Executive Conference
4/5/2016

David Turpin
President & Executive Director
Agenda 2020 Technology Alliance
Agenda 2020 – A Unique Voice for the Industry

Mission: Promote the development of advanced manufacturing technologies that promise transformational impact on the paper and forest-based industries

- Member-funded 501(c)(3) organization
- Identify industry technology needs / Drive consensus on R&D priorities
  - 2010 Forest Products Industry Technology Roadmap
  - 2015 Detailed Roadmaps - NIST Advanced Manufacturing Technology Planning Grant
- Inform government agencies and universities about industry research needs
- Promote R&D programs funded in part by government
Vision

Roadmap Targets
- $1.5B in cost reduction
- > 200 Trillion BTU energy savings
- 480 Billion gallons water reduction
- $5 Billion new product sales
- Protect 380,000 jobs
Current Projects / Priorities

Member Company Priorities
- Process efficiency
- Sustainability – energy, water, products
- Fiber properties – virgin, recycled

Active Projects
- Press Section Modeling – HPC4Mfg
- Molecular Modeling of Potential Pulping Catalysts – USFS / FPL
- Teledyne Scientific – Novel Sacrificial Superhydrophilic Anti-fouling Coating - DOE Funded
- Georgia Tech, RBI – Robust Membranes
- High-Performance Architectured Surface Selective (HiPAS) Membranes – ORNL
- Cellulose Nanomaterials – Oral Toxicity Study - Vireo Advisors

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**Reuse of Process Effluents**

**Goal**
Reduce average water usage by half

**Value**
> $300mm, 45 TBTU, 480 Billion gallons

**Strategy**
- Identify target areas for reuse and establish water quality requirements
- Develop cost-effective, broadly applicable technical solutions to address contaminants that inhibit reuse
- Focus on Paper Machine Whitewater Reuse and Reuse of Biologically Treated Effluents

**Priority Projects**
- **Model development** – Develop predictive process and economic model to determine possible water reuse options
- **Removal of suspended solids 10-40 µm** – Develop processes to separate particles based on material properties other than size
- **Removal of dissolved organic and colloidal substances** – Evaluate technologies utilized in other industries
- **Removal of inorganic constituents** – Explore feasibility of chemical agglomeration and filtration, surface passivation, or both

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Next-Generation Pulping

Goal
Reduce total energy 25%. Increase yield 5 percentage points. Reduce BOD/COD

Value
$900 MM, 70 TBTU

Strategy
• Develop advanced pulping technologies to increase the fiber yield and strategies to keep the yield gains throughout the bleaching process

Priority Projects

• **Yield-protective pretreatment** - Develop an approach to stabilize carbohydrate end-groups toward primary peeling

• **Accelerate delignification** - Identify/evaluate catalysts or methods to activate lignin e.g. higher content of free phenolic hydroxyl groups, decrease in molecular weight of lignin prior to delignification

• **Improve O₂ delignification selectivity to enable higher-kappa** - Identify an inter-stage filtrate treatment process and/or activation chemistry to improve second-stage reactivity and selectivity

• **Complete delignification** - Determine the composition of the oxidation-resistant lignin. Identify co-oxidants that can work within the existing O₂ technology and/or alternative oxidation catalysts

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# Black Liquor Concentration

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<tr>
<th>Goal</th>
<th>Develop a more energy-efficient method to remove water from kraft pulp mill black liquor.</th>
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<tr>
<td>Value</td>
<td>$95 MM, 23 TBTU</td>
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| Strategy | • Overcome issues with membrane separation technology in current development projects: Sacrificial Coatings, Robust Membranes, HiPAS membranes  
         • Develop more fundamental understanding of issues with commercially available membranes |

### Priority Projects

- **Modeling permeate quality** – *Iterative process and economic model to define acceptable conditions for permeate use*
- **Screen existing membrane technology** – *Evaluation of existing commercial technologies for feasibility by membrane providers*
- **Conduct bench-scale membrane screening and research** - Test membranes and conduct research to understand issues
- **Develop a portable test skid to analyze and optimize membrane technology** – *Build skid mounted equipment with capability to test at mill sites*
- **Process simulation/modeling to predict stream composition**
Reduce Drying Energy

Goal: Increase dryness of paper webs entering dryer section by ~ 30% (from 45-55% up to 65%)

Value: $250 MM, 80 TBTU

Strategy:
- Develop a fundamental understanding of rewet and technologies to control or eliminate it
- Develop advanced fiber matrix to facilitate water release without impacting sheet strength and uniformity

Priority Projects:
- **Decoupling Strength and Water Removal** – Develop approaches to decouple strength and water retention through chemical bonding strategies or use of alternative fiber types and minerals
- **Modeling Rewet** - Develop general mathematical model describing water flow rate and direction in the complex 3-D porous media
- **Measuring Rewet** - Develop measurement techniques to visualize and quantify rewet under dynamic conditions
- **Adaptive Felt Materials** - Develop “adaptive” felt materials or structures
- **Unidirectional Membrane** - Identify or develop a membrane that will support preferential flow of water away from the fiber web
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Cellulose Nanomaterials

Goal
Facilitate broad range of commercial development through development of pre-competitive technologies

Strategy
- Develop production methods (focus on issues of drying and dewatering)
- Characterize morphology and properties
- Pre-competitive research to enable applications

Priority Projects
- **GRAS designation** - Conduct toxicological investigation to obtain FDA Generally Regarded As Safe designation
- **Dewatering/redispersion methods** – Investigate ways to modulate hydrophilicity, drainage rates, rheology; create temporary or reversible flocculation; explore alternative solvents
- **Drying/redispersion methods** – Explore drying technologies for nanomaterials via literature review and evaluations; explore chemical aids to prevent agglomeration/hysteresis
- Develop characterization standards
- **Facilitate application in high-volume composites** - Develop scalable dispersion technologies by investigating alternative modes to incorporate nanocellulose including surface functionalization
Roadmaps to Road Trips

Specific Destinations

Funding

Partners

RFPs

Hit the Road

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### Agenda 2020 Members and Partners

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David Turpin, President & Executive Director
Agenda 2020 Technology Alliance
david_turpin@agenda2020.org
740-649-2307