Biorefinery Panel

Moderator – *Lori Perine – Agenda 2020*

- Introduction Comments – *Lori Perine*
- Remarks – *Panel Members*
- Open Forum Discussion – *All*
- Key Lessons Learned – *Lori Perine*

Biorefinery Panel – *Goals*

- **Panel Members will collectively address the evolving arena of biorefineries:**
  - ✓ ***Innovative research in*** **Thermo-Chemical Biorefineries** ***indicates that the forest products industry is*** **a potential fuels producer and a co-generator of electricity**
  - ✓ ***This panel will address the opportunities and challenges of deploying this technology*** **in an open innovation environment**
  - ✓ ***The panel will discuss how organizations can best prepare for the process changes, technical practicalities and business partnerships required*** **to fully exploit this promising product platform**

Components of the Agenda 2020 IFPB Technology Strategy

Sustainable Forest Productivity

- Apply biotechnology and nanotechnology breakthroughs to sustainable forestry to manage U.S. forest land at a high intensity and engineer feedstock optimized to co-products of the biorefinery

Value Prior to Pulping

- Separate and extract selected components of wood prior to pulping, and process these streams to produce commercially attractive chemical and liquid fuel products

New Value Streams **from residuals and spent pulping liquors**

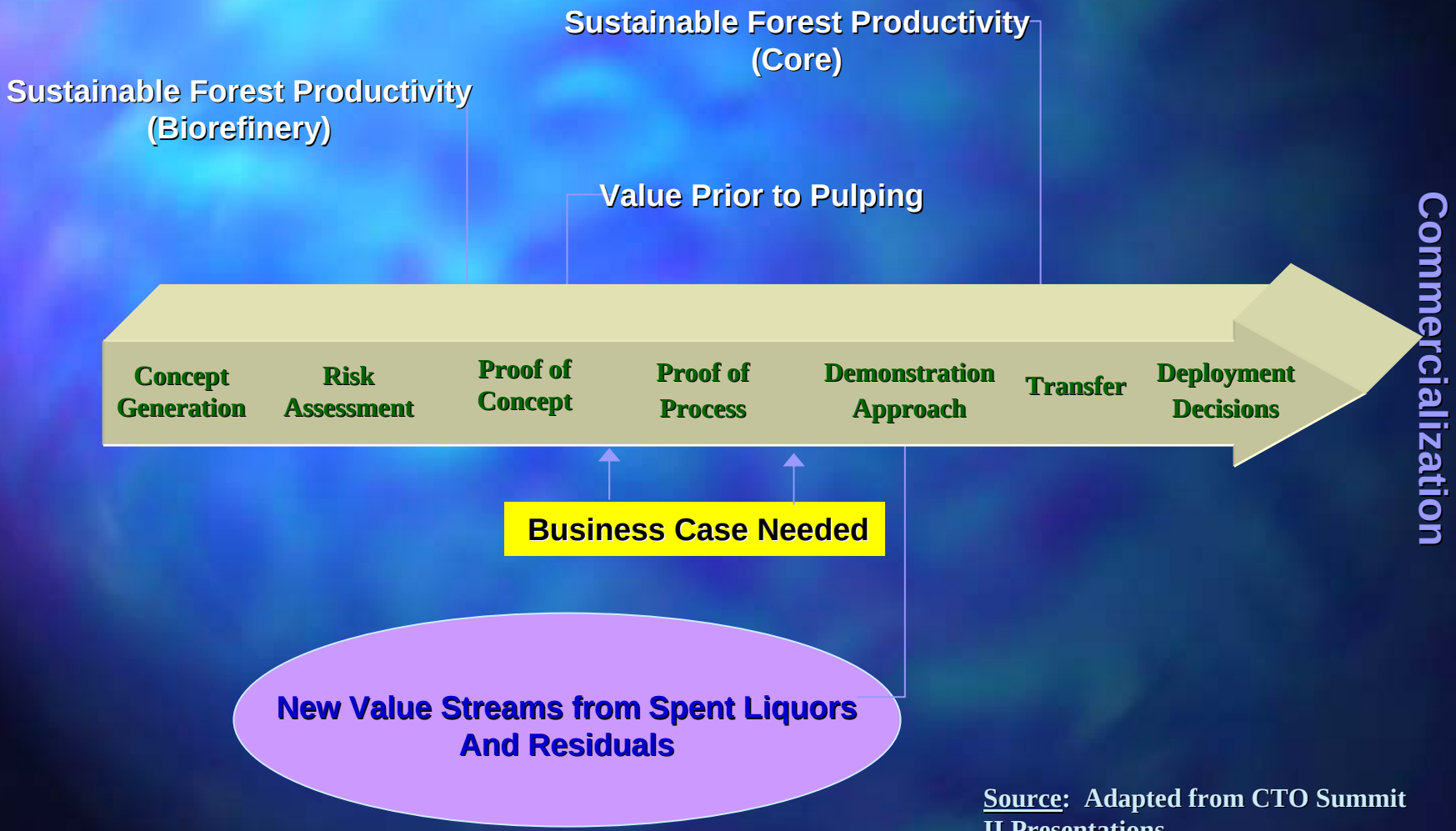
- Convert forest residues, mill residuals and spent pulping liquors into liquid fuels, power, and/or chemicals

Thermo-Chemical Biorefinery

New Value Streams (NVS) from Residuals and Spent Pulping Liquors

- Thermochemical conversion (gasification, pyrolisis, other) of mill residuals, spent pulping liquor and other woody biomass
- Gasification is the dominant technology platform being evaluated and demonstrated
- Potential for three primary value streams from the synthetic gas (syngas) produced via gasification:
  - ✓ ***Power generation:*** *Potential for 18-24 GW net export to grid*
  - ✓ ***Liquid fuels and/or chemicals:*** *manufacture equivalent of 216 million bbl/yr (renewable) or 11 billion bbl/50 years*
  - ✓ ***Hydrogen production:*** *daily production from a single mill of at least 55 million SCF of hydrogen*

IFPB Stage of Technology Development



Source: Adapted from CTO Summit II Presentations

Challenges and Opportunities for Advancing Innovation in Thermo-Chemical Biorefineries

- What are the requirements for and impacts of innovation on:
  - ✓ *Processes (gasification as core enabling technologies)*
  - ✓ *Products (bio-based fuels and products)*
  - ✓ *Markets (new and traditional)*
- How do we advance and capture the value of these innovations to benefit the forest products industry?
- How would more effective implementation of open innovation principles increase enterprise effectiveness?

Reaching Across Boundaries: *Enabling Partnerships is Essential*

Partnerships provide systematic and realistic approach to fund innovation and leverage technical and business expertise needed to address competitive challenges

- **Create options for the US forest products industry through innovation in processes, materials, *and markets* – *while strengthening core infrastructure and industry competitiveness***
- **Align technology objectives to provide options for addressing key industry competitive challenges**
- **Manage portfolio to maximize value/minimize risk of adopting new technologies**
- **Enable a fully-integrated pipeline of pre-competitive activity from concept through deployment**

Reaching Across Boundaries: *Examples of Key Collaborations*

- **Research Collaboration**
  - ✓ *IFPB technology objectives*
  - ✓ *New product development*
  - ✓ *Business case and strategy*
- **Tech Transfer and Commercialization**
  - ✓ *Demonstration of industrial units*
  - ✓ *Intellectual property management*
  - ✓ *Access to delivery infrastructure*
- **Markets**
  - ✓ *Enhanced quality/functionality of "traditional" products*
  - ✓ *New value streams > new business models + new customers*
- **Funding**
  - ✓ *Research*
  - ✓ *Demonstration*
  - ✓ *Capital for commercialization*
- **Legislative and Regulatory**
  - ✓ *Credits & Subsidies*
  - ✓ *Environmental Regulations*