Biorefining in Canada

The Need for a Comprehensive Energy Policy, the role of Biofuels within it, and within the broader Sustainability framework

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Designing Law and Policy for the Transition to Sustainable Energy

Ottawa, Canada

10 June 2011

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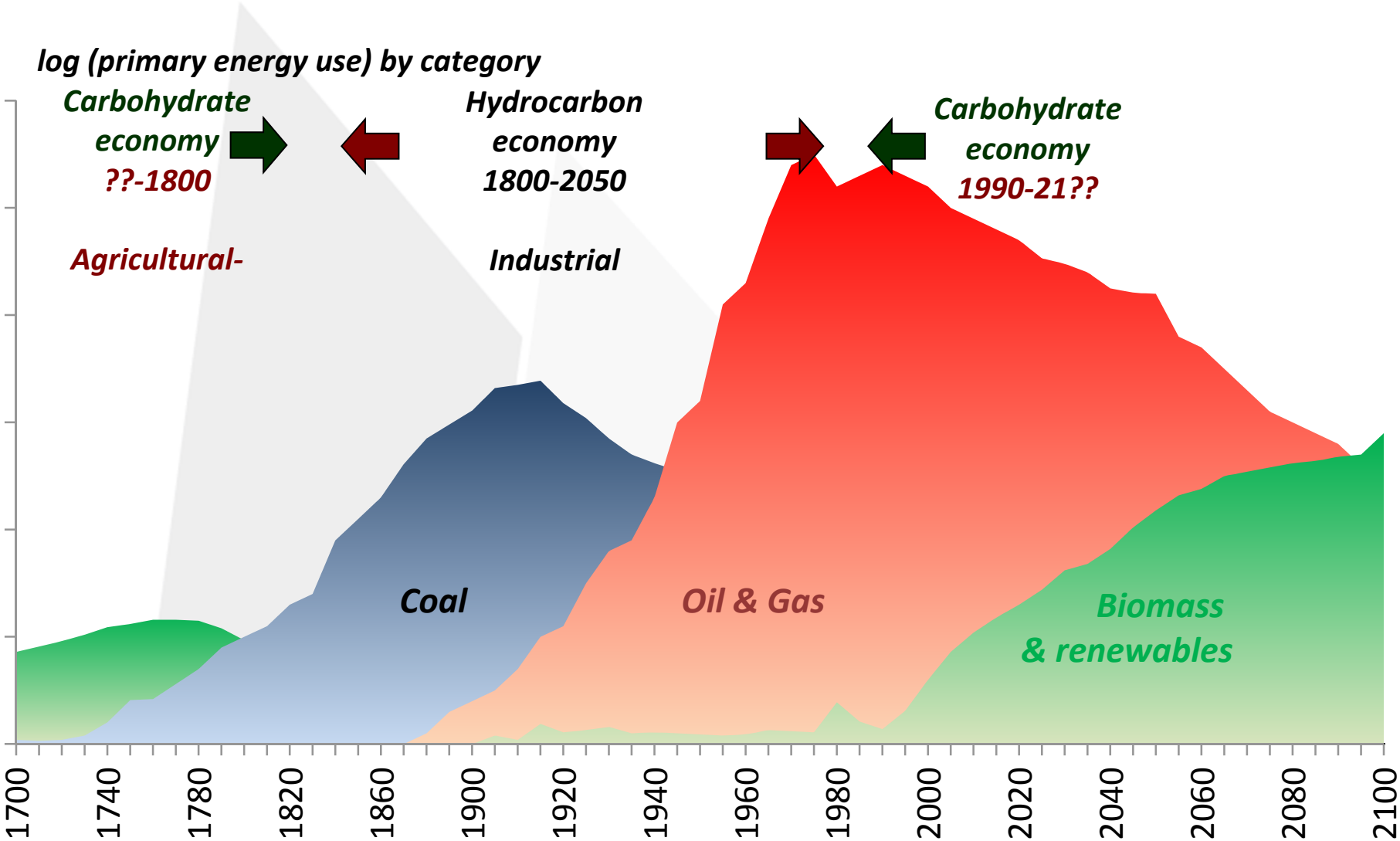
Overview

1. **Historical perspective**
2. Evolution of biorefining
3. Developing the forest-based biorefinery
4. Take-home messages

Beyond Oil



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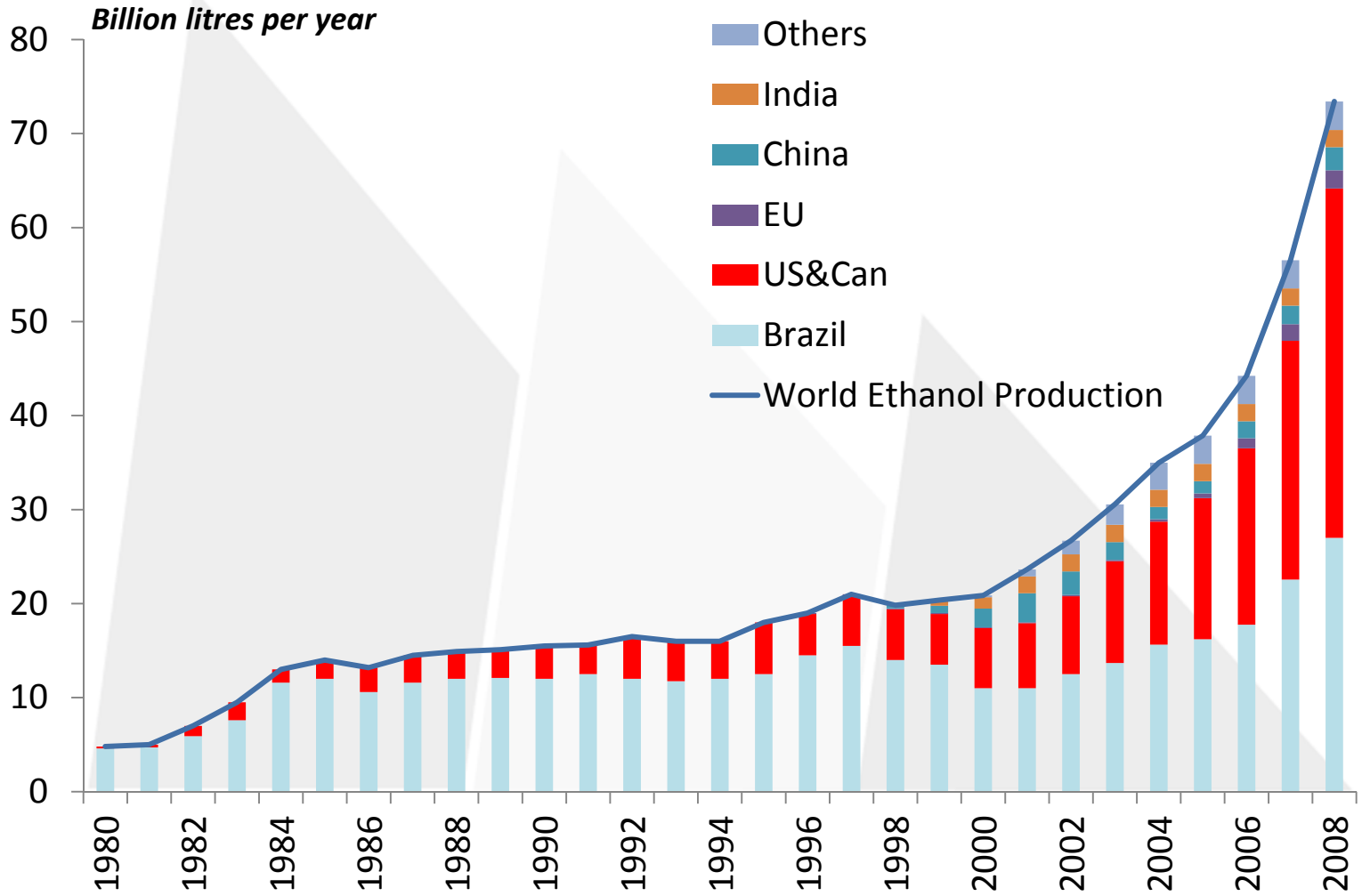
Global bioethanol production



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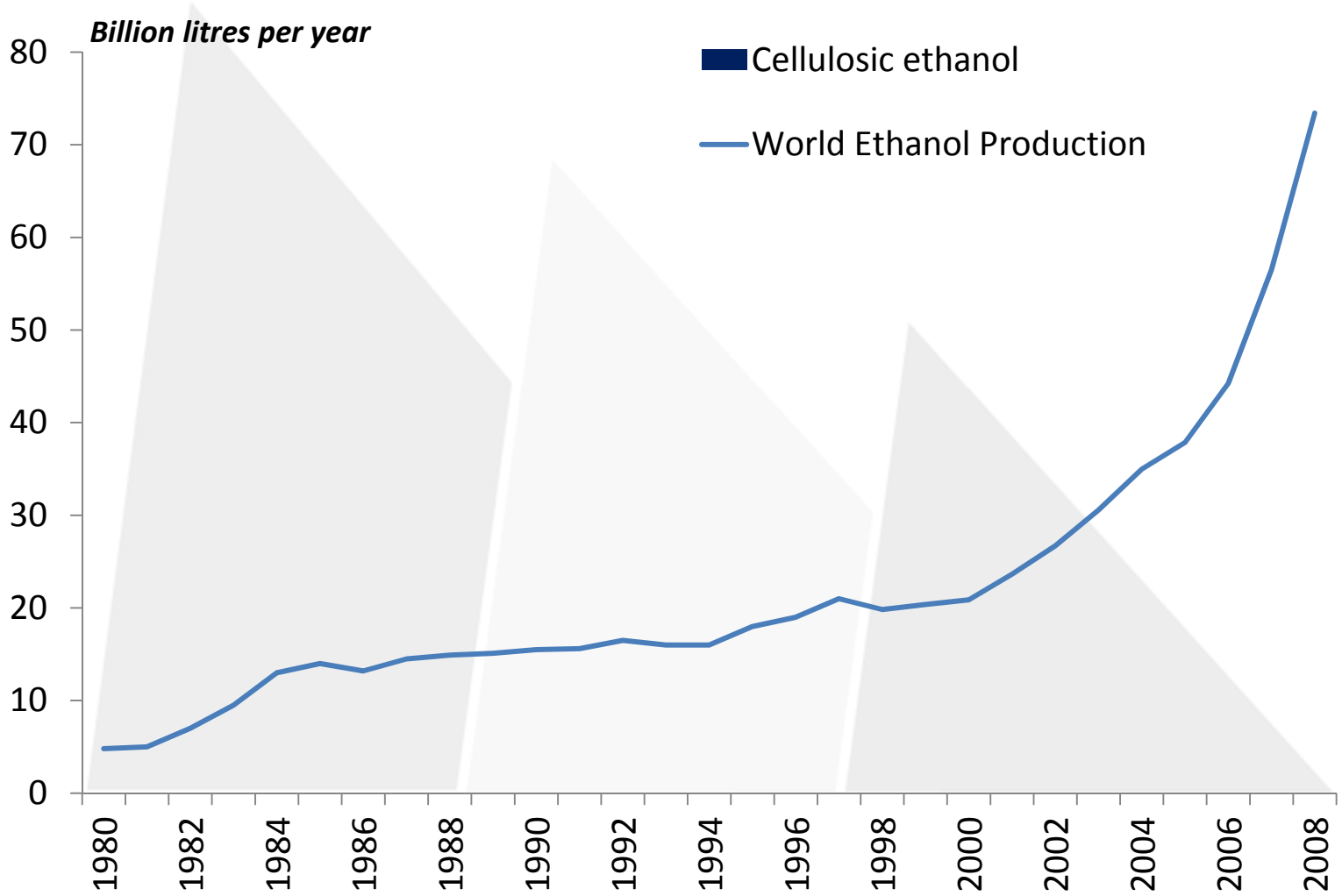
Cellulosic bioethanol production



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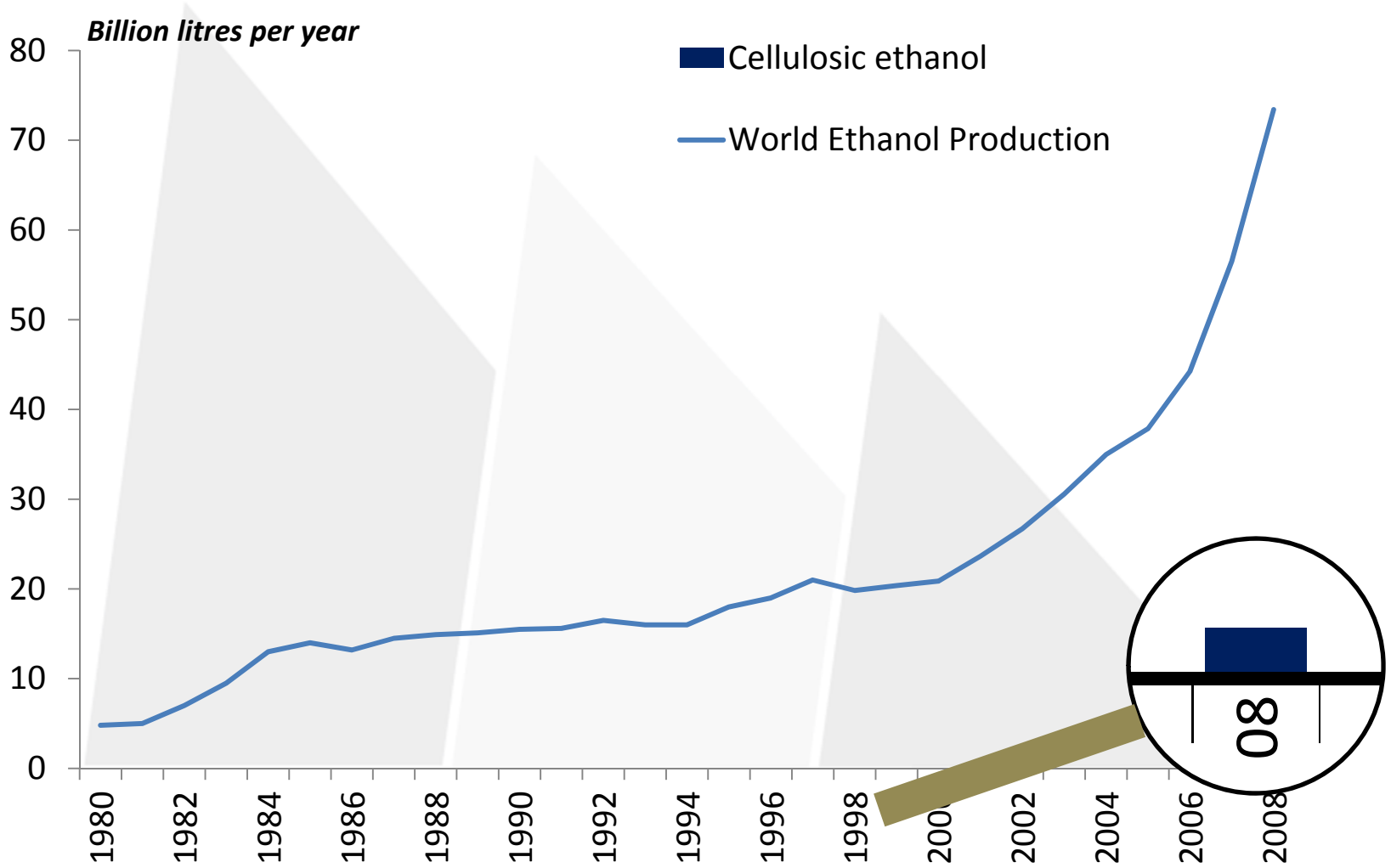

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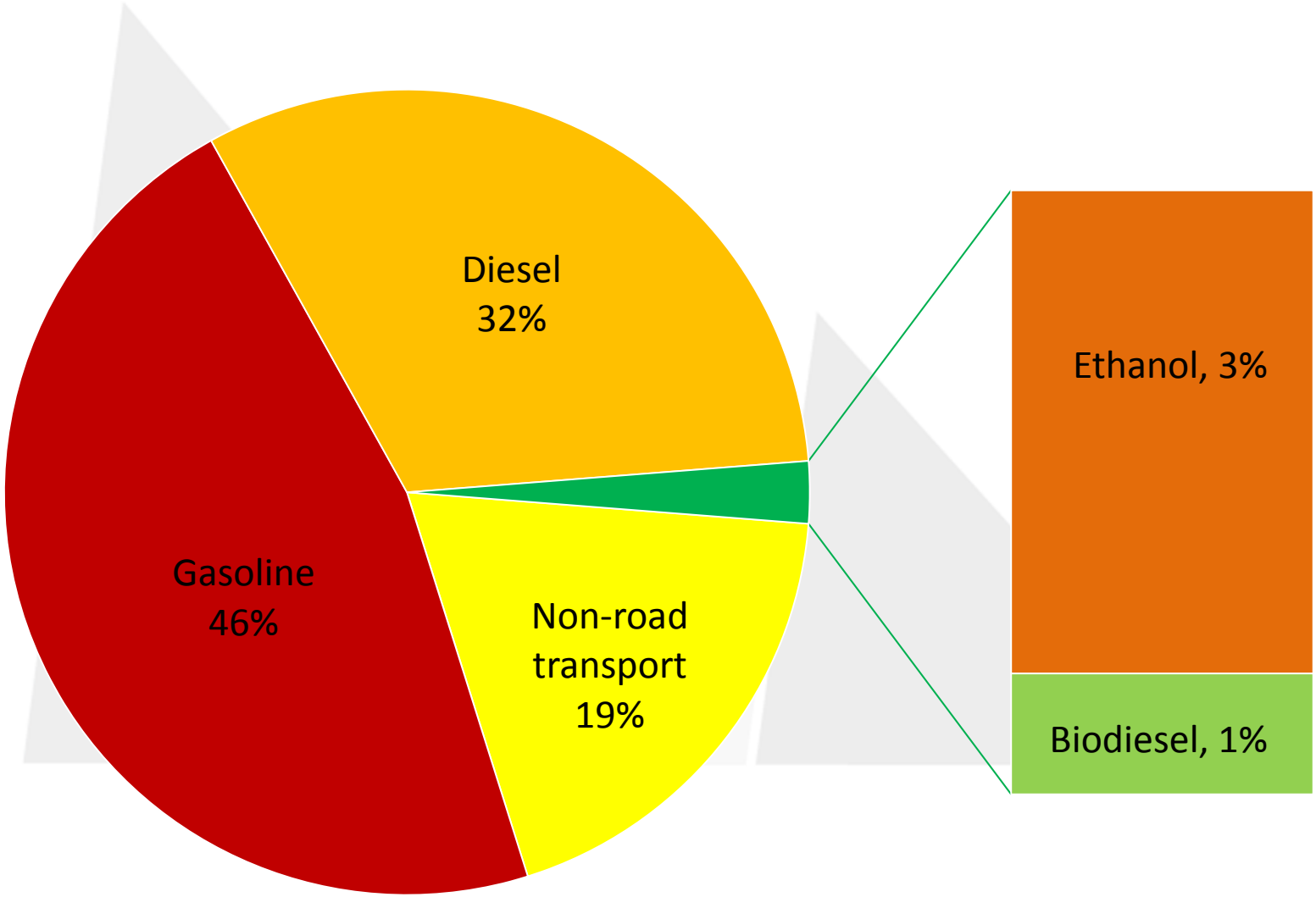
Global transport fuel shares, 2009



IEA/OECD 2008

IEA/OECD 2010

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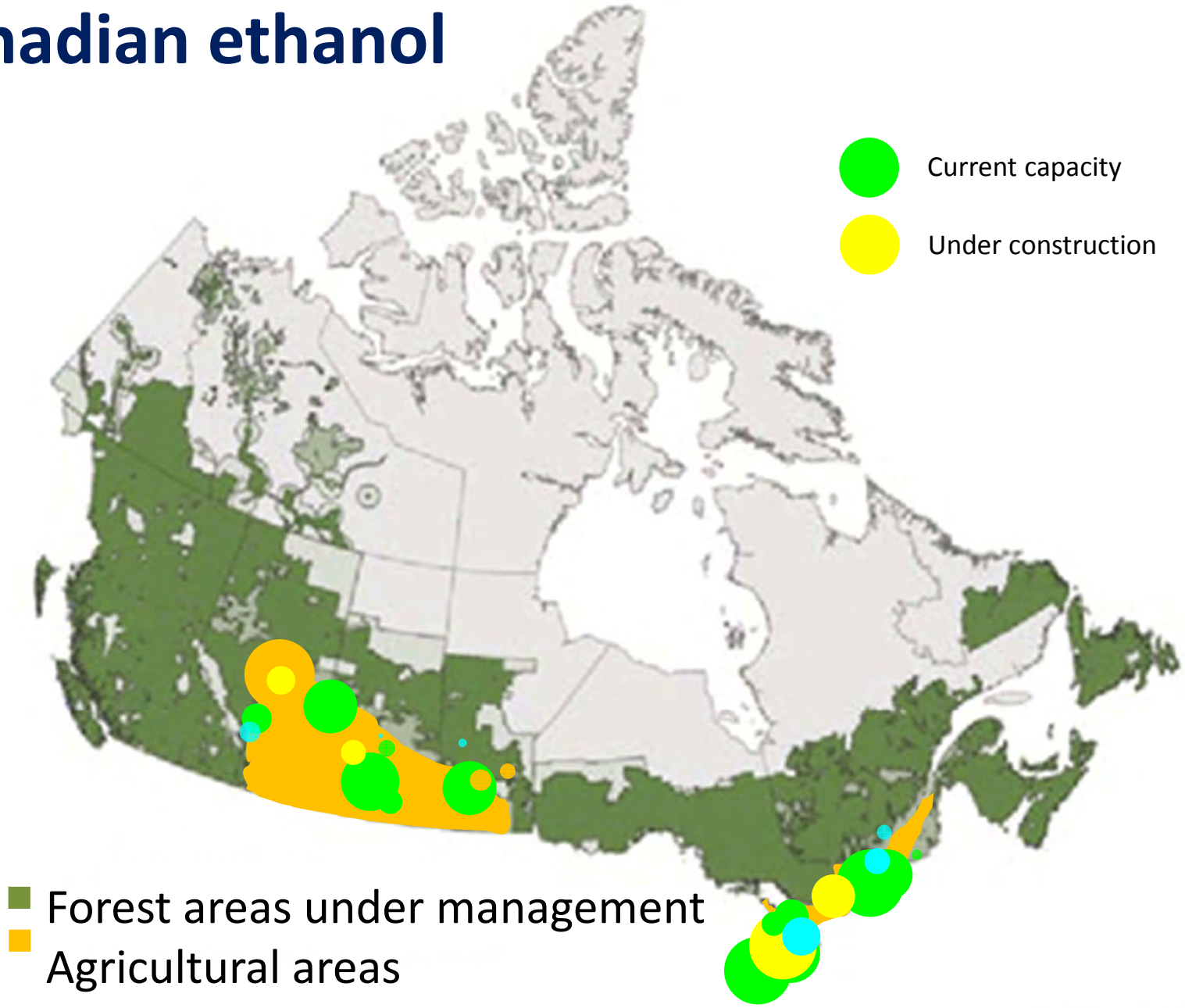
Canadian ethanol



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IEA Bioenergy Task 39 'Liquid biofuels'

Norway - Karin Oyass, Judit Sandquist

Finland - Tuula Makinen, Niklas von Weymarn

Sweden – Alice Kempe, Lisbeth Olsson

Denmark - Michael Persson, Henning Jorgensen

Germany - Axel Munack, Jürgen Krahl

The Netherlands - John Neeft

Austria - Manfred Wörgetter, Dina Bacovsky

United Kingdom - Tony Sidwell

Italy - Gerardo Montanino

Canada - Jack Saddler, Don O'Connor, Warren Mabee

United States - Jim McMillan

South Korea - JinSuk Lee, JunSuk Kim, Seonghun Park

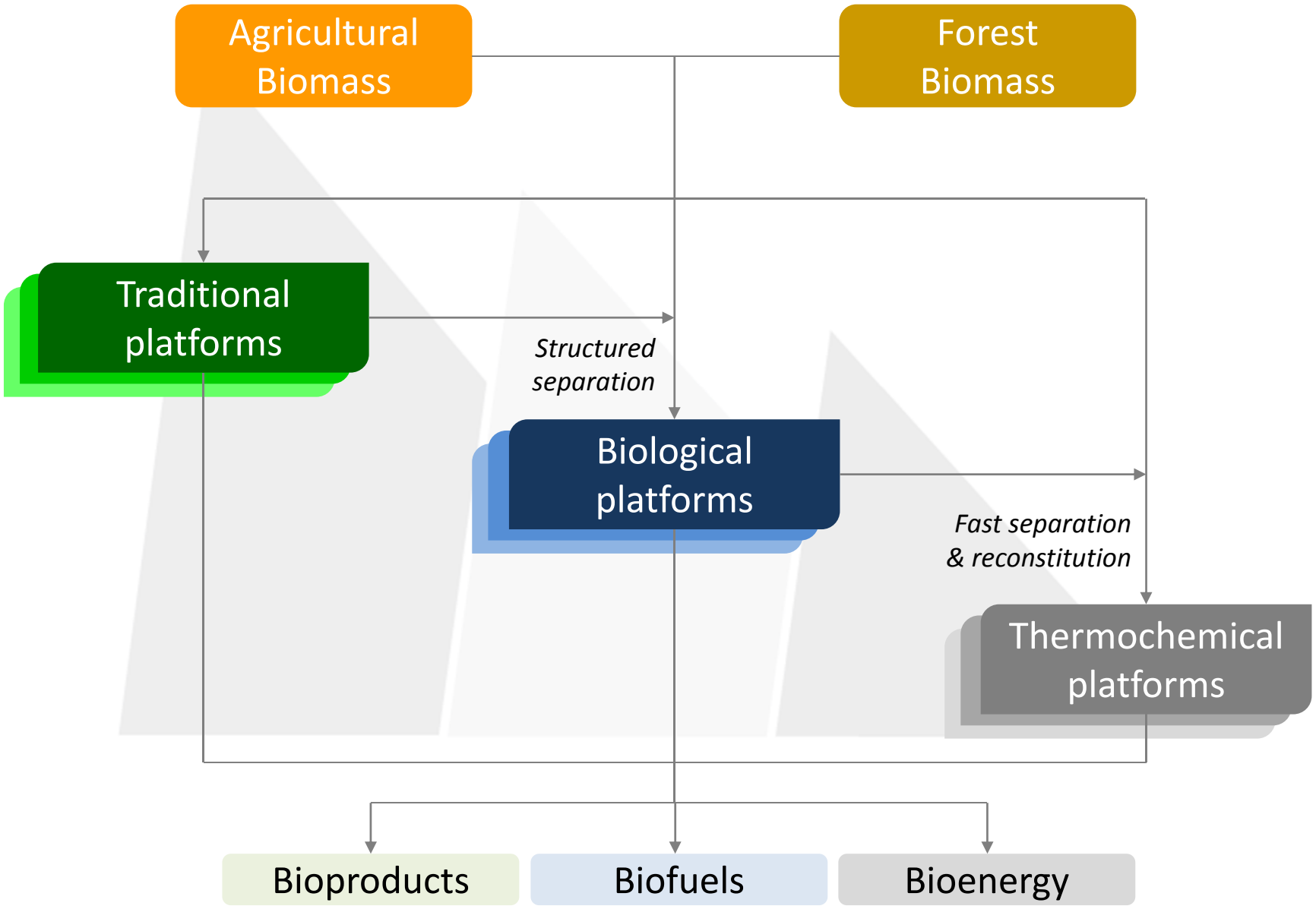
Japan - Shiro Saka, Yukinori Kude

Brazil – Viviana Coelho, Paulo Barbosa

South Africa - Emile van Zyl, Bernard Prior

New Zealand – Ian Suckling

Australia - Les Edye


Agricultural Biomass
Forest Biomass
Traditional platforms
Structured separation
Biological platforms
Fast separation & reconstitution
Thermochemical platforms
Bioproducts
Biofuels
Bioenergy

Key issues

- Technical barriers remain for cellulosic biofuel production
- Production costs are uncertain and vary with the feedstock available, (currently around US$ 0.80 – 1.00/litre of gasoline equivalent)
- There is no clear candidate for “best technology pathway” between the competing biochemical and thermo-chemical routes

Recommendations:

- Monitoring of several large-scale demonstration projects is essential
- More investment in RD&D is needed to ensure that future production of the various biomass feedstocks can be undertaken sustainably and that the preferred conversion technologies are identified and proven

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- Will we see a transition from conventional (corn) to advanced (forest-based) fuels – or will the status quo rule?

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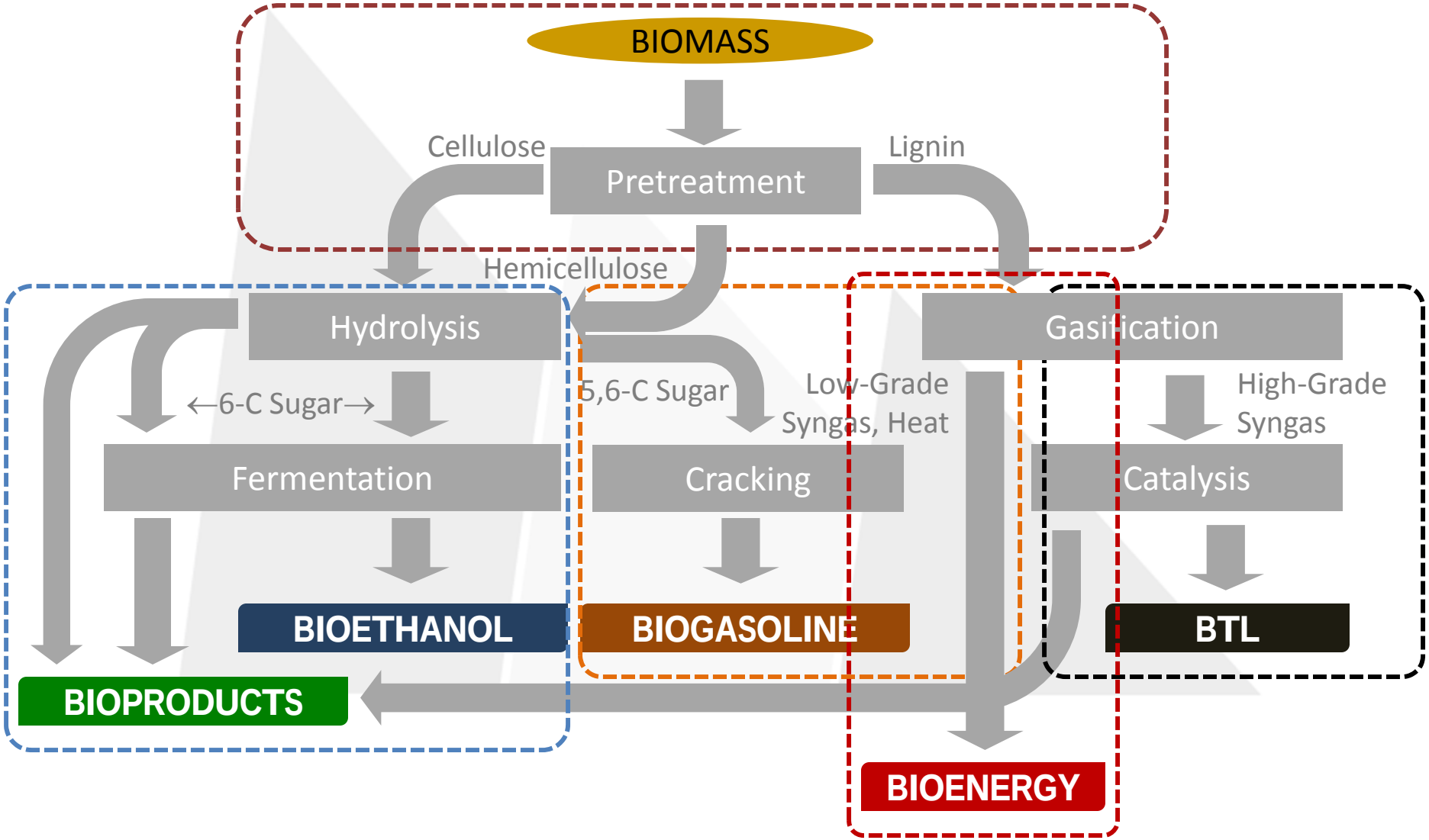
Issues for RD&D on biomass:
Quality, homogeneity
Cost
Quantity, growth rates
Sustainability, indirect land use change


BIOMASS
Cellulose
Pretreatment
Lignin
Hemicellulose
Hydrolysis
Gasification
←6-C Sugar→
5,6-C Sugar
Low-Grade
Syngas, Heat
High-Grade
Syngas
Fermentation
Cracking
Catalysis
BIOETHANOL
BIOGASOLINE
BTL
BIOPRODUCTS
BIOENERGY

Policy tools supporting biorefining - $

	Start date	End date	Type	Funding
Agri-Opportunities Program	2007	2011	Incentive	$134 M
ecoAgriculture Biofuels Capital Initiative	2007	2011	Incentive	$200 M
Accelerated capital cost allowance	1996		Incentive	
ecoEnergy for Biofuels	2007	2017	Incentive	Up to 1.5 B
ecoENERGY Technology Initiative (ecoETI) Bio-based	2007	2011	RD&D	$ 230 M
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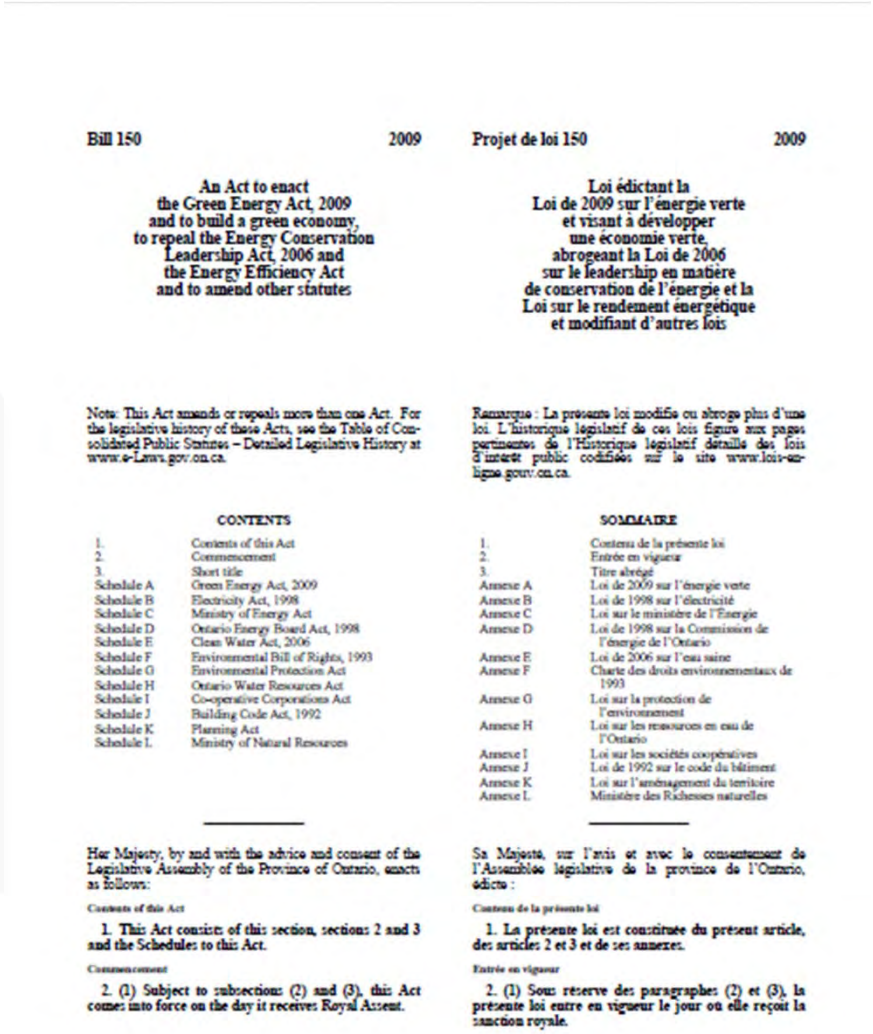
- No mandates for anything but **fuels** (RFS 2 coming)
- Some funding for **bioproducts**…but no targeted development trajectory
- Absolutely **no funding** or long-term support for energy crops

Role of the provinces

- Create their own mandates for renewable fuels…
- …but also have a focus on electricity generation
- Competition will emerge between the need for heat and power, and the need for liquid fuels



Bill 150 2009

An Act to enact the Green Energy Act, 2009 and to build a green economy, to repeal the Energy Conservation Leadership Act, 2006 and the Energy Efficiency Act and to amend other statutes

Note: This Act amends or repeals more than one Act. For the legislative history of these Acts, see the Table of Consolidated Public Statutes – Detailed Legislative History at www.e-Laws.gov.on.ca.

CONTENTS

1.	Contents of this Act
2.	Commencement
3.	Short title
Schedule A	Green Energy Act, 2009
Schedule B	Electricity Act, 1998
Schedule C	Ministry of Energy Act
Schedule D	Ontario Energy Board Act, 1998
Schedule E	Clean Water Act, 2006
Schedule F	Environmental Bill of Rights, 1993
Schedule G	Environmental Protection Act
Schedule H	Ontario Water Resources Act
Schedule I	Co-operative Corporations Act
Schedule J	Building Code Act, 1992
Schedule K	Planning Act
Schedule L	Ministry of Natural Resources

Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

Contents of this Act

1. This Act consists of this section, sections 2 and 3 and the Schedules to this Act.

Commencement

2. (1) Subject to subsections (2) and (3), this Act comes into force on the day it receives Royal Assent.

Projet de loi 150 2009

Loi édictant la Loi de 2009 sur l'énergie verte et visant à développer une économie verte, abrogeant la Loi de 2006 sur le leadership en matière de conservation de l'énergie et la Loi sur le rendement énergétique et modifiant d'autres lois

Remarque : La présente loi modifie ou abroge plus d'une loi. L'historique législatif de ces lois figure aux pages pertinentes de l'Historique législatif détaillé des lois d'intérêt public codifiées sur le site www.lois-en-ligne.gouv.on.ca.

SOMMAIRE

1.	Contenu de la présente loi
2.	Entrée en vigueur
3.	Titre abrégé
Annexe A	Loi de 2009 sur l'énergie verte
Annexe B	Loi de 1998 sur l'électricité
Annexe C	Loi sur le ministère de l'Énergie
Annexe D	Loi de 1998 sur la Commission de l'énergie de l'Ontario
Annexe E	Loi de 2006 sur l'eau saine
Annexe F	Charte des droits environnementaux de 1993
Annexe G	Loi sur la protection de l'environnement
Annexe H	Loi sur les ressources en eau de l'Ontario
Annexe I	Loi sur les sociétés coopératives
Annexe J	Loi de 1992 sur le code du bâtiment
Annexe K	Loi sur l'aménagement du territoire
Annexe L	Ministère des Richesses naturelles

Sa Majesté, sur l'avis et avec le consentement de l'Assemblée législative de la province de l'Ontario, édicte :

Contenu de la présente loi

1. La présente loi est constituée du présent article, des articles 2 et 3 et de ses annexes.

Entrée en vigueur

2. (1) Sous réserve des paragraphes (2) et (3), la présente loi entre en vigueur le jour où elle reçoit la sanction royale.

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Renewable energy portfolio

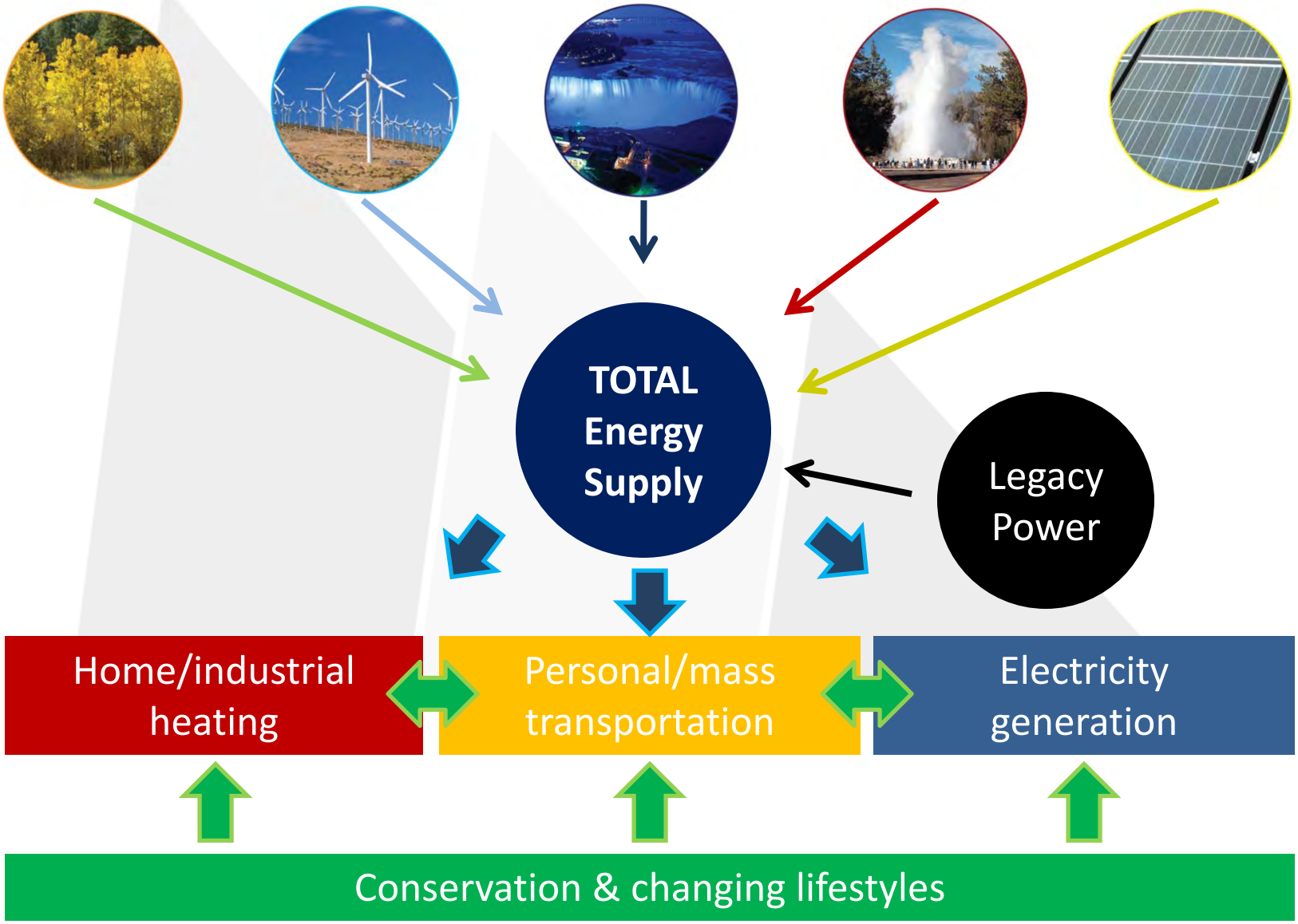




- Only so much feedstock - must balance fuel with heat and power needs
- How do we determine what mix is appropriate?
- Trade-offs
  - Jobs, $, carbon, GJ/MW
- Sector demands will change

Home/industrial heating	Personal/mass transportation	Electricity generation

Transformative technologies



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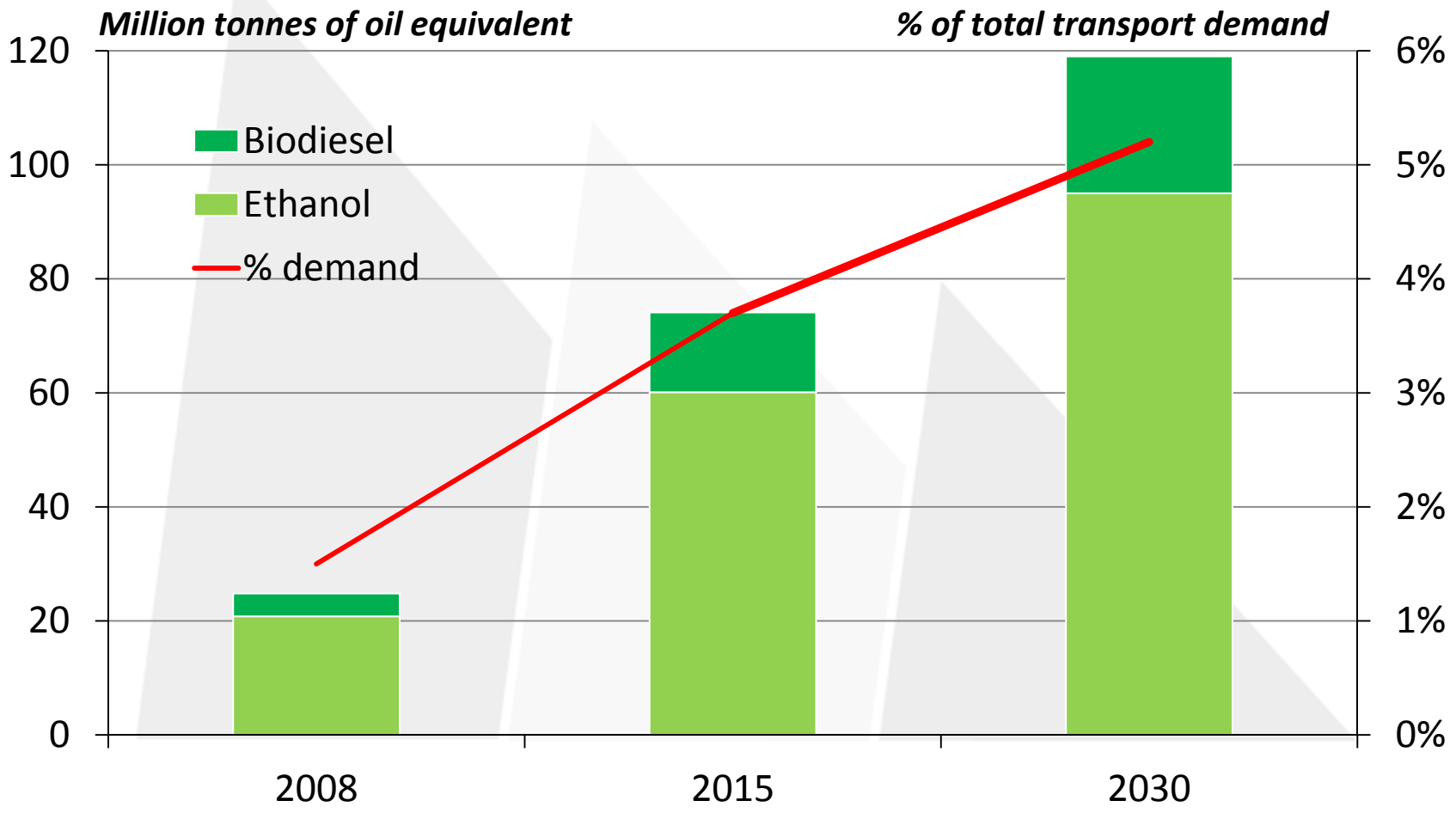
World biofuels consumption to 2030?



Biofuels projected to climb from about 0.6 Mb/day in 2006 to 3.2 Mb/day in 2030 – 5% of total road-transport fuel demand

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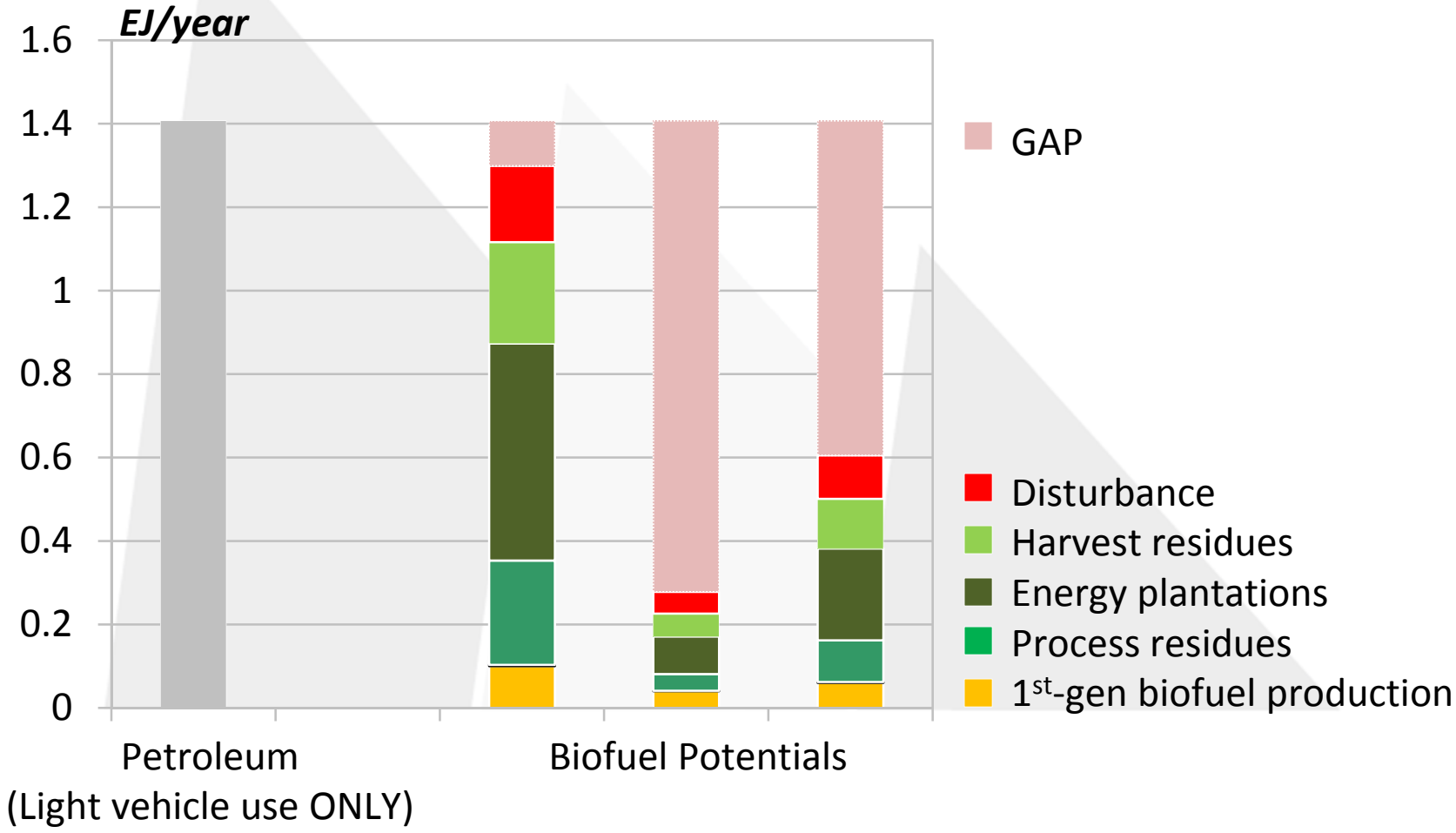
Canadian biofuel potentials



Summary

- Canada has huge potential to grow renewable fuel production with forest-based biorefining

- We need to set priorities in policy: jobs, GHG's, or $?

- We need real mandates, not targets, which create certainty for the industry to develop in the areas of:
  - Feedstock supply (no support for energy crops or biomass removals yet)
  - Technology development (need to build and operate plants)
  - Bioproducts markets

- Biofuels are probably not the right choice if we are looking to reduce GHG concentrations (vs. holding the line on increasing atmospheric CO_2) ; however, short-term biofuel plants can become long-term biorefineries

Acknowledgments

- Members of the NSERC Bioconversion Network
- Members of IEA Bioenergy Task 39

- Collaborators/Students/PDFs from Queen's, Toronto, and UBC (Particularly Jamie Stephen, UBC, for scaling analysis)

- Funding & research support from
  - NSERC
  - Natural Resources Canada
  - FPInnovations

- Thanks to all participants in this meeting

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