What is the right pathway to be sustainable? Case of biofuels and bioproducts in Europe

CHEMICAL ENGINEERING

Processes and Sustainable Development

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15/5/2013 - Glasgow

Université de Liège

LGC CHEMICAL ENGINEERING

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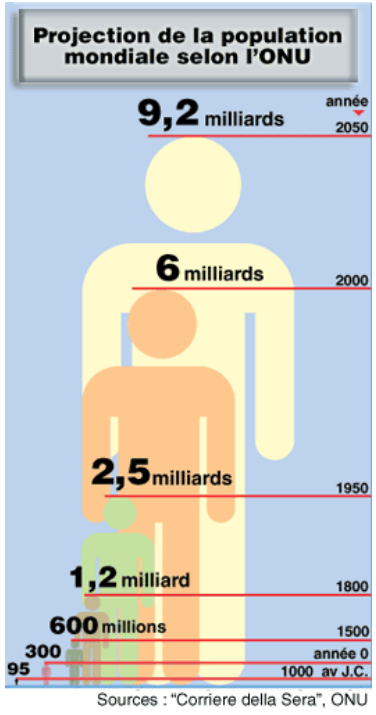
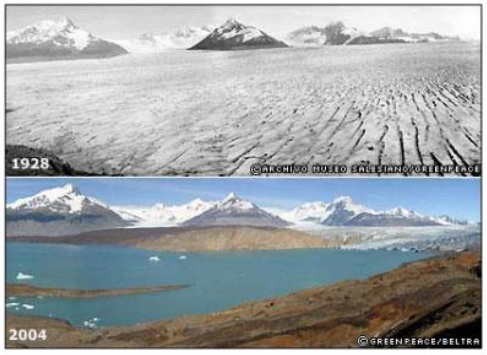
1. Introduction

1.1. Worldwide energy context

What are the next challenges?



Population increase



Climate change

Natural ressources depletion

1. Introduction

1.1. Worldwide energy context

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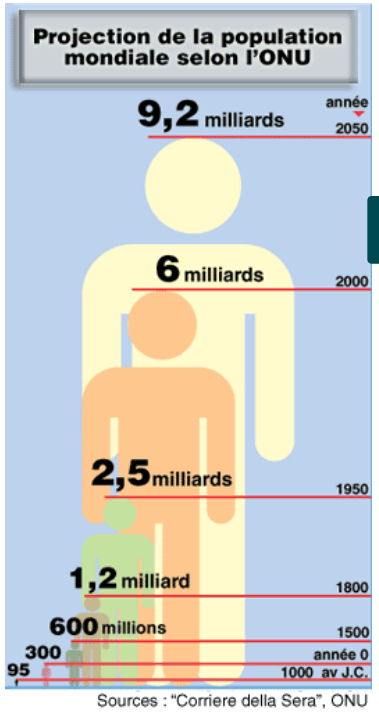

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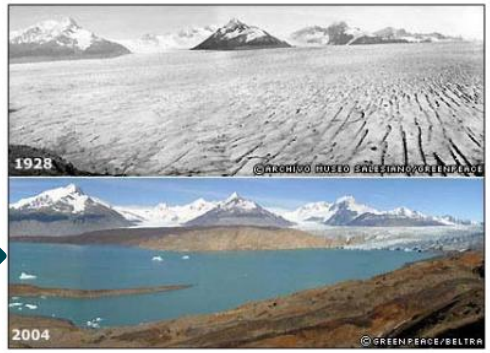

Climate change

Natural ressources depletion

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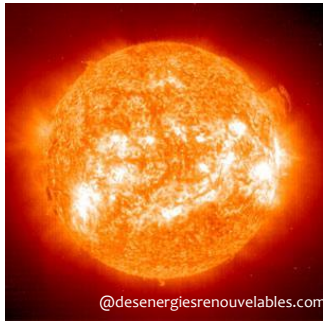
1.1. Worldwide energy context

What are the possible solutions?

For electricity production:



For transportation sector:

SUGAR CHAIN =
BIOETHANOL

OIL CHAIN =
BIODIESEL

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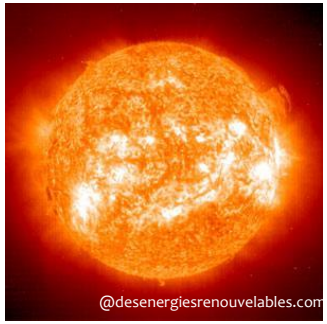
1.1. Worldwide energy context

What are the possible solutions?

For electricity production:



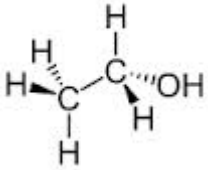
For transportation sector:

SUGAR CHAIN = BIOETHANOL

OIL CHAIN = BIODIESEL

1. Introduction

1.2. Bioethanol



What crops are used?

In America

North and Central America

Brazil

Canada

In Europe

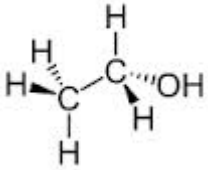
25%

23%

18%

1. Introduction

1.2. Bioethanol



What crops are used?

In America

North and Central America

Brazil

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In Europe

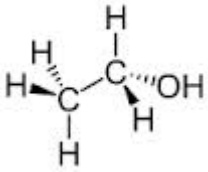
SUGAR BEET

WHEAT

18%

1. Introduction

1.3 Bioethanol uses



What are the available bioethanol uses?

Most common use:

- Biofuels

Other possibility:

- Feedstock for chemical industry
  - Production of bioplastics

$$C_2H_5OH \rightleftharpoons C_2H_4 + H_2O$$

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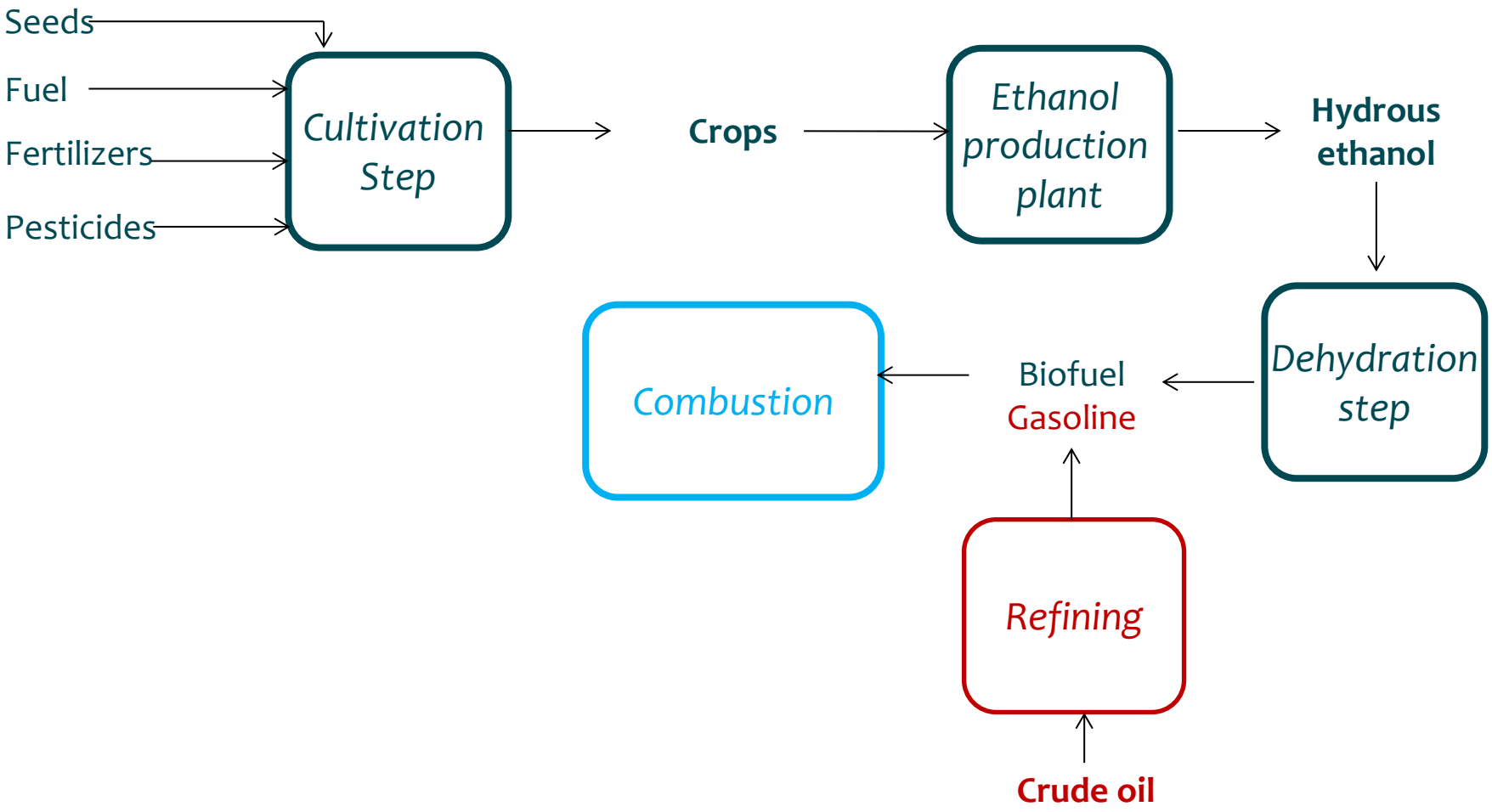
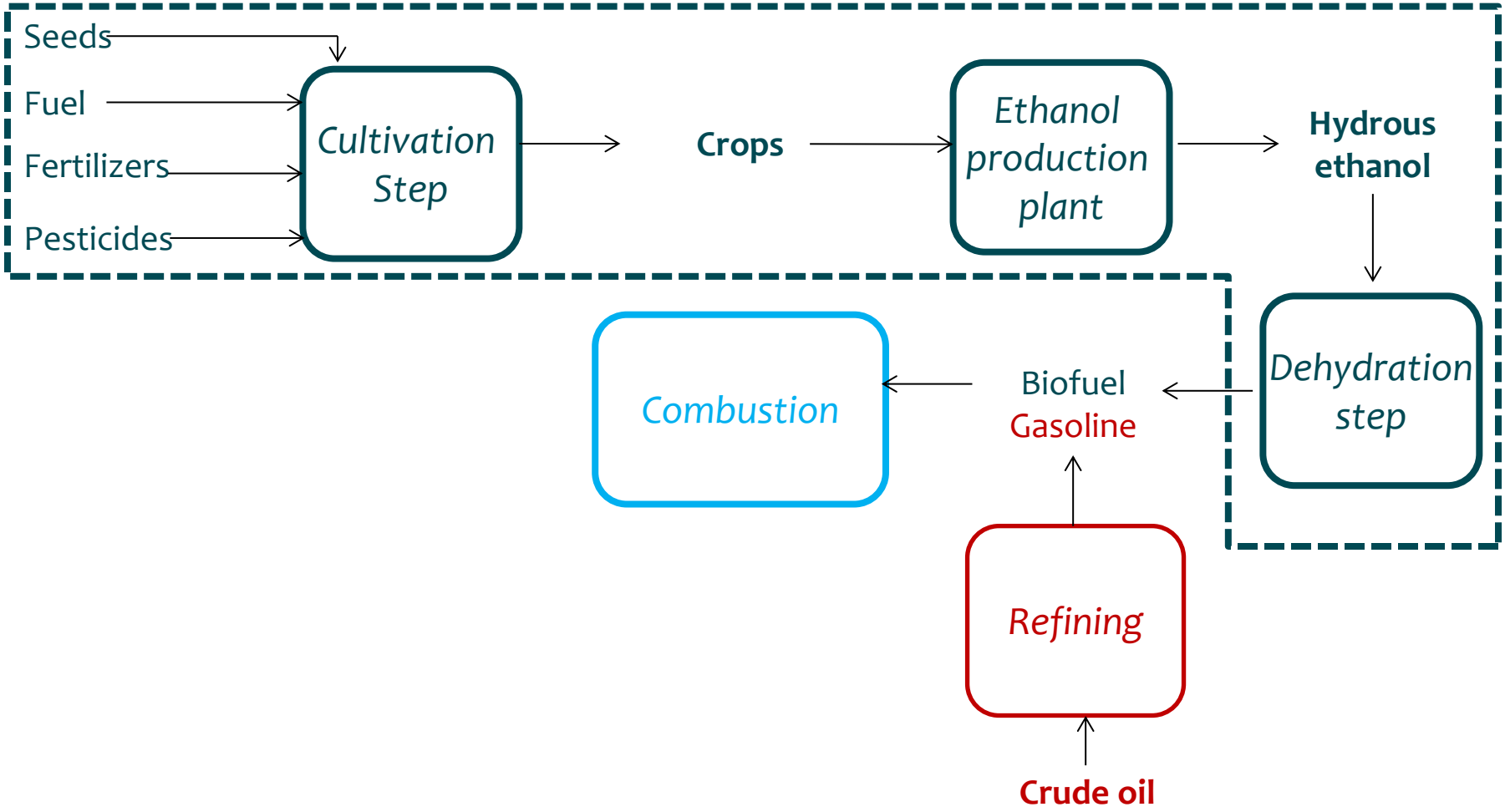
2. Production of biofuel

Systems boundaries



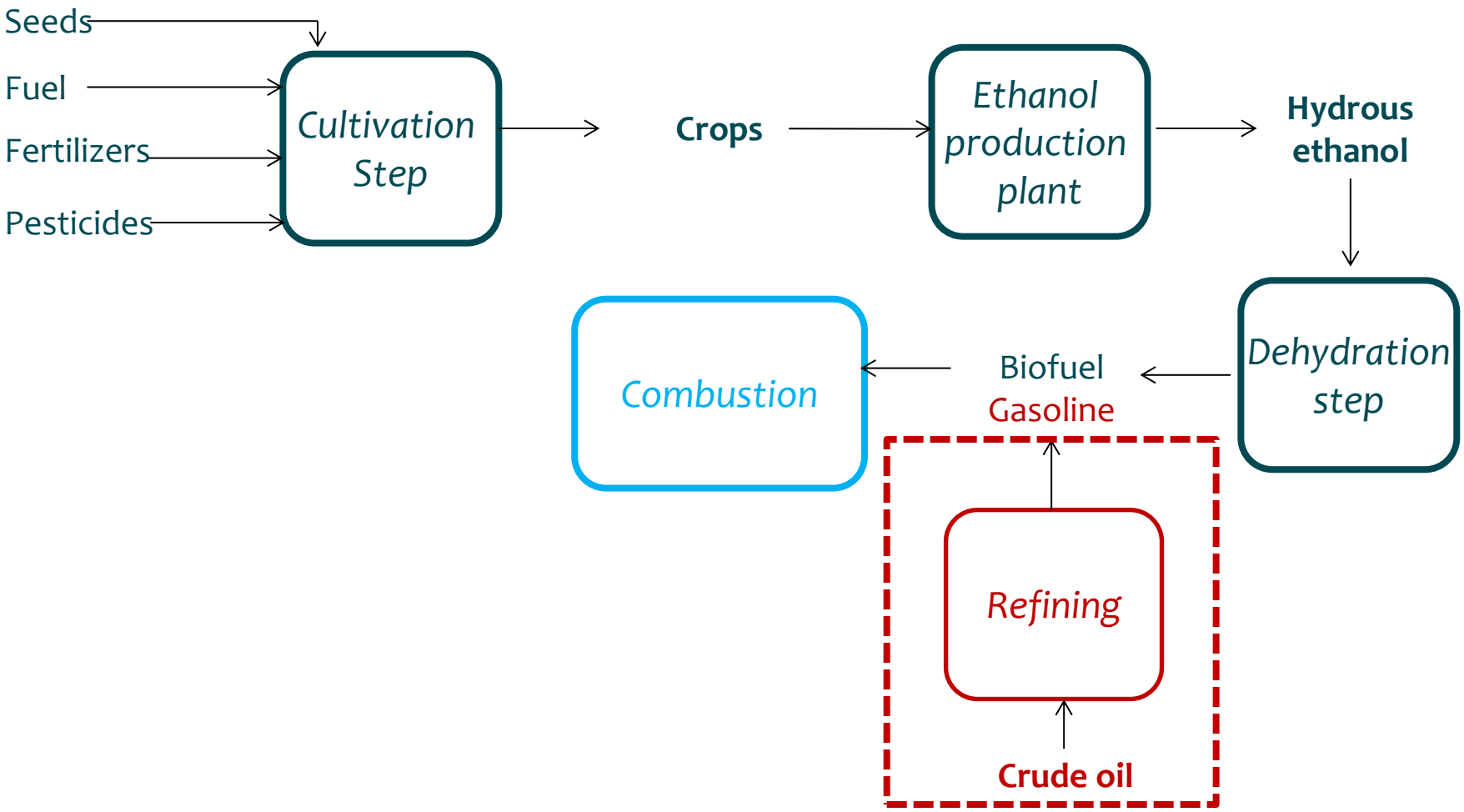
2. Production of biofuel

From biomass to biofuel



2. Production of biofuel

From oil to gasoline



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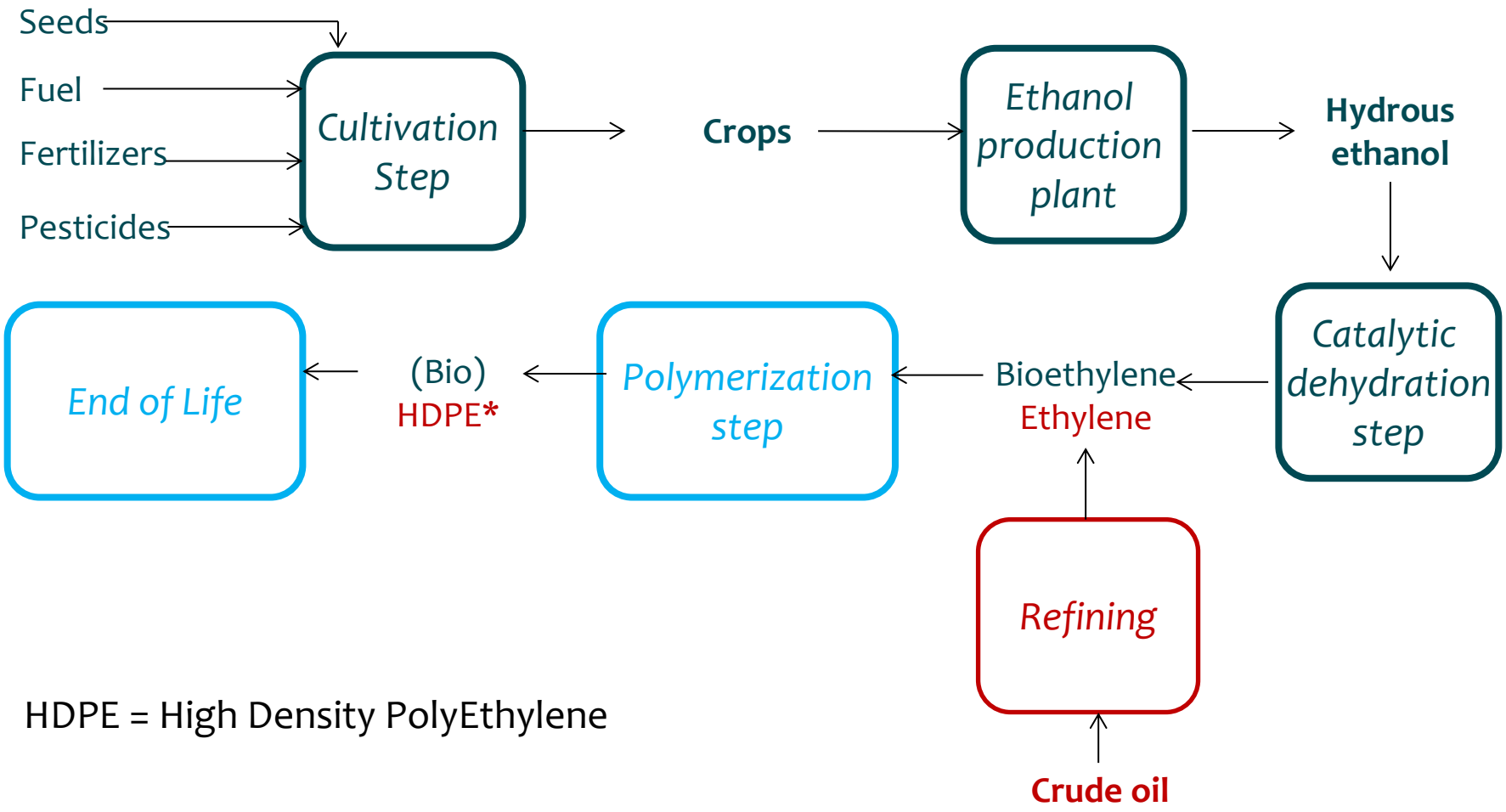
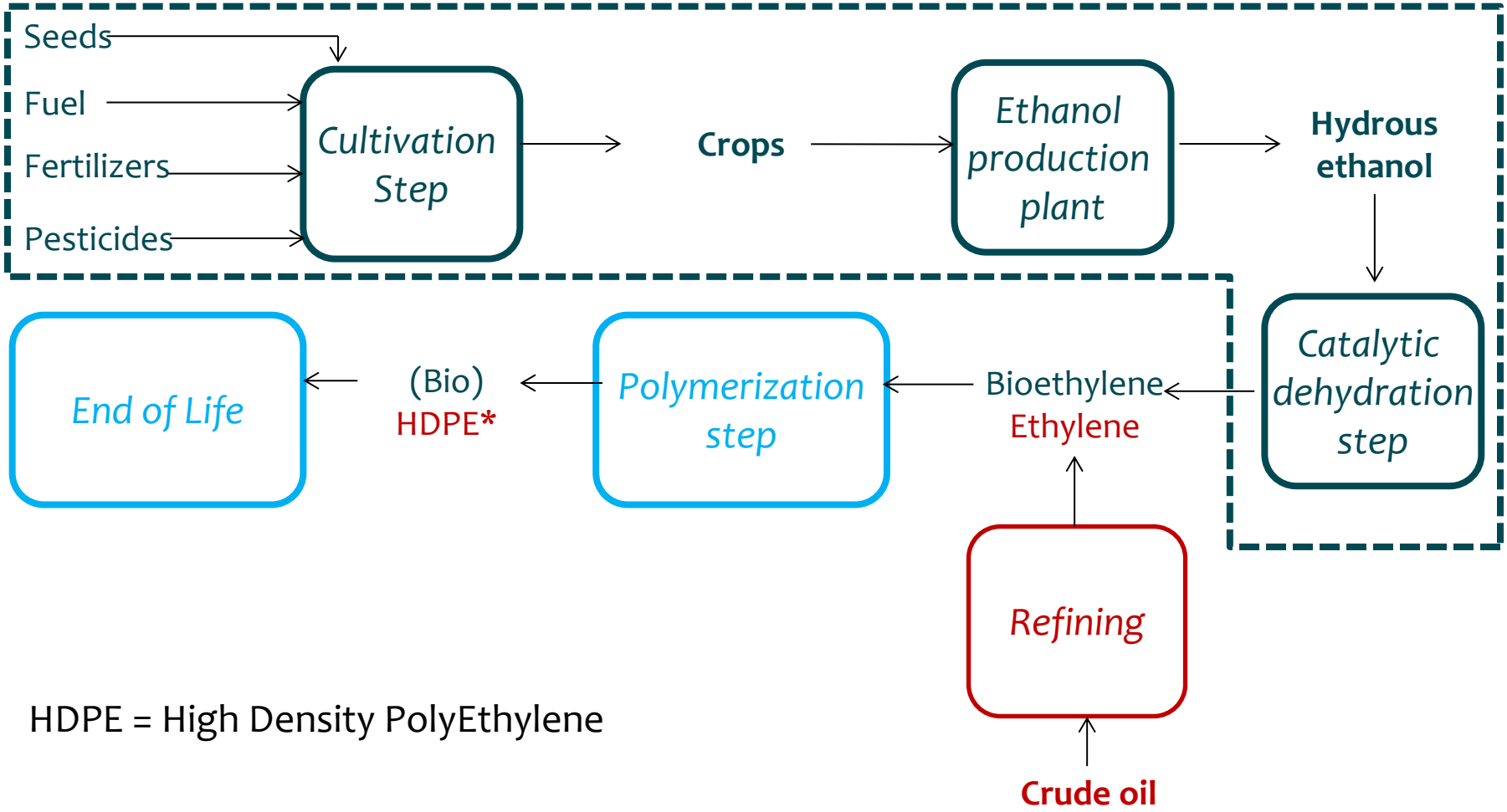


HDPE = High Density PolyEthylene

3. Production of HDPE

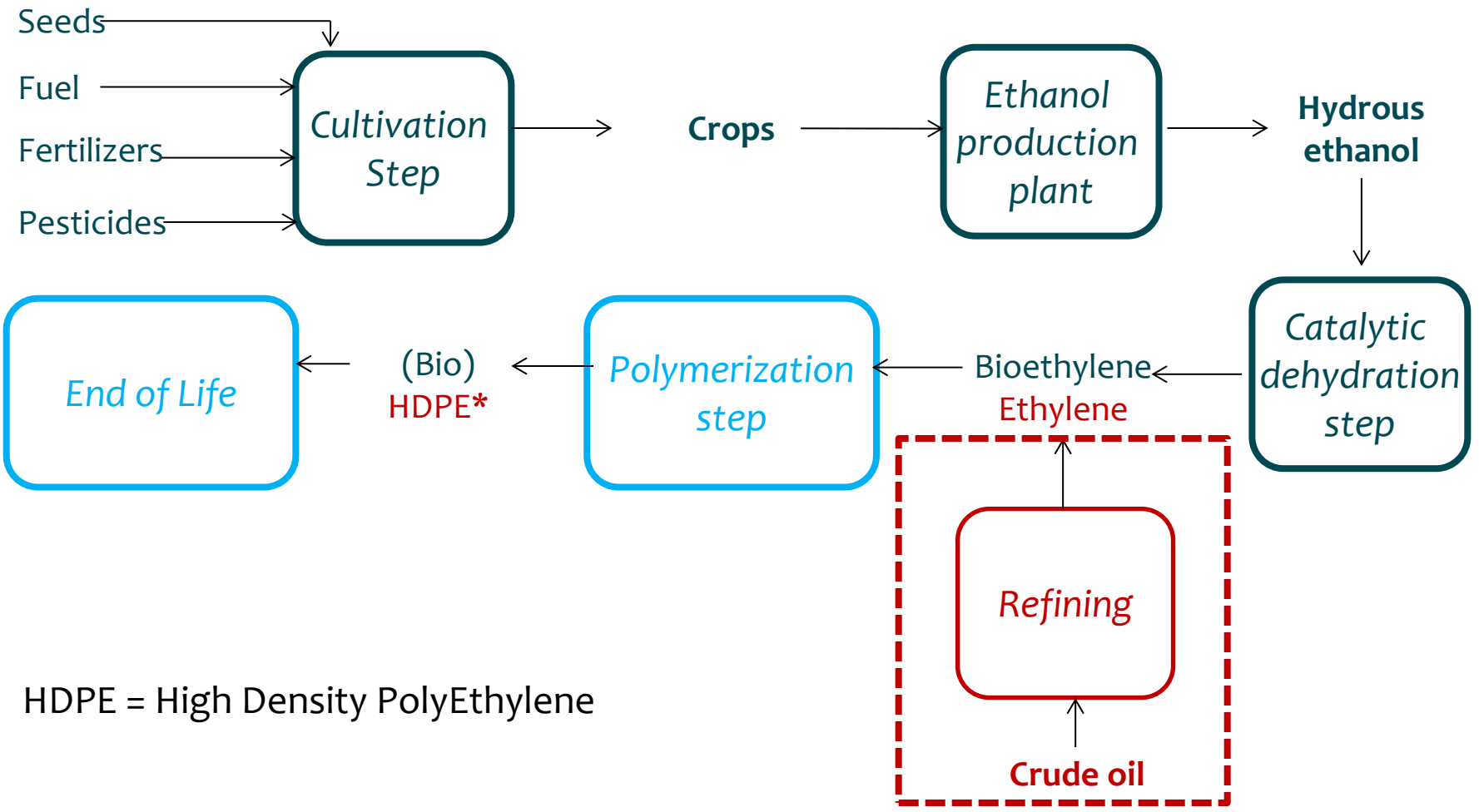
From biomass to ethylene



HDPE = High Density PolyEthylene

3. Production of HDPE

From oil to ethylene



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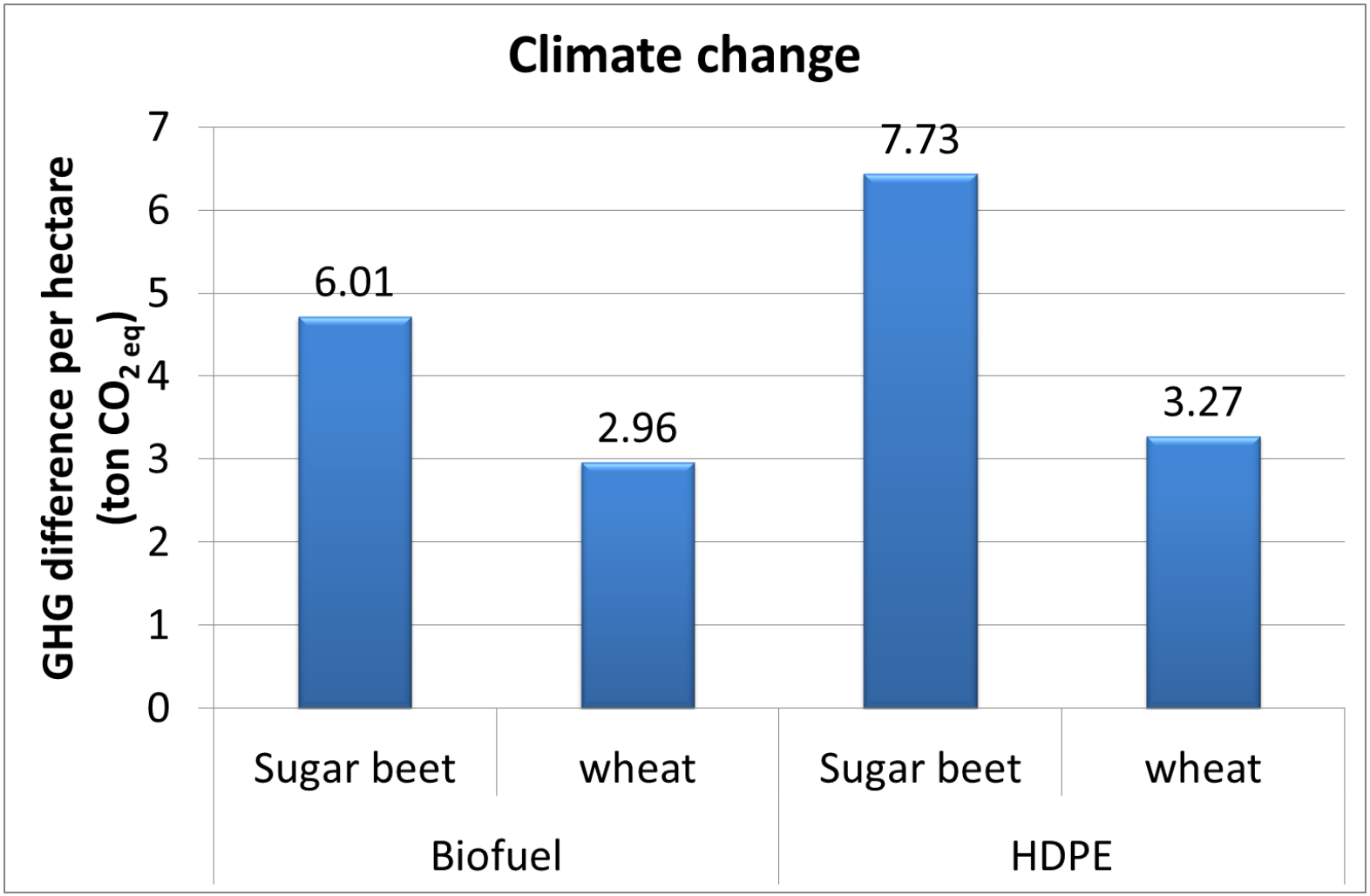
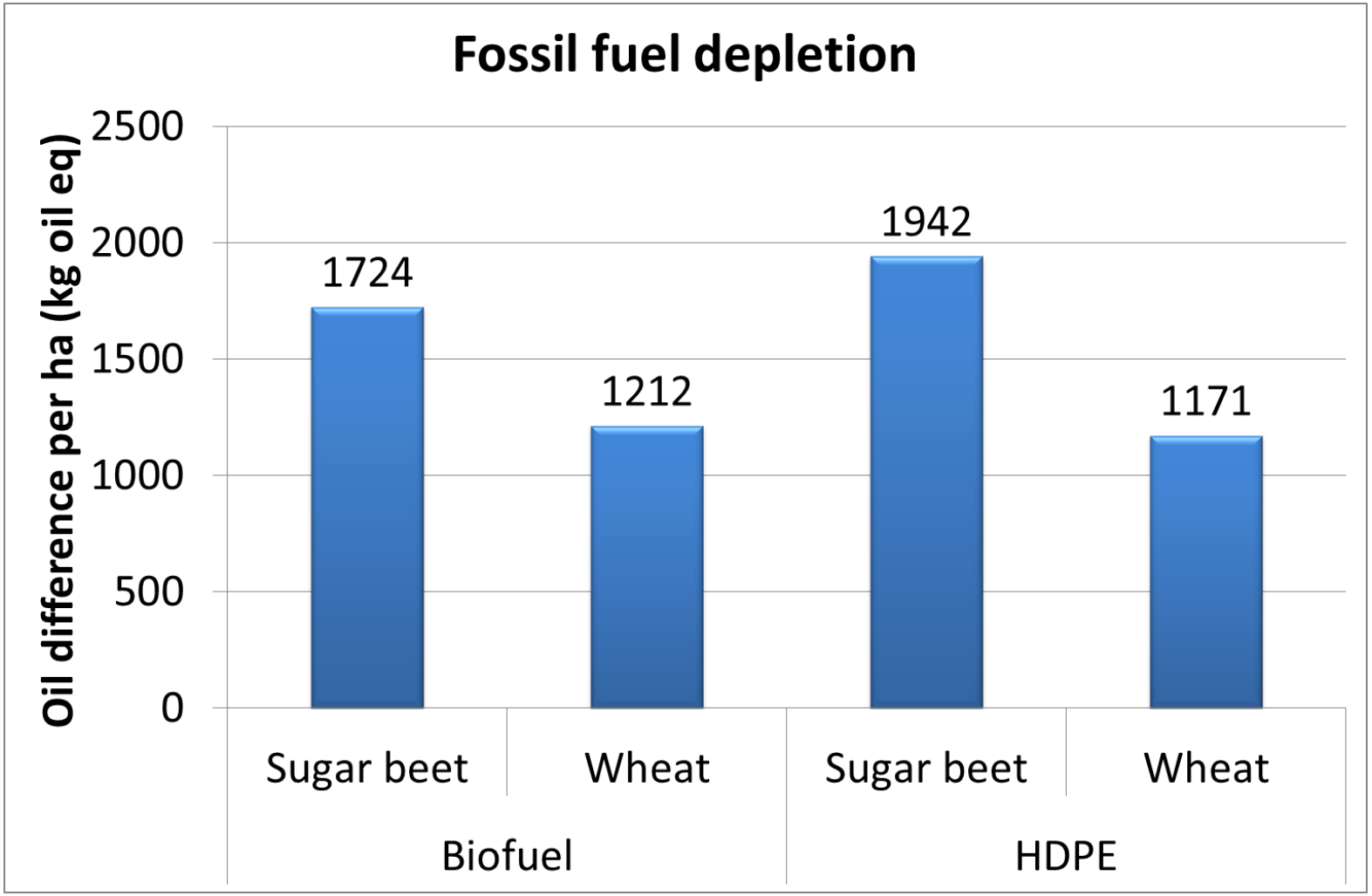
4. Results

4.1. Climate change



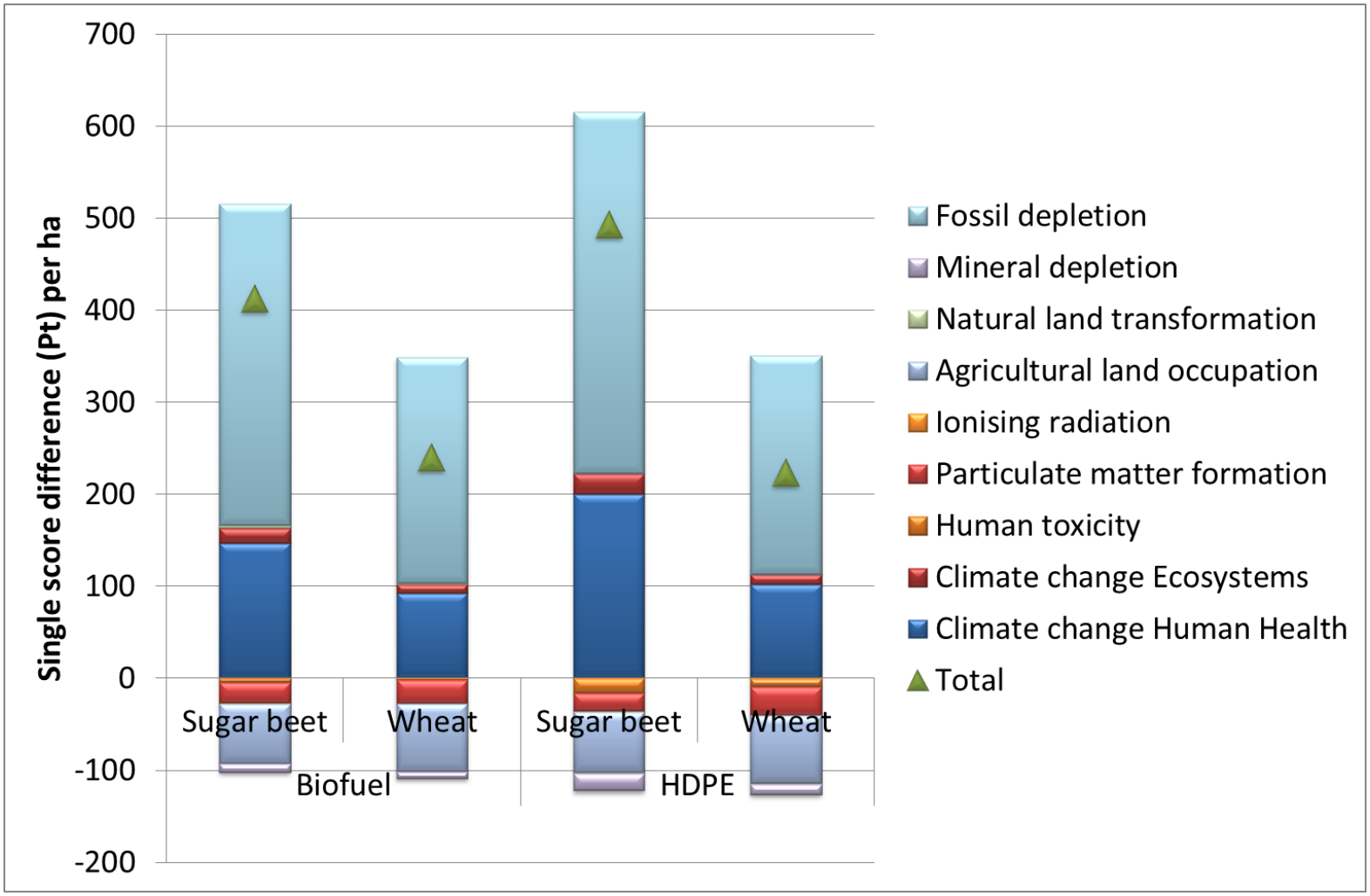
4. Results

4.2. Fossil fuel depletion



4. Results

4.3. Single score



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5.1. Conclusions

- Importance of yield:
  - Sugar beet allows more bioethanol per hectare than wheat
  - Belgian yields are very high in Europe

- When comparing biofuel and bioplastic:
  - Best score is obtained by sugar beet
  - Bioplastic allows more GHG and fossil fuel consumption reduction

5. Conclusions

5.2. Perspectives

- Complete LCA with all other environmental impact:
  - Human toxicity
  - Water depletion
  - Etc.

- Inclusion of consequential approach:
  - Effects on crops, plastics and biofuels markets

- Definition of a hierarchy for the land occupation:
  - Food
  - Feed
  - Material
  - Fuel

Thank you for your attention!

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