

# ENVIRONMENTAL Science & Technology

September 17, 2013  
Volume 47  
Number 18  
pubs.acs.org/est



**Achieving  
U.S. Renewable Fuel Standards:  
Varying Visions**



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**ON THE COVER:** The U.S. Renewable Fuel Standards require increasing amounts of biofuels to be produced annually through 2022. This issue's feature article compares visions from three federal agencies of how and where the biomass needed to meet these goals might be grown. The cover shows two perennial grasses, big bluestem (*Andropogon gerardii*) and Miscanthus (*Miscanthus x giganteus*), currently being explored as biofuel feedstocks.

## Features

10095

[dx.doi.org/10.1021/es402181y](https://dx.doi.org/10.1021/es402181y)

### U.S. Federal Agency Models Offer Different Visions for Achieving Renewable Fuel Standard (RFS2) Biofuel Volumes

Bonnie L. Keeler, Brian J. Krohn, Thomas A. Nickerson, and Jason D. Hill\*

The Renewable Fuel Standard (RFS2) in the U.S. Energy Independence and Security Act of 2007 (EISA) sets annual volume targets for domestic renewable transportation fuel consumption through 2022, but allows for flexibility in the types of biomass used for biofuels and where and how they are grown. Spatially explicit feedstock scenarios for how the agricultural and forestry sectors can produce sufficient biomass to meet these targets have been developed by the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Agriculture (USDA). Here we compare the models used to generate these scenarios and their underlying assumptions on crop yields, feedstock prices, biofuel conversion efficiencies, land availability, and other critical factors. We find key differences in the amounts of land devoted to different biomass sources and their geographic distribution, most notably for perennial grasses. These different visions of land use and management for bioenergy in the U.S. are currently being used both for regulation and to set research funding priorities. Understanding the key assumptions and uncertainties that underlie these scenarios is important for accurate assessment of the potential economic and environmental impacts of RFS2, as well as for optimal design of future energy and agricultural policy.

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## Viewpoints

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[dx.doi.org/10.1021/es403145x](https://dx.doi.org/10.1021/es403145x)

### Panama Canal Expansion Illustrates Need for Multimodal Near-Source Air Quality Assessment

Gayle S. W. Hagler,\* Timothy M. Barzyk, Sue Kimbrough, Vlad Isakov, Paul Gagliano, Michelle S. Bergin, David D'Onofrio, Richard W. Baldauf, and Chad R. Bailey

10104 [dx.doi.org/10.1021/es403353d](https://doi.org/10.1021/es403353d)  
**Recognizing the Limitations of Performance Reference Compound (PRC)-Calibration Technique in Passive Water Sampling**  
Hui-Hui Liu, Charles S. Wong, and Eddy Y. Zeng\*

10106 [dx.doi.org/10.1021/es4036418](https://doi.org/10.1021/es4036418)  
**Geological Sequestration of Biomass Char to Mitigate Climate Change**  
Anthony Dufour

10108 [dx.doi.org/10.1021/es403443n](https://doi.org/10.1021/es403443n)  
**Measurable Resilience for Actionable Policy**  
Igor Linkov,\* Daniel A. Eisenberg, Matthew E. Bates, Derek Chang, Matteo Convertino, Julia H. Allen, Stephen E. Flynn, and Thomas P. Seager

10111 [dx.doi.org/10.1021/es403576t](https://doi.org/10.1021/es403576t)  
**Waste Plastic and Pharmaceuticals, Could an Integrated Solution Help?**  
Karel D. Klika\*


10113 [dx.doi.org/10.1021/es403619m](https://doi.org/10.1021/es403619m)  
**Salt Management for Sustainable Degraded Water Land Application under Changing Climatic Conditions**  
Runbin Duan\* and Clifford B. Fedler


10115 [dx.doi.org/10.1021/es403469c](https://doi.org/10.1021/es403469c)  
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10137  [dx.doi.org/10.1021/es401426b](https://doi.org/10.1021/es401426b)  
**Food Losses and Waste in China and Their Implication for Water and Land**  
Junguo Liu,\* Jan Lundqvist, Josh Weinberg, and Josephine Gustafsson

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[dx.doi.org/10.1021/es4027503](https://doi.org/10.1021/es4027503)

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Jerry E. Ongerth\*


## Articles

### Characterization of Natural and Affected Environments

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**Nitrogen Stable Isotopes in Primary Uptake Compartments Across Streams Differing in Nutrient Availability**  
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[dx.doi.org/10.1021/es401525n](https://doi.org/10.1021/es401525n)

**First Report of a Chinese PFOS Alternative Overlooked for 30 Years: Its Toxicity, Persistence, and Presence in the Environment**  
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**Effects of Switching to Lower Sulfur Marine Fuel Oil on Air Quality in the San Francisco Bay Area**  
Ling Tao, David Fairley, Michael J. Kleeman, and Robert A. Harley\*

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[dx.doi.org/10.1021/es4015663](https://doi.org/10.1021/es4015663)

**Quantifying the Contribution of Long-Range Saharan Dust Transport on Particulate Matter Concentrations in Houston, Texas, Using Detailed Elemental Analysis**  
Ayse Bozlaker, Joseph M. Prospero, Matthew P. Fraser, and Shankaraman Chellam\*

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[dx.doi.org/10.1021/es4016348](https://doi.org/10.1021/es4016348)

**Complex Anthropogenic Sources of Platinum Group Elements in Aerosols on Cape Cod, USA**  
Indra S. Sen,\* Bernhard Peucker-Ehrenbrink, and Nicholas Geboy

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[dx.doi.org/10.1021/es4017365](https://doi.org/10.1021/es4017365)

**Exploring Variation of Antibiotic Resistance Genes in Activated Sludge over a Four-Year Period through a Metagenomic Approach**  
Ying Yang, Bing Li, Feng Ju, and Tong Zhang\*


10206 


[dx.doi.org/10.1021/es401964s](https://doi.org/10.1021/es401964s)

**Intracellular and Extracellular Antimicrobial Resistance Genes in the Sludge of Livestock Waste Management Structures**  
Yuping Zhang, Daniel D. Snow, David Parker, Zhi Zhou, and Xu Li\*

10214  [dx.doi.org/10.1021/es402302z](https://doi.org/10.1021/es402302z)  
**Direct Evaluation of in Situ Biodegradation in Athabasca Oil Sands Tailings Ponds Using Natural Abundance Radiocarbon**  
Jason M. E. Ahad\* and Hooshang Pakdel


10223  [dx.doi.org/10.1021/es4020508](https://doi.org/10.1021/es4020508)  
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J. Brad Glenn\* and Stephen J. Klaine


10231  [dx.doi.org/10.1021/es402303w](https://doi.org/10.1021/es402303w)  
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
10240  [dx.doi.org/10.1021/es402429h](https://doi.org/10.1021/es402429h)  
**Ultrafine Particles: Exposure and Source Apportionment in 56 Danish Homes**  
Gabriel Bekö,\* Charles J. Weschler, Aneta Wierzbicka, Dorina Gabriela Karottki, Jørn Toftum, Steffen Loft, and Geo Clausen

10249  [dx.doi.org/10.1021/es401658t](https://doi.org/10.1021/es401658t)  
**Pathways of Superoxide ( $O_2^-$ ) Decay in the Eastern Tropical North Atlantic**  
Kathrin Wuttig, Maija I. Heller, and Peter L. Croot\*










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10257  [dx.doi.org/10.1021/es4016603](https://doi.org/10.1021/es4016603)  
**Reactivity of Inorganic Mn and Mn Desferrioxamine B with  $O_2$ ,  $O_2^-$ , and  $H_2O_2$  in Seawater**  
Kathrin Wuttig, Maija I. Heller, and Peter L. Croot\*

10266  [dx.doi.org/10.1021/es304688g](https://doi.org/10.1021/es304688g)  
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Shan Liu, Guang-Guo Ying,\* You-Sheng Liu, Fu-Qiang Peng, and Liang-Ying He

10277  [dx.doi.org/10.1021/es4002482](https://doi.org/10.1021/es4002482)  
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10285  [dx.doi.org/10.1021/es4003247](https://doi.org/10.1021/es4003247)  
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- 10293  [dx.doi.org/10.1021/es400945v](https://doi.org/10.1021/es400945v)  
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- 10302  [dx.doi.org/10.1021/es401046s](https://doi.org/10.1021/es401046s)  
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- 10312  [dx.doi.org/10.1021/es401285s](https://doi.org/10.1021/es401285s)  
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- 10339  [dx.doi.org/10.1021/es401352n](https://doi.org/10.1021/es401352n)  
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- 10356  [dx.doi.org/10.1021/es401729c](https://doi.org/10.1021/es401729c)  
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- 10364  [dx.doi.org/10.1021/es402108d](https://doi.org/10.1021/es402108d)  
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10372  [dx.doi.org/10.1021/es402200h](https://doi.org/10.1021/es402200h)

**Multiwalled Carbon Nanotube Deposition on Model Environmental Surfaces**

Xiaojun Chang and Dermont C. Bouchard\*

10381  [dx.doi.org/10.1021/es4023267](https://doi.org/10.1021/es4023267)

**Laboratory Study on the Hygroscopic Behavior of External and Internal C<sub>2</sub>-C<sub>4</sub> Dicarboxylic Acid-NaCl Mixtures**

Qingxin Ma, Jinzhu Ma, Chang Liu, Chengyue Lai, and Hong He\*

10389  [dx.doi.org/10.1021/es4023738](https://doi.org/10.1021/es4023738)

**Diasteroselective Metabolism of a Novel Cis-Nitromethylene Neonicotinoid Paichongding in Aerobic Soils**

Qinguo Fu, Jianbo Zhang, Xiaoyong Xu, Haiyan Wang, Wei Wang, Qingfu Ye,\* and Zhong Li\*

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**Global Civil Aviation Black Carbon Emissions**

Marc E. J. Stettler, Adam M. Boies, Andreas Petzold, and Steven R. H. Barrett\*

10405  [dx.doi.org/10.1021/es401447w](https://doi.org/10.1021/es401447w)

**Environmental Determinants of Polychlorinated Biphenyl Concentrations in Residential Carpet Dust**

Curt T. DellaValle,\* David C. Wheeler, Nicole C. Deziel, Anneclaire J. De Roos, James R. Cerhan, Wendy Cozen, Richard K. Severson, Abigail R. Flory, Sarah J. Locke, Joanne S. Colt, Patricia Hartge, and Mary H. Ward

10415  [dx.doi.org/10.1021/es4023909](https://doi.org/10.1021/es4023909)

**Model-Based Integration and Analysis of Biogeochemical and Isotopic Dynamics in a Nitrate-Polluted Pyritic Aquifer**

Yan-Chun Zhang, Henning Prommer,\* Hans Peter Broers, Caroline P. Slomp, Janek Greskowiak, Bas van der Grift, and Philippe Van Cappellen

10423 [dx.doi.org/10.1021/es4025035](https://doi.org/10.1021/es4025035)

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Donald Scavia,\* Mary Anne Evans, and Daniel R. Obenour

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10429  [dx.doi.org/10.1021/es402528q](https://doi.org/10.1021/es402528q)

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Pamela J. Reitsma, Dave Adelman, and Rainer Lohmann\*

10438  [dx.doi.org/10.1021/es400609y](https://doi.org/10.1021/es400609y)

**Limits of the Linear Accumulation Regime of DGT Sensors**

Sandrine Mongin,\* Ramiro Uribe, Carlos Rey-Castro, Joan Cecilia, Josep Galceran, and Jaume Puy\*

10446  [dx.doi.org/10.1021/es401134u](https://doi.org/10.1021/es401134u)

**Fast In Situ Airborne Measurement of Ammonia Using a Mid-Infrared Off-Axis ICOS Spectrometer**

J. Brian Leen,\* Xiao-Ying Yu,\* Manish Gupta, Douglas S. Baer, John M. Hubbe, Celine D. Kluzek, Jason M. Tomlinson, and Mike R. Hubbell II

10454  [dx.doi.org/10.1021/es401250k](https://doi.org/10.1021/es401250k)

**The Use of Levoglucosan and Radiocarbon for Source Apportionment of PM<sub>2.5</sub> Carbonaceous Aerosols at a Background Site in East China**

Di Liu, Jun Li,\* Yanlin Zhang, Yue Xu, Xiang Liu, Ping Ding, Chengde Shen, Yingjun Chen, Chongguo Tian, and Gan Zhang

10462  [dx.doi.org/10.1021/es401357z](https://doi.org/10.1021/es401357z)

**Distribution and Uptake Dynamics of Mercury in Leaves of Common Deciduous Tree Species in Minnesota, U.S.A.**

Aicam Laacouri,\* Edward A. Nater, and Randall K. Kolka

10471  [dx.doi.org/10.1021/es401706m](https://doi.org/10.1021/es401706m)

**Non-Targeted Analysis of Petroleum Metabolites in Groundwater Using GC×GC–TOFMS**

Rachel E. Mohler,\* Kirk T. O'Reilly, Dawn A. Zemo, Asheesh K. Tiwary, Renae I. Magaw, and Karen A. Synowiec

10477  [dx.doi.org/10.1021/es401822x](https://doi.org/10.1021/es401822x)

**Diffusive Gradients in Thin Films Technique Equipped with a Mixed Binding Gel for Simultaneous Measurements of Dissolved Reactive Phosphorus and Dissolved Iron**

Di Xu, Yifei Chen, Shiming Ding,\* Qin Sun, Yan Wang, and Chaosheng Zhang

10485  [dx.doi.org/10.1021/es4020458](https://doi.org/10.1021/es4020458)

**Correlative Assessment of Fecal Indicators using Human Mitochondrial DNA as a Direct Marker**

Vikram Kapoor, Christopher Smith, Jorge W. Santo Domingo, Ting Lu, and David Wendell\*

10494  [dx.doi.org/10.1021/es402175n](https://doi.org/10.1021/es402175n)

**Adapting Enzyme-Based Microbial Water Quality Analysis to Remote Areas in Low-Income Countries**

Adam Abramson,\* Maya Benami, and Noam Weisbrod

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**Effects of Reduced Sulfur Compounds on Pd-Catalytic Hydrodechlorination of Trichloroethylene in Groundwater by Cathodic H<sub>2</sub> under Electrochemically Induced Oxidizing Conditions**

Songhu Yuan,\* Mingjie Chen, Xuhui Mao, and Akram N. Alshawabkeh\*




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[dx.doi.org/10.1021/es401389g](https://doi.org/10.1021/es401389g)

**Arsenic Removal from Contaminated Water Using Three-Dimensional Graphene-Carbon Nanotube-Iron Oxide Nanostructures**

Sridhar Vadahanambi, Sang-Heon Lee, Won-Jong Kim, and Il-Kwon Oh\*

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[dx.doi.org/10.1021/es4015629](https://doi.org/10.1021/es4015629)

**Development of a Constructed Wetland Water Treatment System for Selenium Removal: Incorporation of an Algal Treatment Component**

Jung-Chen Huang, María C. Suárez, Soo In Yang, Zhi-Qing Lin, and Norman Terry\*

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[dx.doi.org/10.1021/es4017624](https://doi.org/10.1021/es4017624)

**Dechlorination of Commercial PCBs and Other Multiple Halogenated Compounds by a Sediment-Free Culture Containing *Dehalococcoides* and *Dehalobacter***

Shanquan Wang and Jianzhong He\*

## Sustainability Engineering and Green Chemistry

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[dx.doi.org/10.1021/es4019282](https://doi.org/10.1021/es4019282)

**Solar Photothermochemical Reaction and Supercritical CO<sub>2</sub> Work up for a Fully Green Process of Preparation of Pure *p*-Nitrobenzyl Bromide**


Milan Dinda, Supratim Chakraborty, Supravat Samanta, Chitrangi Bhatt, Subarna Maiti,\* Sandip Roy, Yogesh Kadam, and Pushpito K. Ghosh\*

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[dx.doi.org/10.1021/es402250g](https://doi.org/10.1021/es402250g)

**Effect of Carbon Dioxide on the Thermal Degradation of Lignocellulosic Biomass**

Eilhann E. Kwon,\* Eui-Chan Jeon, Marco J. Castaldi, and Young Jae Jeon\*

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[dx.doi.org/10.1021/es402534m](https://doi.org/10.1021/es402534m)

**A Natural Driven Membrane Process for Brackish and Wastewater Treatment: Photovoltaic Powered ED and FO Hybrid System**

Yang Zhang,\* Luc Pinoy, Boudewijn Meesschaert, and Bart Van der Bruggen

## Ecotoxicology and Human Environmental Health

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[dx.doi.org/10.1021/es401604b](https://doi.org/10.1021/es401604b)

**Compound- and Mixture-Specific Differences in Resistance to Polycyclic Aromatic Hydrocarbons and PCB-126 among *Fundulus heteroclitus* Subpopulations throughout the Elizabeth River Estuary (Virginia, USA)**

Bryan W. Clark,\* Ellen M. Cooper, Heather M. Stapleton, and Richard T. Di Giulio


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[dx.doi.org/10.1021/es401144c](https://doi.org/10.1021/es401144c)


**Assessment on the Occupational Exposure of Manufacturing Workers to Dechlorane Plus through Blood and Hair Analysis**

Haidong Zhang, Pu Wang, Yingming Li, Hongtao Shang, Yawei Wang, Thanh Wang, Qinghua Zhang,\* and Guibin Jiang

10574  [dx.doi.org/10.1021/es401265q](https://doi.org/10.1021/es401265q)  
**Toxicogenomic Responses of Zebrafish Embryos/Larvae to Tris(1,3-dichloro-2-propyl) Phosphate (TDCPP) Reveal Possible Molecular Mechanisms of Developmental Toxicity**  
Jie Fu, Jian Han, Bingsheng Zhou, Zhiyuan Gong, Eduarda M. Santos, Xiaojing Huo, Weiling Zheng, Hongling Liu, Hongxia Yu, and Chunsheng Liu\*


10583  [dx.doi.org/10.1021/es401394g](https://doi.org/10.1021/es401394g)  
**Properties and Inflammatory Effects of Various Size Fractions of Ambient Particulate Matter from Beijing on A549 and J774A.1 Cells**  
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10591  [dx.doi.org/10.1021/es401464p](https://doi.org/10.1021/es401464p)  
**Occurrence and Potential Causes of Androgenic Activities in Source and Drinking Water in China**  
Xinxin Hu, Wei Shi,\* Si Wei, Xiaowei Zhang, Jianfang Feng, Guanjiu Hu, Sulan Chen, John P. Giesy, and Hongxia Yu\*

10601  [dx.doi.org/10.1021/es4017188](https://doi.org/10.1021/es4017188)  
**Bioaccumulation of CdTe Quantum Dots in a Freshwater Alga *Ochromonas danica*: A Kinetics Study**  
Ying Wang, Ai-Jun Miao,\* Jun Luo, Zhong-Bo Wei, Jun-Jie Zhu, and Liu-Yan Yang

10611  [dx.doi.org/10.1021/es4019018](https://doi.org/10.1021/es4019018)  
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Dong Fu, Chunbo Leng, Judas Kelley, Guang Zeng, Yunhong Zhang, and Yong Liu\*

10619  [dx.doi.org/10.1021/es401905e](https://doi.org/10.1021/es401905e)  
**Biomonitoring of Perfluoroalkyl Acids in Human Urine and Estimates of Biological Half-Life**  
Yifeng Zhang, Sanjay Beesoon, Lingyan Zhu,\* and Jonathan W. Martin\*

10628  [dx.doi.org/10.1021/es401961j](https://doi.org/10.1021/es401961j)  
**Field-Based Approach for Assessing the Impact of Treated Pulp and Paper Mill Effluent on Endogenous Metabolites of Fathead Minnows (*Pimephales promelas*)**  
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10637  [dx.doi.org/10.1021/es402209w](https://doi.org/10.1021/es402209w)  
**Changes in *Arabidopsis thaliana* Gene Expression in Response to Silver Nanoparticles and Silver Ions**  
Rashid Kaveh, Yue-Sheng Li, Sibia Ranjbar, Rouzbeh Tehrani, Christopher L. Brueck, and Benoit Van Aken\*

10645  [dx.doi.org/10.1021/es402249b](https://doi.org/10.1021/es402249b)  
**Effects of Magnetite Nanoparticles on Soybean Chlorophyll**  
Mohammad H. Ghafariyan,\* Mohammad J. Malakouti, Mohammad R. Dadpour, Pieter Stroeve, and Morteza Mahmoudi\*

10653  [dx.doi.org/10.1021/es402646c](https://doi.org/10.1021/es402646c)

**Comprehensive Assessment of a Chlorinated Drinking Water Concentrate in a Rat Multigenerational Reproductive Toxicity Study**

Michael G. Narotsky,\* Gary R. Klinefelter, Jerome M. Goldman, Deborah S. Best, Anthony McDonald, Lillian F. Strader, Juan D. Suarez, Ashley S. Murr, Inthirany Thillainadarajah, E. Sidney Hunter III, Susan D. Richardson, Thomas F. Speth, Richard J. Miltner, Jonathan G. Pressman, Linda K. Teuschler, Glenn E. Rice, Virginia C. Moser, Robert W. Luebke, and Jane Ellen Simmons

10660  [dx.doi.org/10.1021/es402848d](https://doi.org/10.1021/es402848d)

**Characterization of Biological Aerosol Exposure Risks from Automobile Air Conditioning System**

Jing Li, Mingzhen Li, Fangxia Shen, Zhuanglei Zou, Maosheng Yao,\* and Chang-yu Wu

10667  [dx.doi.org/10.1021/es401763d](https://doi.org/10.1021/es401763d)

**Bioconcentration of Organic Contaminants in *Daphnia* Resting Eggs**

Aurea C. Chiaia-Hernandez, Roman Ashauer, Markus Moest, Tobias Hollingshaus, Junho Jeon, Piet Spaak, and Juliane Hollender\*

## Energy and the Environment

10676  [dx.doi.org/10.1021/es4006459](https://doi.org/10.1021/es4006459)

**Ethanol or Bioelectricity? Life Cycle Assessment of Lignocellulosic Bioenergy Use in Light-Duty Vehicles**

Jason M. Luk,\* Mohammad Pourbafrani, Bradley A. Saville, and Heather L. MacLean

10685  [dx.doi.org/10.1021/es401018d](https://doi.org/10.1021/es401018d)

**Anaerobic Digestion for Simultaneous Sewage Sludge Treatment and CO Biomethanation: Process Performance and Microbial Ecology**

Gang Luo, Wen Wang, and Irini Angelidaki\*

10694  [dx.doi.org/10.1021/es401455j](https://doi.org/10.1021/es401455j)


**Potential Impacts of CO<sub>2</sub> Leakage on Groundwater Chemistry from Laboratory Batch Experiments and Field Push–pull Tests**

Patrick J. Mickler,\* Changbing Yang, Bridget R. Scanlon, Robert Reedy, and Jiemin Lu

10703  [dx.doi.org/10.1021/es4016926](https://doi.org/10.1021/es4016926)

**Coordinated EV Adoption: Double-Digit Reductions in Emissions and Fuel Use for \$40/Vehicle-Year**

Dong Gu Choi, Frank Kreikebaum, Valerie M. Thomas,\* and Deepak Divan

10708  [dx.doi.org/10.1021/es4020184](https://doi.org/10.1021/es4020184)

**Metagenomics of Hydrocarbon Resource Environments Indicates Aerobic Taxa and Genes to be Unexpectedly Common**

Dongshan An, Sean M. Caffrey, Jung Soh, Akhil Agrawal, Damon Brown, Karen Budwill, Xiaoli Dong, Peter F. Dunfield, Julia Foght, Lisa M. Gieg, Steven J. Hallam, Niels W. Hanson, Zhiguo He, Thomas R. Jack, Jonathan Klassen, Kishori M. Konwar, Eugene Kuatsjah, Carmen Li, Steve Larter, Verlyn Leopatra, Camilla L. Nesbø, Thomas Oldenburg, Antoine P. Pagé, Esther Ramos-Padron, Fauziah F. Rochman, Alireza Saidi-Mehrabad, Christoph W. Sensen, Payal Sipahimalani, Young C. Song, Sandra Wilson, Gregor Wolbring, Man-Ling Wong, and Gerrit Voordouw\*

## Additions and Corrections

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[dx.doi.org/10.1021/es403789p](https://doi.org/10.1021/es403789p)

**Addition to The Role of Metal Nanoparticles in Influencing Arbuscular Mycorrhizal Fungi Effects on Plant Growth**  
Youzhi Feng, Xiangchao Cui, Shiyong He, Ge Dong, Min Chen, Junhua Wang, and Xiangui Lin\*