Advancing forest-based bioproducts capacity in Canada

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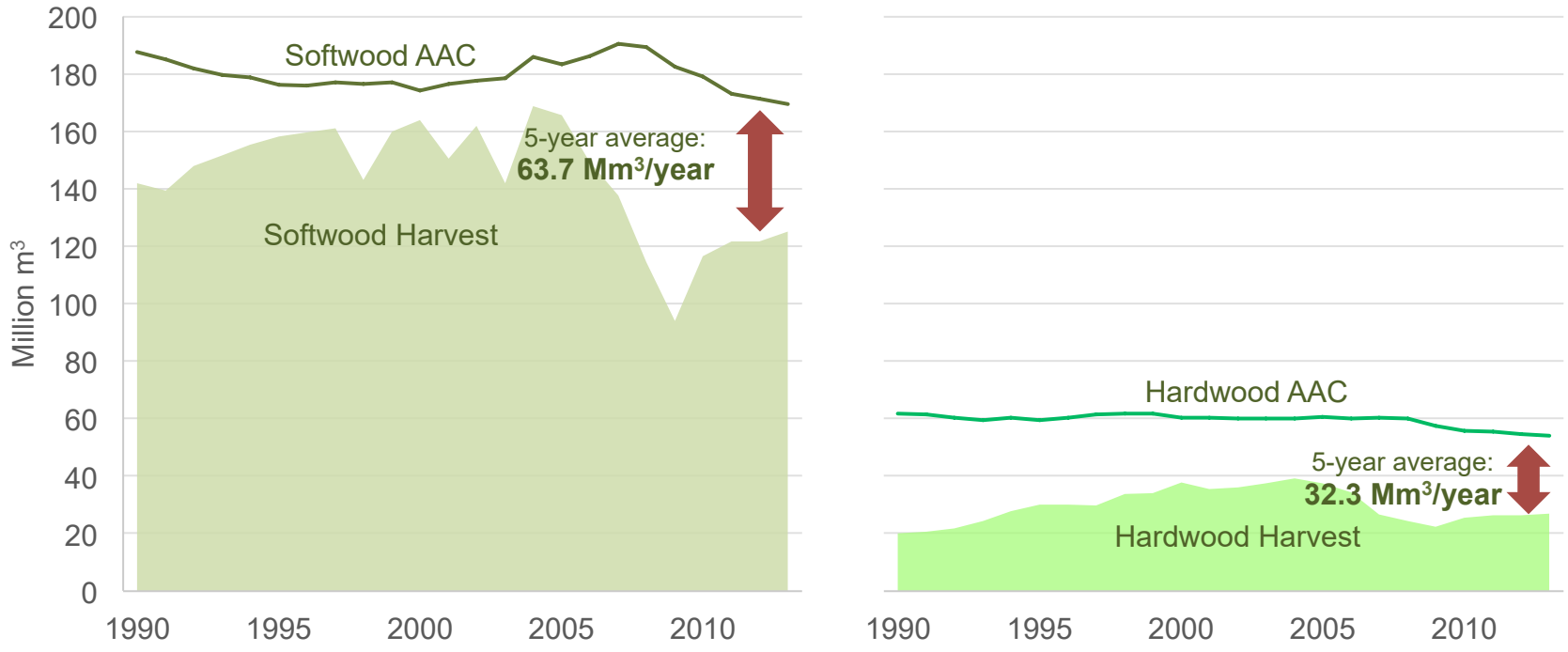
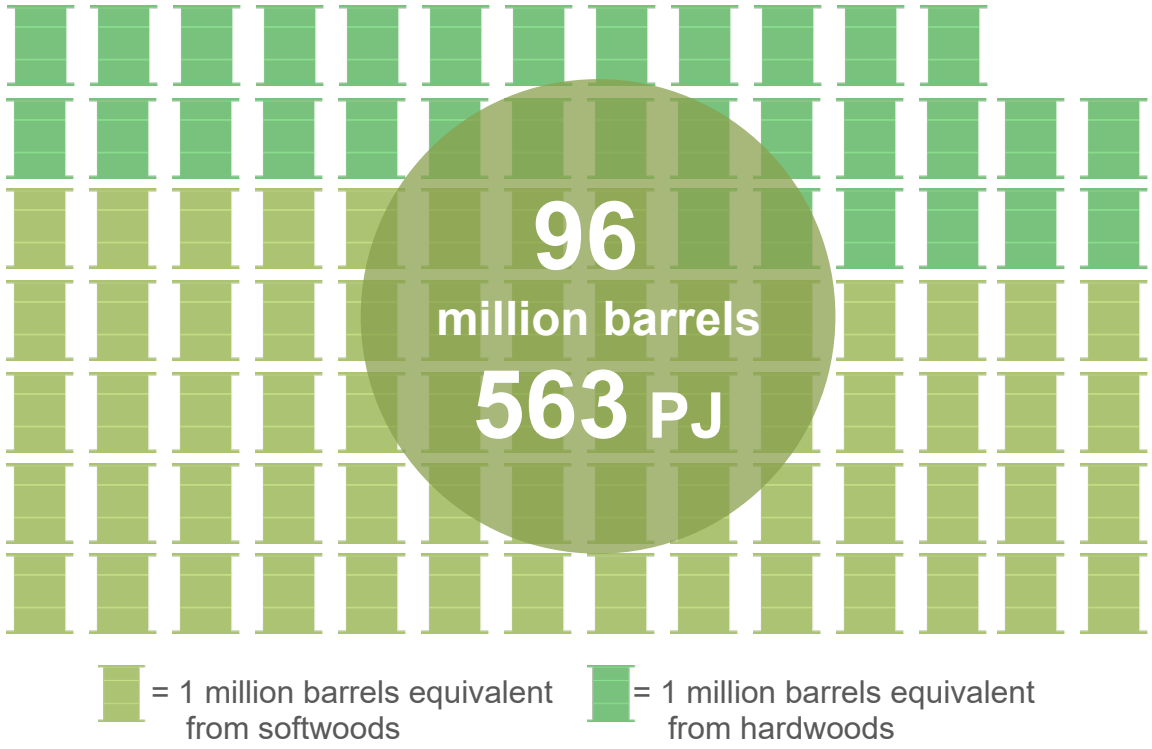
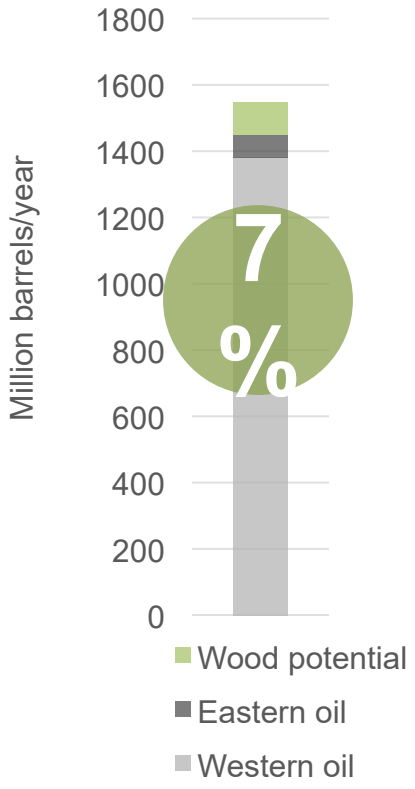
An opportunity



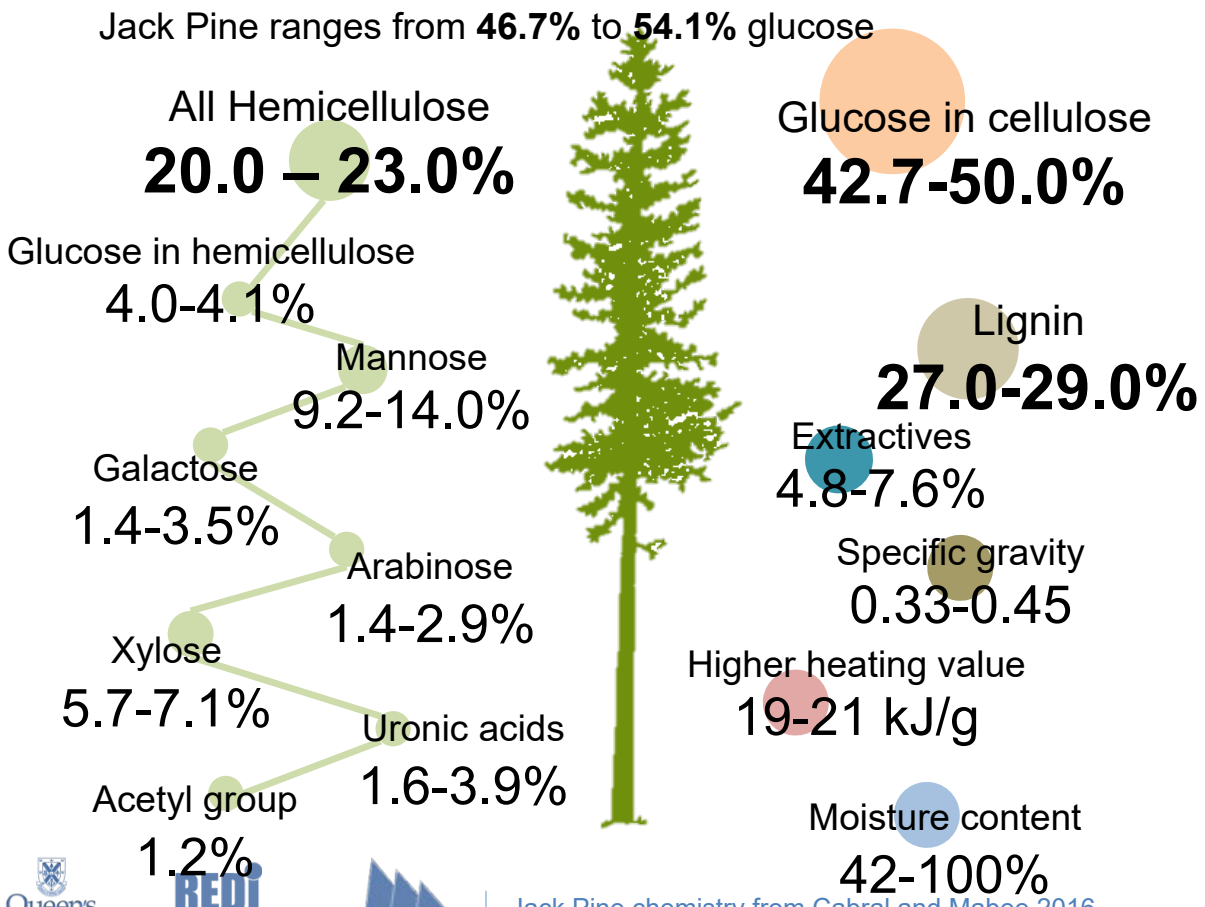
National Forestry Database 2016; FAOStat 2016

An opportunity





A chemical and energy storage system…



- Wide diversity of chemical products embedded in wood
- Chemical make-up varies from species to species
- Significant amounts of energy in most species

…with significant differences between species

Poplar ranges from **35.3** to **57.3%** glucose

All Hemicellulose
5.4-31.0%

Glucose in hemicellulose
2.2-4.3%

Mannose
0.9-5.3%

Galactose
0.4-3.5%

Arabinose
0.3-2.4%

Xylose
12.5-19.2%

Uronic acids
3.3-4.3%

Acetyl group
3.4-3.7%

Glucose in cellulose
33.1-53.0%

Lignin
16.3-26.7%

Extractives
1.7-4.1%

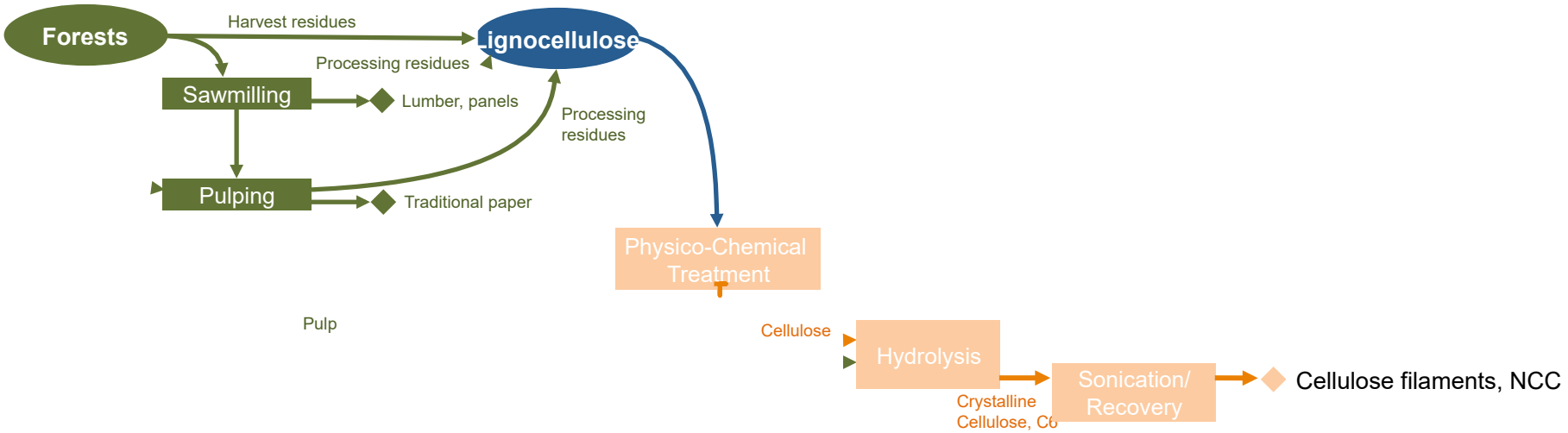
Specific gravity
0.40

Higher heating value
19.0-19.7 kJ/g

Moisture content
75 - 100%

- Greater amount of xylose in hardwoods
- More lignin in softwoods, but different character

Unlocking potential



Cellulosic filaments

Isolated components of wood structure – exhibit high strength and unique surface qualities, serves as a building block

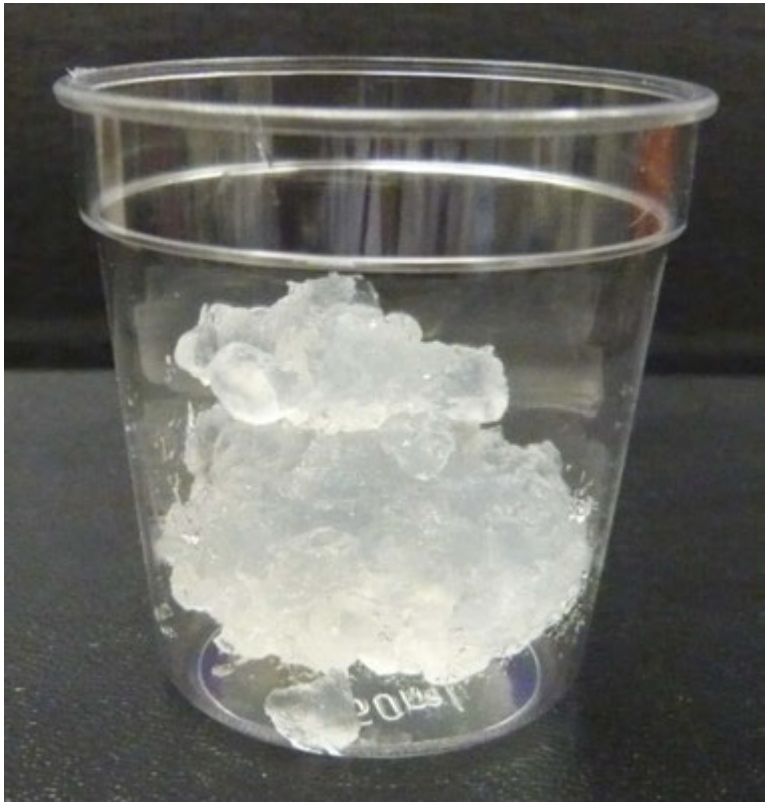
Prime example:

nanocrystalline cellulose (NCC)

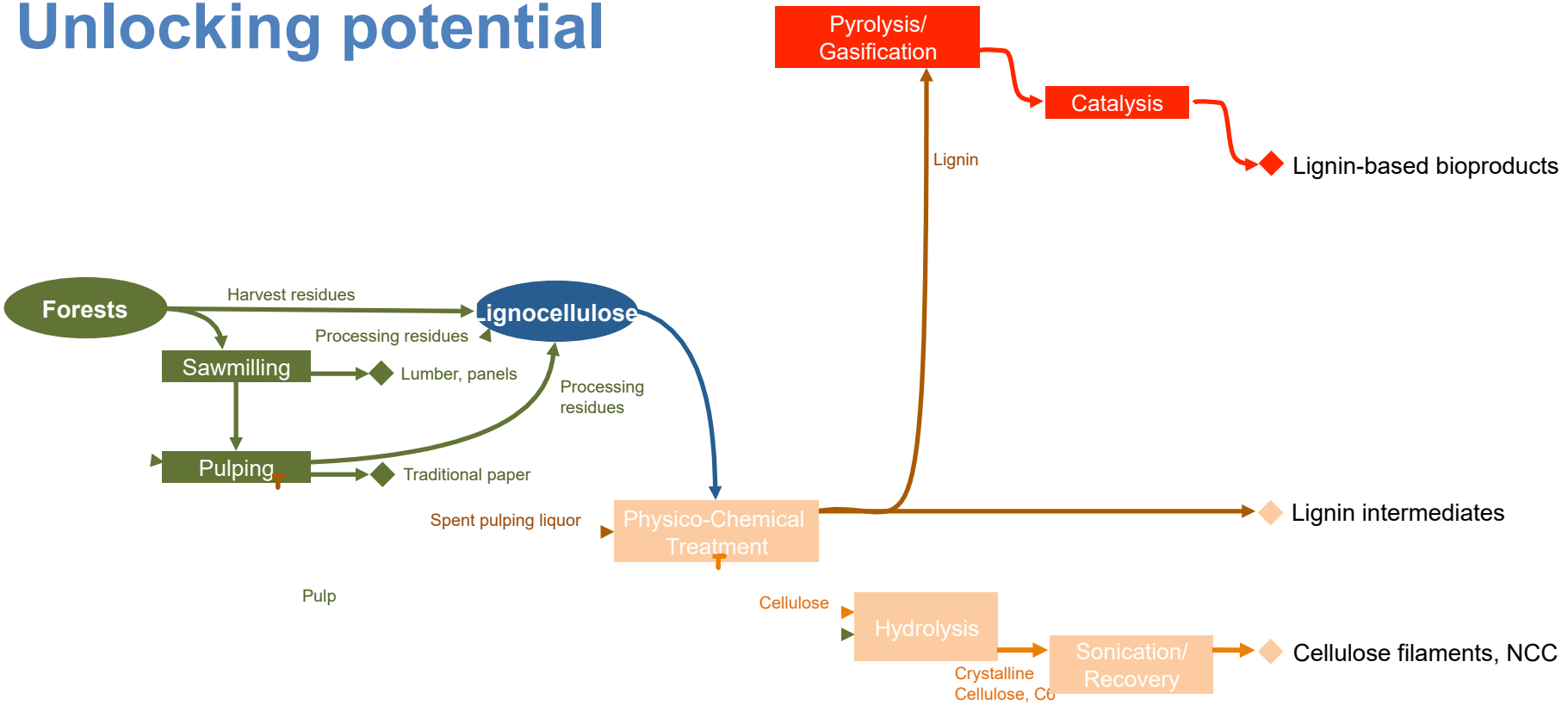
CelluForce (Canada); Melodea (EU); Zelpho (EU)

Substitutes for:

carbon nanotubes; can be used in place of metals such as aluminum, synthetic fibres such as Kevlar



Unlocking potential



Lignin-based bioproducts

Isolated components of wood structure – phenolic compounds recovered directly from wood or from spent pulping liquors

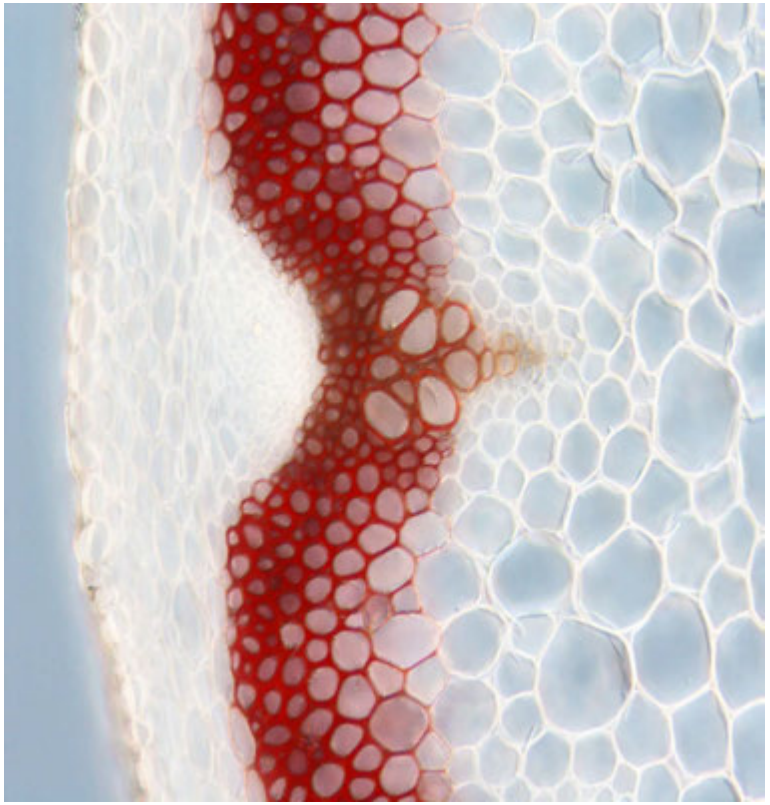
Prime examples:

arboform, LignoForce

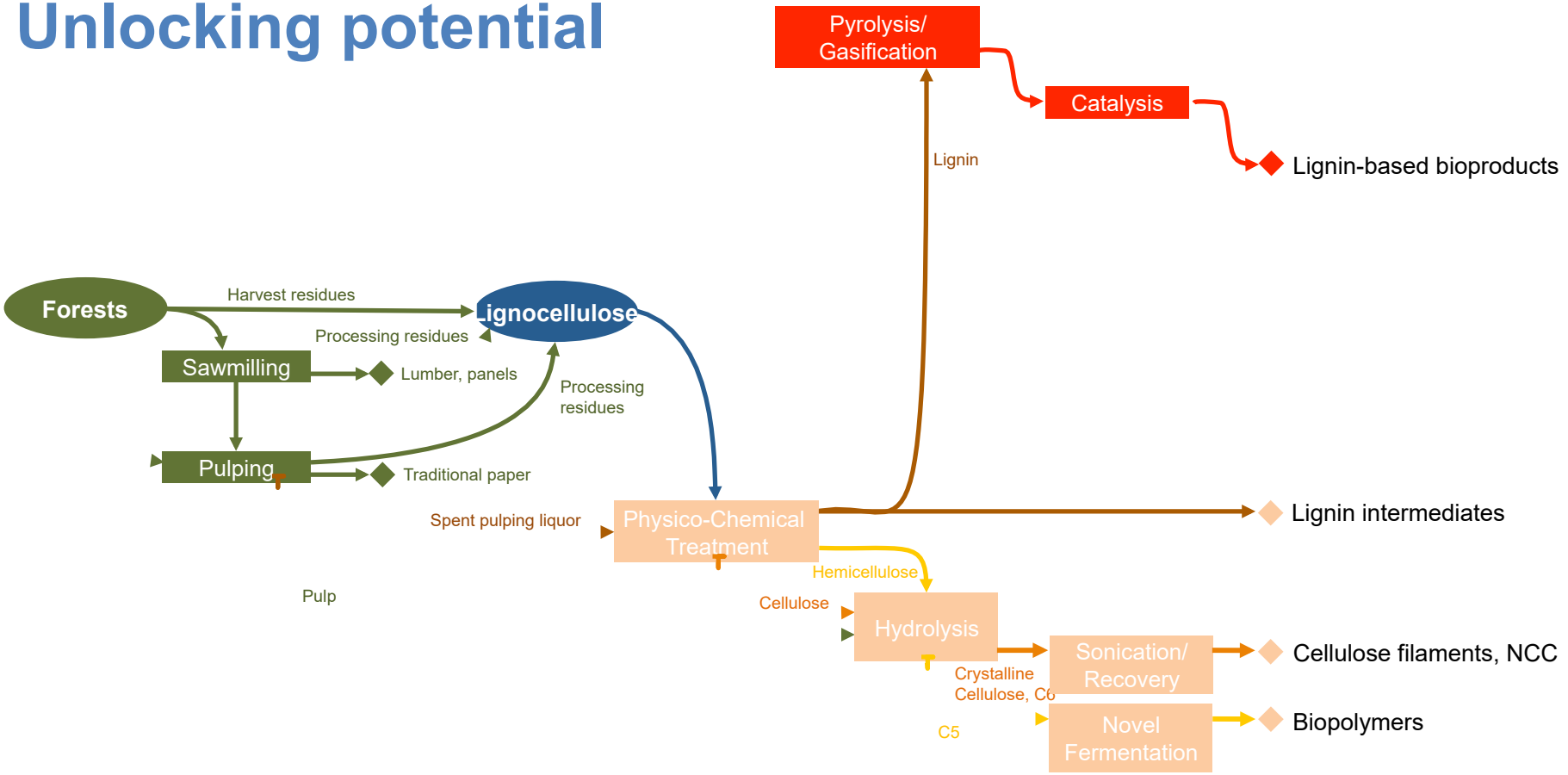
Fibria Innovations-Canada, FPInnovations-Canada, Tecnaro-Germany

Substitutes for:

resins, dispersants, carbon fibre



Unlocking potential



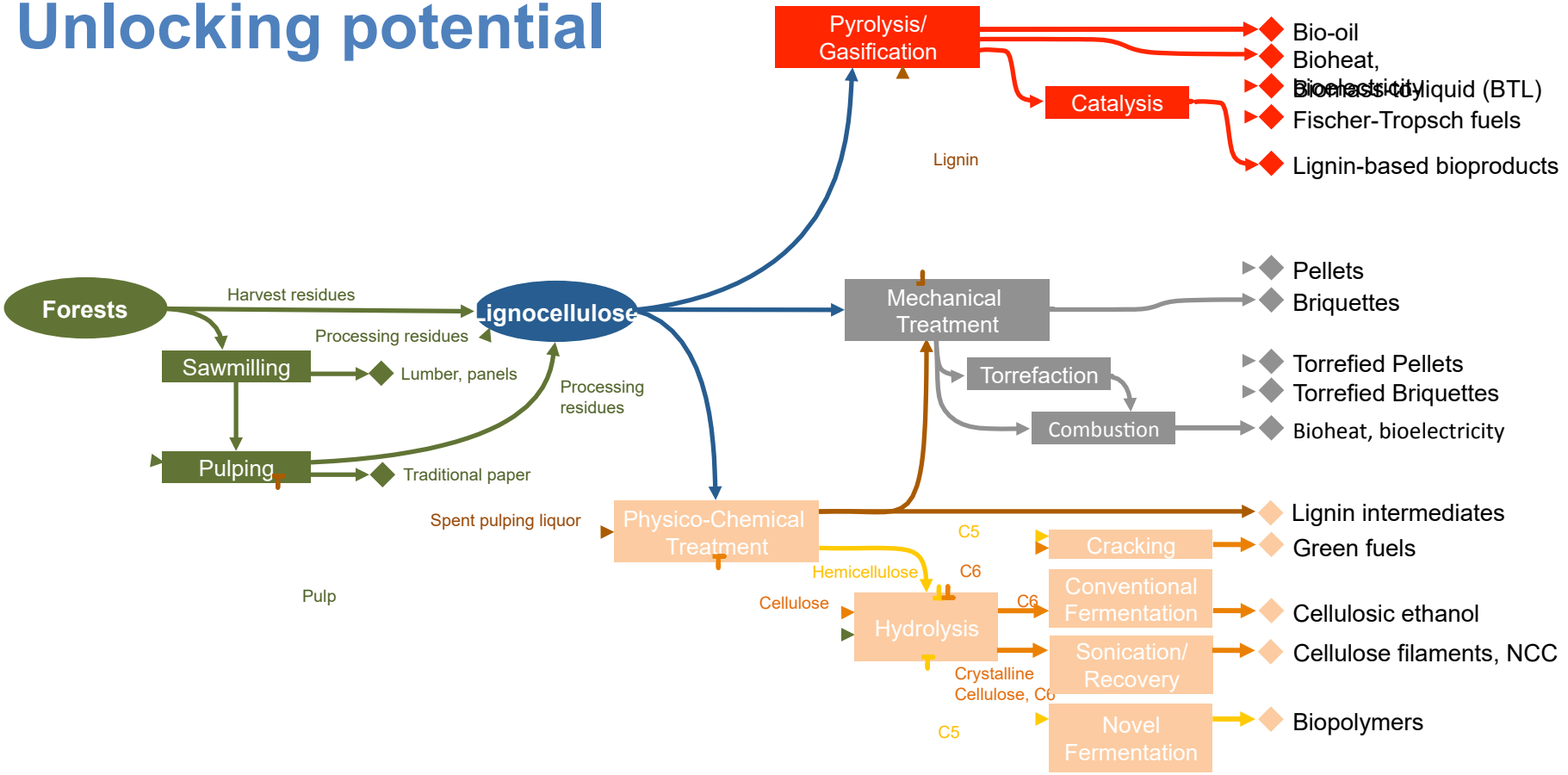
Biopolymers

Reconstituted wood chemicals via various
pathways (e.g. anaerobic fermentation to succinic acid, aerobic fermentation to 3-Hydroxypropionic acid)

Prime examples:
succinic acid, ingeo fibre, sorona fibre
BioAmber (Canada); NatureWorks (USA)

Substitutes for:
synthetic textile products
(nylon, lycra, etc.)

Unlocking potential



Bioenergy and biofuels

Direct combustion of wood under varying conditions, or conversion to solid, liquid, or gaseous products

Prime examples:

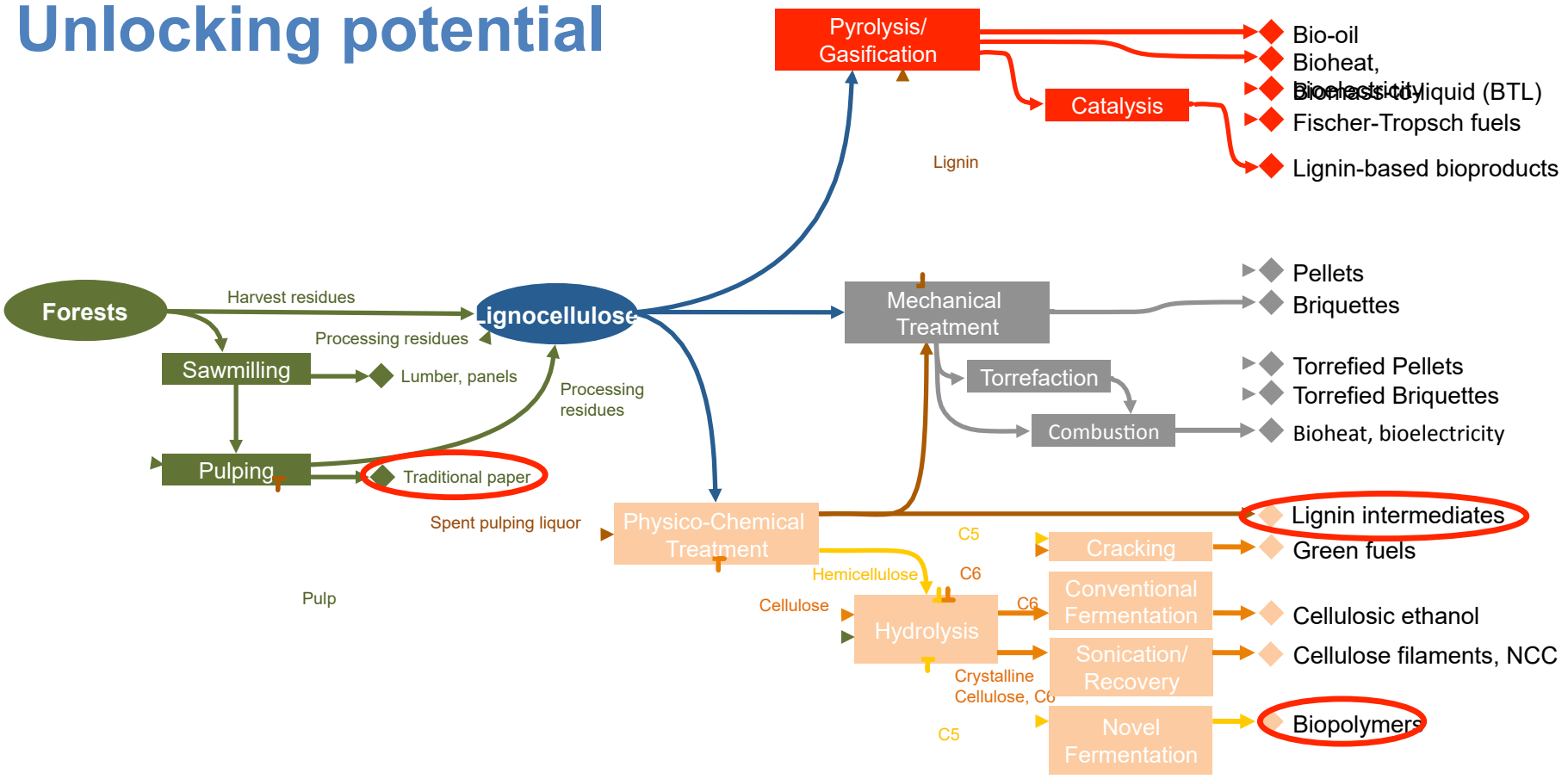
cellulosic ethanol, bio-oil, wood pellets

Enerkem (Canada); Ensyn (Canada);
Fibria Innovations (Canada/Brazil); Raizen (Brazil)

Substitutes for:

petroleum fuels (gasoline and diesel), coal, natural gas

Unlocking potential



Advanced biomaterials

Combining different bio-based polymers to create unique products

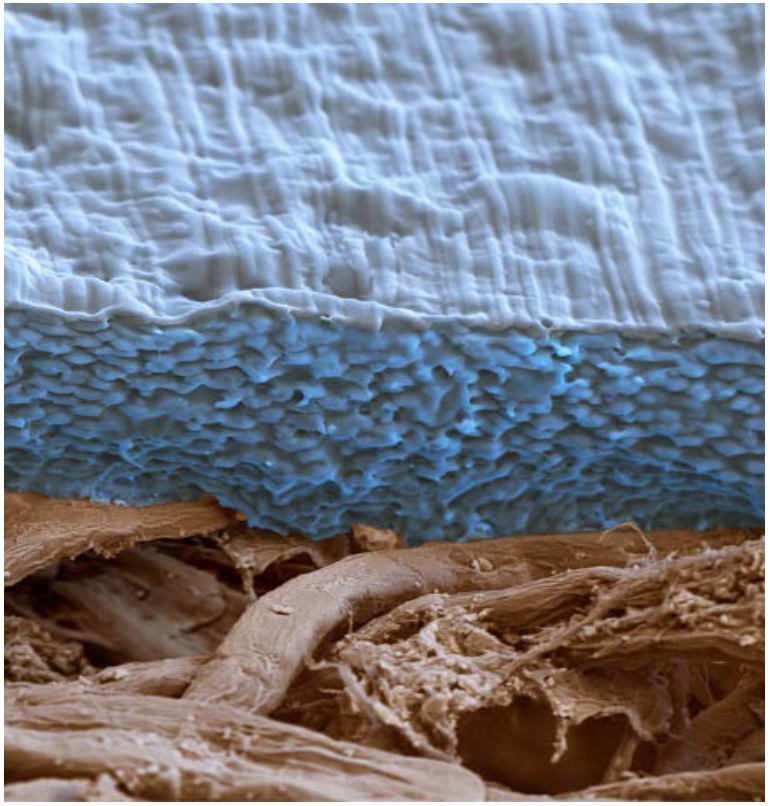
Prime example:

composite bioplastic/wood products – compostable coffee cups and K-cups

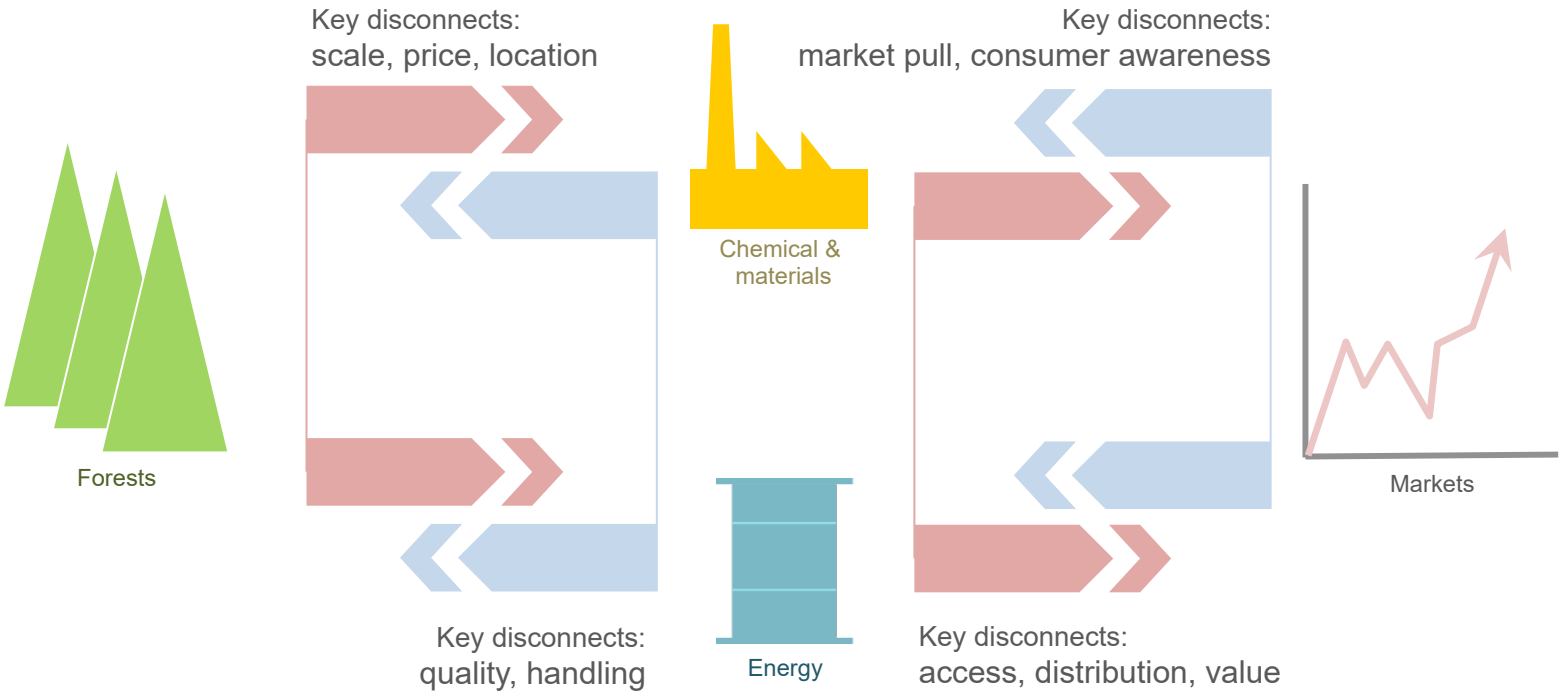
BASF (EU); NatureWorks (USA)

Substitutes for:

petro-based coatings in consumer goods; structural products; furniture; automotive parts



Broken telegraph



Goal

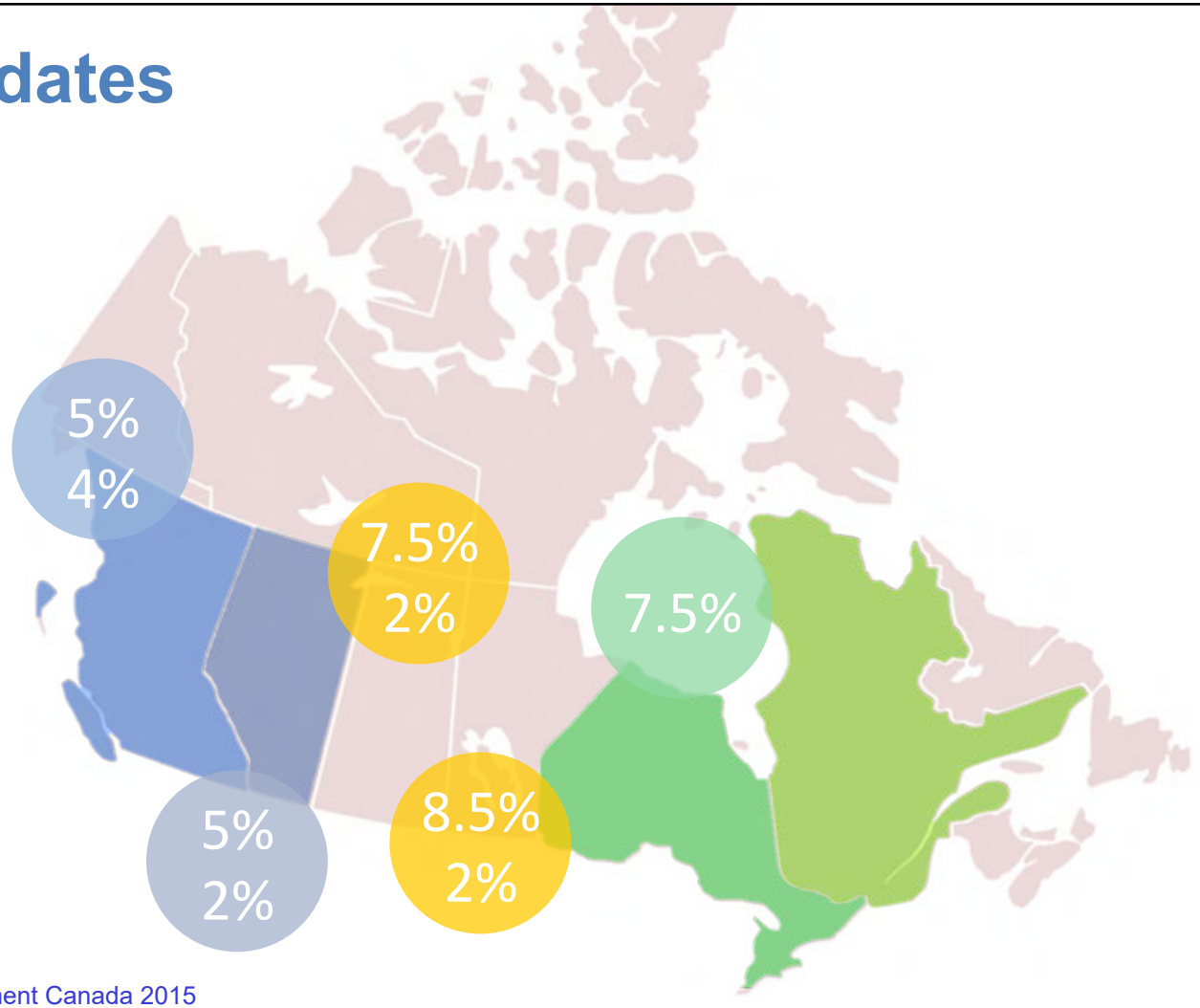
Can policy be used to tackle these disconnects and discover new opportunities for collaboration and development?

What's required to shift thinking out of sectoral silos and address these challenges?

Global trends are towards bio-based products in all sectors;
how do we take advantage of the Canadian opportunity?

Renewable mandates

Federal:
5% in gasoline,
2% in heavy
distallates



Key policy mechanisms

Carbon pricing

-BC, AB ($30/t) via carbon tax

-ON, PQ ($12-15/t) via cap-and-trade

Low carbon standards

-Primarily employed for fuels (California, BC)

-Could b employe in other locations

Other approaches

R&D support – inside and outside government labs, NCEs (e.g. BioFuelNet)

Commercialization – Pilot and demo program (PDS), SDTC

Infrastructure spending – e.g. Ethanol Expansion Program

Producer incentives – e.g. ecoEnergy for Biofuels

Consumer incentives – e.g. excise tax exemptions

Summary

Carbon pricing may drive some innovation but it comes down to consistency in how the prices are imposed

- Possible that capital will focus on ‘cleantech’ and skip bio-based products altogether

Mandates are useful but world seems to be evolving past simple mandates to low carbon fuel standards

- Again, a mechanism to drive innovation in heavy-duty fuels is essential

Important to consider a suite of initiatives that cover all aspects of development (from R&D through to implementation and use)

Team and partners

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RÉSEAU BIOFUELNET CANADA

FFABnet
Functionalized Fibre and Biochemicals Network

ACW | Adapting Canadian Work and Workplaces

Carbon Management Canada
CMC-NCE

NSERC CRSNG

LAFARGE
bringing materials to life

VCO Value Chain Optimization

NSERC BIOCONVERSION NETWORK

ForValueNet ForêtValeur