Incorporating Bioenergy in Sustainable Landscape Designs Workshop One: Forested Landscapes

Summary of a workshop held in New Bern, North Carolina, on March 4-6, 2014

Organizers:

Department of Energy Bioenergy Technologies Office, Oak Ridge National Laboratory, Argonne National Laboratory, and the National Council for Air and Stream Improvement, Inc. (NCASI)

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Summary:

Landscape design provides an approach under which bioenergy production systems can be integrated into other components of the land, environment and socioeconomic system. Landscape design is a spatially explicit collaborative plan for resource allocation and management. It should be applied to a particular area and developed with the involvement of key stakeholders. Appropriately applied, landscape design can guide choices toward more sustainable provision of bioenergy and other services. The approach includes elements of design, monitoring and reporting of measures of sustainability along the bioenergy supply chain and within specific contexts. Landscape designs should be implemented in a way that is achievable from the perspective of producers along the supply chain. Hence it requires clear communication of environmental and socioeconomic opportunities and concerns to both the participants in production and other stakeholders. The landscape design approach contains three basic steps:

(1) Develop landscape design scenarios with stakeholders for a defined spatial and temporal context

(2) Evaluate the scenarios applying best available science, data and tools

(3) Communicate landscape designs that best meet the multiple development goals (those prioritized for the defined spatial and temporal context).

Links to each presentation and the field trip briefing book can be found at http://web.ornl.gov/sci/ees/cbes/workshop.shtml.

Applying the landscape design approach to coastal North Carolina forest systems

Workshop participants learned how a landscape design approach might focus on bioenergy production systems and integrate it into other components of the land, environment and socioeconomic system. The workshop began with an interesting overview provided by a field trip that highlighted forestry activities in eastern North Carolina.

As a case study for landscape design, the workshop provided an opportunity to learn about the eastern North Carolina system and how bioenergy is a part of it. Information presented about the land-use history, multiple waves of disturbance, and current pressures on eastern North Carolina enhanced understanding of that particular context.

Today's lowland forests and wetland landscape are products of centuries of extreme disturbance including pests, fire, ice, drought, flood, mining, drainage and other human activities. Forestry has been a major component of land use in the region from the 1700 pine tar boom to the expansion of tree farms, parks and hunting areas in the late twentieth century. The greatest pressure on forests comes from development associated with urbanization. "Natural forests"[1] in the region have been harvested 2-3 times. Hence current biodiversity is a result of dynamic changes. Management of hardwood bottomlands remains a conflictive issue, for these forests are home to diverse species but also locations where forestry is actively practiced. There are robust legal and regulatory frameworks to

[1] Natural forests or (more expansively) naturally regenerating forests are defined as those forests that regenerate via natural seed dispersal.

protect biodiversity, water and air quality. Active forest management is often a key part of preservation of native species.

The forest industry in the southeastern US is driven largely by the pulp and lumber markets. Any material available for biomass feedstock is a result of pre-commercial thinning or field or mill residues from those two activities.

A challenge to engagement in landscape design in the southeastern United States occurs because 91% of forest land is privately owned and 64% of that area is in non-corporate holdings (RPA 2012). Active land management and stakeholder engagement is critical to enhancement of ecosystem benefits. Landscape design for bioenergy can play a role in facilitating engagement of stakeholder toward a focus on effective management. Diverse markets for forest products promote management and improve returns, and increased economic benefits can support enhanced management, which can support improvements in ecosystem services such as biodiversity protection and soil, water and air quality. For example, fire and safety issues can be reduced with improved management. Without a market, residues left on the ground can lead to more fires or decay without displacement of fossil fuels.

Proposed action areas

Workshop participants discussed tangible actions that can be taken under the paradigm of landscape design that includes bioenergy to enable and expand sustainable development of the bioeconomy in the southeast. Proposed actions listed below fall into five topic areas.

1. Stakeholder engagement in the southeast forestry sector

Stakeholders play an important role in the process of deciding on overall goals for landscape design in a region when bioenergy production is a part of the vision. While most corporate timber landowners have management plans for long-term economic and environmental sustainability of timber resources, non-corporate owners typically do not. The stakeholder engagement process should involve diverse land owners and consider how bioenergy could be part of the forest management system. The approach could use a diversity of tools – for example establishing zones for particular management activities, plans and guidelines for economic growth, and setting targets for air and water quality, as well as aesthetic concerns. The process should consider how local landowner and stakeholders' goals align with regional and state objectives.

To understand the concerns and needs of a region's stakeholders, it is important that key stakeholders' opinions are represented. This process requires assessing and communicating the incentives for each stakeholder to make a compelling case for why they should participate in landscape design discussions. For instance, wood producers could diversify their products by supplying bioenergy feedstocks, or land owners could decide what to grow or when to thin based on clear specifications of demand for biomass and projected market dynamics. Landscape design can also assist in building partnerships that bring together policy makers, scientists, and managers to help communicate these party's ideas and concerns. This process of bringing multiple parties together can be assisted by a neutral party who

serves as a facilitator and "honest broker." This process may include state governments playing a role in integrating many stakeholders into the landscape design process.

Once the relevant parties have been notified about the organization of the landscape design process, and their interests and concerns have been addressed, they should be convened to share potential opportunities and relevant research results. This group may include parties like state extension offices, biofuels centers and biorefineries (the approach being "start at the end"). Potential conveners are Agriculture and Food Research Initiative Coordinated Agricultural Projects (AFRI CAP), land grant universities, existing industry procurement organizations, landscape conservation cooperatives (LCC), and regional programs (e.g., the South Carolina Bioenergy Commission). The LCCs are particularly relevant because they convene agencies, nongovernmental organizations, and industry to discuss topics such as landscape design. Once together, these organizations can share resources such as data on potential biomass supplies (including the availability of woody biomass based on transportation infrastructure, land-owner objectives, and other variables in the southeast), supply growth and removal data from the USDA Forest Inventory Analysis, and input from the Sustainable Forestry Initiative (SFI) or Forest Stewardship Council (FSC) fiber sourcing program.

2. Certification

Certification offers one means to address concerns about sustainability of forest operations and some certification schemes have been developed for bioenergy. Both the SFI and FSC schemes are well established and understood. Logging activities on non-corporate land are typically conducted by foresters who have been certified. Forestry certification systems are used by commercial land owners in most situations. However these certification procedures do not include calculations for greenhouse gas (GHG) emissions, which are complicated, for forestry operations occur at regional scale and due to the uncertainties surrounding past land use and disturbances over long-time horizons.

Certification systems could be used as part of landscape designs to promote progress toward sustainability. These systems could help address goals like considering spatial patterns of plantings or collection of thinnings that would be suitable for landscape design. However, the interests of small landowners would need to be accounted in the certification program to address their potential low participation. For small forest landowners, it may be easiest to participate through certified loggers or procurement and manufacturing organizations. Existing certification systems should consider how to better communicate goals and benefits to these stakeholders and to evaluate opportunities to better meet their needs. For small landowners, there are legal and economic risks that may be associated with the certification scheme. For example, the presence of endangered species habitat or species might limit use of the land; however, proactive solutions, such as those under Safe-Harbor agreements of the Endangered Species Act, can provide a means to protect the rights of private land owners.

3. Market stability

One of the objectives that the landscape design process should address is identifying variables that support a stable biomass market. For example, the multi-stakeholder group could engage crop insurers to identify lessons that may be applicable to bioenergy produced under landscape designs, such as how

they assess risk, create markets, and assign value to insurance. The group should discuss ways to share risk so that individual components of the supply chain do not bear more of a burden than others. The group should find ways to build upon state policies that are designed to support the Renewable Fuel Standard, and they should support state programs and regulatory stability because policy uncertainty undermines investment and management.

4. Planning and guidance tools

There are several planning and guidance tools that the multi-stakeholder group can adopt or develop for landscape design. The group could flesh out the steps needed for bioenergy facility siting (e.g., permits, supply contracts, how to assess/understand competing demands, etc.). They could assess what can be learned from recent experiences, (e.g., the Chemtex plant in North Carolina). There should be an evaluation of opportunities to build on existing expertise, such as the pulp and paper industry (based on their history of fiber procurement) to reduce or manage risks. The group should work to develop tools, models, and technical approaches to monitor and guide policy and management decisions toward incremental improvement and goal achievement. Lastly, the group should work to build from harvesting guidelines along the same lines as the forest guilds. For instance, South Carolina has water quality best management practices (BMPs) that are relevant to the biomass community. States could develop landscape design BMPs by preparing guidelines that are linked to existing policies or BMPs (i.e., BMPs for harvesting). The guidelines would have a greater chance of being adopted if the actions were added to existing BMPs. However, one consideration that must be factored into the BMP is that people who are already using BMPs are sometimes resistant to new additions. These guidelines could be developed either proactively or when the demand for biomass starts to grow.

5. Analysis tools

There is no simple tool applicable for these multi-functional landscapes that would provide a means to increase cellulosic feedstock production, validate the environmental and social sustainability impacts at a watershed or comparable scale, and assess the feedstock characteristics and logistics systems (e.g., harvesting, preprocessing, and transport) associated with those landscape designs. Instead landscape design is a process.

Applying the landscape design approach to bioenergy requires attention to the context in which the particular bioenergy system occurs (Efroymson et al. 2013). The most appropriate bioenergy design options depend on the different biophysical, environmental, societal and power settings found at the fuel-shed scale (Duvenage et al. 2013). Depending on circumstances, factors that may be appropriate to consider include the climate and microclimates; topography and orientation, prior and current land ownership and use; land owner objectives; air, water and soil baseline conditions; site drainage and groundwater recharge; municipal and resource building codes and zoning; human and vehicular access and circulation; property safety and security; construction parameters; income/energy/resource-access; and other measurable considerations.

Adoption of more sustainable practices entails developing metrics appropriate for and within the particular context. Indicators provide information about potential or realized effects of human

activities on phenomena of concern. Indicators for bioenergy derive from both environmental categories (e.g., soil quality, water quality and quantity, greenhouse gases, biodiversity, air quality, and productivity) (McBride et al. 2011) and socioeconomic categories (e.g., social well-being, energy security, trade, profitability, resource conservation, and social acceptability) (Dale et al. 2013). In the context of US energy and environmental policy, a limited set of indicators have been proposed and are considered as they apply across the entire bioenergy supply chain (Efroymson et al. 2013; Dale et al. 2013). As applied to any particular bioenergy system, the indicators collectively convey where that system is in relation to particular goals or as compared to other systems with other main goals (e.g., biodiversity conservation or provisioning of clean drinking water).

Policy and decisions are a result of human values in time and space. Applying landscape design provides an opportunity to interact with stakeholders and come to agreement on values in sector development and to integrate that development with existing environment and human infrastructure. There are a few examples of applying landscape design principles to site selection when the goals involve a relatively small project with flexibility to be located anywhere in a large region (e.g., see McCormick et al. 2009 and Conservation International 2011).

There are several analysis and guidance tools that could support decision making for landscape design. One effort to start with is identifying set-aside areas from locations of parks, reserves, protected waterways, and local, state, and federal natural areas along with private conservation easements, riparian buffers, and wetland reserves to incorporate into a landscape design. The group could develop optimization procedures for selecting feedstock sourcing areas based on multiple objectives (i.e., biorefinery location, size of the facility, and existing infrastructure). This approach would help the stakeholders consider tradeoffs in achievement of multiple goals.

Case studies on sustainability would be useful for quantifying and testing proposed indicators. The New Bern area is one candidate because a large quantity of data has already been collected there. Another potential case study would be partnering with a group such as the SFI to study sustainable fiber sourcing in coastal plains of the southeast. This study could then feed into relevant data from other states. Another case study could look at the region that supplies pellets to the Savannah port, which is about the same size as a large-scale biorefinery.

Another form of analysis relevant to the region would be conducting a cost-benefit analysis for how much investment in equipment such as chippers and woody debris collection would be reasonable. This approach could be used to assess where collection of these resources would make sense economically and environmentally and to identify the break-even point for other biomass price scenarios. Other tradeoffs should be explored, including scenarios in which multiple objectives influence regional resources like water. For example, saw timber markets are the primary driver of forestry industry activities in the region, and the tradeoffs of the bioenergy industry should be assessed based on economic and environmental benefits and costs of adding that to the mix. However, assessments should not be performed in isolation, for there are environmental and economic tradeoffs with alternative land-use plans.

Another tool that was suggested is geographic information systems (GIS). GIS could inform the group of the potential supply and demand as well as the environmental parameters around this supply and demand and be used as a tool for spatial design. Existing GIS-based monitoring platforms (i.e., USDA Forest Service FOREWARN) could be adapted to support landscape design planning and monitoring.

Lastly, the multi-stakeholder landscape design group should develop better definitions of terms and concepts. Questions that the group should address include the definition of "natural forest," how management activities in natural forests are quantified and how prior history of forest disturbance can be fairly and consistently described and communicated. Also to resolve are questions around how the management intensity spectrum is defined. How deep, how often, and with what equipment and tools are soils disturbed manipulated or compacted? Where are soils disturbed? How is the effect defined spatially and volumetrically, and relative to what other parameters? What is being removed by bioenergy operations (rates, volumes, frequency)? What other disturbances occur (rates, frequency, volumes affected)? Lastly, the other questions that the group should address are how values for above and below ground carbon stocks are determined, and how the flows and fluxes of nutrients and water are defined and measured.

Characteristics of current bioenergy production in coastal North Carolina

Discussing key characteristics of current bioenergy production in the coastal North Carolina landscape (Table 1) was an important activity at the workshop. Most of these attributes relate to landscape design as it is applied to particular regions and cases of bioenergy sustainability.

Table 1. Components of landscape design for bioenergy sustainability that align with specific attributes were proposed by workshop participants. Examples associated with the current situation in coastal North Carolina were discussed.

Attribute	Situation in North Carolina	Implication for landscape design for bioenergy sustainability in the southeastern United States
Feedstock availability	Forest residues are abundantly available	Supply is high and spatially identifiable
Demand for bioenergy	There is growing demand from local users and Europe.	High Demand could lead to better planning and development of supply and processes
Land ownership patterns	There are many small private forest owners.	Collaboration and communication challenges
Site specific concerns	Wetlands and the water table are an issue for coastal forestry.	Site-specific management
Local and regional coalitions	Small land owner associations exist.	Facilitates communication

Economic conditions	Rural poverty means that there is a need for new economic opportunities.	Social services
Potential for multiple benefits to the community	Forestry is an integral part of the community	Benefits across the community
Potential for local processing of bioenergy	Landowners benefit from increased value of wood products. Jobs in forestry and transport are provided	Economic/social benefits at the local scale
Matching spatial opportunities with local services	Hog spray-fields, for example	Site-specific management
Bioenergy does not exist in a vacuum across the landscape	Many activities occur on the landscape	Integration of landscape objectives
The history of the landscape disturbances	Disturbances are common	Site-specific considerations
Parks, protected areas, and hunting activities, military lands/federal presence	Many lands are federal and state owned and managed	Important baseline conditions: opportunities for synergy with managed forest landscapes
Human migration	There is an influx of retirees	Site specific issues need to be addressed. Consider zoning.
Increase of extreme disturbances	Hurricanes, wind storms, ice storms, droughts and insect outbreaks occur in coastal NC	Resilience and adaptive management; planning that considers current landscape and potential changes
Identifying sites with high biodiversity and high conservation value for appropriate protections	Species of special concern are often associated with unique habitats, many of which require disturbances	Guiding informed decisions for conservation set asides or special management
Capturing long-term data from multiple sources to address multiple environmental aspects	Some long-term trends are well documented	Knowing the baseline and trends
Different governance structures (BMPs, regulatory)	Federal, state and local governance differ	Building on and recognizing the variety of governance structures
Markets are drivers for land management; high-value saw timber market drives forestry activity	The lumber markets drives most forest practices	Connection between economics, available residues and ecological interests
Infrastructure – impact from roads, ports, railways	Deep ports, railways and roads are well established	Infrastructure defines limits and opportunities
Historic patterns of land change (*fluidity of change	Agriculture and forestry have been intensely practiced for	Resilience and reversibility of decisions, lack of constraints

from forestry to agriculture)	decades	
Urban growth and development pressure	Urban growth and development are prime pressures for deforestation	Spatial constraint
Opportunity for multiple benefits from an integrated approach. Timing offers opportunity to influence implementation.	Forest lands provide many benefits	Value of integration, and challenge of carrying ball forward. How can you create incentives to carry it forward?
Topography	The low gradient coastal landscape is vulnerable to flooding and climate change.	Data requirements, tools, and management. Spatial constraint and opportunity to engage developers
Coordination amongst federal agencies to examine landscape design from a larger scale	There is a history of good collaboration among state and federal entities	Collaboration challenge
Use of remote sensing and optimization tools to assess feasibility of options	Tools are available and have been used to described and assess the NC landscape	Landscape design tools
New tools – using gaming to predict how scenarios may play out	New tools are beginning to be made available	Landscape design tools
Landscape design offers new opportunities to address web of regulations and the pace of change of regulations	The landscape design approach offers a way to engage the community.	Landscape design tools offer ways to meet regulations. Planning is ongoing
Adaptive management – *in situ* optimization	Adaptive management is adopted by federal and state organizations	Landscape design tools
Consider biomass factors in parallel with other priorities and tradeoffs	Bioenergy is one of many products from forest systems	Planning within context, optimization
Difficulty to predict product success	Modern wood-based bioenergy is just beginning to become productive in the SE US	Maintain flexibility
Need to deal with uncertainties	Uncertainties in market demand have a big impact on business opportunities	Tools and data that contain uncertainty,
Risk identification and mitigation	Risk need to be identified and quantified	Long-term perspectives

Collaboration and integrative planning process that uses spatial analyses of current and future landscape conditions to develop a suite of landscape design targets and means to address them	Bioenergy is just one potential product from the forest systems of NC	Holistic management prescriptions
Influence of politics	For example, the State legislature shut down the North Carolina Biofuel Center	Policy context, need for consistency and support from organizing body

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Appendices

Agenda: Incorporating Bioenergy into Sustainable Landscape Designs
March 4-6, 2014
New Bern, North Carolina

Day 1—Tuesday, March 4, 2014: Field Trip

Day 2—Wednesday, March 5, 2014: Workshop

8:00 a.m.-8:30 a.m. **Registration and networking**

8:30 a.m.–9:00 a.m. **Introduction to workshop**

- Welcome—Alison Goss Eng
- Workshop goals and a brief description of the U.S. Department of Energy's (DOE's) Bioenergy Technologies Office—Kristen Johnson and Mark Elless
- Overview of two workshops on sustainable landscape designs—Cristina Negri
- Individual introductions

9:00 a.m.–10:00 a.m. **Pressures on resources in the southeastern region of the U.S**

- Eastern North Carolina Land Use History 101—Joe Hughes
- Pressures on forests in the southeastern region of the United States—Bob Abt
- Key environmental challenges in the southeast — Jessica Daniel
- Discussion

10:00 a.m.–10:30 a.m. **Break**

10:30 a.m.–11:15 a.m. **Landscape design approach for woody biomass used for bioenergy**

- A landscape design approach that incorporates bioenergy systems—Virginia Dale
- Projected effects of biofuel production on landscapes in North Carolina—Jennifer Costanza
- Discussion

11:15 a.m.–12:30 p.m. **Current systems that use forest biomass for bioenergy**

- Agroforestry in Southeastern US - Alan J. Franzluebbers
- European perspective – Floor van der Hilst
- Panel and discussion
    - Land holders' perspectives: large private forest land owner – Bob Emory
    - Land holders' perspectives: small private forest land owner – Frank Rankley

12:30 p.m.–1:30 p.m. **Lunch**

1:30 p.m.–2:15 p.m. **Panel on priority environmental concerns for woody biomass systems**

- Bottomland forests and wetland systems—Al Lucier
- Greenhouse gas emission (GHG) calculations for forest operations involving residues—Reid Miner
- Residual removal and biodiversity—Jessica Homyack
- Other issues and discussion

2:15 p.m.–3:00 p.m. **Break-out group:** Provide a list of potential opportunities to use landscape design to address the main sustainability concerns of forest systems that supply bioenergy. Each breakout group will address one aspect of this topic.

- Group 1A. What are the priority concerns, and how can they be addressed with landscape design?
- Group 1B. What aspects of landscape design have been used to date to improve the sustainability of forest biomass? What are the pros and cons of these different approaches?
- Group 1C. What steps are necessary to implements these opportunities?

3:00 p.m.–3:30 p.m. **Break**
3:30 p.m.–4:30 p.m. **Case studies of how forest systems use landscape**

- AFRI CAP projects
    - Southeastern Partnership for Integrated Biomass Supply Systems —Steve Kelley
    - Northeast Woody/Warm Season Biomass Consortium —Tim Volk
    - Systems for advanced biofuels production for woody biomass in the Pacific Northwest – Prasad Bandaru
- Brazilian experience—Arnaldo Walter

4:30 p.m.–5:00 p.m. **Plenary discussion: Breakout groups report back**

Day 3—Thursday, March 6, 2014: Workshop

7:30 a.m.-8:00 a.m. **Networking**
8:00 a.m.–8:45 a.m. **Breakout groups reconvene:** Provide a list of recommended goals and practices that promote incorporating bioenergy into the sustainable design of forested landscapes. Each breakout group will address one aspect of this topic.

- Group 2A. How could these recommended goals and practices be implemented? What are the steps in this implementation?
- Group 2B. What science gaps and other obstacles preventing broad application of landscape design approaches in systems that use woody biomass for bioenergy?
- Group 2C. Are there lessons learned from bioenergy systems that use woody biomass that could be offered to other systems (e.g., agriculture)?

8:45 a.m.–9:45 a.m. Panel: Recommended practices for using forest biomass for feedstocks—State of the Art

- Environmental and governance challenges for mobilization of sustainable forest bioenergy supply chains—Tat Smith
- Sustainable Forestry Initiative — Nadine Block
- Forest Guild—Alyx Perry
- Discussion

9:45 a.m.–10:10 a.m. Panel: Can landscape design principles be applied to help meet regulatory requirements for sustainable feedstock?

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- Roundtable on Sustainable Biomaterials—Matt Rudolf
- Biomass standards — Keith Kline
- Discussion

10:10 a.m.–10:30 a.m. **Break**
10:30 a.m.–11:15 a.m. **Breakout groups report back**
11:15 a.m. –12:00 p.m. **Plenary group discussion**

- Tangible next steps to move forward with landscape design for bioenergy in a manner that best serves industry, decision makers, and producers.
- A plan for collaborative research or other opportunities moving forward.

12:00 p.m. **Adjourn**

List of Participants

First Name	Last Name	Company / institution
Bob	Abt	North Carolina State University
Daniel	Adams	BCS, INC.
Devendra	Amatya	USDA Forest Service
F.G.	Beauregard	National Wildlife Federation
Nadine	Block	Sustainable Forestry Initiative Inc.
Max	Broad	BCS, Incorporated
Robert	Campellone	U.S. Fish and Wildlife Service
George	Chescheir	North Carolina State University
Jennifer	Costanza	North Carolina State University
Virginia	Dale	Oak Ridge National Laboratory
Jessica	Daniel	US Environmental Protection Agency
Jesse	Daystar	North Carolina State University
Mark	Elless	Bioenergy Technologies Office, Department of Energy
Bob	Emory	Weyerhaeuser Company
Jody	Endres	Univ. of Illinois at Urbana Champaign
Alan	Franzluebbers	USDA-ARS
Alison	Goss Eng	U.S. Department of Energy, Bioenergy Technologies Office
Natalie	Griffiths	Oak Ridge National Laboratory
Jessica	Homyack	Weyerhaeuser Company
Joe	Hughes	retired Weyerhaeuser Company
Daniel	Inman	National Renewable Energy Laboratory
Michael	Jacobson	Pennsylvania State University
Jake	Jacobson	Idaho National Laboratory
Henriette	Jager	Oak Ridge National Laboratory
Kristen	Johnson	DOE Bioenergy Technologies Office
Steve	Kelley	NCSU, SE Integrated Biomass Supply Systems
Keith	Kline	Oak Ridge National Lab
Zakiya	Leggett	Weyerhaeuser Company
Alicia	Lindauer	U.S. Department of Energy
Alan	Lucier	National Council for Air and Stream Improvement (NCASI)
Reid	Miner	National Council for Air and Stream Improvement (NCASI)
Maria	Negri	Argonne National Laboratory
Jami	Nettles	Weyerhaeuser Company
Vance	Owens	North Central Sun Grant Center, SDSU
Alyx	Perry	The Forest Guild
Matthew	Rudolf	Roundtable on Sustainable Biomaterials (RSB)
Tat	Smith	University of Toronto
Herbert	Ssegane	Argonne National Lab
Floor	van der Hilst	Utrecht University

Judith	Verstegen	Utrecht University
Timothy	Volk	State University of New York ESF
Arnaldo	Walter	University of Campinas
Todd	Watson	Enviva LP