Green chemistry: Progress and needs

Overview of green chemistry at UO
Status on green chemistry in academia

Communicating the value of green chemistry
Illuminating market needs
Charting a roadmap for green chemistry (education)

Professor Jim Hutchison
University of Oregon
hutch@uoregon.edu

UNIVERSITY
OF OREGON

Nearly 20 years of green chemistry at the UO

1996: Developed first undergraduate green chemistry curriculum

2000: Initiated the world's first greener nanoscience program

2001: Nearly $1M in funding from NSF and private donors to develop Green Organic Chemistry Lab for national dissemination

2004: Published first undergraduate green chemistry textbook

2006: Sustainability infused into graduate and undergraduate education

2008: NSF Center for Green Materials Chemistry

2011: NSF Center for Sustainable Materials Chemistry

2014: EPA Lifecycle Nano (LCnano) Center

The UO is a world leader in green chemistry

Over $40M in research support for "green" programs over the last 8 years

With more than 10 research groups now involved in green chemistry

Green chemistry has infiltrated every sector of our campus

At least 6,000 UO undergraduates, 60,000 undergraduates worldwide and 250 U.S. faculty have benefited from our curriculum

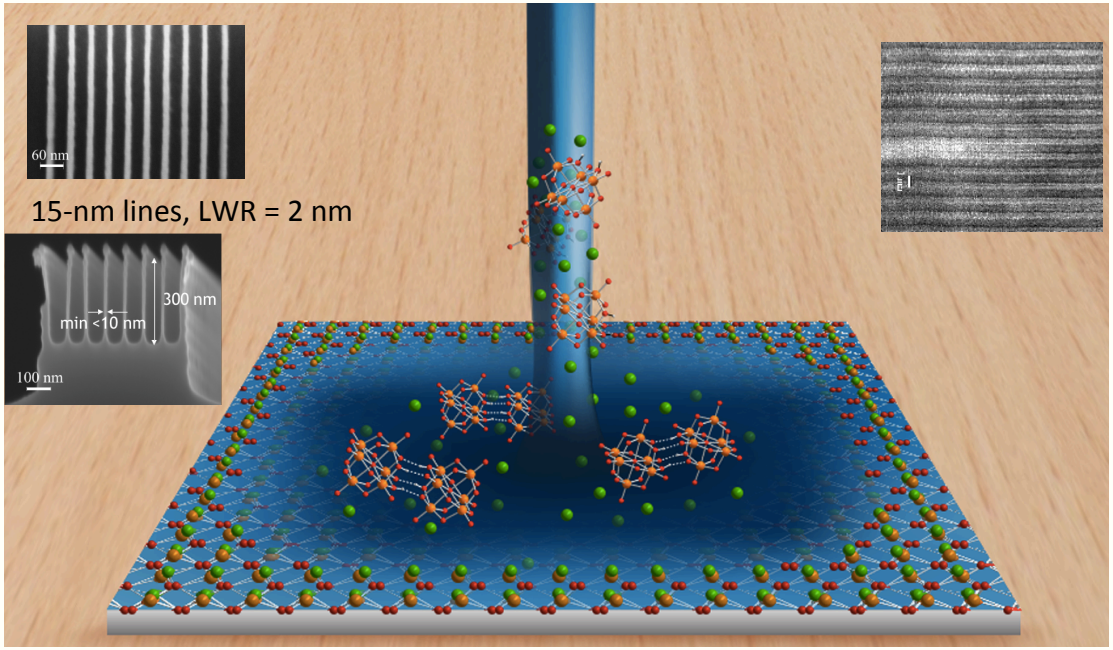
CSMC center for sustainable materials chemistry

A 5-Year, $20M NSF Center for Chemical Innovation

Mission: To conduct curiosity-driven and use-inspired research to enhance the green chemistry toolbox with new methods and new techniques that will advance the scientific enterprise and transform the next generation of products

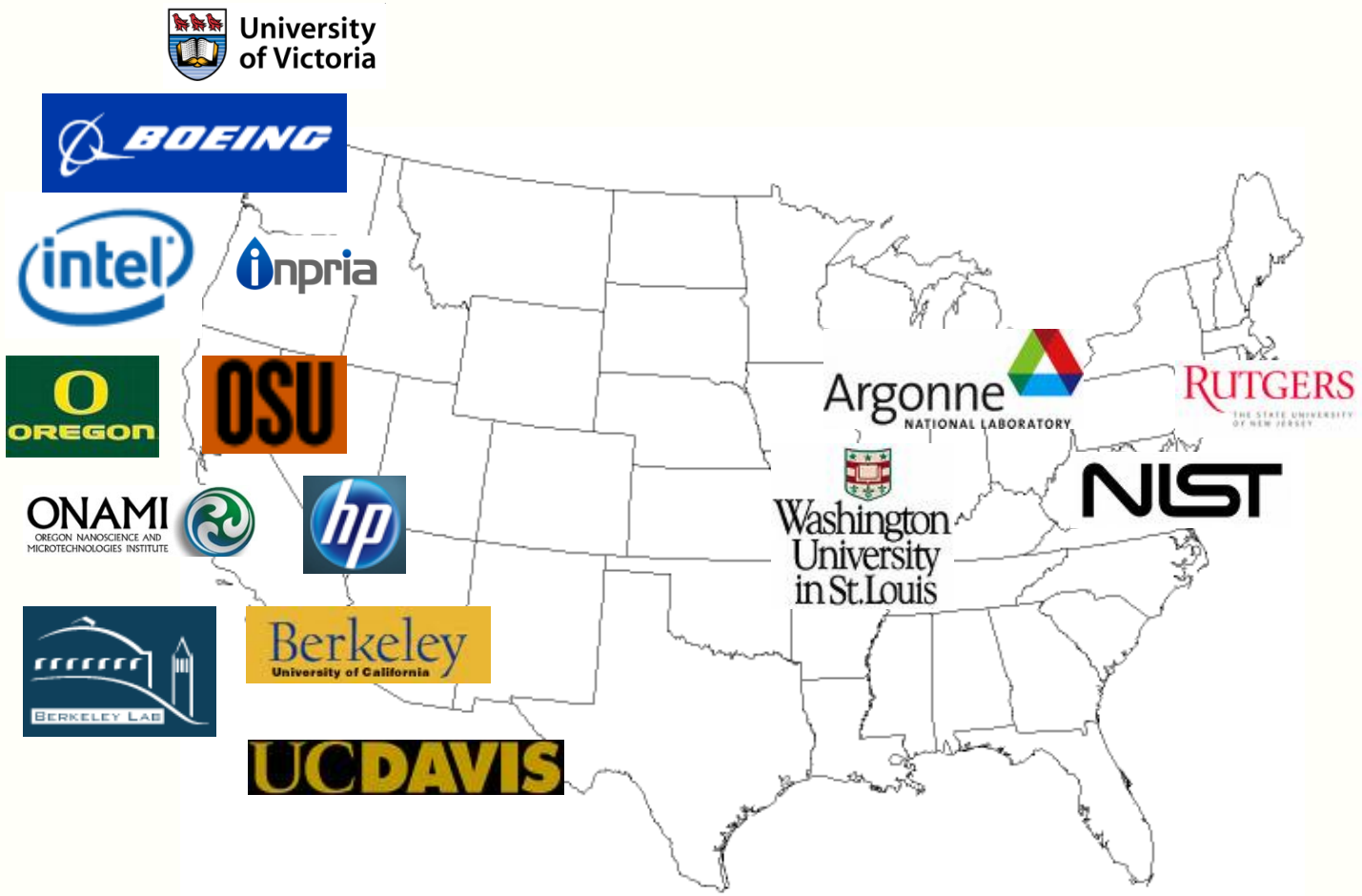
Nanowrite

Pattern Transfer



Self-assembly with near-atom control

CSMC center for sustainable materials chemistry



UNIVERSITY OF OREGON

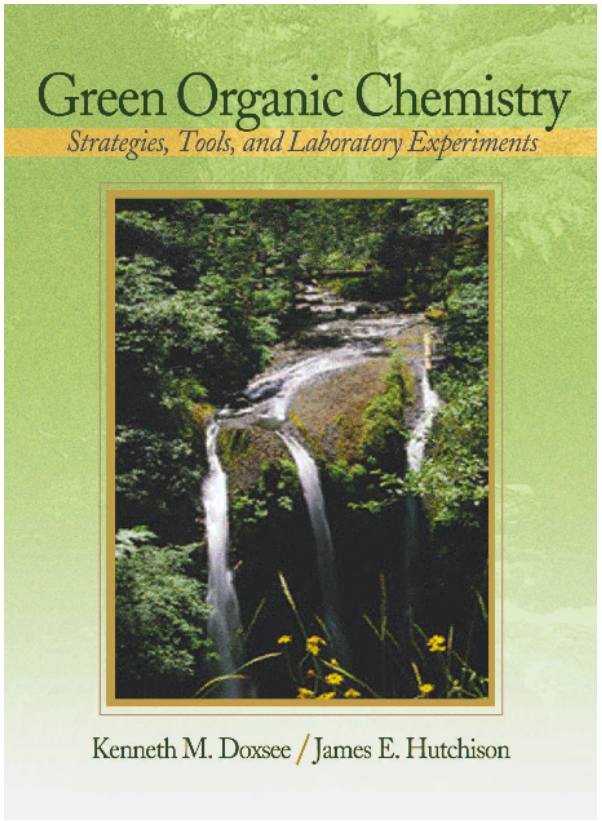
Life Cycle of Nanomaterials

EPA funded
$5M/4 year project

- Measuring and evaluating impacts of nanomaterials and nano-enabled products across the life cycle
- Informing greener design of these materials and products
- Testing and comparing new and existing alternatives

Yale University · Mines · Duke University · UIC University of Illinois at Chicago · ASU · Johns Hopkins University · Oregon · Carnegie Mellon University · Oregon State University OSU · Purdue University · W

UO Green Chemistry Education



GCEdNet™

Curriculum development, dissemination workshops, outreach

Green Chemistry in Education Workshops: Hundreds of faculty are now teaching green chemistry

Status for academic green chemistry

Lots of interest in green chemistry, but not across the board

- Research: early adopters, younger faculty, opportunistic projects (e.g. energy)
- Teaching: significant adoption at PUIs and by younger faculty

Situation in universities similar to companies: *Pockets* of activity

- Champions vs. those who don't see the value

100's of institutions, 500-1000s of faculty – wide range of adoption from majors to non-majors

Need to increase visibility of what is going on more widely, demonstrate market pull, define problems and coordinate

Communicating the value of green chemistry

Shared language: What is meant by green chemistry?

- Chemicals/materials selection
- Molecular level design and production
- Metrics that help define success

Invention/Innovation will attract more talent

- Best science/solutions: Beyond the 12 principles
- Concrete metrics that define problems and successes

How to recruit more talent? Articulate needs in ways that illustrate specifics needs and challenges

- Workforce needs?
- Technology and metrics?
- Resources to support research and development efforts

Illuminating market needs

Green chemistry solves real problems. Without a lens to the market, efforts in academia will miss the mark

Need to increase efforts to make the right problems visible

- Precompetitive
- Resources for use-inspired basic research to discover the next generations of solutions

Leadership: Need industry pull for solutions that consider market, lifecycle, systems, etc. What do *real* solutions look like?

Mechanisms? Portal, workshops, regional centers

Accelerating progress in green chemistry education

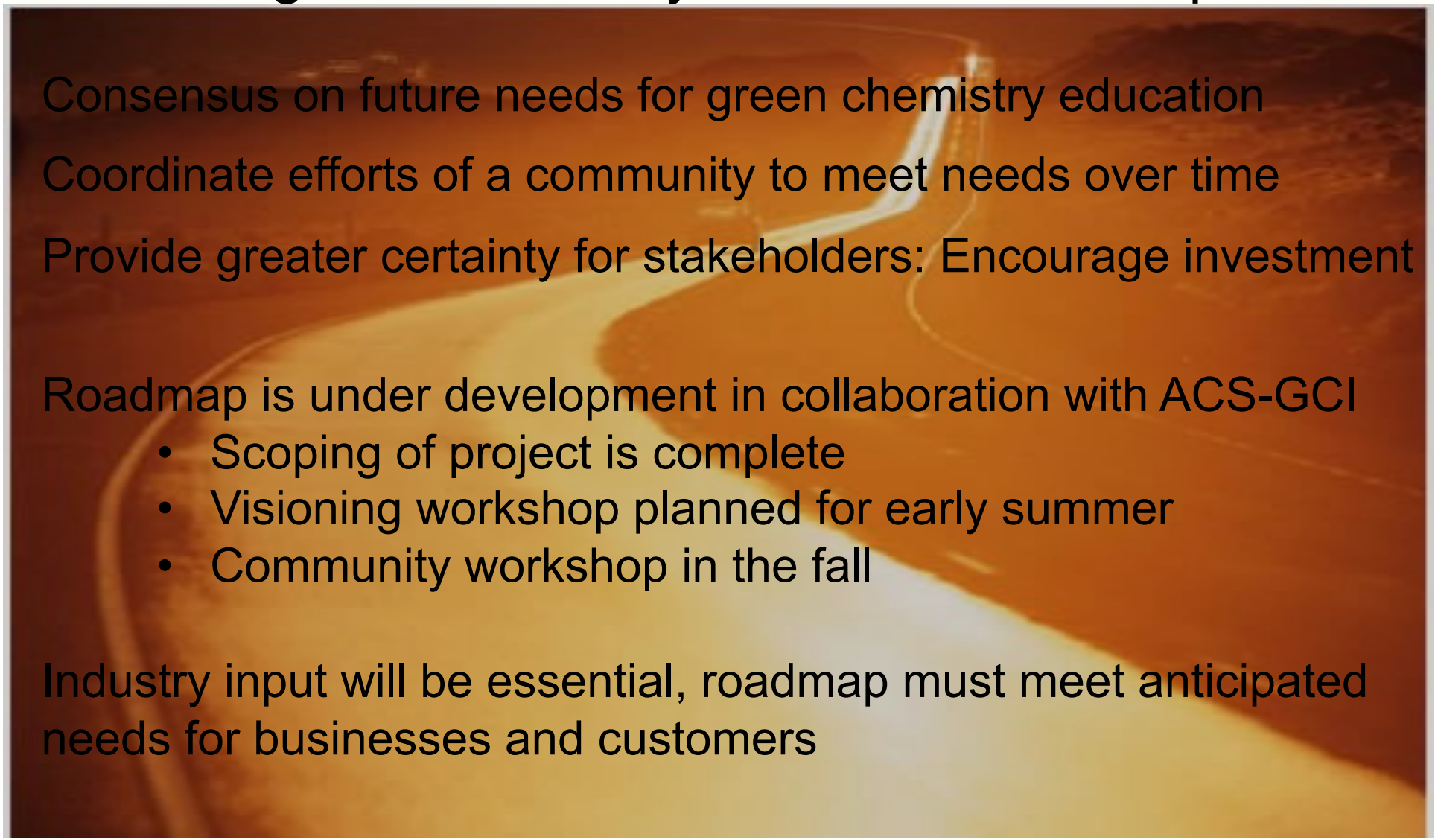
- Sense that things are moving too slowly
- Few, if any, metrics for success or standards
- Lack of coordination in a resource-limited environment

Goals

- Education that meets society's and industry's long-term needs to address sustainability challenges
- Cutting edge chemistry education
- Coordinated effort that makes good use of resources and attracts additional resources

Roadmap?

A green chemistry education roadmap



Consensus on future needs for green chemistry education

Coordinate efforts of a community to meet needs over time

Provide greater certainty for stakeholders: Encourage investment

Roadmap is under development in collaboration with ACS-GCI

- Scoping of project is complete
- Visioning workshop planned for early summer
- Community workshop in the fall

Industry input will be essential, roadmap must meet anticipated needs for businesses and customers

Green chemistry: Progress and needs

Overview of green chemistry at UO
Status on green chemistry in academia

Communicating the value of green chemistry
Illuminating market needs
Charting a roadmap for green chemistry (education)

Professor Jim Hutchison
University of Oregon
hutch@uoregon.edu

UNIVERSITY
OF OREGON