



We will begin momentarily at 2pm ET



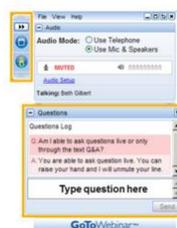
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“Why am I muted?”

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Chris Nicholas



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Thursday, September 11, 2014

“Garlic and Other Alliums: The Lore and the Science”

Dr. Eric Block, Professor of Chemistry, University of Albany, Author and ACS Fellow



Thursday, September 18, 2014

“Tragic Chemical Accidents: Combustible Dust Hazards”

Dr. Tara Henriksen, Senior Chemical Engineer and Certified Fire and Explosion Investigator, CASE Forensics Corp.

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“Planting the Seeds for Sustainable Chemistry”

Co-produced with the ACS Green Chemistry Institute



Dr. Cliff Coss
Vice-Chair and Treasurer, NESSE
CTO, GlycoSurf



Julian R. Silverman
Ph.D. Candidate,
CUNY Graduate Center



Dr. Jennie Dodson
Chair, NESSE

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Jennie Dodson

Chair of NESSE

Post-doctoral researcher in biomaterials at
Green Chemistry Centre of Excellence,
University of York

jennifer.dodson@sustainablescientists.org

- **Research** – research focus in bio-based materials, elemental sustainability and thermochemical conversion of biomass
- **Educational work** – taught MSc course in Public Awareness of Science and delivered over 70 hands-on green chemistry workshops to schools
- **Policy work** – fellowship at Parliamentary Office of Science & Technology
- **Science & Development** – two year post-doc in heterogeneous catalysis in Brazil



Cliff Coss

Vice-Chair and Treasurer of NESSE

Co-Founder and CTO of GlycoSurf, LLC
in Tucson, AZ

cliff.coss@sustainablescientists.org

- **Research** – research focus in organic chemistry with a PhD in green procedures for the synthesis of glycolipids
- **Educational work** – Founder of GREEN at the University of Arizona and educator of greening research in chemistry laboratories
- **Science & Development** – co-founding GlycoSurf and creating of an environmentally-friendly process for producing green carbohydrate products for cleaning and cosmetics

Planting the Seeds of Sustainable Chemistry

Dr. Jennifer Dodson and Dr. Cliff Coss

Network of Early-career Sustainable Scientists & Engineers (NESSE)



www.sustainablescientists.org

[@greenscientists](https://twitter.com/greenscientists)

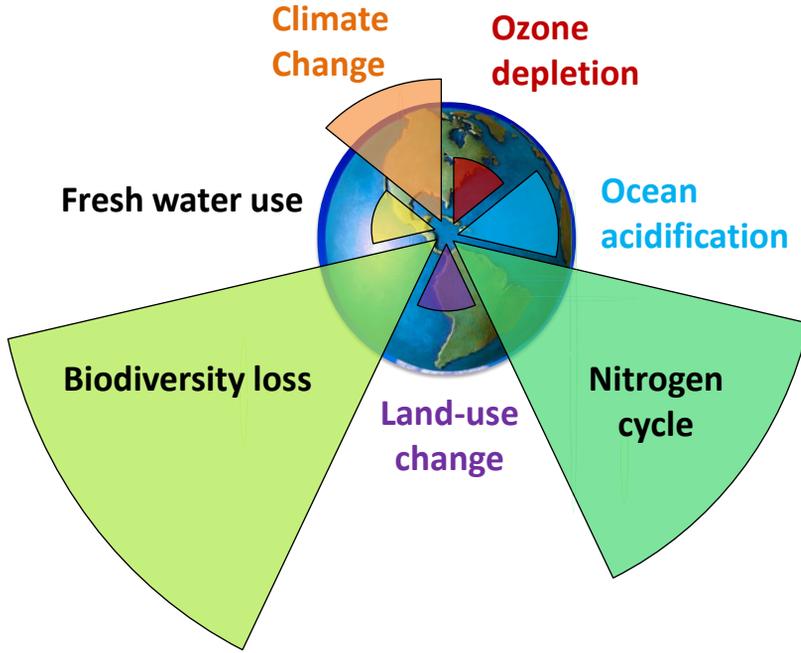
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Audience Survey Question

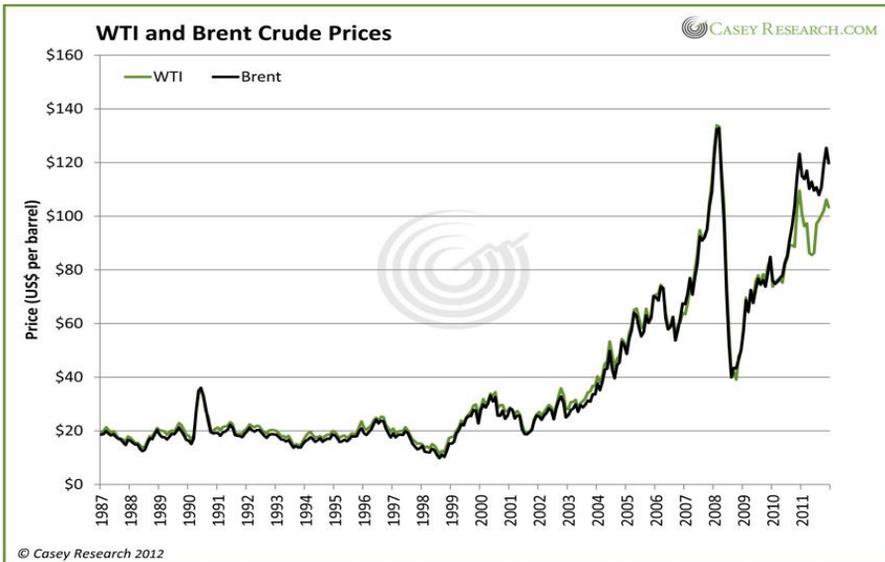
What do you think is the biggest environmental problem we face?

- Climate change
- Resource depletion
- Chemical pollution
- Fresh water usage
- Biodiversity loss



Rockstrom et al, *Nature*, 461, 472-475 (2009)

Resource Pressures



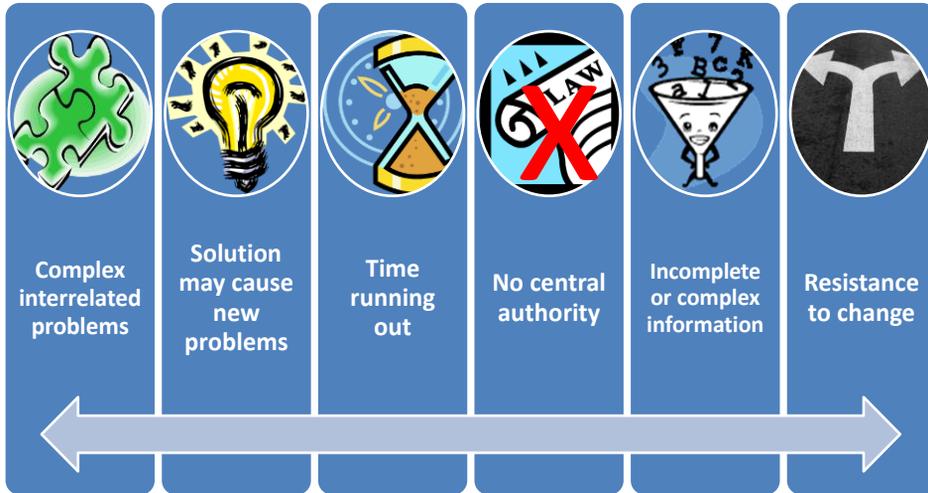


= Global environmental problems

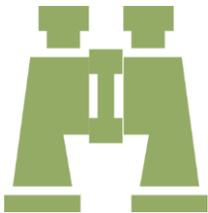
We've entered the *'Anthropocene'*

Human dominance of
biological, chemical and
geological processes on
Earth

Super Wicked Problems



Hide and hope the problem will go away...



Be optimistic, pragmatic and aim to be part of the solution...



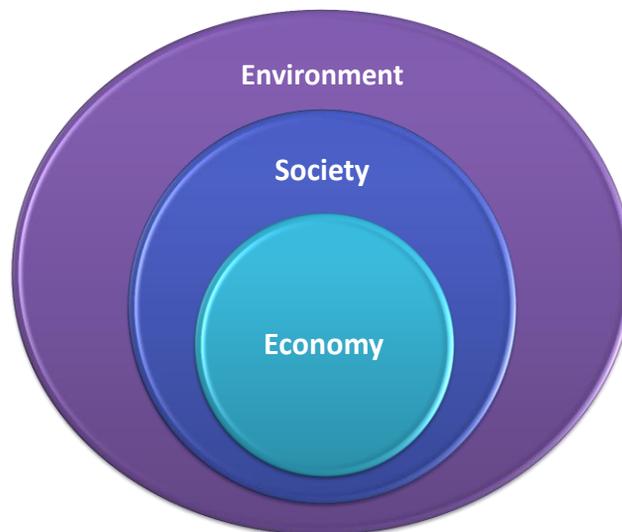
*[We will] understand the enormity of **humanity's responsibility** as stewards of the Earth. It [will] highlight the immense power of our **intellect** and our **creativity**, and the opportunities they offer for shaping the future.*

Paul Crutzen

*We are confident that the **young generation** of today holds the key to transforming our energy and production systems **from wasteful to renewable** and to valuing life in its diverse forms.*

Paul Crutzen

Sustainability



'Building a culture that grows with Earth's biological wealth instead of depleting it. ..in this new era, nature is us.'

Challenge: How do we get to a future with high wellbeing **FOR ALL** within the confines of our planetary resources?



What does this have to do with Chemistry?

- Chemistry is the science of the material world
- Understanding and developing new THINGS
- Contributed to increase in wellbeing



- BUT plays a large role in impacts of society on the environment



Green and Sustainable Chemistry

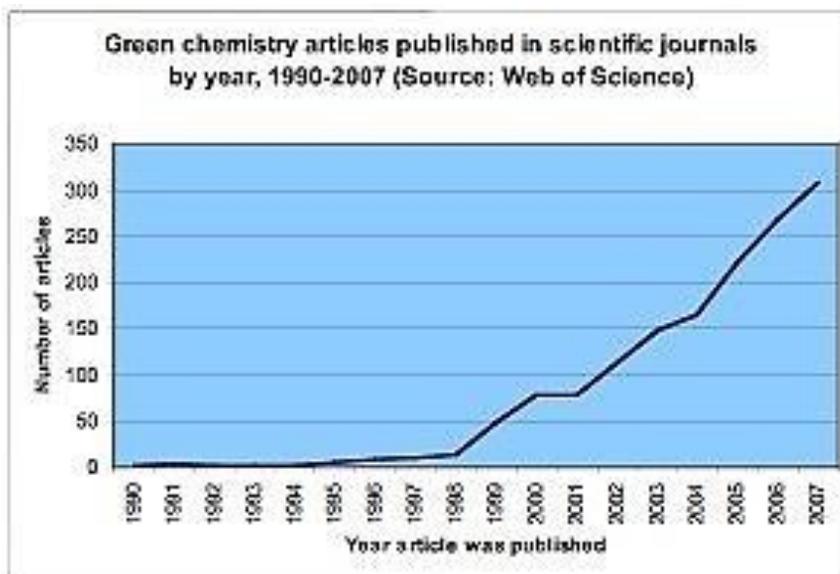
Doing more with less:

- reducing the environmental impact of processes and products
- optimizing the use of finite resources
- minimizing waste

⇒ whole systems approach
 ⇒ solutions relevant to society



20 years of Green Chemistry



MASTERS

MSc Double Degree in Environmental and Sustainable Chemical Technologies
Università Ca' Foscari Venezia and Univerza v Novi Gorici

MSc in Chemistry, Skills Profile: Green and Sustainable
University of Copenhagen, Denmark

MSc in Chemical Research (Green Chemistry with Industry)
University of Leicester

MRes in Green Chemistry: Energy and the Environment
Imperial College London

Environment and Sustainable Technology MSc
The University of Manchester – School of Chemical Engineering and Analytical Science

Green and Sustainable Chemistry MSc
University of Nottingham

MSc Degree in Green Chemistry and Clean Technologies
University of Patras

1st year Master of Science: Chemistry, Specializing in Green Chemistry
The University of Strasbourg

MSc in Green Chemistry and Sustainable Industrial Technology
University of York

Master en Química Sostenible
University of Zaragoza

Master of Science in Green Chemistry
Chatham University, PA

PhDs

University of Bath 4 Year PhD Studentships – EPSRC DTC in Sustainable Chemical Technologies
Centre for Sustainable Chemical Technologies

The Berkeley Center for Green Chemistry
Graduate Group

Carnegie Mellon University

Universidad Complutense de Madrid
Green Chemistry Doctorate Programme

Monash University

Portuguese Universities: Aveiro, NOVA Lisbon and Porto – ITQB PhD in Sustainable Chemistry:
PhD Program in Sustainable Chemistry

SINCHEM: The European Doctoral Programme on Sustainable Industrial Chemistry

The University of Sydney
Green Chemistry and Renewable Energy

UMass Boston – Chemistry, PhD (Green Track) Green Chemistry:
The Green Chemistry Track in the Chemistry PhD Program

UMass Lowell
Green Chemistry PhD

University of York – Green Chemistry Centre of Excellence

GREEN CHEMISTRY

ACS Green Chemistry Institute®

GLYCOSURF

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INSPIRED BY NATURE

FIND OUT MORE

Eco-Friendly

Our processes follow The 12 Principles of Green Chemistry and Life-Cycle Analysis (LCA), and our products are biodegradable and low toxicity "green" materials.

Sugar-Based

GlycoSurf's technology can produce surfactant products with a variety of mono- and disaccharide carbohydrates. This results in safe, eco-friendly, therapeutic products.

High Purity

GlycoSurf's synthetic process produces products in >95% yields; resulting in higher purities and greater performance properties than the competition.

the consumer, employee, and the community/environment.

Audience Survey Question

How well do you think Green Chemistry is embedded in industry and academia?

- Very well
- Quite well
- Okay
- Quite poorly
- Very poorly

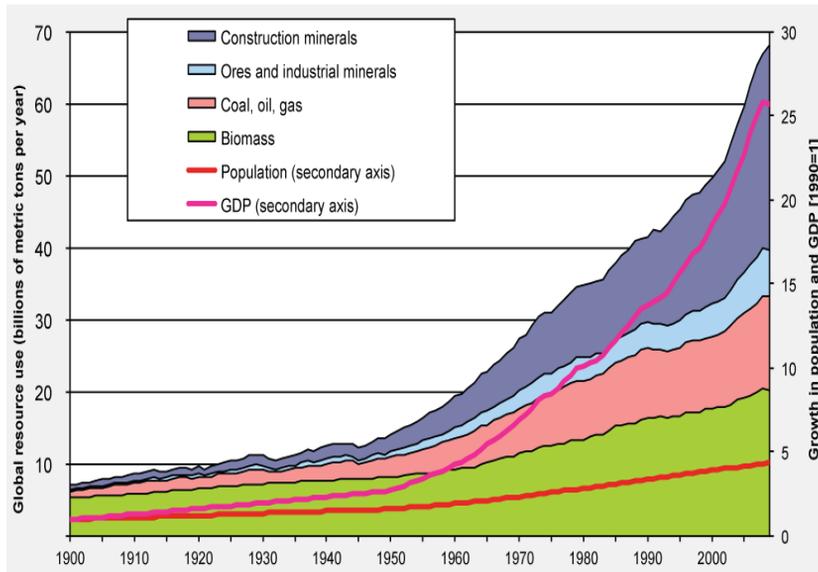
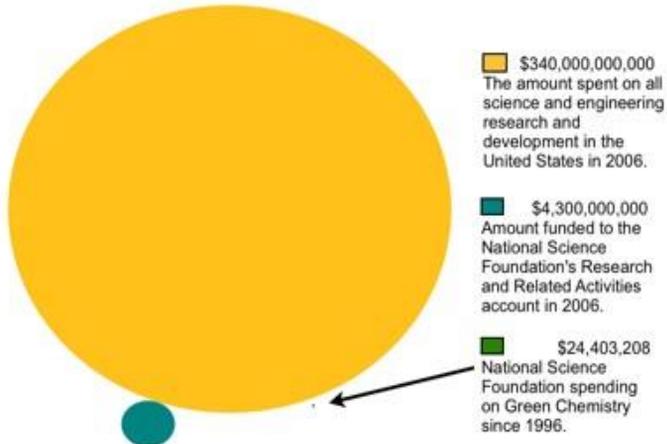
Current Limitations

- Training and awareness in green chemistry is fragmented
- Doesn't incorporate broader sustainability understanding

=> Science graduates don't have the skills industry and society needs to lead and innovate sustainably.

Funding Is Limited

National Science Foundation investment in Green Chemistry compared to national investments in science and engineering research and development.



Doesn't challenge the dominance of consumption and resource-intensive 'growth' economy

What do we need?

A new vision for chemistry that embeds sustainability

WE NEED SUSTAINABLE SCIENTISTS WHO:

- Have knowledge of core science AND sustainability
- Have the language and contacts to work across boundaries: chemistry, biology and engineering
- Collaborate
- Are “Scientific Citizens” – use their knowledge and skills for benefit of society and the planet



The Role of Early-Career Scientists

- Upon our shoulders to build a more sustainable future
- Large percentage of science workforce
- In position to call for new approaches and knowledge



Early-career scientists are vital



Network of Early-career Sustainable Scientists & Engineers (NESSE)

Who we are

An international community of academic researchers and young professionals in the first ten years of their career working on technological solutions to today's most pressing environmental and energy challenges.

Our Vision

We envision a sustainable future for all, facilitated by collaborative and green approaches to science and engineering.

Our Mission

To inspire and mobilize a new generation of interdisciplinary scientists and engineers who strive to achieve a more sustainable future.

How can we achieve our mission?

- **Build Community**
- **Train leaders**
- **Influence Research**
- **Shape Education**
- **Share Ideas**
- **Promote Advocacy**



Build Community

Connect scientists and engineers across disciplines to share resources and forge collaborations

Launch Event



Online Community

Welcome to the Network of Early-Career Sustainable Scientists & Engineers

The world faces multiple environmental challenges including climate change, biodiversity loss, resource depletion, and pollution whilst huge social inequalities remain. To tackle this we need technological solutions and social change that are integrated and work for both people and the environment.

NESSE is a global interdisciplinary support network run by and for early-career scientists who are striving to tackle today's environmental and energy challenges and help the move towards a more sustainable future.

We are a network of graduate students, postdoctoral researchers, early faculty members and educators from diverse backgrounds including chemists, biologists and engineers.

Through this network you can:

- share knowledge and find solutions to research problems
- forge collaborations and meet other early-career professionals in similar and relevant disciplines
- learn about ways to make your research and its outcomes greener and more sustainable
- gain interdisciplinary knowledge
- help to build a community of green scientists
- find resources to communicate about greener science and build greener science network



Students at the ACS Green Chemistry Summer School

Tweets

ACS Webinars @acswebinars
28 Aug
Learn more about the work of NESSE (@greenscientists) during next week's webinar! bit.ly/1L5q84a pic.twitter.com/9jvgE0HPDD
Retweeted by NESSE



Collaborative, interactive website

NESSE Members Events Photos Files Search this group

Write something...

Giulia Paggiola via Green STEMs at York August 27 at 10:28am
To build on the previous post about LAUNCH, here are some other interesting fellowships and programmes that may be of interest to some of you! - a bit UK focused perhaps. [1](#)
Parliamentary Office of Science and Technology (POST) for the Huffield Foundation Flowers fellowship. DEADLINE Sept 28th

66 members

Public Group

The Network of Early-career Sustainable Scientists and Engineers (NESSE) is a global interdiscip... See More

66 members (46 new) Invite by Email

ADD PEOPLE TO GROUP

CREATE NEW GROUPS

Groups make it easier than ever to share with friends, family and teammates.

CREATE GROUP

ENJOY GREEN CHEMISTRY

Like 48

Social media discussion groups

- ask questions, network, get careers info

Sustainable Science Groups



University of Toronto



NEXT STEPS IN GREEN CHEMISTRY RESEARCH

A Student Workshop 
Hosted by the
at the University of Toronto
St. George Campus, Toronto, Ontario, Canada
May 21-23, 2014

Green Chemistry Initiative at the University of Toronto

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Past Seminars

Sean Dragan, Vice President of Corporate Development, Bullfinch Powers - Seeing the Seeds of a Greener Economy

Seminar Series

Thursday April 24th 2014, 10-11am

Davenport East Seminar Room

Bullfinch Power is Canada's 100% green energy provider. By sourcing electricity and green natural gas (20-methane from renewable, pollution-free sources and rejecting them into the energy grid), Bullfinch makes it easy for Canadian homes and businesses to switch to renewable energy. The presentation and discussion will focus on Bullfinch's mix of customers and expertise, its efforts to stimulate the development of new renewable energy production across Canada, and potential future directions for the industry.

Sean Dragan is Vice President, Corporate Development at Bullfinch Power, responsible for expanding the scope of the company's business. Sean joined Bullfinch at the beginning of 2014 after nearly a decade in Corporate Strategy and Business Development at Canada Bread and its parent company, Maple Leaf Foods, for which he led the development of an environmental sustainability strategy. His background also includes forecasting and analytics, analytics, general management as a videoconferencing start-up in the late 1990s, and teaching and teacher-training in Tokyo. He has been a Bullfinch customer since 2010 and has partnered with Bullfinch to power neighbourhood environmental events with renewable energy.



Sustainable Science Groups

Building sustainable science network
across STEM subjects and social sciences.



'Green Reactions'

- train early-career researchers across biology, chemistry in public communication
- dialogues with public about sustainable technology being developed at the University of York



Train Leaders

Foster the development of confident and
able leaders for sustainable science
communities

Train Leaders



- How-to guides for developing sustainable communities
 - Setting-up a sustainable science groups
 - Getting funding
- Developing mentorship programme
- Develop broader knowledge of sustainability
 - Connections with other early-career groups in economics and ecology

Getting Started

The information on this page has been developed by NESSE members who have successfully started sustainable science groups at their home institutions. These groups consist of both discipline-specific and interdisciplinary teams of scientists who, by working together, have been able to change the local conversation about green science and engineering - significantly impacting the way research and education is carried out at their universities. While this page is primarily focused on student-run sustainable science groups at educational institutions, it is by no means limited to that purpose - we are happy to help anyone promote sustainable science within their community! For more info and advice contact groups@unesse.com.

Scroll through to read step by step, or click through to what you'd like to learn about:

[Taking the First Steps](#)
[Ideas For Group Activities, Events, and Educational Outreach](#)
[Working Within a University Community](#)
[Frequently Asked Questions](#)

Enable Sustainable Research

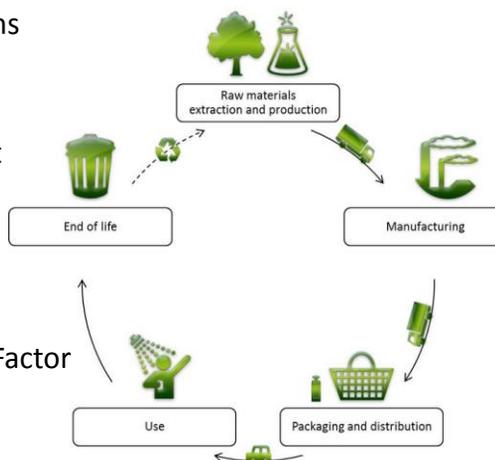
Promote greener, cross-disciplinary research practices.

Metrics for Sustainability

Example: greener chemistry

NESSE strives to encourage chemists to use metrics that:

- Make objective comparisons
- Benchmark progress
- Drive change
- Demonstrate improvement
- Increase transparency



Such as...

- Solvent selection
- Process Mass Intensity/E-Factor
- Reaction Mass Efficiency
- Life Cycle Analysis

Enable Sustainable Research

- Promoting greener lab practices
 - Chemical hazards
 - Reagent and solvent alternatives
 - Energy consumption
 - Waste prevention
 - Reuse/recycling
- Build the “toolbox”
- Encourage incorporation
 - Greener practices in lab

green

Enable Sustainable Research

Resource hub for stocking your “toolbox”

- Green lab practices
- Access to current alternatives
- Network with experts
- Ask questions
- Education and implementation

Simple Techniques to Make Everyday Lab Work Greener

Solvent Selection

1 Use dry ice/isopropanol for cooling baths

Reaches essentially the same temperature as dry ice/acetone (-77°C vs. -78°C), but the lower volatility of isopropanol minimizes vapor emissions and inhalation, and makes the bath last longer.

2 Use heptane instead of hexanes

Heptane has almost identical chemical properties to hexanes, but is significantly less toxic due to the odd number of carbons, which alter its metabolic product in the body.

3 Use 2-MeTHF instead of THF

2-MeTHF is indirectly derived from bio-based renewable feedstocks. Its chemical properties are very similar to THF but it is immiscible with water, making separations, recycling, and drying easier. See D. F. Aycock, *Org. Process Res. Dev.* **2007**, *11*, 136-139 for more information.

4 Substitute DCM in column chromatography

One of the largest contributors to chlorinated solvent waste is chromatography. While selecting a new solvent system may seem challenging, J. P. Taggart, et al. *J. Green Chem.* **2012**, *14*, 3020-3025 have already done the work for you.

Waste Reduction

5 Recycle wash solvents

Wash solvents are ideal for recycling because they're dry and pretty hot as is. Simply wash your glassware as usual, collect the liquid in a separate container. When it's full, transfer to the outdoors and distill into a clean collection flask.



Shape Education

Support the incorporation of sustainable science and engineering into graduate and undergraduate curricula.

Shape Education

Collaboration not competition

- Awareness of the environmental and energy challenges
- Supporting early-career researchers in finding solutions
- Education and incorporation of sustainable practices
- Create new scientific traditions and practices



Audience Survey Question

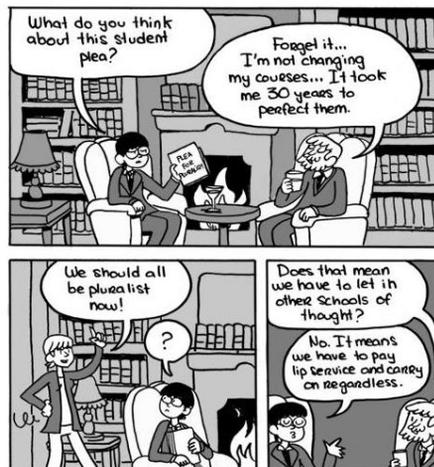


How much knowledge do you feel you have about sustainable chemistry?

- A lot
- A fair amount
- A little
- None at all

Lack of Sustainable Science Education

- Scientific traditions
 - 100+ year practices
- Academic resistance
 - Out-of-date education
- Academic hesitation
 - Set in their ways
 - Fear of consequences
- Degree structure
 - Limited time; results based
 - Undergrad/grad projects
 - Tenure system



International student initiative for pluralism in economics



Green Chemistry: The Green Curriculum

"Design by design," green chemistry is designed to have less impact on the environment by creating lower levels of waste and toxicity than traditional chemistry. Green chemistry is also a compelling way to assist teachers as they strive to interest middle school students (ages 9 – 13) in science and math.



Curriculum & Teacher Training

The curriculum and teacher training work of Beyond Benign seeks to deliver teaching and learning tools to K-12 educators in order that they may share dynamic science experiences with their students with an emphasis on objective reasoning through the consideration of economy, society and the environment in equal measure.



The Green Chemistry Commitment

TRANSFORMING CHEMISTRY EDUCATION

What is the Green Chemistry Commitment?

The **Green Chemistry Commitment (GCC)** is helping to *transform chemistry education* in college and university chemistry departments who strive to:

- prepare world class chemists whose skills are well aligned with the needs of the planet and its inhabitants in the 21st century, and
- design and develop innovative, efficient, and environmentally sound solutions to the safety and effectiveness of chemical products and processes.

"The goal of Green Chemistry is for the term to disappear and it simply becomes how we practice chemistry."

- John C. Warner
Co-author of Green Chemistry: Theory and Practice
Co-Founder of Warner Babcock Institute for Green Chemistry

The Green Chemistry Commitment offers access to a broad and supportive community of chemistry experts and a flexible framework for green chemistry curriculum and training. With multiple pathways to the implementation of green chemistry education, the Green Chemistry Commitment sets a benchmark to track progress on specific learning and research objectives.



PROJECTS

Overview
 Engaging Retailers in the Adoption of Safer Products
 Facilitating Chemical Data Flow Along Supply Chains
Advancing Green Chemistry Education
 Mainstreaming Green Chemistry
 Promoting Green Chemistry Innovation

Advancing Green Chemistry Education

Background

The vast majority of chemistry students receive little or no education in how chemical design may affect health or sustainability. Similarly, most industrial chemists, designers, and business managers have received little training in green chemistry, toxicology, lifecycle evaluation, or sustainability. For green chemistry to thrive, there is a need for professionals who are well-educated in green chemistry concepts, including green chemical design, toxicology, lifecycle evaluation, and environmental policy. The lack of such education can present a barrier to advancing green chemistry within firms and supply chains, especially when price and performance may take precedent over environmental impacts. Companies increasingly want to chemists, engineers, designers and business managers who have sustainability knowledge.

Webinar in the Spring with speakers from three companies

- What are the green chemistry knowledge and skills required by companies?
- Sustainable science career opportunities using green chemistry

Share Ideas

Communicate inspiring sustainable science and engineering stories to researchers and professionals, as well as the general public.

NESSE
Connecting early-career sustainable scientists and engineers

Welcome About us Join NESSE Sustainable Science Groups Events Blog

SEARCH GO

Working together to move towards a more sustainable future

July 3, 2014

NESSE launches at the Green Chemistry & Engineering Conference

Last week was an exciting moment for NESSE as we launched the organisation at the [American Chemical Society Green Chemistry & Engineering Conference](#) in Washington DC. After a year of setting up the network, writing our constitution, scrambling to finish our website and organising the 'From Bench to Big Picture' launch event in collaboration with the [American Chemical Society Green Chemistry Institute](#), we were nervous, excited, and a little unsure as to how it would be received. Coming back after the conference we are energised and excited by the enthusiasm from the early-career scientists present and lots of other organisation to be part of, to build and support NESSE.

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ACS Webinars @acswebinars 23h
Learn more about the work of NESSE (@greenscientists) during next week's webinar! bit.ly/11ISqBA pic.twitter.com/5jwJ50hP00
Retweeted by NESSE



For information about our blog or to contribute, email us at:
blog@sustainablechemists.org

Promote Advocacy

Education and encourage sustainable scientists to engage with peers and decision-makers in all sectors

Promote Advocacy

Train scientists in communication to:

- Promote need for sustainable science in all sectors
- Educate peers
- Engage with decision-makers
 - University department chairs
 - University leaders
 - Industry executives
 - Community decision-makers



NISSE

Take Home Lessons

- Inter-connected 'Wicked Problems' that cannot be solved by individuals
- Chemistry has a huge impact on environmental challenges
- Moves towards sustainable chemistry still fragmented, graduates don't have skills and knowledge necessary
- Early-career chemists have huge role to play in building a new vision:
 - Be open to change
 - Share knowledge
 - Collaborate
 - Look beyond our discipline



What's Next



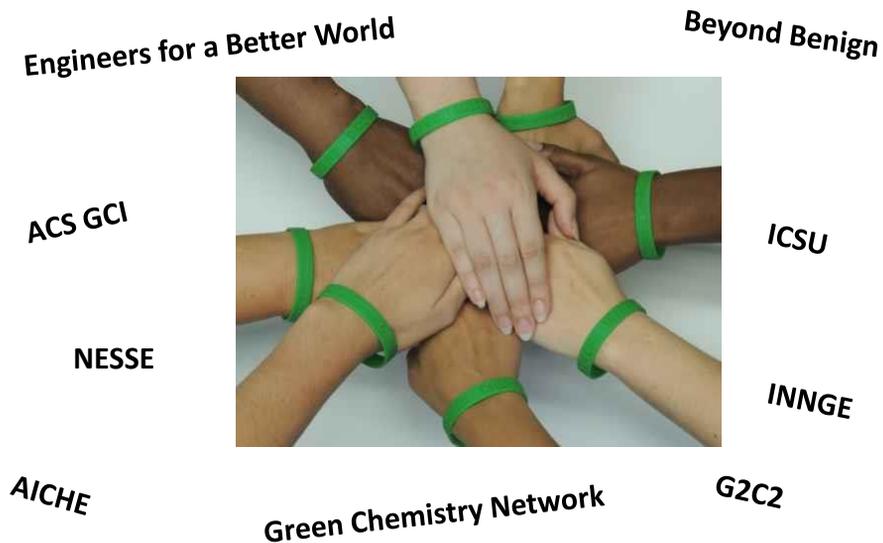
- Become a member of NESSE
sustainablescientists.org

It's FREE!

- Share information and connect through Facebook (NESSE) and twitter (@greenscientists)
- Set-up your own Sustainable Science Group –
groups@sustainablescientists.org

Help us build a community of sustainable scientists

Building a coalition for sustainable science and engineering



The NESSE Team



Oxana



Laura



Michael



Jennie



Savannah



Anna



Giulia



Cliff

Special thanks to the staff at ACS:



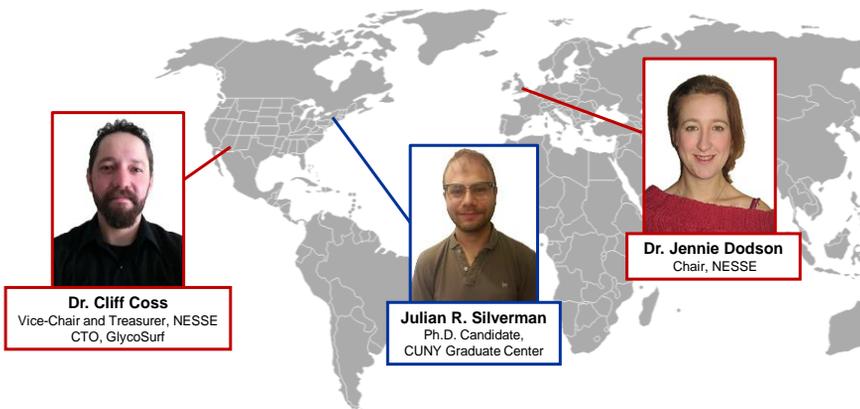
Resources

- Rockstrom *et al*, 'A safe operating space for humanity', *Nature*, 461, 472-475 (2009)
- Will Steffen, Paul J. Crutzen and John R. McNeil, 'The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?', *Ambio*, 36, 614-621 (2007)
- Paul Anastas, '20 years of Green Chemistry', <https://pubs.acs.org/cen/coverstory/89/8926cover6.html>
- NESSE-affiliated Sustainable Science Groups: <http://www.sustainablescientists.org/sustainable-science-groups/active-groups/>



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“providing interesting topics not normally discussed with a wider audience, delivered by experts. The Q&A session at the end has some excellent input from the world wide audience adding tremendous value to the webinar experience.”

Fan of the Week

Chris Nicholas



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