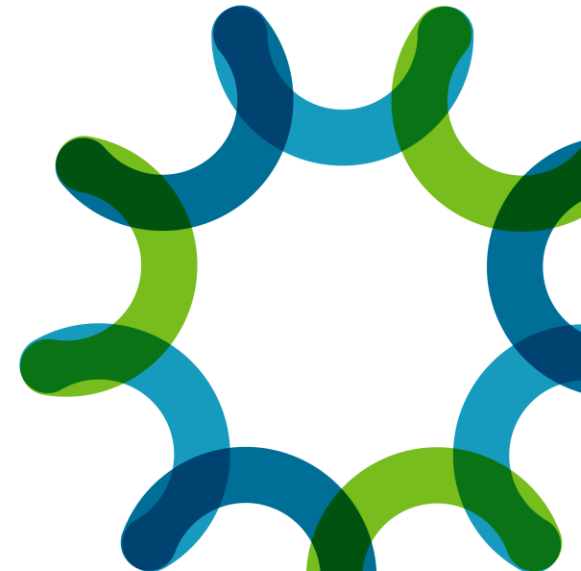




Industry Engagement & Outreach

Philip Laible, Christopher Johnson, and Babetta L. Marrone

BETO Peer Review 2019
Conversion Technologies
3:45-4:15 PM
March 7, 2019
Denver, CO



ABF Goal Statement

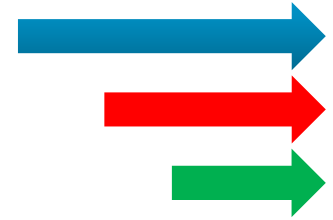
- **Goal:** Enable biorefineries to achieve 50% reductions in time to bioprocess scale-up as compared to the current average of around 10 years by establishing a distributed Agile BioFoundry that will productionize synthetic biology.
- **Outcomes:** 10X improvement in Design-Build-Test-Learn cycle efficiency, new host organisms, new IP, and **manufacturing technologies effectively translated to U.S. industry** ensuring market transformation.
- **Relevance:** Public infrastructure investment that increases U.S. industrial competitiveness and enables new opportunities for private sector growth and jobs.



Industry Engagement and Outreach (IEO) Goal Statement

Goal

- Identify and help remove barriers to industry adoption of biomanufacturing technologies
- Expand number and diversity of industry partnerships
- Maintain metrics for determining impact of project technologies on industry
- Increase the visibility of the ABF



Outcome

- Interactions between industry and the ABF will be established, organized, and facilitated
- Feedback from the industry stakeholder community to the ABF and BETO will support decision-making and project-planning activities



Relevance

- IEO will enable the ABF to serve the needs of, and be responsive to, the industrial biotech industry

Quad Chart Overview

Timeline

- October 1, 2016
- September 30, 2019
- 83% complete

Barriers addressed

- At-D. Identifying New Market Opportunities for Bioenergy and Bioproducts
- At-G. Social Acceptance and Stakeholder Involvement
- Ct-L. Decreasing Development Time for Industrially Relevant Microorganisms
- ADO-D. Technology Uncertainty of Integration and Scaling

Objective

Increase the visibility of the ABF and attract collaborators from academic and industrial communities

End of Project Goals

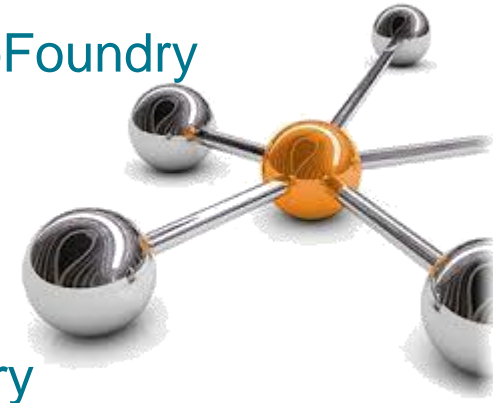
- Submit three reports on industry needs through interview and survey activities
- Manage dynamic relationship with IAB
- Organize yearly ABF Industry Days
- Coordinate at least one panel per year at a major society meeting

	Total Costs Pre FY17	FY 17 Costs	FY 18 Costs	Total Planned Funding (FY 19- Project End Date)
DOE Funded	--	116,948	278,384	469,654
Partners: LBNL (13%); NREL (17%); PNNL (0%); SNL (0%); LANL (34%); ORNL (2%); ANL (31%); INL (3%)				

1 – Project Overview

History: Task initiated at the inception of the Agile BioFoundry

- Efforts delocalized in first year
- Activities refocused and expanded in second and third years with increased budget



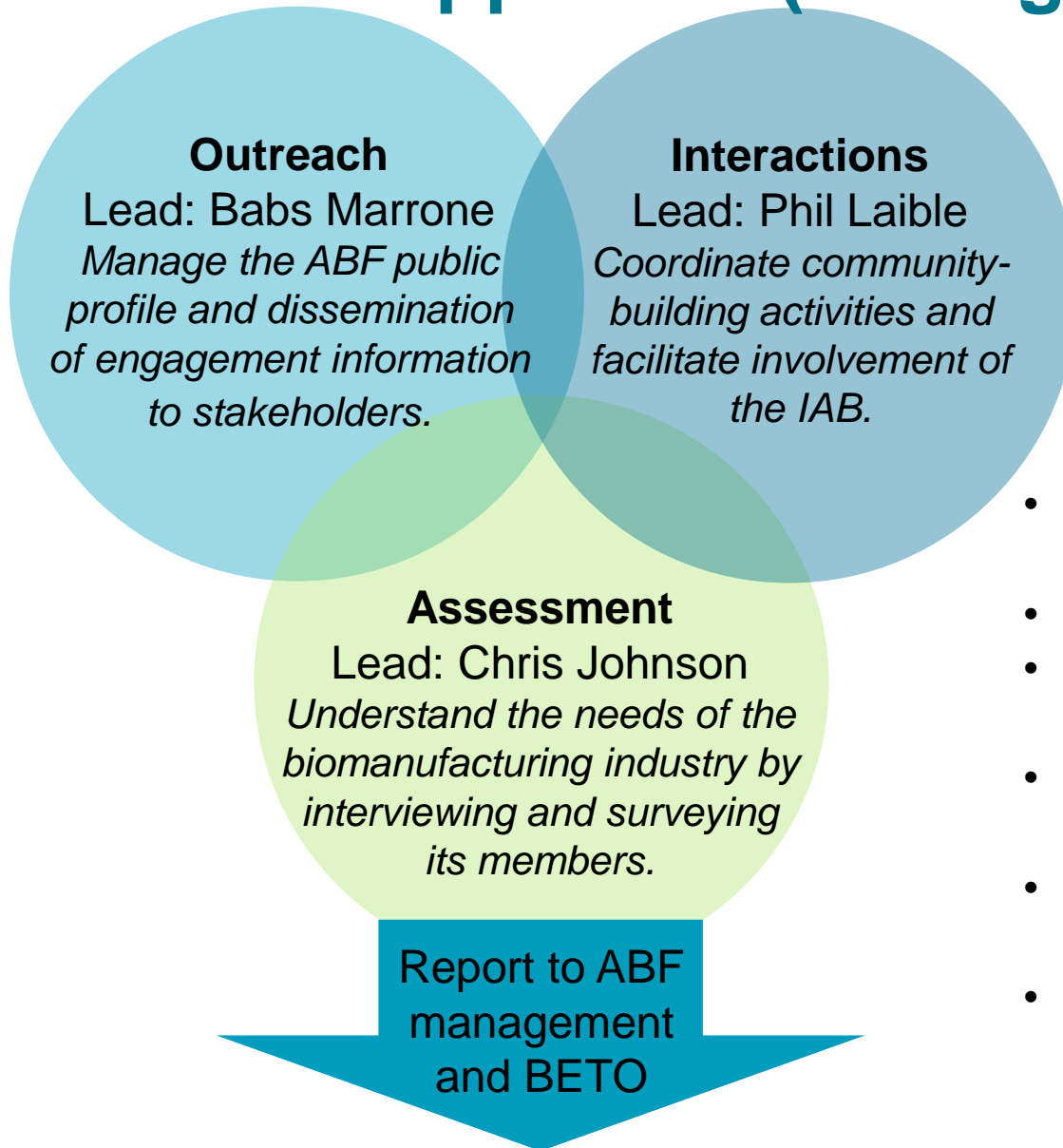
Context: To fulfill Foundry's mission, needs of industry need to be known and Foundry efforts need to be visible

- Tremendous opportunity to learn how to increase success rate of infant biomanufacturing industry
- Foundry succeeds only as industry is engaged and adopts resulting technologies

Project goals: Contribute significantly to the synthetic biology revolution

- Generate reports on industry needs (via interviews and surveys)
- Provide feedback from industry stakeholders to inform ABF R&D
- Organize yearly ABF Industry Days
- Facilitate transfer of ABF tools and technology to industry

2 – IEO Approach (management)



Team coordination and ABF integration

- Collaborative approach with leads focusing on strategic areas
- Biweekly internal calls
- Monthly calls with ABF management and BETO
- Coordination of outreach materials with Foundry members
- Involvement of Task leads in Industry Days & IAB interactions
- Submission of annual interview reports to ABF and BETO

2 – IEO Approach (technical)

Outreach

- Fact Sheet: Active distribution
- Website: Main source of visibility to industry
- IP FAQ sheet: Facilitates industrial interactions
- Social media: Presence expanding

Interactions

- IAB Meetings: Quarterly
- Conferences: As many as relevant and possible
- Industry Day: Annually

Assessment

- Energy I-Corps Approach
- Interviews: 25+ yearly
- Surveys: Effort expanding



BIO World Congress



SIMB Annual Meeting

3 – Technical Accomplishments/ Progress/Results

Potential Challenges

- Dependent upon interactions with biotech industry
 - Mitigation: Over-request input or interactions (e.g., for 20 useful interviews, request 100; interview the 25 that respond).
- Need clear, effective messaging of ABF value proposition
- Difficult to convey pre-competitive R&D message
 - Engage in efforts that the industry could not pursue on its own
 - Not working in competitive space



Critical Success Factors

- Rapid identification of relevant industry communities and members
- Balance needs of start-ups with those of large, established companies
- Quorums at IAB meetings
- Attendance at Industry Days
- Ability to attract visitors to website



3 – Technical Accomplishments/ Progress/Results – Cont.

Assessment: One-on-One Interviews

- Interviews are conducted each year
 - 25 or more each year
 - diverse industrial biotechnology stakeholders—scientists, executives, investors, etc.
 - representing companies and organizations that are diverse with respect to size, geography, product(s), and business model
- Energy-I-Corps approach utilized
 - and guided by a set of questions developed with the ABF management team and BETO
 - 30-60 minutes long; short ABF briefing used to introduce the interview
 - Part of continuous effort to refine the unique ABF value proposition
- Identities and responses not shared outside ABF
 - ensures privacy
 - encourages candidacy
 - promotes honest feedback



3 – Technical Accomplishments/ Progress/Results – Cont.

Assessment: Key Learnings from one-on-one interviews

“ABF provides companies with technology and expertise that companies can test drive. There’s value in de-risking technologies and improving the DBTL cycle.” – Zachary Sun, SynvitroBio

- The mission and goals of the ABF were viewed favorably
- Interest in learning how companies can work with the Foundry is growing
- Providing cost share, even in-kind support, is a frequent concern, especially for smaller, less established companies
- Could benefit from making it easier to engage and work with industry
 - clearly communicate capabilities
 - facilitate streamlined partnership agreements
 - define IP treatment in Industry-Foundry partnerships
- Provide information related to Foundry organisms publicly
- Investigate a fee-for-service model for larger companies



3 – Technical Accomplishments/ Progress/Results – Cont.

Interactions: Industry Advisory Board

Assembled diverse IAB

- Area of specialization
- Age/size of company
- Location of operation
- Gender

Established charter in FY18

- Expresses expectations and governs operations
- Operate without NDAs with IAB members or firms

Collected/reported feedback

- Approach
- Operations
- Milestone achievements
- Target/host selection process
- Outreach activities
- Overall impact

Companies represented in FY19 roster

amyris

LYGOS

CALYSTA

Trelys

GINKGO BIOWORKS™
THE ORGANISM COMPANY

BASF
We create chemistry

ebrc

teselagen
BIOTECHNOLOGY

SYNTHETIC
EVOLUTION™

AUTODESK.
RESEARCH

zymergen

3 – Technical Accomplishments/ Progress/Results – Cont.

Interactions: Meetings and conferences

- Encourage presentations at national meetings
 - Grass roots infiltration of symposia and sessions at major meetings and national conferences
- Organize panels and sessions that highlight Foundry successes and missions
 - One example: In planning stage for SIMB 2019 (Washington, D.C.)
 - Co-convening panel session: Federal Perspective on Biomanufacturing R&D
 - Assemble representatives from agencies funding this area
 - Realize goal of understanding the differentiation, challenges, and future opportunities of the agencies while highlighting ABF work and progress
- Plan ABF Industry Day(s)
 - Find opportunities, seek attendees, and develop agendas

3 – Technical Accomplishments/ Progress/Results – Cont.

Outreach Activities

- Report timely news and events related to ABF successes
- Amplify relevant announcements (funding opportunities, press releases, etc.) from BETO, DOE, or ABF member labs
- “Advertise” the ABF to attract new visitors to the ABF website, and potential collaborators/partners in industry and academia
- Participate in an active online community focused on advancement of synthetic biology technology and applications, through original postings and re-tweets
- In conjunction with ABF LinkedIn site, amplify ABF-related job opportunities



3 – Technical Accomplishments/ Progress/Results – Cont.

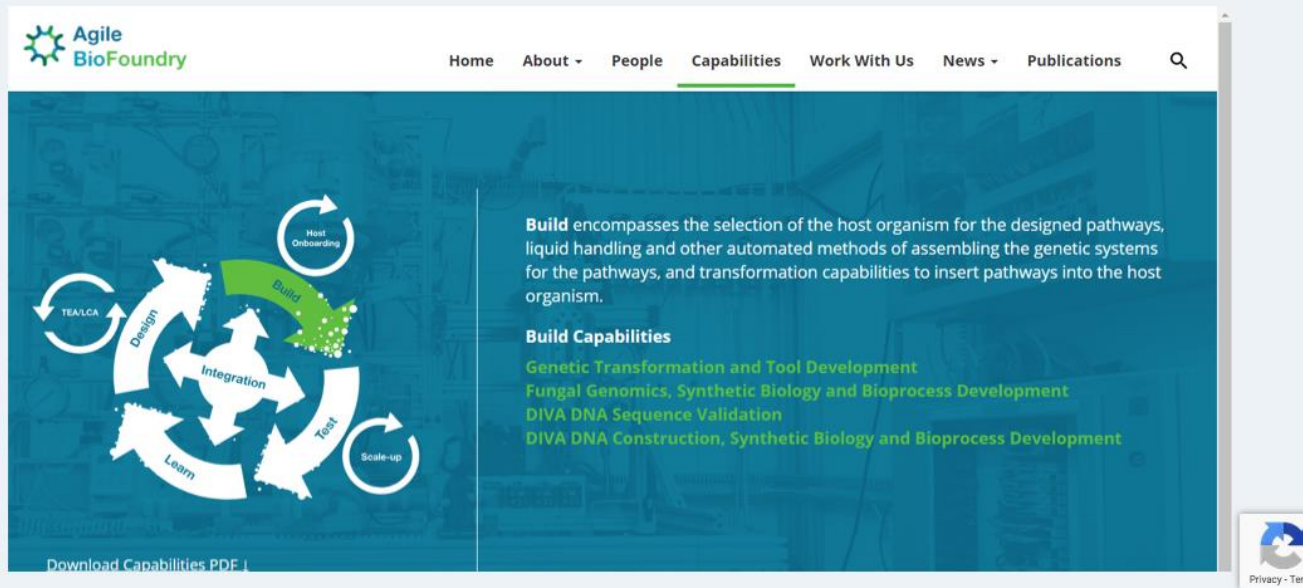
Outreach Activities: ABF Website



Home About ▾ People Capabilities Work With Us News ▾ Publications Q

ABF Launches New Website

The ABF launched their new website December 6, 2018, which has been updated to reflect the growing interest in the work of the consortium and to that end, outlines the unique skills, experience, and capabilities that the team brings to the areas of synthetic biology and biomanufacturing. The new capabilities page is the main material upgrade from the original site, and identifies and describes what the ABF offers to potential project partners in key research areas.



<https://agilebiofoundry.org/>

3 – Technical Accomplishments/ Progress/Results – Cont.

Outreach Activities: ABF Website

The screenshot displays the Agile BioFoundry website. At the top left is the logo, which consists of a green gear icon followed by the text "Agile BioFoundry". The navigation menu includes "Home", "About" (with a dropdown arrow), "People", "Capabilities", "Work With Us", "News" (with a dropdown arrow), and "Publications", followed by a search icon. Below the navigation is a large blue-tinted hero image of laboratory equipment. The main content area features a section titled "About the ABF" in white text on the blue background. Below this, there are two columns: "Vision" and "Mission". The "Vision" section states: "The Agile BioFoundry will unite and expand the capabilities of the national laboratories to develop a robust, agile biomanufacturing platform accessible to researchers across the private and public sectors." The "Mission" section states: "The Agile BioFoundry will integrate industrially relevant production microbes, advanced tools for biological engineering and data analysis, and robust, scaled-up processes for integrated biomanufacturing." A green button labeled "Watch Video" is centered below the mission statement. At the bottom, a "Meet Our Team" section features a background image of a lab and text: "The Agile BioFoundry brings together a specialist team of scientists, engineers, and technical staff from eight of the U.S. Department of Energy's national laboratories, with the aim that their collective skills, expertise, and experience lead to rapid innovation and growth in the biomanufacturing sector." A small "Privacy - Terms" icon is visible in the bottom right corner of the page.

Agile BioFoundry

Home About ▾ People Capabilities Work With Us News ▾ Publications 🔍

About the ABF

Vision

The Agile BioFoundry will unite and expand the capabilities of the national laboratories to develop a robust, agile biomanufacturing platform accessible to researchers across the private and public sectors.

Mission

The Agile BioFoundry will integrate industrially relevant production microbes, advanced tools for biological engineering and data analysis, and robust, scaled-up processes for integrated biomanufacturing.

Watch Video

Meet Our Team

The Agile BioFoundry brings together a specialist team of scientists, engineers, and technical staff from eight of the U.S. Department of Energy's national laboratories, with the aim that their collective skills, expertise, and experience lead to rapid innovation and growth in the biomanufacturing sector.

Privacy - Terms

3 – Technical Accomplishments/ Progress/Results – Cont.

Outreach Activities: ABF Website



Work With Us

CRADAs & SPPs

Academic Collaborations

Collaborative Research and Development Agreements and Strategic Partnership Programs

Collaborative Research and Development Agreements (CRADAs) and Strategic Partnership Programs (SPPs) are mechanisms under which the ABF can work together with Industry.

SPPs tend to be smaller engagements and often involve the ABF performing a single unit operation (e.g., targeted proteomics analysis) for the Industrial Partner. SPPs may be very attractive to Industry, as the Industrial Partner retains all intellectual property (IP) rights derived from the work performed. CRADAs tend to be larger engagements involving the ABF performing multiple unit operations in collaboration with the Industrial Partner (which may embed its staff at ABF facilities while pursuing the scope of the project's work).

Under CRADAs, IP ownership follows inventorship, with the Industrial Partner generally having an option to negotiate an exclusive license to ABF (co-)invented IP in specific field(s) of use. There may be certain other restrictions placed on CRADAs and SPPs, for example the scope of the project's work must only include domain expertise and capabilities exclusively/uniquely available from the ABF national labs (i.e., are not otherwise commercially available), and developed processes/products that are derivative of the work performed may need to be first substantially implemented/manufactured in the United States.

The Agile Biofoundry CRADA will be used for all ABF projects, and if the project is receiving DOE-funding, this CRADA is non-negotiable. The CRADA is applicable only to ABF projects where there is one non-DOE lab party, although there may be any number of DOE labs.

Active Collaborations



5 – Future Work

Plans for FY19 and Beyond

- Continue with interviews, questionnaires and surveys
 - May have different foci and be somewhat dynamic regarding content as Foundry matures
- Organize strategic planning exercise for the ABF
 - Strength, Weakness, Opportunity, Threat analysis (SWOT)
 - Internal and external factors
- Refine and expand interactions with IAB
 - Increase diversity
- Establish social media presence
 - Use platforms like Twitter and LinkedIn for publicity
 - Amplify news and accomplishments of ABF members
- Organization of panels at national/international scientific meetings.
 - SIMB 2019 Washington D.C.: Federal perspective on biomanufacturing R&D
 - SIMB 2020 San Francisco: Panel on industry trends, R&D needs

Summary

Overview

- Facilitate transfer of ABF tools and technology to industry

Approach

- focus on assessment, interactions, and outreach
- continually conduct interviews and surveys, provide feedback from industry stakeholders to inform ABF R&D, and participate in active online community

Technical accomplishments

- submitted yearly reports on findings from interviews and surveys
- conducted regular meetings with IAB
- organized Industry Days and advertised the ABF on website and fact sheets

Relevance

- provide feedback supporting project-planning and decision-making activities

Future work

- coordinate strategic planning exercise
- continue interviews and surveys
- plan panels and sessions at national meetings



Acknowledgements

Katy Christiansen
Nathan Hillson
Christopher Johnson
Philip Laible
Babetta Marrone
Alastair Robinson
Blake Simmons
Leah Freeman Sloan

Additional Slides

Responses to Previous Reviewers' Comments

- Weaknesses include geographic separation
 - As a distributed effort, we clearly have faced operational challenges, although these have more than been made up for by the Agile BioFoundry's ability to leverage physical and human resources across distributed national laboratories. The Agile BioFoundry's program manager, together with regular communications across the consortium (via teleconferences, webinars, informatics servers, SharePoint, annual in-person meetings), have helped mitigate communications risks. Sample transfer risks (i.e., sample stability, sample loss) will continue to be assessed through local/proximal compared with remote sample analysis, and to date we have not suffered from any notable sample losses. We are continuing to make progress in addressing disconnects in technology adoption, and it continues to be an operational imperative to standardize workflows and data-exchange formats wherever possible.
- Do not yet have a compelling argument as to why and how their approach will be better than other potential approaches to the problem
 - What sets the Agile BioFoundry apart from other foundries is that we develop and distribute publicly available tools, methods, and strains aimed at broadly benefiting the biofuels and bioproducts industry. Whereas private foundries are incentivized to develop proprietary tools and organisms, the Agile BioFoundry is a publicly funded effort aimed at delivering technology that will enable industry to either leverage our resources through partnership or adopt our methodologies for developing bioproducts. In comparison to the publicly funded Defense Advanced Research Projects Agency Living Foundries program, there are distinct programmatic and technical differences between the aims of the two efforts. Where the Living Foundries program is primarily focused on developing biological pathways to materials that cannot be achieved through transformations of petroleum feedstocks, the Agile BioFoundry is focused developing biological pathways for producing advanced biofuels and renewable, high-volume chemicals.

Responses to Previous Reviewers' Comments (cont.)

- Rationale for their choice of product targets needs to be strengthened
 - The Agile BioFoundry is pursuing multiple target/hosts to demonstrate that the methods, software, and technologies can be productively applied across product classes. The process and rationale for selecting the three target/hosts pairs for FY 2017 (and the 15 pairs for initially prioritized for FY 2017 – FY 2019) was described during the 2017 Peer Review, and the details were provided to BETO. For our FY 2018 and FY 2019 target/host selection processes, in addition to quantitative technical assessments across multiple categories (TEA and Market, LCA, Strategic Value, Scientific Novelty, DOE Relevance, How Designable, How Buildable, How Hostable, How Testable, How Scalable, and Chemical and Biological Safety), we proactively consulted with the Agile BioFoundry Industry Advisory Board to ensure that our prioritized targets and hosts remain aligned with industry's needs.
- Isn't clear that reducing the cycle time to, say, adipic acid, would be generally applicable to other material
 - As will be / has been presented in the Target/Host ABF presentations at the 2019 Peer Review, we have started to diligently measure cycle times across targets and hosts. This is the pre-requisite step to measuring improvements in (i.e., reductions to) cycle time. It should be noted that we are now pursuing multiple targets in the same host (which could suggest how cycle times for the second target have benefitted from improvements for the first target) and the same target in multiple hosts (which could suggest how cycle times in the second host have benefitted from improvements for the first host). While the former is more directly relevant for this previous reviewer's comment, both are important to capture and understand as they both directly affect the Agile BioFoundry's ability to broadly accelerate biomanufacturing process development across targets and hosts.

Responses to Previous Reviewers' Comments (cont.)

- More emphasis should be placed on the performance gap between small-scale culturing and bench-scale fermentation, which is a well-known problem in the field
 - We recognize that there are challenges associated with each increase in process scale, including the transition from high-throughput, small-scale culturing to bench-scale fermentation. Agile BioFoundry workflows leverage design of experiments and small-scale culture to select strains to grow in bench-scale bioreactors. Bench-scale fermentation provides critical data for the “Learn” component of Design-Build-Test-Learn, both to inform future designs and to develop predictive models that may be applied to small-scale experiments. Agile BioFoundry facilities have recently procured Robo/Biolector(Pro) and Ambr250 instrumentation which both serve to bridge the gap between small-scale culturing and bench-scale fermentation.
- PI is encouraged to look deeply into high-throughput fermentation techniques mastered by enzymes and biobased chemicals and fuels companies
 - As mentioned above, towards adopting the techniques practiced and mastered by companies, Agile BioFoundry facilities have recently procured Robo/Biolector(Pro) and Ambr250 high-throughput fermentation instrumentation.
- Encourage the PI to form a strong liaison between fermentation and the high-throughput team
 - There are strong connections between Agile BioFoundry high-throughput and bio-reactor fermentation teams, with staff shared in common between them.

Publications, Patents, Presentations, Awards, and Commercialization

Publications

- Garima Goyal, Zak Costello, Jorge Alonso Guitierrez, Aram Kang, Taek Soon Lee, Hector Garcia Martin, and Nathan J Hillson. (2018) "Parallel Integration and Chromosomal Expansion of Metabolic Pathways" ACS Synthetic Biology DOI: 10.1021/acssynbio.8b00243
- Costello, Zak, and Hector Garcia Martin. "A machine learning approach to predict metabolic pathway dynamics from time-series multiomics data." NPJ systems biology and applications 4.1 (2018): 19. <https://doi.org/10.1038/s41540-018-0054-3>
- Oyetunde, Tolutola, et al. "Leveraging knowledge engineering and machine learning for microbial bio-manufacturing." Biotechnology advances (2018). <https://doi.org/10.1016/j.biotechadv.2018.04.008>
- Amin Zargar, Jesus F. Barajas, Ravi Lal, Jay D. Keasling. "Polyketide Synthases as a Platform for Chemical Product Design" AIChE (2018) <https://doi.org/10.1002/aic.16351>
- Jha RK*, Bingen JM, Johnson CW, Kern TL, Khanna P, Trettel DS, Straus CEM, Beckham GT, Dale T* (2018). A protocatechuate biosensor for Pseudomonas putida KT2440 via promoter and protein evolution. Metabolic Engineering Communications (6) 33-38. <https://doi.org/10.1016/j.meteno.2018.03.001>
- Mitchell G. Thompson, Nima Sedaghatian, Jesus F. Barajas, Maren Wehrs, Constance B. Bailey, Nurgul Kaplan, Nathan J. Hillson, Aindrila Mukhopadhyay & Jay D. Keasling. (2018) "Isolation and characterization of novel mutations in the pSC101 origin that increase copy number". Scientific Reports 8, 1590 doi:10.1038/s41598-018-20016-w
- Jesus F. Barajas, Amin Zargar, Bo Pang, Veronica T. Benites, Jennifer Gin, Edward E. K. Baidoo, Christopher J. Petzold, Nathan J. Hillson, and Jay D. Keasling. (2018) "Biochemical Characterization of β -Amino Acid Incorporation in Fluvirucin B2 Biosynthesis". ChemBioChem 10.1002/cbic.201800169
- Denby, Charles M., et al. "Industrial brewing yeast engineered for the production of primary flavor determinants in hopped beer." Nature communications 9.1 (2018): 965
- Garber ME, Rajeev, Kazakov AE, Trinh J, Masuno D, Thompson M, Kaplan, N, Novichkov PS and Mukhopadhyay A. (2018) "Multiple signaling systems target a core set of transition metal homeostasis genes using similar binding motifs" Mol Microbiol. 107(6):704-717. doi: 10.1111/mmi.13909
- Ando, D., Garcia Martin, H. (2018) "Two-Scale ¹³C Metabolic Flux Analysis for Metabolic Engineering". In "Synthetic Metabolic Pathways - Methods and Protocols", Springer Protocols - Methods in Molecular Biology, Jensen, Michael Krogh, Keasling, Jay D (Eds.) ISBN 978-1-4939-7295-1 <http://www.springer.com/us/book/9781493972944>
- Backman TWH, Ando D, Singh J, Keasling JD, Garcia Martin H. (2018) "Constraining Genome-Scale Models to Represent the Bow Tie Structure of Metabolism for (¹³C) Metabolic Flux Analysis". Metabolites. 2018 Jan 4;8(1). pii: E3. doi: 10.3390/metabo8010003
- Yuzawa S, Bailey CB, Fujii T, Jovic R, Barajas JF, Benites VT, Baidoo EEK, Chen Y, Petzold CJ, Katz L, Keasling JD. Heterologous Gene Expression of N-Terminally Truncated Variants of LipPks1 Suggests a Functionally Critical Structural Motif in the N-terminus of Modular Polyketide Synthase. ACS Chem Biol. 2017 Nov 17;12(11):2725-2729. doi: 10.1021/acschembio.7b00714

Publications, Patents, Presentations, Awards, and Commercialization (cont.)

Publications (cont.)

- Morrell, W., Birkel, G., Forrer, M., Lopez, T., Backman, T.W.H, Dussault, M., Petzold, C., Baidoo, E., Costello, Z., Ando, D., Alonso Gutierrez, J., George, K., Mukhopadhyay, A., Vaino, I., Keasling, J., Adams, P., Hillson, N., Garcia Martin, H. "The Experiment Data Depot: a web-based software tool for biological experimental data storage, sharing, and visualization" (2017) ACS Synthetic Biology DOI: 10.1021/acssynbio.7b00204
- Eng, C.H.*, Backman, T.W.H.*, Bailey, C.B., Magnan, C., Garcia Martin, H.G., Katz, L., Baldi, P., Keasling, J.D. "ClusterCAD: a computational platform for type I modular polyketide synthase design." (2017) Nucleic Acids Research DOI: 10.1093/nar/gkx893 *Contributed equally
- Barajas, J.F., Blake-Hedges, J., Bailey, C.B., Curran, S., Keasling, J.D. (2017). "Engineered polyketides: Synergy between protein and host level engineering" Synthetic and Systems Biotechnology doi.org/10.1016/j.synbio.2017.08.005
- Shymansky, Christopher M., et al. "Flux-enabled exploration of the role of Sip1 in galactose yeast metabolism." Frontiers in Bioengineering and Biotechnology 5 (2017)

Presentations

- Gregg Beckham, Hybrid biological and catalytic processes to manufacture and recycle plastics, Princeton University, November 28th, 2018
- Garcia Martin, H. "Towards a predictive synthetic biology enabled by machine learning and automation". Ginkgo Bioworks, Boston, MA, November 12, 2018
- Nathan J. Hillson. "DIVA (DNA Design, Implementation, Validation Automation) Platform". Invited Talk, 2nd Darmstadt RoboWorkshop, Darmstadt, Germany, November 8, 2018
- Nathan J. Hillson. "Recent developments at the U.S Department of Energy Agile BioFoundry". Invited Talk, 2nd Darmstadt RoboWorkshop, Darmstadt, Germany, November 7, 2018
- Garcia Martin, H. "Towards a predictive synthetic biology enabled by machine learning and automation". AIChE annual meeting, Pittsburgh, PA, October 31 2018
- Garcia Martin, H. "Towards a predictive synthetic biology enabled by machine learning and automation". Thermo Fisher, San Jose, CA, October 19, 2018
- Garcia Martin, H. "Towards a predictive synthetic biology enabled by machine learning and automation". DTRA Tech Watch, Ft. Belvoir, VA, October 10, 2018
- Nathan J. Hillson. "DOE Agile BioFoundry Overview". Invited Talk, SynBioBeta 2018 visit to ESE, Emeryville, CA, October 1, 2018
- Nathan J. Hillson. "ABF Organization, Progress, and FY19 Plans". Invited Talk, ABF All Hands Annual Meeting 2018 (Industry Day), Emeryville, CA, September 12, 2018
- Nathan J. Hillson. "Agile BioFoundry Overview". Invited Talk, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018
- Garcia Martin, H. "A new approach to flux analysis". Invited Talk, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018

Publications, Patents, Presentations, Awards, and Commercialization (cont.)

Presentations (cont.)

- Hector Plahar. "DIVA Software Platform". Invited Talk, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018
- Tijana Radivojevic. "Automatic Recommendation Tool", Invited Talk, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018
- Jennifer Chiniquy. "DIVA DNA-Seq and DNA Construction", Invited Talk, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018
- Garcia Martin, H. "A New Approach to Flux Analysis". ABF Annual Meeting, Berkeley CA, September 7, 2018
- Garcia Martin, H. "Towards a predictive synthetic biology enabled by machine learning and automation". Invited talk, Machine learning for science workshop, Berkeley, CA, September 5, 2018
- Nathan J. Hillson. "Agile BioFoundry Overview". Invited Lightning Talk, LBNL BioSciences Area Retreat 2018, Lafayette, CA, August 30, 2018
- Garcia Martin, H. "Modeling from molecules to ecosystems : opportunities, challenges and vision". Invited talk, BioEpic meeting, Berkeley, CA, August 23, 2018
- Garima Goyal "DIVA DNA Construction". Invited Talk, JBEI Annual Meeting 2018, Sonoma, CA, August 20-22, 2018
- Tijana Radivojevic. "Automatic Recommendation Tool", Invited Talk, JBEI Annual Meeting 2018, Sonoma, CA, August 22, 2018
- Garcia Martin, H. "Opportunities in the intersection of synthetic biology, machine learning and automation". Invited talk, JBEI Annual Meeting, Berkeley, CA, August 20, 2018
- Garcia Martin, H. "Towards a predictive synthetic biology enabled by machine learning and automation". Invited talk, SIMB, Chicago, IL, August 15, 2018
- Garcia Martin, H. "Towards a predictive synthetic biology enabled by machine learning and automation". Invited talk, International Workshop for BioDesign and Automation (IWBDA), Berkeley, CA, August 2nd, 2018
- Garcia Martin, H. "Towards a predictive synthetic biology enabled by machine learning and automation". Invited talk, Biocruces, Bilbao, Spain, July 20, 2018
- Garcia Martin, H. "Machine Learning to Predict Metabolic Pathway Dynamics from Multiomics Data". Invited talk, AI for synthetic biology, Stockholm, Sweden, July 15, 2018
- Garcia Martin, H. "Towards a predictive synthetic biology enabled by machine learning and automation". Invited talk, BCAM, Bilbao, Spain, July 3, 2018
- Nathan J. Hillson, "Berkeley (and other) National Lab(s): Current Biosecurity Frameworks and Strategies in Action", Invited Talk, EBRC meeting - Improving Security Considerations in Engineering Biology Research, Emeryville, CA, June 26, 2018
- Nathan J. Hillson and Hector A. Plahar, "ICE Software Platform", Invited Talk, Software for Synthetic Biology Workflows Workshop, SEED 2018, Scottsdale, Arizona, June 7, 2018
- Gregg Beckham. Developing new processes to valorize lignin and sugars to building-block chemicals and materials, RWTH Aachen University, May 28th, 2018

Publications, Patents, Presentations, Awards, and Commercialization (cont.)

Presentations (cont.)

- Gregg Beckham. Adventures in engineering *Pseudomonas putida* for expanded substrate specificity and improved tolerance, RWTH Aachen University, May 28th, 2018
- Hillson, N.J. "Berkeley Lab project activities, biosecurity practices, and their roles within the larger biosecurity landscape". Invited Talk, Working Group on Automation in SynBio, Gryphon Scientific, Takoma Park, MD, May 23, 2018
- Hillson, N.J. "Recent developments at the Agile BioFoundry". Invited Talk, Diligence Ventures/Suzhou Government visit to ABF, Emeryville, CA, May 2, 2018
- Gregg Beckham. Hybrid biological and catalytic processes to manufacture and recycle plastics, MIT, April 27th, 2018
- Hillson, N.J. "Recent developments at the Agile BioFoundry". Invited Talk, 2018 Life Science Symposium - Synthetic Biology and Metabolic Engineering, MilliporeSigma Innovation Center, St. Louis, MO, April 27, 2018
- Garcia Martin, H. "A Machine Learning Approach to Predict Metabolic Pathway Dynamics from Time Series Multiomics Data". Invited talk at Madison Microbiome Meeting at University of Wisconsin, Madison, WI, April 25, 2018.
- Jennifer Chiniqy, Cindi Hoover, Joel Guenther, Nurgul Kaplan, Garima Goyal, Mark Kulawik, Hector Plahar, Zachary Costello, Brian Bushnell, Samuel Deutsch, and Nathan J. Hillson. "Overcoming Challenges in MiSeq DNA Construct Sequence Validation". Invited Poster, DOE JGI User Meeting 2018, San Francisco, CA, March 14, 2018
- "Test" and "Learn" in process research informs design strategy Sundstrom, E. R., M. Mirsiaghi, F. Tachea, N. Sun, T.R. Pray, D. Tanjore. ECO-BIO, Dublin, Ireland, March 5, 2018.
- Garcia Martin, H. "EDD as a data warehouse and Learn facilitator". Invited talk at Argonne National Lab, St. Louis, Lemont, IL, March 5, 2018
- Garima Goyal, Nurgul Kaplan, Jennifer L. Chiniqy, Hector A. Plahar, Annabel Large, Lisa Simirenko, Samuel Deutsch, and Nathan J. Hillson. "DIVA Services: PCR, Full DNA Construction, and MiSeq Validation". Invited Poster, DOE BER GSP Contractor's Meeting 2018, Tysons Corner, VA, February 27, 2018
- Hillson, N.J. "Three synthetic biology design challenges we face, and how we are approaching them". Invited Talk, Dagstuhl Seminar 18082, Wadern, Germany, February 19, 2018
- Jennifer Chiniqy, Nurgul Kaplan, Garima Goyal. "DIVA DNA-Seq Service", JBEI User Meeting presentation, February 12, 2018.
- Garcia Martin, H. "Metabolic Modeling of -omics Data for Biofuel Production". Invited talk at Bayer, Sacramento, CA, February 2, 2018.
- Garcia Martin, H. "Machine Learning and Mechanistic Models to Predict Biological Outcomes using 'omics Data". Invited talk at Environmental Genomics and Systems Biology retreat, Berkeley, CA, January 19, 2018
- Jesus F. Barajas. "Current progress towards engineered PKS lactam pathways". JBEI/BBD group meeting presentation, December 13, 2017
- Hillson, N.J. "Agile BioFoundry Overview". Invited Talk, iSynBio/SIAT visit to JGI, Walnut Creek, CA, December 9, 2017
- Jennifer Chiniqy, Nurgul Kaplan. "DIVA DNA-Seq Service". ESE User Meeting presentation, November 20, 2017

Publications, Patents, Presentations, Awards, and Commercialization (cont.)

Presentations (cont.)

- Hillson, N.J. “Agile BioFoundry Overview”. Invited Talk, Cargill visit to ESE, Emeryville, CA, November 17, 2017
- Hillson, N.J. “Flanking Homology DNA Assembly, Protocol Design Software, and Synthetic DNA”. Invited Talk, Bitesize Bio Webinar, November 15, 2017
- Simmons, B.A. and Hillson, N.J. “The BioDefense Foundry”. Invited Talk, DTRA Tech Watch Briefing, Springfield, VA, November 8, 2017
- Hillson, N.J. “Agile BioFoundry Overview”. Invited Talk, University of Wyoming, Laramie, WY, November 3, 2017
- Hillson, N.J. “Parallel Integration and Chromosomal Expansion of Metabolic Pathways”. Invited Talk, University of Wyoming, Laramie, WY, November 3, 2017
- Hillson, N.J. “Agile BioFoundry Overview”. Invited Talk, Braskem Zoom Teleconference, November 1, 2017
- Hector Garcia Martin. “Modeling of -omics data for Biofuel Production through Synthetic Biology”. EECE Department seminar, Washington University, St. Louis MO, October 20th, 2017
- Hillson, N.J. “Agile BioFoundry Overview”. Invited Talk, ABLC Next Tour of ESE (ABF/ABPDU/JBEI), Emerville, CA, October 16, 2017
- Hillson, N.J. “Agile BioFoundry Overview”. Invited Talk, Berkeley Lab Workshop: Industrialization of engineering biology: from discovery to scale-up, SynBioBeta SF 2017, UCSF Mission Bay, San Francisco, CA, October 3, 2017
- Hillson, N.J. “How the Agile BioFoundry Thinks About Paths to Commercialization”. Invited Talk, SynBio for Defense, Arlington, VA, September 27, 2017
- Hillson, N.J. “BioDefense – the Agile BioFoundry and Predictive Biology”. Invited Talk, Presentation for Dimitri Kusnezov (Chief Scientist, DOE NNSA), Berkeley, CA, September 21, 2017
- Hillson, N.J. “Sustainable development through a synthetic biology foundry”. Invited Talk, CellPress LabLinks - Basic to Applied Science for Sustainable Development, Berkeley, CA, September 18, 2017
- Plahar, H.A. “Software Session: Recent DeviceEditorjs/DIVA/ICE improvements”. Invited Talk, JBEI Annual Meeting, Monterey, CA, September 15, 2017
- Costello, Z. “Software Session: The Automatic Recommendation Tool”. Invited Talk, JBEI Annual Meeting, Monterey, CA, September 15, 2017
- Backman, T.W.H. “ClusterCAD: a computational platform for type I modular polyketide synthase design.” Invited Talk, JBEI Annual Meeting, Monterey, CA, September 14, 2017
- Hillson, N.J. “Agile BioFoundry Update”. Invited Talk, JBEI Annual Meeting, Monterey, CA, September 13, 2017
- Plahar, H.A. “ICE/DIVA Software Tutorial”. Invited Talk, Agile BioFoundry Annual Meeting, NREL IBRF, Golden, CO, August 29, 2017
- Hillson, N.J. “Agile BioFoundry Overview”. Invited Talk, Agile BioFoundry Annual Meeting, NREL IBRF, Golden, CO, August 28, 2017
- De Paoli, H.C. “A. pseudoterreus 3HP Design and Build”. Invited Talk, Agile BioFoundry Annual Meeting, NREL IBRF, Golden, CO, August 28, 2017.
- Chiniquy J., “DIVA DNA-Seq Service”. Invited Talk, Agile BioFoundry Annual Meeting, NREL IBRF, Golden, CO, August 28, 2017

Publications, Patents, Presentations, Awards, and Commercialization (cont.)

Presentations (cont.)

- Garcia Martin, H. "Predicting Metabolic Pathway Dynamics by Combining Multiomics Data with Machine Learning and Kinetic Modeling". Invited talk at "Multi-omics for Microbiomes" conference, Pasco, WA, July 31, 2017.
- Johnson, C.W. "Metabolic engineering of *Pseudomonas putida* KT2440 for production of muconic acid from sugar", SIMB Annual Meeting, July 31, 2017
- Hillson, N.J. "j5 Software Through the Years: Insights from Aggregate Public Usage Metrics". Invited lightning talk, World Metrology Day Symposium, Stanford, CA, May 22, 2017.
- Beckham, G.T. "The Agile BioFoundry: Investing in Biomanufacturing Infrastructure", TechConnect World, May 16, 2017
- Derek Vardon. Potential commercialization opportunities for valorization of biomass to polymer precursors. Invited Seminar. Alliance Commercialization and Deployment Committee Meeting, NREL. May 2017.
- Gregg Beckham. The Agile BioFoundry: Investing in Biomanufacturing Infrastructure, TechConnect World, May 16, 2017
- Hillson, N.J. "Overview of the Agile BioFoundry". Invited talk, IMP (Mexican Petroleum Institute) Visit to JBEI, Emeryville, CA, April 21, 2017.

Posters

- J. Meadows, C. Johnson, S. Notonier, Y.M. Kim, S. Tripathy, K. Burnam-Johnson, M. Burnet, J. Magnuson, G. Beckham, N. Hillson, J. Gladden. "Engineering *Pseudomonas putida* KT2440 to produce adipic acid from lignocellulosic components". Invited Poster, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018
- Jesus F. Barajas, Jingwei Zhang, Amin Zargar, Bo Pang, Huaxiang Deng, Veronica T. Benites, Edward E. K. Baidoo, Christopher J. Petzold, Nathan J. Hillson, Jay D. Keasling. "Development of Valerolactam and Caprolactam Biosynthetic Routes". Invited Poster, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018
- Garima Goyal, Nurgul Kaplan, Jennifer L. Chiniquy, Jonathan Diab, Joel M. Guenther, Hector A. Plahar, Joanna Chen, Manjiri Tapaswi, Nina Stawski, Lisa Simirenko, Samuel Deutsch, and Nathan J. Hillson. "DIVA (Design Implementation Validation Automation) DNA Construction". Invited Poster, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018
- Jonathan Diab, Jennifer Chiniquy, Cindi Hoover, Joel Guenther, Nurgul Kaplan, Garima Goyal, Mark Kulawik, Hector Plahar, Zachary Costello, Brian Bushnell, Samuel Deutsch, and Nathan J. Hillson. "MiSeq DNA Construct Sequence Validation". Invited Poster, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018
- Edward E.E.K. Baidoo and Veronica Teixeira Benites. "High throughput analysis of isoprenoid pathway intermediates by HILIC-QTOF-MS". Invited Poster, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018.
- Isaac Wolf, Carolina Barcelos, Shawn Chang, Nilufer Oguz, Matt Dorsey, Davinia Salvachua, Robert Nelson, Todd Pray, Eric Sundstrom and Deepti Tanjore. "Harmonization of Fermentation for Production of *P. putida*-derived Muconic Acid". Invited Poster, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018

Publications, Patents, Presentations, Awards, and Commercialization (cont.)

Posters (cont.)

- J. Prah, S. Coradetti, D. Liu, G. Geiselman, T. Pray, J. Gladden, E. Sundstrom, and D. Tanjore. "Insights from Bioreactors make Scale-Down Modeling more Effective". Invited Poster, ABF All Hands Annual Meeting 2018, Emeryville, CA, September 10, 2018
- Garima Goyal, Nurgul Kaplan, Jennifer L. Chiniquy, Jonathan Diab, Joel M. Guenther, Hector A. Plahar, Joanna Chen, Manjiri Tapaswi, Nina Stawski, Lisa Simirenko, Samuel Deutsch, and Nathan J. Hillson. "DIVA (Design Implementation Validation Automation) DNA Construction". Invited Poster, JBEI Annual Meeting 2018, Sonoma, CA, August 20-22, 2018
- William Morrell, Mark Forrer, Garrett Birkel, Traci Lopez, Nathan J Hillson, Hector Garcia Martin. "Collaboration with the Experiment Data Depot". Invited Poster, JBEI Annual Meeting 2018, Sonoma, CA, August 20-22, 2018
- Jonathan Diab, Jennifer Chiniquy, Cindi Hoover, Joel Guenther, Nurgul Kaplan, Garima Goyal, Mark Kulawik, Hector Plahar, Zachary Costello, Brian Bushnell, Samuel Deutsch, and Nathan J. Hillson. "MiSeq DNA Construct Sequence Validation". Invited Poster, JBEI Annual Meeting 2018, Sonoma, CA, August 20-22, 2018
- Sarah A LaFrance, Jacob Coble, Thomas Rich, Hector Plahar, Joshua Nixon, Nathan J. Hillson. "VectorEditor: Freely Open-Source Javascript Webapp for DNA Visualization, Annotation, and Editing". Invited Poster, JBEI Annual Meeting, Monterey, CA, September 13, 2017
- Annabel Large, Nurgul Kaplan, Jennifer Chiniquy, Garima Goyal, and Nathan Hillson. "Expansion and Optimization of DIVA DNA Sequence Validation Services". Invited Poster, JBEI Annual Meeting, Monterey, CA, September 13, 2017
- Garima Goyal, Nurgul Kaplan, Jennifer L. Chiniquy, Joel M. Guenther, Hector A. Plahar, Joanna Chen, Manjiri Tapaswi, Nina Stawski, Lisa Simirenko, Samuel Deutsch, and Nathan J. Hillson. "DIVA (Design Implementation Validation and Automation) DNA Construction". Invited Poster, JBEI Annual Meeting, Monterey, CA, September 13, 2017
- Nurgul Kaplan, Garima Goyal, Jennifer L. Chiniquy, Joel M. Guenther, Hector A. Plahar, Joanna Chen, Manjiri Tapaswi, Nina Stawski, Lisa Simirenko, Samuel Deutsch, and Nathan J. Hillson. "Using DIVA, DeviceEditor, and j5 for DNA Construction". Invited Poster, JBEI Annual Meeting, Monterey, CA, September 13, 2017
- William Morrell, Garrett Birkel, Mark Forrer, Traci Lopez, Nathan J Hillson, Hector Garcia Martin. "The Experiment Data Depot platform". Invited Poster, JBEI Annual Meeting, Monterey, CA, September 13, 2017
- Backman, T.W.H., Eng, C.H., Bailey, C.B., Keasling, J.D., Garcia Martin, H. "Software for polyketide synthase (PKS) design". Invited Poster, JBEI Annual Meeting, Monterey, CA, September 13, 2017
- Garima Goyal, Nurgul Kaplan, Jennifer L. Chiniquy, Joel M. Guenther, Hector A. Plahar, Joanna Chen, Manjiri Tapaswi, Nina Stawski, Lisa Simirenko, Samuel Deutsch, and Nathan J. Hillson. "DIVA (Design Implementation Validation and Automation) DNA Construction". Invited Poster, Agile BioFoundry Annual Meeting, NREL IBRF, Golden, CO, August 28, 2017
- Nurgul Kaplan, Garima Goyal, Jennifer L. Chiniquy, Joel M. Guenther, Hector A. Plahar, Joanna Chen, Manjiri Tapaswi, Nina Stawski, Lisa Simirenko, Samuel Deutsch, and Nathan J. Hillson. "Using DIVA, DeviceEditor, and j5 for DNA Construction". Invited Poster, Agile BioFoundry Annual Meeting, NREL IBRF, Golden, CO, August 28, 2017

Publications, Patents, Presentations, Awards, and Commercialization (cont.)

Posters (cont.)

- Jennifer L. Chiniqy, Cindi A. Hoover, Joel M. Guenther, Nurgul Kaplan, Christopher W. Beitel, Samuel Deutsch, and Nathan J. Hillson. "Towards a High-Throughput Low-Cost Automated DNA Sequence Validation Workflow". Invited Poster, Agile BioFoundry Annual Meeting, NREL IBRF, Golden, CO, August 28, 2017
- William Morrell, Garrett Birkel, Mark Forrer, Traci Lopez, Nathan J Hillson, Hector Garcia Martin. "The Experiment Data Depot platform". Invited Poster, Agile BioFoundry Annual Meeting, NREL IBRF, Golden, CO, August 28, 2017
- Hector A. Plahar, Elena Aravina, Oge Nnadi, Joanna Chen, Paul D. Adams, Jay D. Keasling, and Nathan J. Hillson. "ICE: A Distributed and Interconnected Biological Part Registry". Invited Poster, Agile BioFoundry Annual Meeting, NREL IBRF, Golden, CO, August 28, 2017
- Jha, R., Narayanan, N., Johnson, C., Beckham, G., Dale, T. "Whole cell biosensing in Pseudomonas putida KT2440". Invited Poster, Agile BioFoundry Annual Meeting, NREL IBRF, Golden, CO, August 28, 2017
- Pandey N., Krishnamurthy, M., Jha, Ramesh., Hennelly, S., Dale, T. "Riboregulator Development To Increase Metabolic Flux Towards Muconate Production". Invited Poster, Agile BioFoundry Annual Meeting, NREL IBRF, Golden, CO, August 28, 2017
- John Meng, Angela Tarver, Matthew Hamilton, Robert Evans, Lisa Simirenko, Nathan J. Hillson, Jan-Fang Cheng, and Samuel Deutsch. "SynTrack 2: A Scalable DNA Assembly Production Workflow Management". Invited Poster, 2017 Synthetic Biology: Engineering, Evolution & Design (SEED), Vancouver, British Columbia, Canada, June 20-23, 2017.
- Sarah A LaFrance, Jacob Coble, Thomas Rich, Hector Plahar, Joshua Nixon, Nathan J. Hillson. "VectorEditor: Freely Open-Source Javascript Webapp for DNA Visualization, Annotation, and Editing". Invited Poster, 2017 Synthetic Biology: Engineering, Evolution & Design (SEED), Vancouver, British Columbia, Canada, June 20-23, 2017.
- William Morrell, Garrett Birkel, Mark Forrer, Traci Lopez, Nathan J Hillson, Hector Garcia Martin. "The Experiment Data Depot platform". Invited Poster, 2017 Synthetic Biology: Engineering, Evolution & Design (SEED), Vancouver, British Columbia, Canada, June 20-23, 2017.
- Nurgul Kaplan, Garima Goyal, Jennifer L. Chiniqy, Joel M. Guenther, Hector A. Plahar, Joanna Chen, Nina Stawski, Manjiri Tapaswi, Lisa Simirenko, Samuel Deutsch, and Nathan J. Hillson. "DIVA (Design, Implementation, Validation Automation) DNA Construction: Wet-Lab Workflow and Software Platform". Invited Poster, 2017 Synthetic Biology: Engineering, Evolution & Design (SEED), Vancouver, British Columbia, Canada, June 20-23, 2017.
- Philip C. Gach, Manasi Rajee, Nurgul Kaplan, Sangeeta Nath, Samuel Deutsch, Jay D. Keasling, Paul D. Adams, Nathan J. Hillson and Anup K. Singh. "A Microfluidic Platform for Combinatorial Gene Assembly, Transformation, Culture and Assay". Invited Poster, 2017 Synthetic Biology: Engineering, Evolution & Design (SEED), Vancouver, British Columbia, Canada, June 20-23, 2017.
- Hillson, N.J. "j5 Software Through the Years: Insights from Aggregate Public Usage Metrics". Invited Poster, World Metrology Day Symposium, Stanford, CA, May 22, 2017.
- Jennifer L. Chiniqy, Cindi A. Hoover, Joel M. Guenther, Nurgul Kaplan, Christopher W. Beitel, Samuel Deutsch, and Nathan J. Hillson. "Towards a High-Throughput Low-Cost Automated DNA Sequence Validation Workflow". Invited Poster, World Metrology Day Symposium, Stanford, CA, May 22, 2017.

Publications, Patents, Presentations, Awards, and Commercialization (cont.)

Posters (cont.)

- G. Goyal, Z. Costello, J.A. Gutierrez, A. Kang, T.S. Lee, H.G. Martin, and N.J. Hillson. "PIACE: Parallel Integration and Chromosomal Expansion of Biofuel Pathways in E. coli". Invited Poster, World Metrology Day Symposium, Stanford, CA, May 22, 2017.
- Nurgul Kaplan, Garima Goyal, Jennifer L. Chiniquy, Joel M. Guenther, Hector A. Plahar, Joanna Chen, Nina Stawski, Manjiri Tapaswi, Lisa Simirenko, Samuel Deutsch, and Nathan J. Hillson. "DIVA (Design, Implementation, Validation Automation) DNA Construction: Wet-Lab Workflow and Software Platform". Invited Poster, World Metrology Day Symposium, Stanford, CA, May 22, 2017.