" Environmental Science & Technology 51, no. 21 (2017): 12434 - 12442.
- d) 4. Sharma, Deepak K., Shalmali Bapat, William F. Brandes, Elizabeth Rice, and Marco J. Castaldi. " *Technical Feasibility of Zero Waste for Paper and Plastic Wastes.*" Waste and Biomass Valorization (2017): 1 -9.
- e) 5. M J Castaldi, J van Deventer, JM Lavoie, J Legrand, A Nzihou, Y Pontikes, " *Progress and Prospects in the Field of Biomass and Waste to Energy and Added - Value Materials* " Waste and Biomass Valorization" 8 (6), 1875 – 188.
- f) 6. MJ Castaldi, " *Biomass and RDF Gasification Utilizing Ballistic Heating TGA Analysis*" in *Thermochemical Waste Treatment: Combustion, Gasification, and Other Methodologies* , CRC Press, (2017).
- g) 7. Megan Webster , Hae Yang Lee, Kristi Pepa, Nathan Winkler, Ilona Kretzschmar, Marco J. Castaldi* , *Investigation on Electrical Surface Modification of Waste to Energy (WtE) Ash for Possible Use as an Electrode Material in Microbial Fuel Cells (MFCs)* , Waste Management & Research, in press (2017).
- h) 8. Tsiamis, Demetra A., Torres , Melissa and Castaldi , Marco J. *Role of Plastics in Decoupling Municipal Solid Waste and Economic Growth in the U.S.* , Journal of Waste Management, in review (2017).
- i) 9. Methods of Responsibly Managing End - of - Life Foams and Plastics Containing Flame Retardants ; Green Science Policy Institute.
- j) Other EEC|CCNY activities include dissemination of information on waste sustainability through research and education . In addition to our publications, we routinely give presentations to the public and private sectors and provide opportunities to the students of CCNY and other collaborating universities . In the past year, we gave a total of 11 presentations , communicating to diverse audiences quantitative research on sustainable waste management and explaining how all options, including waste to energy (WTE) , are needed to

manage the global waste issue. These presentations are listed below:

- k) 1. Transforming Waste Materials to Energy and Chemicals: An Update on Sustainable Waste Management – AIChE Metro N.Y. Section, November 2017.
- l) 2. The Role of Plastics in the Decoupling of Municipal Solid Waste Generation and Economic Growth; ISWA World Congress, September 2017
- m) 3. Reuse in NYC: ISWA World Congress, September 2017
- n) 4. Technical Assessment of Gasification and Pyrolysis Technologies in the USA – MATER Bi - Annual Conference, May 2017
- o) 5. Technical Overview of Current Technology Landscape in Waste Gasification and Pyrolysis – NAWTEC Annual Conference, April 2017
- p) 6. The Grove School of Engineering; External Advisory Board Meeting: Waste Management and Research at the Earth Engineering Center|CCNY – April 2017
- q) 7. City College Lecture Series; Conversations in Engaged Scholarship: Sustainable Waste Management: Impacts of Our Trash on Society – April 2017
- r) 8. Pyrolysis of Plastic Waste: Research Overview – ISWA Energy Recovery Working Group Meeting, Copenhagen, Denmark, April 2017
- s) 9. The Role of WTE in The Circular Economy – University of Bolzano, March 2017
- t) 10. Pyrolytic reactions in Municipal Solid Waste landfills: Experiment and Theory – Geofrontiers, March 2017
- u) 11. Carbon-based Materials for Energy and Environmental Considerations; University of Perugia, March 2017
- v) We have engaged in extensive international collaborations with colleagues from Italy, France, China, and Japan. Recently graduated EEC|CCNY student, Dane Fearon, attended Tokyo Institute of Technology in the winter of 2017 where he conducted research on char gasification. Associate Director Demetra Tsiamis recently returned from a 6-month collaboration in Italy with MatER, the Italian sister organization of Global WTERT directed by Professor Stefano Consonni, where she conducted a detailed study comparing the waste statistics methodologies of the U S and the European Union. This past October, the US Department of State organized a visit of the Chinese EPA to EEC|CCNY to learn more about WTE in the US and WTE opportunities that could be applied to projects in China.
- w) EEC|CCNY has graduated four student research associates, one of whom who has gone to work at HDR as a solid waste coordinator. Current EEC|CCNY student research associates, Tasnuva Moutushi and Grace Correa, won the 2017-2018 Floyd Hasselriis Awards of the ASME Materials and Energy Recovery (MER) Division for their work in solid waste management. Finally, our

collaboration with the Department of Sanitation of New York (DSNY) continues to grow through a professional seminar series on waste sustainability that will be offered to undergraduate and graduate students at CCNY in the spring of 2018. This seminar series will combine guest lectures by experts from around the world from the Global WtERT, industry, academia, and government with field trips to waste facilities in New York City to provide the next generation with a first - hand education and awareness of sustainable waste management.

- x) We look forward to another year of vigorous activity with current and, hopefully, new collaborators and sponsors as we continue , in collaboration with EEC - Columbia, with preparations for the WtERT 2018 bi annual meeting that will be held at the CCNY campus on October 4-5, 2018.

2) USA-2: 2017 Activities at Earth Engineering Center at Columbia University

By: N. J. Themelis, A.C. Bourtsalas, and Z.H.K. Cheng

1. Formation of the WtERT-Asia regional organization

This was the first regional organization of the Global WtERT Council (GWC). Its mission is to advance sustainable waste management in Asia. The inaugural meeting was held in Nanjing, China (April 25-27) and was sponsored by China Everbright International, the major WTE company of China. The inaugural meeting was attended by representatives of several Asian countries as well as WtERT managers from Brazil, Colombia, Germany, and the U.S. and was reported in www.wtert.org and www.wtert.eu.

2. WTE Guidebook editions for Greece and China

Mr. Vasilis Axiotis, M.S. alumnus of the Earth Engineering Center developed the Greek edition of the WTE Guidebook that is already available in English, Portuguese, and Spanish. Also, progress has been made by WtERT-Asia, headquartered in Hong Kong, in developing the Chinese rendition of the WTE Guidebook.

3. The U.S. continues to lag behind the E.U. with regard to fraction of MSW landfilled

On the basis of Eurostat data (August 2017), GWC has put together a graph showing that, in the period of 1995-2015, the E.U. increased its WTE processing capacity to 28.4% of the total MSW generated and decreased its landfilling to 25.3% of the total. In contrast, the fraction of U.S. MSW to WTE plants and to landfilling has remained constant at about 7% and 63%, respectively.

4. Graduate research supervised by WtERT-Columbia (Advisors: Prof. Nickolas Themelis; Dr. A.C. (Thanos) Bourtsalas)

4.1 Studies completed in 2017 (*Please note: All completed theses are available at www.wtert.org, Resources, Theses*)

Anna Libey: Assessment of the waste management systems of the United Nations (New York) and Columbia University.

Dianyi Yan: Application of thermal spray techniques for combatting high temperature corrosion in waste-to-energy boilers

Fernanda Cabanas: Integrated sustainable waste management and inclusion of the informal sector in Santiago de Chile

Hongwei Liang: Life Cycle Cost Analysis of corn based ethanol fuels in U.S.

Irene Pavlakis: Analysis on the market of the recyclable and compostable products in the US.

Zhuo (Kevin) Cheng: Development of an analytical framework for advancing sustainable waste management in the U.S.

Ronglong Shen: Marketing survey of beneficial use of waste-to-energy bottom ash for civil engineering applications

Vaios Triantafyllou: Comparative Study of European Mechanical Biological Treatment Plants

Yating Yu: An inventory analysis of WTE dioxin emissions in China

Yenaxika Bolate: Inventory of all mercury emission in U.S. This study included all Covanta Energy and Wheelabrator Technologies plants and showed that the WTE industry represented only 0.6% of all U.S. mercury emissions to the atmosphere.

Yi Xu: Life Cycle Analysis of processes for resource recovery from Waste-to-Energy bottom ash: A comparative analysis between U.S. and E.U.

Yusnu Cai: Evolution of public health benefits from improvements in waste management in New York City.

Zucheng Guo: Pre-feasibility study of a waste-to-energy (WTE) plant for Baotou, China

4.2 Pending M.S. theses

Jane Wu: Analysis of capital costs of waste-to-energy (WTE) plants built in recent years in China and in the U.S.

Yiran Song: Application of MBT technology in China: The case of Shenzhen

Yixi Tian: Laboratory production of concrete using WTE bottom ash and assessment of heavy metals leaching behavior.

5. Education and information dissemination activities

Dr. Thanos Bourtsalas, Manager of WTERT-Columbia continued to teach at Columbia the WTE course (Thermal treatment of waste and biomass materials). The course was attended by about 30 graduate students, some through the Columbia Video Network (CVN), and has received very high course evaluations (4.9/5.0). As in 2016, the WTE class visited the Union County (NJ) WTE power plant of Covanta on December 2. Dr. Bourtsalas is also in charge of the Earth and Environmental Engineering senior laboratory course and authored a laboratory manual describing all experiments.

Prof. Nickolas Themelis participated and presented at the WtERT-Asia inaugural meeting (April 2017, the WtERT-Italy (MatER) Meeting in Piacenza (May), the international waste management meeting in Athens (June. 2017) and the WtERT-Colombia inaugural meeting in Medellin (November 2017).

Dr. Thanos Bourtsalas represented WtERT/EEC-Columbia at the following events:

- Singapore (March): Meeting at the National Environmental Agency (NEA) for the development of a legislative framework for the use of WTE bottom ash for land reclamation;
 - Delhi, India (April): Presentation at roundtable of IIT Delhi, where the major stakeholders of waste management in India participated;
 - Mumbai, India (April): Invited lecture at Columbia Global Center of Mumbai;
 - NAWTEC conference (Minneapolis, April): Presentation on Thermal Spray Coatings in WTE boilers;
 - Hong Kong (May): Meeting of UNECE for the development of Public and Private Partnerships (PPP) in waste management. Dr. Bourtsalas was appointed as an expert of UNECE with regard to WTE PPPs;
 - Astana, Kazakhstan (June): Presentation at the Ministerial conference of UNECE;
 - Santiago, Chile (August): Invited lecture at Columbia Global Center of Santiago
- WtERT-Columbia organized and presented two papers at one of the two WTE sessions of the ISWA Congress in Baltimore (U.S.A., September 25-27, 2017). The second WTE session was organized by the Earth Engineering Center of City College of New York. Dr. Bourtsalas made a presentation on WtERT-Columbia 2017 research at the annual meeting of the U.S. Energy Recovery Council (Morristown, NJ, December 5, 2017).

Kevin Cheng: In the summer of 2017, Kevin Cheng was engaged by the Earth Engineering Center at Columbia to act as Project Coordinator in the development of WtERT-Asia and of WtERT organizations in other countries. In the fall of 2017, Kevin established a student group to look into development options of Indian Point Nuclear Facility, which is being decommissioned by the State of New York. The student group identified three re-development options for Indian Point: Renewable energy (including a WTE plant), industrial/educational, and wastewater treatment. Also headed by Kevin Cheng is an effort to establish WtERT-Jordan, to be hosted by the German Jordan University in Amman. WtERT-Columbia is planning a regional waste management conference in Jordan, to be hosted by the Columbia Global Center-Amman. This conference will introduce the Global WtERT Council (GWC) to the Middle East region and explore opportunities for academic collaborations.

6. Publications

Recycling and WTE Volume: Prof. N.J. Themelis and Dr. A.C. (Thanos) Bourtsalas are the editors of a new volume combining essays on “Materials and energy recovery from urban wastes” (2nd edition of Encyclopedia of Sustainable Science and Technology; Springer, pub.).

‘Comparative Study of European Mechanical Biological Treatment Plants’. To be presented at the [Global Waste Symposium](#), February 2018, California, USA

‘Experimental research of basic properties and reactivity of waste derived chars’, Peng Lu, Qunxing Huang, A.C. (Thanos) Bourtsalas, Yong Chi, Jianhua Yan, *Applied Thermal Engineering*

‘Effect of chlorine on the structure and reactivity of char derived from solid waste’, Binhang Hu, Qunxing Huang, A.C. (Thanos) Bourtsalas, Mujahid Ali, Yong Chi, Jianhua Yan, *Energy & Fuels*

‘Effect of Operating Conditions on Coke Formation and Nickel Catalyst Performance During Cracking of Tar’, Peng Lu, Qunxing Huang, A.C. Bourtsalas, Yong Chi, Jianhua Yan, *Waste and Biomass Valorization*.

‘Initial studies on the cytotoxicity of ceramics prepared from dry discharge incinerator bottom ash dust’, A.C. (Thanos) Bourtsalas, Rainer Detsch, Aldo R Boccaccini, Christopher Cheeseman, *Ceramics International*.

‘Carbon Mitigation Cost of WTE and Comparison with Other Waste Management Methods’, presented at Athens International Conference, June 2017; to be submitted at Waste Management & Research

Five scenarios were investigated: Sanitary landfilling without and with landfill gas recovery and utilization, waste to energy (WTE), and mechanical and biological treatment (MBT) combined with WTE. The GHG reductions, net present costs and carbon mitigation cost were calculated. The carbon mitigation cost followed the same ranking as implied in the waste management hierarchy. Among the five target scenarios, MBT plus WTE indicated the lowest carbon mitigation cost. WTE ranked the second but had the highest GHG reductions. The introduction of carbon credit schemes was beneficial for decreasing carbon mitigation cost.

‘Life Cycle Assessment of processes for resource recovery from waste-to-energy bottom ash’, submitted to Environmental Impact Assessment Review

Six processing scenarios, corresponding to innovative IBA recycling schemes in EU, were subjected to Life Cycle Analysis (LCA) and Material and Substance Flow Analysis. Inventory data was obtained from industry and literature. The results showed that dry discharge is more efficient than wet discharge for resource recovery and energy use. Ferrous and non-ferrous metal extraction and use of the IBA mineral fraction increases resource efficiency. The alternative of landfilling involves significantly higher energy consumption and relatively high eutrophication and abiotic depletion.

‘The Status of Waste Management and Waste to Energy Facilities in South Korea’, submitted to *Waste Management* journal

It was found that about 8% of the district heating demand in Republic of Korea is provided by the low-pressure steam of the 35 operating WTE plants. Also, all WTE plants operate with significantly lower emissions than the national established limits.

‘Use of non-recycled plastics and paper (NRPP) as alternative fuel in cement production’, submitted to *Journal of Cleaner Production*

It was found that the use of NRPP in the cement industry reduces greenhouse gas emission by up to 3 tonnes of CO₂ per tonne of NRPP used in place of a high-quality coal.

‘Comparison of the waste-to-energy (WTE) moving grate and circulating fluidized bed technologies, as applied in China’, submitted to *Waste and Biomass Valorization* journal

The feedstock to MG is as-received MSW while the MSW to CFB reactors is pre-shredded using high torque-low speed shredders. The availability of MG plants, over a one-year period, is 90%+ while that of CFB facilities is 80%+. The CFB combustion chamber is more compact with a heat flux of about 1.7 MW/m² of furnace cross section, while that of MG furnace ranges from 0.5-0.6 MW/m² of grate surface area.

Application of thermal spray techniques for combatting high temperature corrosion in WTE Boilers, presented at NAWTEC 2017

Thermal spray techniques are proven to be the most efficient methods for coating superheater tubes, especially the high velocity oxy-fuel spray technique. High chromium, nickel, and nickel-chromium alloys have exhibited a high level of resistance to high-temperature oxidation in chlorine environments. Based on a comparative analysis of published experimental data from several research studies, coatings with Alloy 265, Alloy 718, Alloy C-276, Colmonoy 88, FeCr, IN625, NiCr, NiCrTi, and two kinds of tube materials that can be used as coating materials, A263 and A265, offer very high corrosion resistance and low material cost.

Inventory of mercury emissions in the U.S. (similar to the dioxins study conducted by WtERT-Columbia in 2014-2015), to be submitted to *Waste Management*

The main findings were that in the late eighties the U.S. WTE power plants emitted about 90 tons of mercury (Hg). By 2003, implementation of the EPA Maximum Achievable Control Technology (MACT) standards, at a cost of one billion dollars, reduced WTE mercury emissions to 0.4 ton of mercury, i.e. 0.6% of total US Hg emissions. EPA now considers coal-fired power plants to be the largest remaining anthropogenic source of mercury emissions.

WtERT Social networks and “Be Wastewise” web

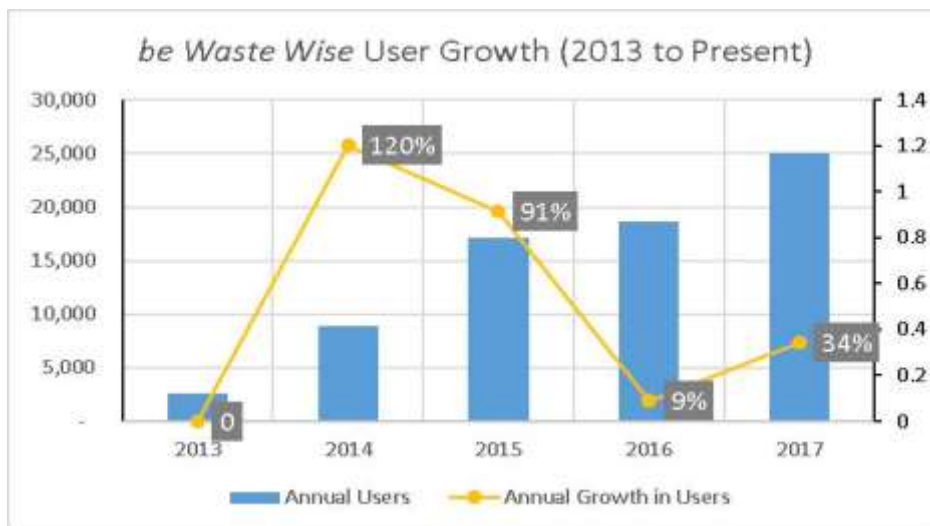
Maintained by Ranjith Annepu and Swetha Dandapani of GWC

The Facebook page of the **Global WtERT Council (GWC)** (www.facebook.com/WtERTGlobal) has attained an audience of 1,500, despite the fact that very few of the senior GWC members have contributed, so far. The social network pages are a good way to inform the general public as to the enormous advantages of recycling and waste-to-energy over the landfilling that still prevails in the U.S. (63% landfilling vs 37% recycling + composting + WTE) and most of the developing world.

The general public is waiting to hear from those of us who have studied the problems and opportunities for sustainable waste management, in the various WtERT sister organizations. The amount of time and resources you put in to research can create more impact by disseminating your published and tacit knowledge through platforms like Facebook or the DST network described in the WtERT-Germany report. We have already create a thriving platform for you to succeed. So, please take some time to look up the WtERT Facebook page, “like” or “dislike”, “comment”. and send your updates,

interesting links, and news to our community builder – Swetha Dandapani (swetha.dandapani@gmail.com). We need to reach a wider audience or it will be “Landfilling For Ever”.

be Waste Wise is a knowledge dissemination platform founded by GWC member and EEC-Columbia alumnus Ranjith Annepuco and co-founded by Global WTERT Council . **be Waste Wise** grew its audience by 34% in 2017, continuing its annual growth since inception in 2013. In 2018, *be Waste Wise* is beginning a weekly series of interviews, starting as of January 17, which will make it the largest and most consistent source of providing easily understandable and first-hand information in the waste management sector. These weekly interviews will be organized in addition to the BWW annual program called the Global Dialogue on Waste and its annual listing of Waste Pioneers (previously called Waste Influencers).



be Waste Wise is also managing a grant for waste management organizations in India. For the year of 2016-2017, this grant was awarded to Thanal, a non-profit organization based in Trivandrum, India. Thanal is working with a start-up called Haritha Gramam to improve waste management services through a decentralized model of on-site composting and monthly recycling. It is also working with schools and the city administration to simultaneously raise awareness about the need to subscribe to waste management services.

Using its innovative model, *be Waste Wise* provided high-quality online training to decision makers and academia in remote Northern Cyprus at 65% the cost. Its expanding the use of its knowledge dissemination model through trainings and partnerships with the International Solid Waste Association (ISWA) and WasteAid UK. *be Waste Wise* has also been invited by a large multi-lateral development bank to apply its model to the wastewater sector. Announcements about these partnerships will be made in early 2018.

New GWC national organizations:



WtERT- Chile activities in 2017

By Prof. Alex Godoy Faundez, Universidad del Desarrollo, Santiago

WTERT expansion

- WTERT Chile is expanding as a Consortium of Universities that includes Universidad del Desarrollo (Prof. Alex Godoy, head), Universidad de Santiago (Prof. Luis Diaz), Universidad de La Frontera (Prof. Rodrigo Navia) and Universidad Andrés Bello (Prof. Edmundo Muñoz)
- WTERT Chile will include waste management companies in Chile. One of them is WTE-Araucania.

Conferences and Workshops



August 18, 2017: The Second Green Innovation Conference was organized by UDD-UWGB-WTERT Chile. Prof. A.C. (Thanos) Bourtsalas was invited as guest speaker. The conference was hosted by Universidad del Desarrollo and sponsored by WTERT Chile.



August 24, 2017: Workshop on Waste to Energy Trends, Technologies and Business Opportunities, Prof. Thanos Bourtsalas and Prof. Alex Godoy were invited speakers. The workshop was hosted by Columbia Global Center-Santiago and sponsored by WTERT Chile.



Forthcoming meeting,, January 17, 2018: Europa-Chile: First International Seminar on Sustainable Waste to Energy. Prof. Alex Godoy is invited as guest speaker. The seminar is hosted by Universidad de Santiago and organized by Sustainable Waste to Energy Centre, sponsored by WTERT Chile

Forthcoming Publications

- Labor Inclusion of Waste Pickers: Convergence between Recycling Law and EPR. Fernanda Cabañas, Athanasios Bourtsalás, and Alex Godoy-Faúndez (To be submitted to– Environmental Policy)
- Integrated sustainable waste management in Santiago, Chile. Coupling WtE to Recycling goals. Fernanda Cabañas, Athanasios Bourtsalás, and Alex Godoy-Faúndez (To be submitted – Journal of Cleaner Production)
- Determination of National Potential and Emissions of the utilization of Municipal Solid Waste for Energy. Andrés Iglesias, Fernanda Cabañas, Athanasios Bourtsalás, Nickolas J. Themelis and Alex Godoy-Faúndez

Advisor

- Determinación del Potencial Teórico y Emisiones de la Utilización de Residuos Sólidos Municipales para Producción Energética. Mr. Andrés Iglesias. Industrial Engineering Program, Universidad del Desarrollo
- WtE potential assessment. Mr. Gabriel Riffin, B.S. Chemical Engineering, Michigan Technological University
- Integrated sustainable waste management and inclusion of the informal sector in Santiago de Chile. Ms. Fernanda Cabañas, earth Engineering Center, Columbia University

WtERT-Colombia activities in 2017

By Professor Emeritus Gavriel Naranjo Pizano, President of WtERT-Colombia

The WtERT-Colombia organization was formed at the beginning of 2017. It is a Strategic Services Unit of ACIEM Antioquia, it has no relationship with ACIEM Nacional. Members of the Advisory Board of WTERT-Colombia are

- Gabriel Naranjo Pizano, Presidente WtERT-Colombia
- Hugo Ospina Cano – Presidente ACIEM Antioquia

- Enrique Posada Restrepo – Juan Pablo Arbeláez: Society
- Javier Ignacio Hurtado Hurtado – Walter Ospina Ortiz : Industry
- Alejandro Hincapié Baena – Nicolás Albeiro Echeverry Alvarán: Government
- Juan Daniel Martínez – Tatiana Molina: Academy

2017 activities

-Visit to Columbia University, headquarters of the Global WTERT Council (GWC) to present the scope of WtERT-Colombia.

-Presentation to the Decanatura de Ingeniería of the U.P.B the Mission, Vision and objectives of WTERT and the potential role that could play a strategic ally as its school of Engineering.

-Feb 2. Second meeting with: U Claretiana and Municipality & Governorate of Chocó, IIAP for the valorization of Quibdó's RSU.

-Feb 9. 1st meeting (virtual) with the management of INTERSASEO in Santa Marta for the valorization of the RSU of the municipality of Santa Marta.

-Feb 15. Meeting with the "Corporación work team in research for applied knowledge (ETICA) interested in a project of" energy valorization "in Bajo Cauca Antioqueño.

-Feb 17. GEN + for the valorization of the RSU of the municipalities of Antioquia

-Feb 20. 2nd meeting to prepare an introductory course on "Energy from Waste" (EfW or WtE) in partnership with the Claretian University Feb 22. 1st meeting with GEN + and FUTURASEO for the valorization of the municipalities of the Urabá region (northern part).

Meetings related to the WTERT Council

Feb 9. Meeting of the Council Projects & Structuring WTERT Colombia.

Feb 16 Board Meeting Projects & Structuring WTERT Colombia.

Feb 27. Meeting of the Council Projects & Structuring WTERT Colombia. Qualitative indicators

April 25-27: Participation at WtERT Asia inaugural Meeting, Nanjing, China

October: Participation in COPIMERA Conference, Medellin; invited presentations by Prof. Nickolas Themelis at COPIMERA, UPB University, and public officials.

Other public information events (number of participants)

- March: 14
- April: Streaming
- June 23 UPB: 37
- October 19 UPB: 15
- October 20 Plaza Mayor: 20
- November 2 EAFIT: 44

- November 23 ROUTE N: 14

Plans for 2018

Development of technical, financial studies and formulation of projects related to sustainable waste management in Colombia the subject

Creation of joint publications and exchange of teaching and bibliographic materials. Dissemination in ICTs and information media

- The Advisory Board of WtERT Colombia, will meet every month in person and will be in constant communication electronically, either by mail or WhatsApp.
- Contacts made for the 2nd Pan-American Waste To Energy Conference and the 1st Meeting of WtERT Councils in Latin America: Consulate of Austria, Cámara Colombo Española, Arena International Events (Headquarters in London, event commercialization), Grupo Kolgrun.
- Cooperation agreement CES University.
- Conformation of the Academic Committee for the evaluation of the works that will be presented at the 2nd Pan American Conference Waste To Energy: Engineers Walter Ospina and Juan Daniel Martínez.
- The Colombian Association of Faculties of Engineering, ACOFI, sent correspondence to 150 engineering faculties of the country announcing the contest and requesting participation of them with works, which are expected to be received before February 17, to be evaluated by the aforementioned Academic Committee. Work has already begun to be received from the Universidad Cooperativa de Colombia and an expression of interest in participating from Costa Rica.

Long term objective of WtERT-Colombia: By 2025 we will be the leading organization in Colombia for the research and use of technologies that allow the integral management of solid waste for the generation of energy and the recovery of materials, contributing to the sustainable development of the country.

WtERT-Cuba 2017 activities

By Prof. C. Maritza Mariño Cala, Universidad del Oriente

Participation in international conferences

IX Conferencia Internacional de Energía Renovable, Ahorro de Energía y Educación Energética, CIER 2017. May 31st - 2nd June, Havana, Cuba.

- A preliminary study of waste to energy potential from municipal solid waste in Havana. By M. Sc. Junior Lorenzo Llanes

III Jornada de Internacional de Ingenierías Mecánica, Eléctrica e Industrial (JIMEI 2017), June 21st- 23rd. Havana, Cuba.

- Propuesta para el uso de desechos sólidos en los procesos de mecanizado en la ciudad de Santiago de Cuba. By Dr. Maritza Mariño Cala and M.Sc. Yanier Sánchez Hechavarría.

ISWA's World Congress & WASTECON, 2017. Baltimore, United States of America. September, 25th – 27th de 2017

In a session “Advancing Sustainable Waste and Biomass to Energy in Cuba”, were presented:

- Prospective development of the use of solid waste in Cuba and management of solid urban and industrial waste in Santiago de Cuba city.
- A preliminary study of waste to energy potential from municipal solid waste in Havana

Congreso Panamericano de Ingenierías Mecánica, Eléctrica, Industrial y Ramas Afines, COPIMERA 2017. October 18thto 20th, Medellín, Colombia

- Manejo de desechos sólidos urbanos e industriales en Santiago de Cuba.

10th ISWA Beacon Conference on Waste-to-Energy. October 25th and 26th, Malmö, Sweden.

- Will Cuba divert from landfilling and embrace Waste-to-Energy? - a case study of Havana and Santiago de Cuba.

Education and information dissemination activities

Universidad Tecnológica de la Habana:

-Intensive Course: [Advancing sustainable waste to energy in Cuba. A renewable energy source.](#) Evaluation of the LHV of MSW as a crucial factor for WtE projects. 23-24 November 2017

Universidad de Oriente, Santiago de Cuba:

-Master Conference: "State of the art and new technologies of WtE". May 26th, 2017.

-1st International Workshop "Advances in sustainable waste management in Cuba: a crucial contribution of society and its benefits". November 27th to December 1st, 2017.

WtERT-Philippines <http://www.wtert.org.ph>

Principals: Matk Bergman: mark.bergman@eqiglobalsolutions.com

Nelson Remulla: nelson.remulla@eqiglobalsolutions.com

WtERT-Serbia 2017 activities

Information provided by Nebojsa Vranes (zwserbia@gmail.com).

WtERT-Serbia, one of the newest GWC members, is headed by Nebojsa Vranes of the organization Zero Waste Serbia and its web page is www.wtert.rs. The management team includes Prof. Goran Vujic of the University of Novi Sad (goranvujic@uns.ac.rs) and Prof. Aleksandar Jovovic (ajovovic@mas.bg.ac.rs) of the University of Belgrade.

In 2017, WtERT-Serbia reviewed the present state of waste management across the country (MSW generated, disposition) and initiated contacts with the cement industry regarding the use of refuse derived fuel (RDF) in cement production. At this time, the cement industry (a total of three factories) is the only one licensed to use waste materials in place of fossil fuels. However, there have not been any concrete agreements and the cement industry expects WtERT-Serbia to facilitate this process, using the research studies already carried out at WtERT-Columbia and other research institutes.

WtERT-Serbia also had contacts and meetings with the city of Belgrade regarding the first incinerator in Belgrade (340,000 tons/year, projected cost of 340 million euro) to be located at the Vinca landfill. This project may have been already awarded to the Japanese-French consortium Suez-CNIM. If not, WtERT-Serbia and GWC may be able to assist with realization of such a project.

WtERT-Serbia has requested the assistance of the Global WtERT Council in suggesting waste management projects that are suitable for Serbia and which would be presented by WtERT-Serbia to the Ministry of the Environment or an international organization. GWC has suggested that a less costly WTE plant could be built in Belgrade and not only generate electricity but also provide heat for the existing district heating system of Belgrade. This would improve the air quality in the city in the cold season by shutting down thousands of residential boilers, as was the case in the city of Brescia, Italy.

Nickolas J. Themelis, GWC Chair - January 27, 2018