Bioeconomy 1.0

Marc Salit, Leader, Genome-Scale Measurements Group, MML

U.S. Bioeconomy in 2012 estimated at $350 billion

- about 2.5% of GDP
- global revenues from biologics reached $125 billion.
- U.S. industrial biotech (fuels, enzymes, materials) reached at least $125 billion.

Rob Carlson, Biodesic at ACS Capitol Hill Briefing and http://www.synthesis.cc/cgi-bin/mt/mt-t.cgi/392

Estimated size of total semiconductor sales in 2012: $291.6 billion

Semiconductor Industry Association

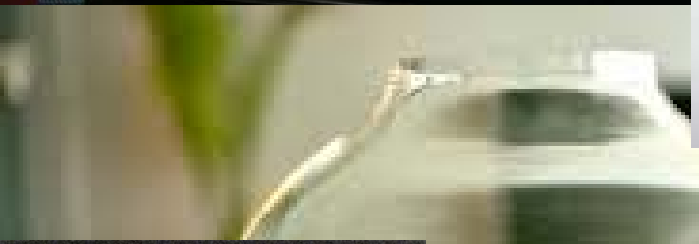
Bioeconomy 2.0

iGEM 2014 at the Hynes Convention Center

1st Wave: Vertically integrated Synthetic Biology

contained, idiosyncratic ecosystems





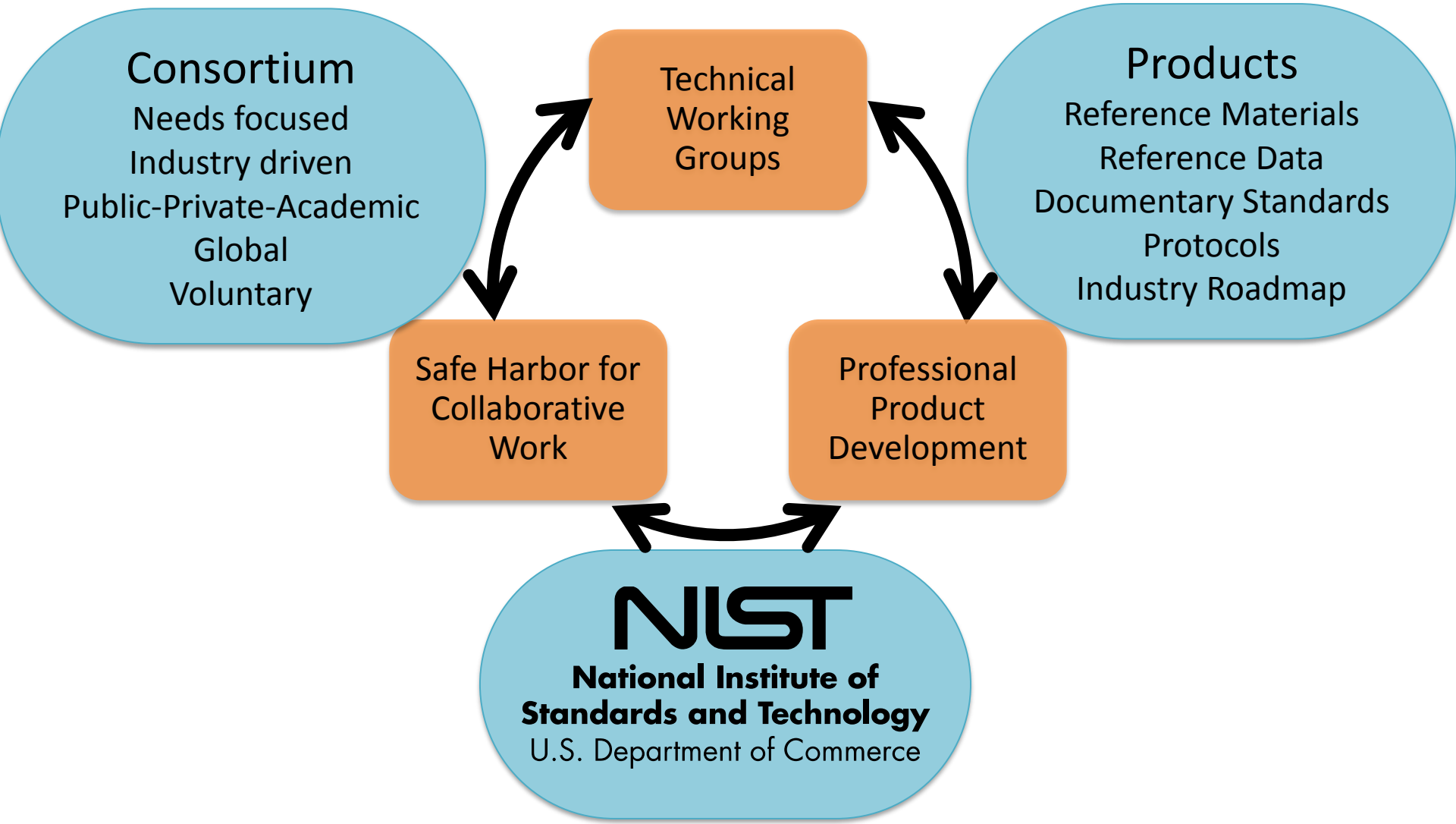


Driving the 2nd Wave
NIST Work will be foundational

- DNA R/W scaling…
  - Usually, it's only "Pick 2"
    - ☑ Good
    - ☑ Fast
    - ☑ Cheap
- Advancing technology
  - distributed fabrication
  - research leading to de facto design, construction standards
  - scaling complexity
- Standards will enable…
  - predictability
  - distribution of labor
  - abstraction
  - specialization
  - interoperability
  - reliability
- Metrology will enable…
  - reproducibility
  - technology development
- Platform technology businesses emerging
  - Gingko Bioworks
  - Zymergen
  - Teselagen
  - Benchling
  - Genome Compiler
  - Transcriptic
  - Emerald Cloud Labs
  - Riffyn
  - …
- Commerce, driven by business-to-business transactions

Synthetic Biology Standards Consortium

Scaling capacity to engineer biology



Convene the stakeholders

Establish consortium to conduct metrology product development

- Kickoff meeting 3/31, establishing terms-of-reference for multiple working groups across technical domains

Automation and Protocol Interoperability

- minimum-information standards protocol exchange, reproducibility, automation

Flow Cytometry

- methods for comparability of results across space, time, and multiple channels

Digital Biological Information

- reproducibility of designs via standard representation, exchange of digital information

Performance Metrics for Engineered Strains

- reference objects and methods for standard strain characterization and validation

Measurements for Regulated Applications

- inventory existing measurement resources, propose research agenda

DNA Construction

- standards describing DNA synthesis, assembly, validation for frictionless transition between DNA design, build, test, deployment

Innovations

Three recent developments in synthetic biology you need to know

By Dominic Basulto May 7 Follow @dominicbasulto

This is what a "bio-factory" looks like. In a yeast fermentation room at Amyris's labs in California, new strains of yeast are tested before going to large production facilities in Brazil. (Peter DaSilva for The Washington Post)

Using synthetic biology techniques, researchers have created everything from new flavors and fragrances to new types of biofuels and materials. While the innovation potential of combining biology and engineering is unquestionable, now comes the hard part of proving that it is possible to design and build engineered biological systems on a cost-effective industrial scale, thereby creating true "bio-factories."

New initiatives to embrace industry-wide standards

…the push is growing for standards… On March 31, the U.S. National Institute of Standards and Technology (NIST) convened a working group at Stanford University to launch the Synthetic Biology Standards Consortium.

This embrace of industry-wide standards could be a huge step forward for the synthetic biology industry, which is still only in its infancy. Industry standards are a cornerstone of any technology industry, and getting major companies such as Dow, DuPont, Lockheed Martin and Novartis – all participants of the consortium – onboard is a positive step.

Emerging Technology: Unknowns

- Institution-based oversight framework struggling to adapt
  - current framework ill-fit for purpose
- Social assent uncertain
- Distributed or centralized innovation?
- Distributed or centralized production?

- Real technical challenges to Synthetic Biology at scale
  - engineering living matter is different than engineering inanimate matter