

# Update on the Task 39 activities, discussion of the progress on the projects in the current triennium (2019-2021)

Jim McMillan and Jack Saddler

**Virtual Business Meeting**  
4PM CET, 2 April 2020

**Thursday, 4.00-6.15PM CET, 2 April 2020**

|            |                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 minutes  | <b>Update on the Task 39 activities, discussion of the progress on the projects in the current triennium (2019-2021) (Jim McMillan and Jack Saddler)</b> <ul style="list-style-type: none"><li>- Very brief summary of triennium projects, deliverables, leads and possible budget</li><li>- Update on Task interaction with other IEA Bioenergy Tasks and other organisations/industries</li></ul> |
| 10 minutes | <b>Update on the implementation Agendas report (compare-and-contrast of biofuels policies). Refining the questionnaire to make the next report more cohesive (Mahmood Ebadian)</b>                                                                                                                                                                                                                  |
| 10 minutes | <b>Update of the drop-in biofuels report (Jianping Su, Jack Saddler and Susan van Dyk)</b>                                                                                                                                                                                                                                                                                                          |
| 10 minutes | <b>Update of biojet fuel/SAF, decarbonization of the aviation sector (Susan van Dyk, Jianping Su and Jack Saddler)</b>                                                                                                                                                                                                                                                                              |
| 10 minutes | <b>a)“Potential for Decarbonisation of Transport” Inter-Task Project and, b) update on Biofuels Demonstration Plants website (Dina Bacovsky)</b>                                                                                                                                                                                                                                                    |
| 10 minutes | <b>Success stories and lessons learned from conventional/advanced biofuels deployment (Franziska Müller-Langer and Tomas Ekbom)</b>                                                                                                                                                                                                                                                                 |
| 10 minutes | <b>Review existing/proposed certifications used for oleochemical- and lignocellulosic-based biofuels supply chains; identify certification scheme improvement opportunities (Paul Sinnige, with input from Mahmood Ebadian and others)</b>                                                                                                                                                          |
| 10 minutes | <b>Update on biofuels in marine shipping report/Issues affecting utilisation of advanced biofuels in the marine sector (Henning Jorgenson, Sune Tjalfe Thomsen and Steve Rogers)</b>                                                                                                                                                                                                                |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10 minutes | Feedstock-to-biofuel(s) supply chain analysis. Focus on CAPEX and OPEX cost reduction opportunities (possibly with Tasks 40 and 43/Feedstocks) (Stephen Dooley and Mahmood Ebadian)                                                                                                                                                                                                                                                                                                                             |
| 10 minutes | Techno-economic analysis (TEAs) of advanced biofuels (including feedstock/technology pathways), particularly for drop-in biofuels (Duncan Akporiaye with input from Franziska Müller-Langer, Tomas Ekbom, and Jin-Suk Lee)                                                                                                                                                                                                                                                                                      |
| 10 minutes | Assess biofuels production and use status in non-IEA countries/emerging economies (Glaucia Mendes Souza)                                                                                                                                                                                                                                                                                                                                                                                                        |
| 15 minutes | Sustainability assessment of biofuels pathway to identify key metrics beyond GHG reduction, spanning both feedstocks and conversion technologies (D. O'Connor and Adrian O'Connell) with contributions from M. Wang and A. Bonomi)                                                                                                                                                                                                                                                                              |
| 5 minutes  | <p><b>Proposed future Task 39 business meetings in current triennium</b></p> <ol style="list-style-type: none"> <li>1) Germany, 25-27 November 2020: (Sao Paulo, in association with BBEST?)</li> <li>2) Denmark, 21-23 April, 2021</li> <li>3) Australia for late 2021, in combination with end of triennium (IEA Bioenergy) meeting</li> </ol> <p><b>Planning for the next newsletters to be published in 2019/2020:</b></p> <p>Early 2020- Germany</p> <p>Mid 2020- Norway??</p> <p>Late 2020- Ireland??</p> |

# Updates on Task 39 activities since last meeting (Stockholm, Sept 2019)

- Published newsletter Issue #53 in December 2019 - Featured article on “Biofuels production and use in Denmark - Status, Advances and Challenges” and a summary of Task 39’s second business meeting of the 2019-2021 triennium
- Completed and published the final report, “Assessment of likely Technology Maturation Pathways for biojet production from forest residues (ATM Project)”
- Completed and published the final report, “LCA Study - Comparison of Biofuel Life Cycle Analysis Tools for Second Generation (2G) Ethanol”

# Updates on Task 39 activities since last meeting, continued (1)

- Completed and published final report, “Implementation Agendas: 2018-2019 Update - Compare and Contrast Transport Biofuels Policies”
- Completed and submitted Task progress report for ExCo84
- Completed and submitted annual report for IEA Bioenergy
- Task 39 contribution to IEA Bioenergy Webinar Series:  
Sept 2019 webinar on Drop-in Biofuels report update launch.

IEA Bioenergy  
WEBINAR SERIES

**Drop-In Biofuels: The Key Role that Co-Processing will Play in their Production**

September 25, 2019

4:00 pm - 5:00 pm Central European Summer Time  
10:00 am - 11:00 am North American Eastern Daylight Time  
2:00 pm - 3:00 pm Greenwich Mean Time

|                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br><small>James D. (Jim) McMillan, Ph.D.<br/>Chief Engineer<br/>National Bioenergy Center<br/>National Renewable Energy Laboratory<br/>Task leader, IEA Bioenergy Task 39</small> | <br><small>Susan van Dyk, PhD<br/>Research Associate<br/>University of British Columbia<br/>Coordinator, IEA Bioenergy Task 39</small> | <br><small>John (Jack) N. Saddler, PhD, FRSC<br/>Professor of Forest Products<br/>Biotechnology, Bioenergy<br/>Dean Emeritus<br/>University of British Columbia<br/>Co-Task Leader, IEA Bioenergy Task 39</small> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

# Updates on Task 39 activities since last meeting, continued (2)

- **Task 39 contributions to Special Projects (Task 41 funded)**
  - **Advanced Biofuels - Potential for Cost Reduction (Adam Brown)- Completed**
    - Distributed project questionnaire to 25 advanced biofuels companies in North America; collected and compiled cost data from the 10 responding companies
    - Feedstock costs and availability
    - Biofuels Policy support
  - **Contribution of advanced renewable transport fuels to decarbonizing transport by 2030 and beyond (Dina Bacovsky) - Ongoing**
    - Role of Biofuel Policies
    - Future Feedstock Availability and Costs
    - Future GHG emissions of advanced biofuels

# Programme of work for 2019-2021

- **Assess successes and lessons learned for conventional/advanced biofuels development and deployment**  
Lead by Franziska Müller-Langer with input from Tomas Ekbom and others
- **Update on biofuels in marine shipping report/Issues affecting utilisation of advanced biofuels in the marine sector**  
Lead by Henning Jorgenson with inputs from Sune Tjalfe Thomsen and Steve Rogers
- **Update on implementation agendas report (compare-and-contrast of biofuels policies)**  
Lead by Mahmood Ebadian with inputs from the country members
- **Update on drop-in biofuels and biojet fuel/SAF, aviation sector decarbonization**  
Lead by Susan van Dyk with inputs from Jianping Su and Jack Saddler

# Programme of work for 2019-2021

- **Update of Biofuels Demonstration database website/report**  
Lead by [Dina Bacovsky](#)
- **Review existing/proposed certifications used for oleochemical- and lignocellulosic-based biofuels supply chains**  
Lead by [Paul Sinnige](#), with input from Mahmood Ebadian and others
- **Feedstock-to-biofuel(s) supply chain analysis. Focus on CAPEX and OPEX cost reduction opportunities**  
Lead by [Stephen Dooley](#) with input from Yuta Shibahara and Mahmood Ebadian
- **Techno-economic analysis (TEAs) of advanced biofuels (including feedstock/technology pathways), particularly for drop-in biofuels**  
Lead by [Duncan Akporiaye](#) with input from Franziska Müller-Langer, Tomas Ekbom, and Jin-Suk Lee

# Programme of work for 2019-2021

- **Assess biofuels production and use status in non-IEA countries/emerging economies**  
Lead by Glaucia Mendes Souza
- **Sustainability assessment of biofuels pathway to identify key metrics beyond GHG reduction, spanning both feedstocks and conversion technologies**  
Lead by D. O'Connor, Adrian O'Connell, A. Bonomi, M. Wang

# Upcoming meetings

- Second half of 2020: Germany, 25-27 November, 2020
- First half of 2021: Denmark, 21-23 April, 2021
- Australia for late 2021, in combination with end of triennium (IEA Bioenergy) meeting

# Upcoming newsletters for 2019-2020

- April 2020: Feature story on/by Germany
- September 2020: Feature story on/by Norway?
- December 2020: Feature story on/by Ireland?

# GANTT Chart of Task 39 Deliverables Status, 2019-2021

| Project No. | Topic (collaboration)                                                                                                                                                    | Deliverable      | % Work completed       |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------|
|             |                                                                                                                                                                          |                  |                        |
| T39-T1      | Techno-economic analysis (TEAs) of advanced biofuels (including feedstock/technology pathways)                                                                           | Report           | Planning<br>Actual     |
| T39-T2      | Review existing/proposed certifications used for oleochemical- and lignocellulosic-based biofuels supply chains; identify certification scheme improvement opportunities | Report           | Planning<br>Actual 15% |
| T39-T3      | Assess successes and lessons learned for conventional/advanced biofuels deployment                                                                                       | Report           | Planning<br>Actual 15% |
| T39-T4      | Analyze biofuels production and use status in non-IEA countries/emerging economies                                                                                       | Report           | Planning<br>Actual     |
| T39-T5      | Update on biofuels in marine shipping report/Issues affecting utilisation of advanced biofuels in the marine sector                                                      | Report           | Planning<br>Actual 15% |
| T39-T6      | Conduct feedstock-to-biofuel(s) supply chain analysis to identify CAPEX and OPEX cost reduction opportunities (with Task 43/Feedstocks)                                  | Report           | Planning<br>Actual 10% |
| T39-T7      | Assessment of large-scale demonstration plants (with Bioenergy 2020+)                                                                                                    | Database updates | Planning<br>Actual     |
| T39-T8      | Update of the drop-in biofuels report /Update of biojet fuel/SAF, decarbonization of the aviation sector                                                                 | Report           | Planning<br>Actual 30% |
| T39-T9      | Update on country policies and implementation agendas                                                                                                                    | Two Reports      | Planning<br>Actual 30% |
| T39-T10     | Sustainability assessment of biofuels pathways; Identify key metrics beyond GHG reduction; span both feedstocks and conversion technologies                              | Report           | Planning<br>Actual 15% |
| T39-T11     | Task 39 Newsletter                                                                                                                                                       | Nine newsletters | Planning<br>Actual 40% |
| T39-T12     | IEA Annual Report (Task progress)                                                                                                                                        | Six reports      | Planning<br>Actual 40% |

# **Implementation Agendas Report: 2020-2021 Update** **(compare-and-contrast transport biofuels policies)**

**Mahmood Ebadian**

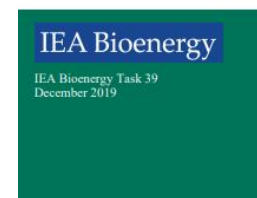
**IEA Bioenergy Task 39, Virtual Business Meeting**  
**April 2<sup>nd</sup>, 2020**

# Implementation agenda report- 2018-2019 Update

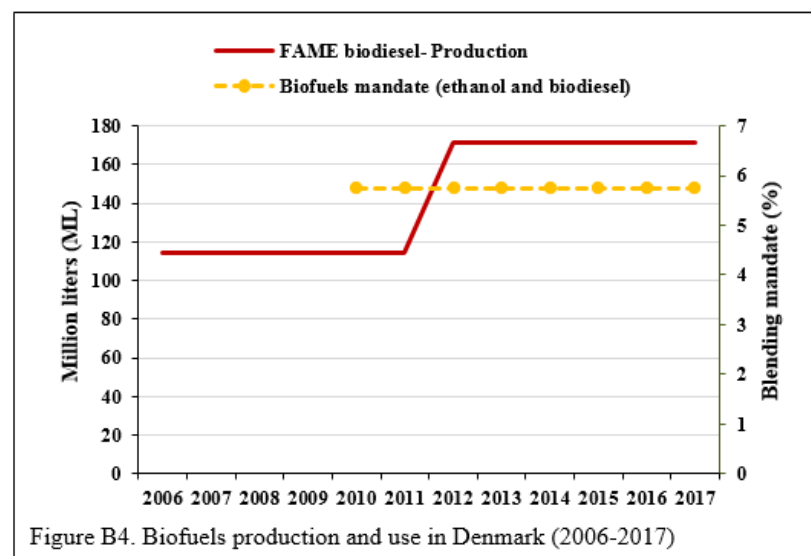
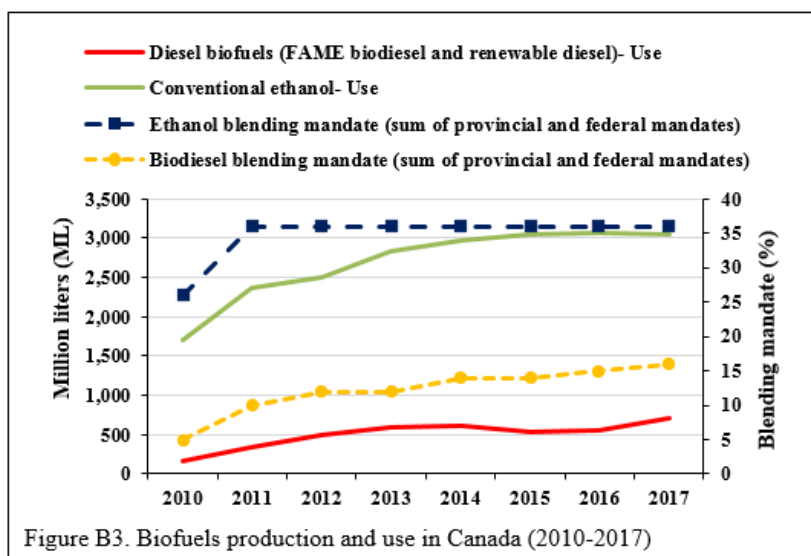
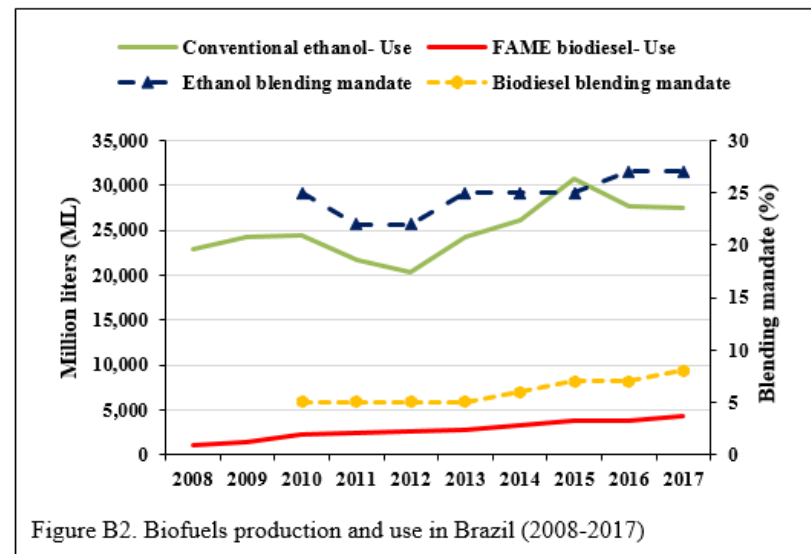
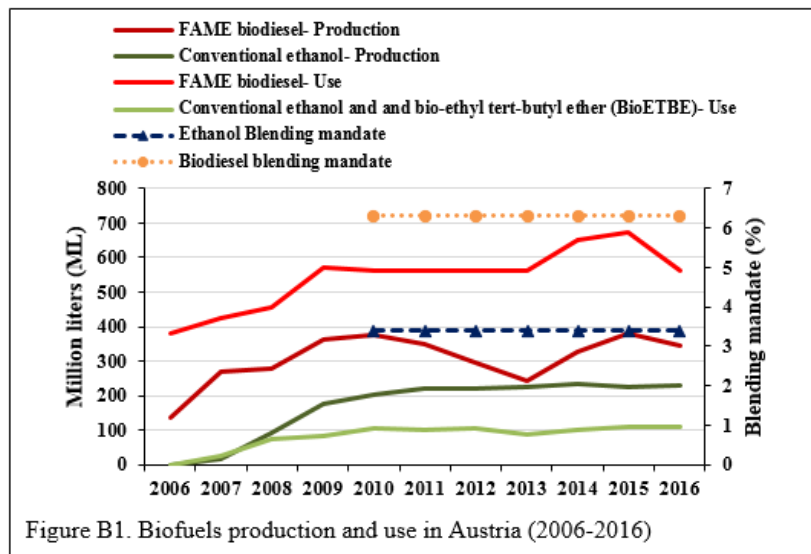
- 180-page report comprised of 18 chapters
  - Chapter 1: global biofuels production and use
  - Chapters 2-17: biofuel policies in 16 countries (country chapters)
  - Chapter 18: Compare and contrast biofuel policies



The full report and executive summary are available at “Publication Section” of Task 39 website.



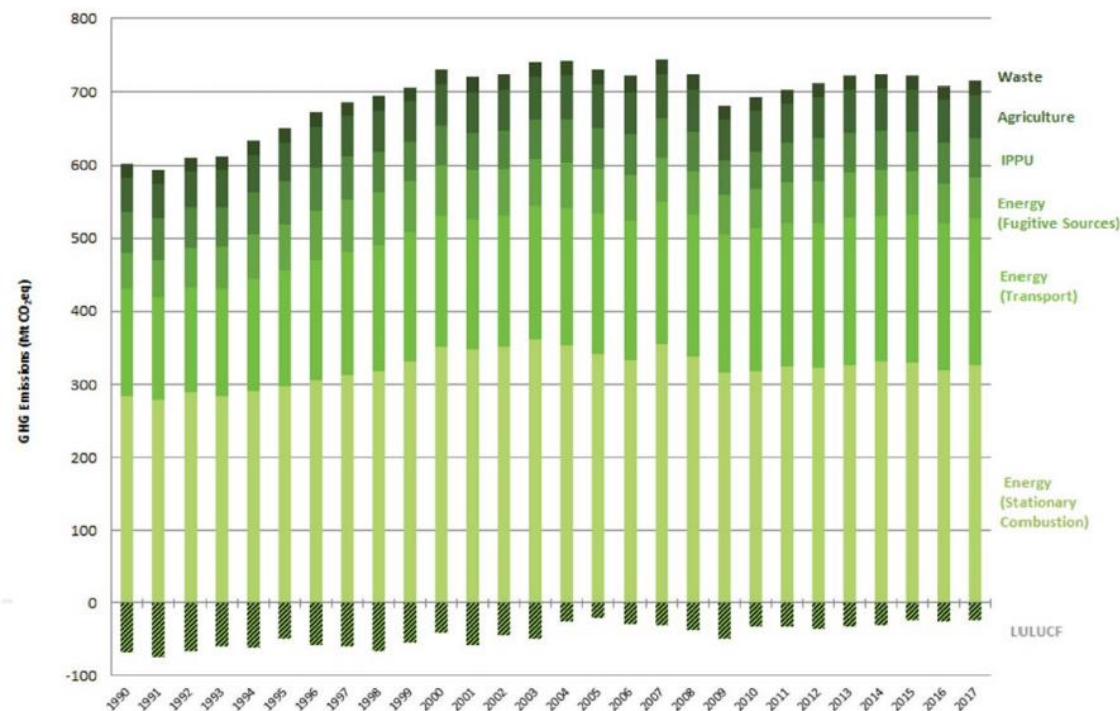
# Biofuels production and use and blending mandate



# Revised questionnaire- New additions

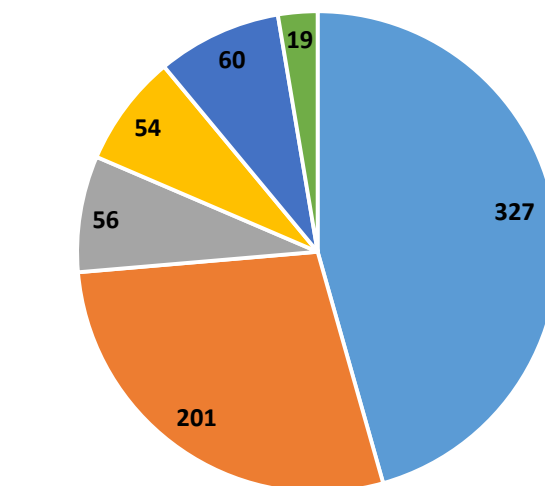
1. Historical GHG emissions inventory data and the contribution of transport sector
2. Existing and emerging sustainability certification schemes for transport biofuels and feedstocks
3. Compliance cost of biofuel policies (e.g. \$/tCO<sub>2</sub>, \$/GJ)
4. Historical biofuels and feedstocks imports and exports
5. Metrics to measure the effectiveness of biofuel policies

# GHG emissions inventory data- Canada as an example



Canada's GHG Emissions Trend, 1990-2017

Emissions by sector (Mt CO<sub>2</sub>-eq)- 2017



- Energy- Stationary combustion sources
- Energy- Transport
- Energy- Fugitive Sources
- Industrial Processes and Product Use
- Agriculture
- Waste

# Existing and emerging sustainability certifications schemes for transport biofuels

| Category                                                   | LCA Tools/<br>Certification schemes                          | Outcome                                                                                                                                                                                                                                     |
|------------------------------------------------------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GHG emissions<br>reduction/carbon<br>intensity of biofuels | US: GREET<br>Canada: GHGenius<br>EU: BioGrace<br>Brazil: VSB | <ul style="list-style-type: none"> <li>- Approve the biofuel pathways if they meet a minimum GHG emissions reduction (e.g. US's RFS2 and REDII)</li> <li>- Generate credits/deficits based on their carbon intensity (e.g. LCFS)</li> </ul> |
| Sustainability of<br>feedstocks                            | ISCC, RSB, FSC, CSBE,<br>RSPO, Bonsucro, etc.                | <ul style="list-style-type: none"> <li>- Approve the use of a specific feedstock for biofuel production</li> </ul>                                                                                                                          |

# Non-compliance cost of biofuel policies- could hinder the investment in biofuels projects

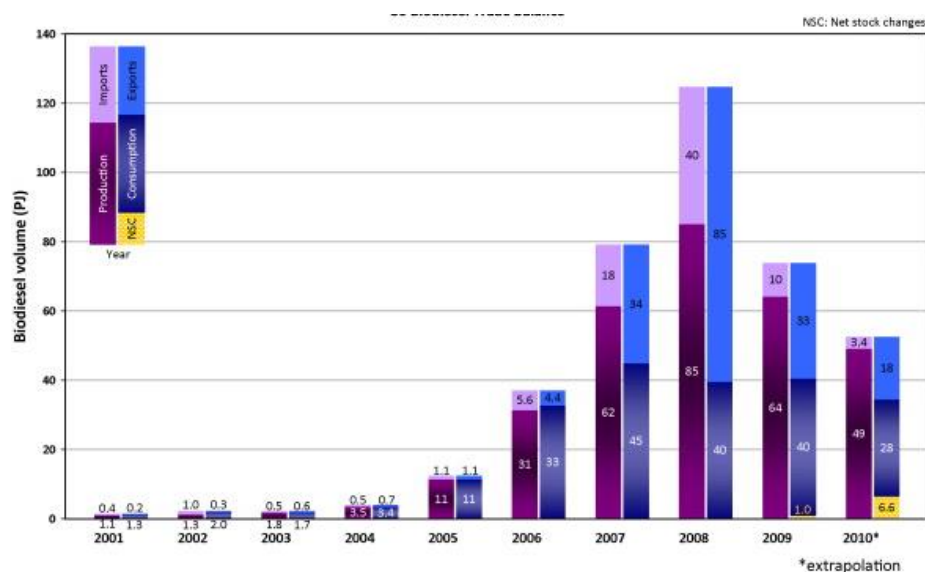
- Obligated parties (e.g. fuel importers, oil refineries, fuel distributors) constantly look for lowest-cost compliance pathways.
- Cost of non-compliance impacts the investors' decision on investing in commercial biofuels projects.

|             | Biofuel Share in Transportation Fuels | Overall Biofuels Mandate | Advanced Biofuels Mandate (Target Year) | GHG Reduction Quote (Target Year)                               | Cap on Conventional Biofuels (Target Year) | Price for Non-compliance <sup>+</sup>                                    |
|-------------|---------------------------------------|--------------------------|-----------------------------------------|-----------------------------------------------------------------|--------------------------------------------|--------------------------------------------------------------------------|
| Denmark     | 5.75%                                 | N/A                      | 0.9% (2020)                             | N/A                                                             | Not Decided                                | Not Decided                                                              |
| Germany     | 5.9%                                  | N/A                      | 0.05% (2020)<br>0.5% (2025)             | -6% (2025)                                                      | 6.5% (2018)                                | \$517/tCO <sub>2</sub> e                                                 |
| Italy       | 4.8%                                  | 7.15%                    | 0.9% (2020)<br>1.85% (2022)             | N/A                                                             | 6.7% (2022)                                | \$82.5/GJ<br>\$165/GJ (advanced biofuels)                                |
| Netherlands | 7.75%                                 | 15.4%                    | 1% (2020)                               | N/A                                                             | 5% (2020)                                  | Not Decided                                                              |
| Sweden      | 31.2%                                 | N/A                      | N/A                                     | -21% diesel (2020)<br>-4.2% gasoline (2020)<br>-40% both (2030) | Not Decided                                | \$418/tCO <sub>2</sub> e (gasoline)<br>\$523/tCO <sub>2</sub> e (diesel) |
| U.K.        | 6%                                    | 9.6%                     | 0.2% (2020)<br>2.8% (2023)              | N/A                                                             | 4% (2020)<br>2% (2032)                     | \$11-\$12/GJ<br>\$56-\$63/GJ (development fuels)                         |

Source: International Council on Clean Transportation (2018)

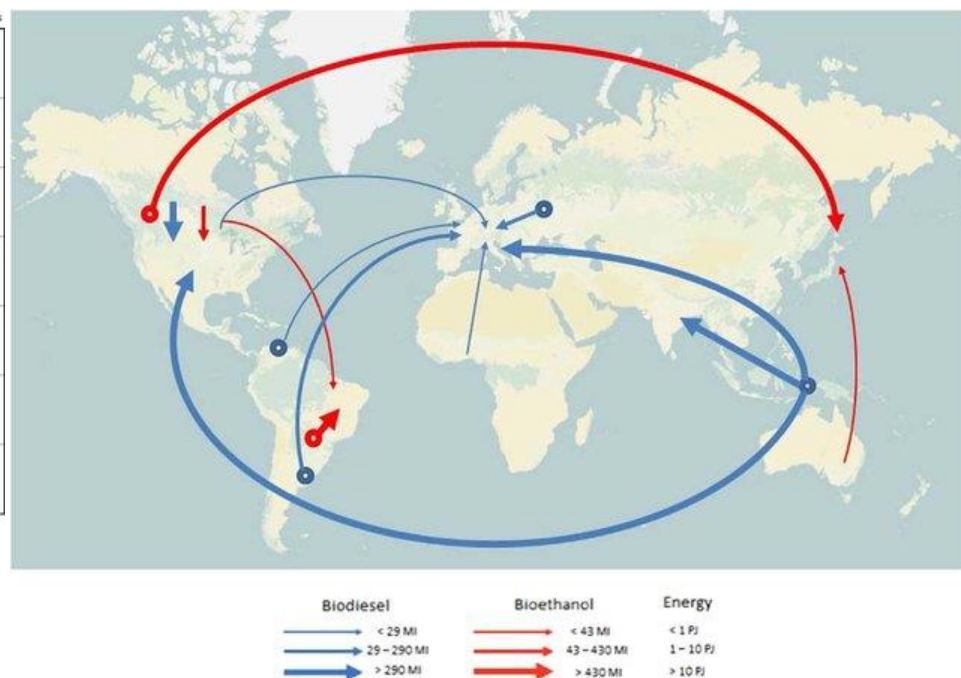
**Overview of EU member states targets and compliance costs for renewable fuels**

# Historical biofuels and feedstock imports/exports



US Biodiesel Trade Balance

Source: Lamers et al., 2011



Source: Rulli et al., 2016

# Metrics to measure the effectiveness of biofuels policies

1. Historical production and use of biofuel trends
2. Historical import and export of biofuels trends
3. Numbers of existing demonstration and commercial advanced biofuels plants.
4. Contribution of biofuels to the GHG emissions reduction in the transport sector (historical trend)
5. others??

# Next steps

- Share a copy of the revised questionnaire with country members- April 2020
- Request completion of the revised questionnaire- June 2020
  - For established members: Share a copy of their respective country chapters, asking for an update of their chapters (e.g. changes in biofuels policies, biofuels production and use)
  - For new members: Fill out the questionnaire and send it back to Mahmood
- Develop the draft report of the implementation agenda and distribute among member countries for review and comments- September 2020
- Collect and incorporate comments and feedbacks from member countries on the initial draft- November 2020
- Review and Finalize the report Update- January/February 2021

# Continuation of Drop-in Biofuels project

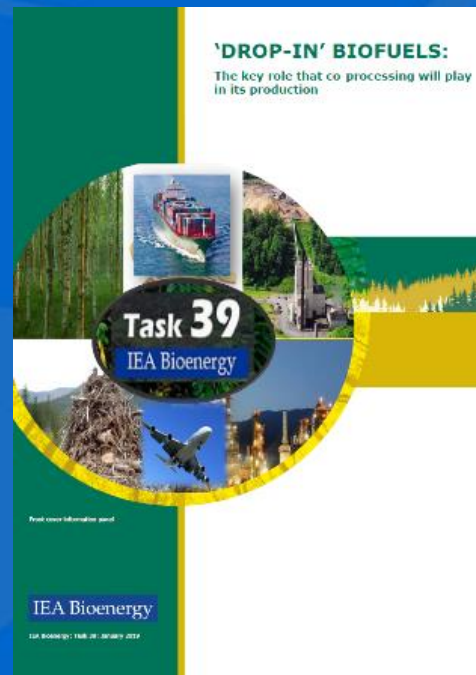
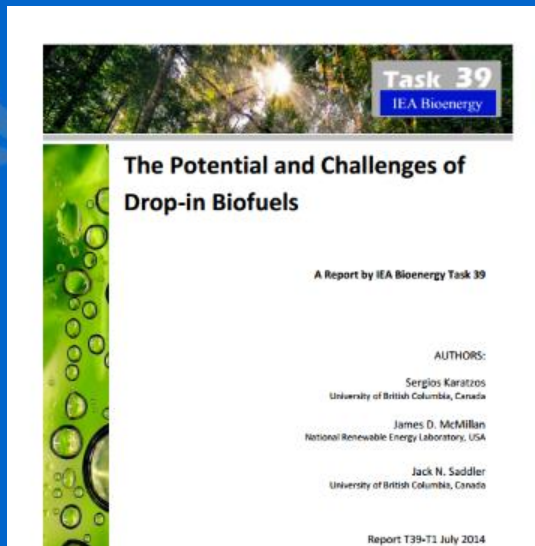
(Production of lower carbon intensive (CI) transportation fuels)

Jianping Su, Susan van Dyk and Jack Saddler

Forest Products Biotechnology/Bioenergy Group: IEA Task 39



# Drop-in biofuels reports (2014 & 2019)



## Definition of “drop-in” biofuels

- Drop-in biofuels: are “liquid bio-hydrocarbons that are: **functionally equivalent** to petroleum fuels and **fully compatible with** existing petroleum infrastructure”

# Focus on Feedstocks (availability, cost and “sustainability”)

- Near term feedstocks:  
 (“Conventional”)

## Oils, fats, and greases (OFGS) or Oleochemical feedstocks

- Used cooking oil, tallow, tall oil
- Vegetable oils: soybean, canola, rapeseed, etc.
- Alternative oilseed crops:  
 camelina, carinata or algae oil

- Long term feedstocks (Biomass):  
 (“advanced”)

## biocrudes/bio-oils

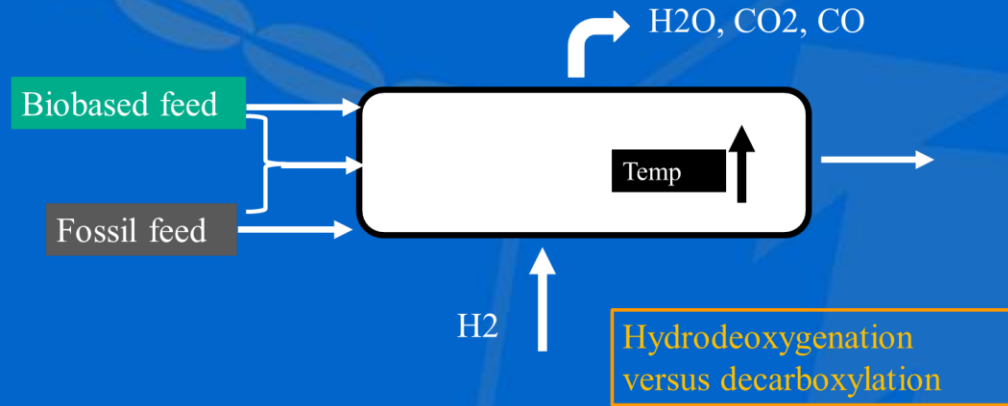
- Fast pyrolysis biocrude
- Catalytic pyrolysis biocrude
- Hydrothermal liquefaction biocrude
- etc.

# Strategies for drop-in expanding drop-in biofuel production

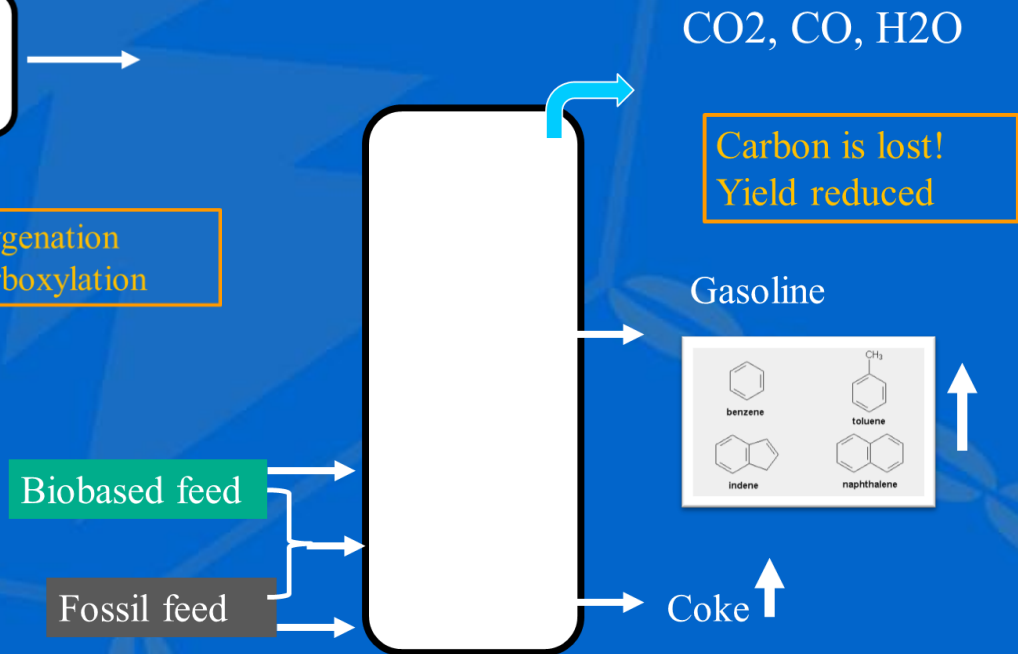
- Stand-alone units (e.g. “renewable diesel focus”)
  - Time needed for the projects, cost, permit risks and uncertainties
- Co-locating, enabling utilizing the existing supply chain, hydrogen
- Repurpose existing infrastructure (e.g. World Energy (AltAir) in California, ENI Italy, Total La Mede, France)
- Co-processing of biobased intermediates in existing refineries to produce fossil fuels with renewable content (lower carbon intensity)
  - Lowest cost for expanding drop-in biofuel
  - Decrease the crude oil demand for fossil fuel refineries

# Possible insertion points

## Hydrotreater co-processing



## FCC co-processing



# Tracking the “green” molecules (CI of the final fuel)

- Policies such as the LCFS have incentivised refineries to co-process
- However, need to determine the carbon intensity/ renewable content (the “green” molecules) of the co-processed fuels
- How do the different methods used to track “green” molecules compare?:
  - e.g. Mass balance/C14 by Accelerator Mass Spectrometry (AMS)/C14 by Liquid Scintillation counting (LSC)/C13/etc.

# *Biojet fuels - technologies and status of commercialisation*

## *Task 39 report*

Susan van Dyk and Jack Saddler

Forest Products Biotechnology/Bioenergy Group

International Energy Agency Bioenergy Task 39

**Task 39**  
IEA Bioenergy



Forest Products Biotechnology/Bioenergy (FPB/B)



# Structure of report (50% completed)

- General technologies for drop-in biofuel production
- ASTM certification status of technologies
- Status of commercialization of biojet
- Companies involved in biojet production and production capacity
- Factors/criteria for technology evaluation
- Fuel use at airports
- Techno-economic analyses
- Sustainability and carbon intensity of fuels
- ICAO and CORSIA (carbon offset and reduction scheme for Int aviation)



# Opportunities and challenges of technology platforms

| Technology platform                             | Opportunities                                                                                  | Challenges                                                                |
|-------------------------------------------------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Oleochemical technologies                       | Low oxygen<br>Commercial scale                                                                 | Feedstock cost, sustainability & availability                             |
| Thermochemical - gasification based             | Low carbon intensity<br>Can use waste feedstocks such as MSW                                   | Syngas cleanup<br>High capital cost<br>Economies of scale                 |
| Thermochemical - liquefaction (pyrolysis & HTL) | Liquid intermediate can be used for coprocessing<br>HTL can use wet feedstocks                 | Hydrogen requirement<br>Complexity of biocrudes<br>High oxygen and low pH |
| Biochemical technologies                        | High specificity and purity of products                                                        | High value of biochemical products<br>Low yields                          |
| Hybrid                                          | Can use feedstocks such as waste gases (Lanzatech)<br>Alcohol to jet an established technology | Alcohol to jet uses expensive feeds such as butanol (Gevo)                |

# Technology platforms - certification and commercialisation

## ■ ASTM certification of pathways

### APPROVED

- Fischer-Tropsch SPK & SKA (2009)
- HEFA SPK (2011)
- Synthesized Iso-paraffins (SIP) (previously DSHC) (2014)
- Alcohol to jet SPK ( isobutanol(2016), ethanol (2018) )
- Catalytic hydro-thermolysis of lipids to jet fuel - ARA (2020)
- Co-processing of lipids (5%)

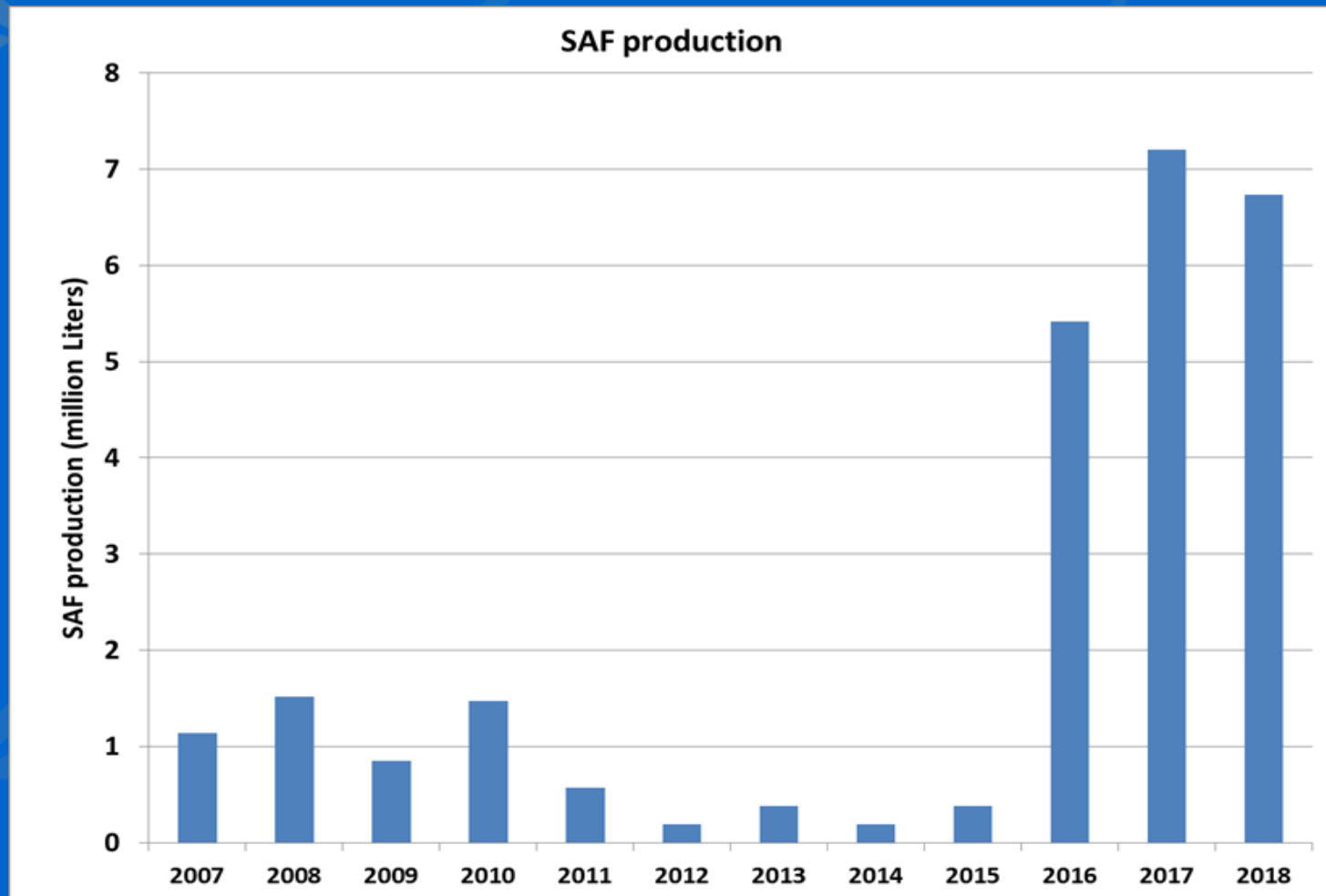
### In progress

- Synthetic kerosene/synthetic aromatic kerosene - Shell/Virent
- HEFA+ - HEFA with improved cold flow properties - Boeing
- Pyrolysis from lignocellulosic feedstocks - UOP, Kior (stalled)
- & 15 others in pre-certification stage



# Current & past production of biojet

Average of 0.29 million litres per year (2013-2015)  
to 6.45 million litres per year (2016-2018).

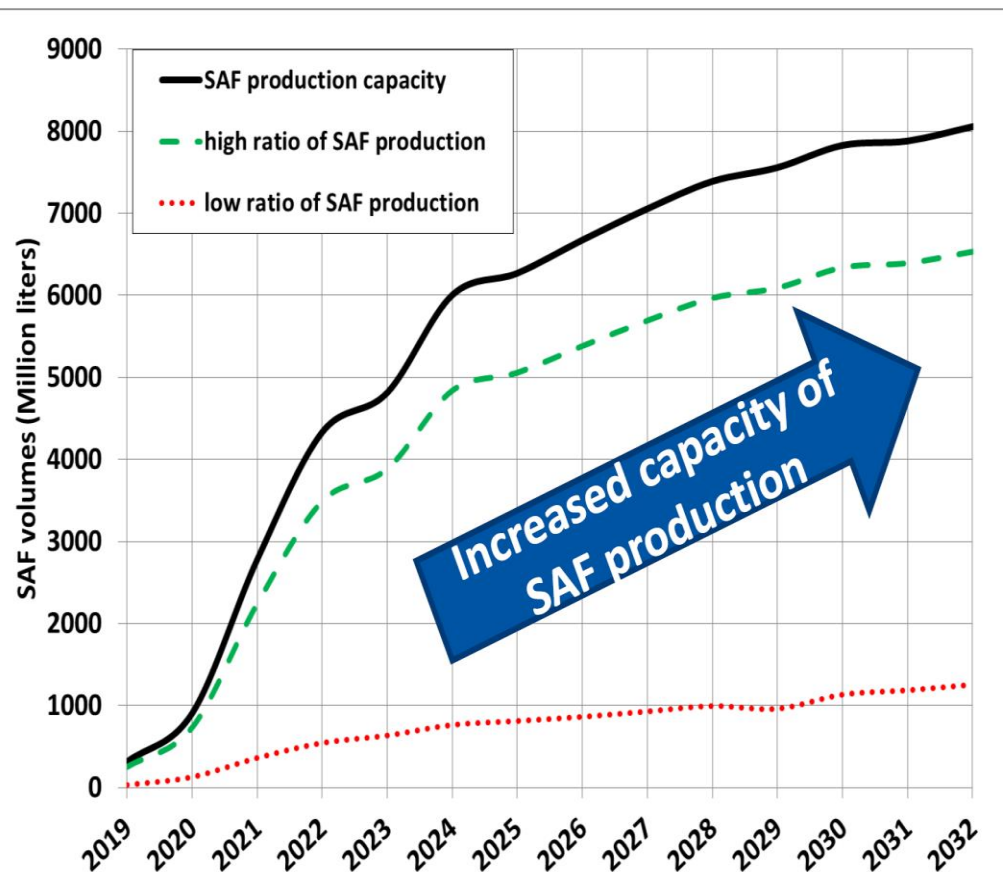


# Future production capacity (SAF)



ICAO ENVIRONMENT

ICAO STOCKTAKING SEMINAR  
TOWARD THE 2050 VISION FOR  
SUSTAINABLE AVIATION FUELS



**8 Billion litres (6.5 MT) of SAF production capacity available by 2032, and 6.3 Billion litres (5 MT) in 2025.**

ICAO Vision is based on the assumptions of a **progressive increase in the use of SAF.**

*Looking to the future - Capacity for SAF production will continue to increase.*

# Techno-economic analysis

| Conversion process | Feedstock                                                      | Cost (feedstock contribution)                                  | Reference                    |
|--------------------|----------------------------------------------------------------|----------------------------------------------------------------|------------------------------|
| HEFA               | Camelina oil                                                   | \$0.80/L                                                       | (Natelson and others 2015)   |
|                    | Palm oil                                                       | \$0.70–0.79/L (75% of OPEX)                                    | (Hilbers and others 2015)    |
|                    | Soybean oil                                                    | \$1.01–1.16/L (up to 70%)                                      | (Pearlson and others 2013)   |
|                    | Yellow grease<br>Tallow                                        | \$0.88–1.06/L (MSP)*<br>\$1.05–1.25/L (MSP)* (65%–76%)         | (Seber and others 2014)      |
|                    | Waste oil                                                      | \$1.03/L (70%)                                                 | (De Jong and others 2015)    |
| FT                 | Corn-stover (gasification)                                     | US\$ 0.90/L                                                    | (Agusdinata and others 2011) |
|                    | Switchgrass (gasification)                                     | US\$ 1.10/L                                                    |                              |
|                    | Lignocellulose (gasification)                                  | US\$ 1.96/L (MSP)*                                             | (Diederichs and others 2016) |
|                    | Wood (gasification)                                            | US\$ 1.14–1.22/L (MSP)*                                        | (Zhu and others 2011)        |
|                    | Wood (gasification)                                            | US\$ 1.13/L                                                    | (Ekbohm and others 2009)     |
| ATJ                | Sugarcane (ethanol)<br>Corn (ethanol)<br>Switchgrass (ethanol) | US\$ 1.56/L (MSP)*<br>US\$ 1.75/L (MSP)*<br>US\$ 2.30/L (MSP)* | (Staples and others 2014)    |
|                    | Lignocellulose (syngas)                                        | US\$ 1.80/L (MSP)*                                             | (Atsonios and others 2015)   |
|                    | Lignocellulose (syngas)                                        | US\$ 2.00/L (MSP)*                                             | (Diederichs and others 2016) |
|                    | Sugarcane (ethanol)                                            | US\$ 2.76/L (MSP)*                                             | (Diederichs and others 2016) |
|                    |                                                                |                                                                |                              |

\* MSP = Minimum Selling Price

ICAO Sustainable  
Aviation Fuels  
guide



# Sustainability issues - default CI values under CORSIA

**Table 1. CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels**

| Fuel Conversion Process | Region | Fuel Feedstock        | Core LCA Value | ILUC LCA Value | LS <sub>f</sub> (gCO <sub>2</sub> e/MJ) |
|-------------------------|--------|-----------------------|----------------|----------------|-----------------------------------------|
|                         | Global | Agricultural residues | 7.7            |                | 7.7                                     |
|                         | Global | Forestry residues     | 8.3            |                | 8.3                                     |

| Technology                            | Total LCA (gCO <sub>2</sub> e/MJ) (includes ILUC) |
|---------------------------------------|---------------------------------------------------|
| Fischer-Tropsch                       | -22.5 to +8.3                                     |
| HEFA                                  | 13.9 to 99.1                                      |
| Isobutanol to jet                     | -10.7 to 77.9                                     |
| Ethanol to jet                        | 32.8 to 90.8                                      |
| Synthesized iso-paraffins (farnesane) | 44.1 to 52.6                                      |

|                                   |        |                                       |      |       |       |
|-----------------------------------|--------|---------------------------------------|------|-------|-------|
| Alcohol (isobutanol) to jet (ATJ) | Brazil | Sugarcane                             | 24.0 | 7.3   | 31.3  |
|                                   | USA    | Corn grain                            | 55.8 | 22.1  | 77.9  |
|                                   | USA    | Miscanthus (herbaceous energy crops)  | 43.4 | -54.1 | -10.7 |
|                                   | EU     | Miscanthus (herbaceous energy crops)  | 43.4 | -31.0 | 12.4  |
|                                   | USA    | Switchgrass (herbaceous energy crops) | 43.4 | -14.5 | 28.9  |
| Alcohol (ethanol) to jet (ATJ)    | Brazil | Sugarcane                             | 24.1 | 8.7   | 32.8  |
|                                   | USA    | Corn grain                            | 65.7 | 25.1  | 90.8  |
| Synthesized iso-paraffins (SIP)   | Brazil | Sugarcane                             | 32.8 | 11.3  | 44.1  |
|                                   | EU     | Sugar beet                            | 32.4 | 20.2  | 52.6  |

# Policies

- Policies are essential for bridging the gap between fossil jet and biojet
- Different jurisdictions have implemented policies to incentivize production of biojet
  - U.S. both RINs and credits under the California Low Carbon Fuel Standard
  - Netherlands (biotickets)
- Carbon Offset and Reduction Scheme for International Aviation (CORSIA) - agreed at the International Civil Aviation Organisation (ICAO) with implementation from 2021
- Individual airlines offer corporate packages or individual purchase of carbon offsets





# BEST

Bioenergy and  
Sustainable Technologies



Ein Fonds der  
Stadt Wien



## “Potential for Decarbonisation of Transport” Inter-Task Project

### Update on Biofuels Demonstration Plants website

IEA Bioenergy Task 39 Virtual Business Meeting  
02/04/2020

Dina Bacovsky

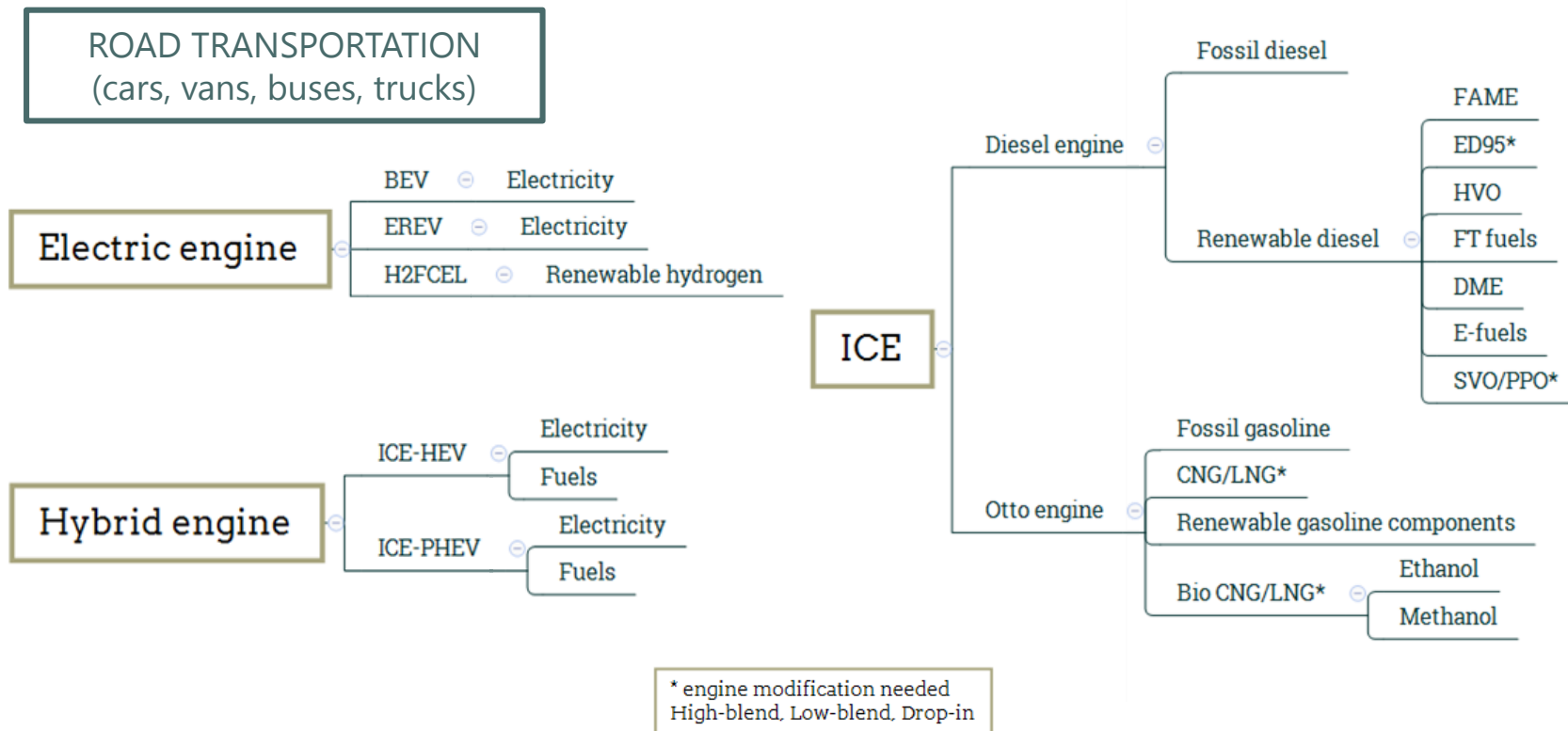


# Potential for Decarbonisation of Transport

- IEA Bioenergy TCP & IEA Advanced Motor Fuels TCP, co-funded by the European Commission
- Project leader: Dina Bacovsky - BEST GmbH
- Duration: 1 January 2019 – 31 March 2020
- Budget: ~130.000€
- Show the contribution of advanced renewable transport fuels to road transport decarbonisation in 2030 and beyond

***What do we have to do in order to reduce GHG emissions in the transport sector?***

# WP3: Fleet analysis - Vehicle and fuel options

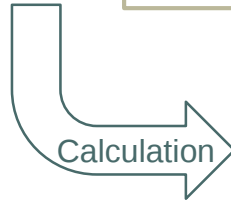




## WP3: Fleet analysis



- Vehicle park composition
  - Annual mileages
  - Use of fuel type
  - Efficiency
  - Carbon intensity
- } per vehicle category and type



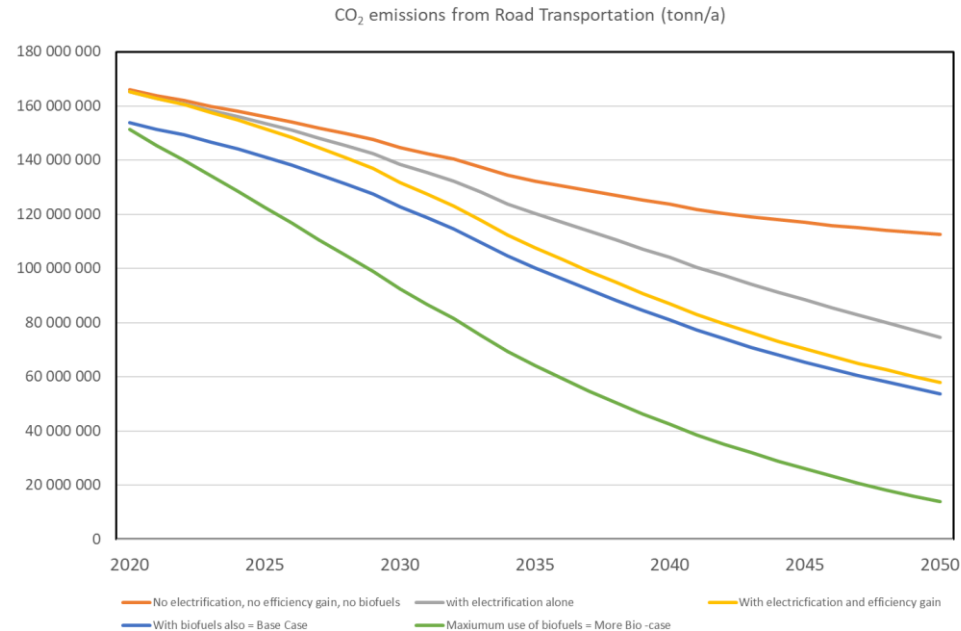
- Transport fuel use per fuel type
- Associated GHG emissions



- Projection until 2050



# Scenarios of CO<sub>2</sub> Emission from Road Transportation for Germany





## Project status

- Last fine-tuning of country assessments has just taken place
  - Last chapters under finalization
  - Final report expected to go out to peer review by end of April
  - Publication envisaged for end of June
- Volunteers for peer review welcome!

Budget for project management entirely spent – additional support (cash or in-kind) could largely improve the quality of the final report



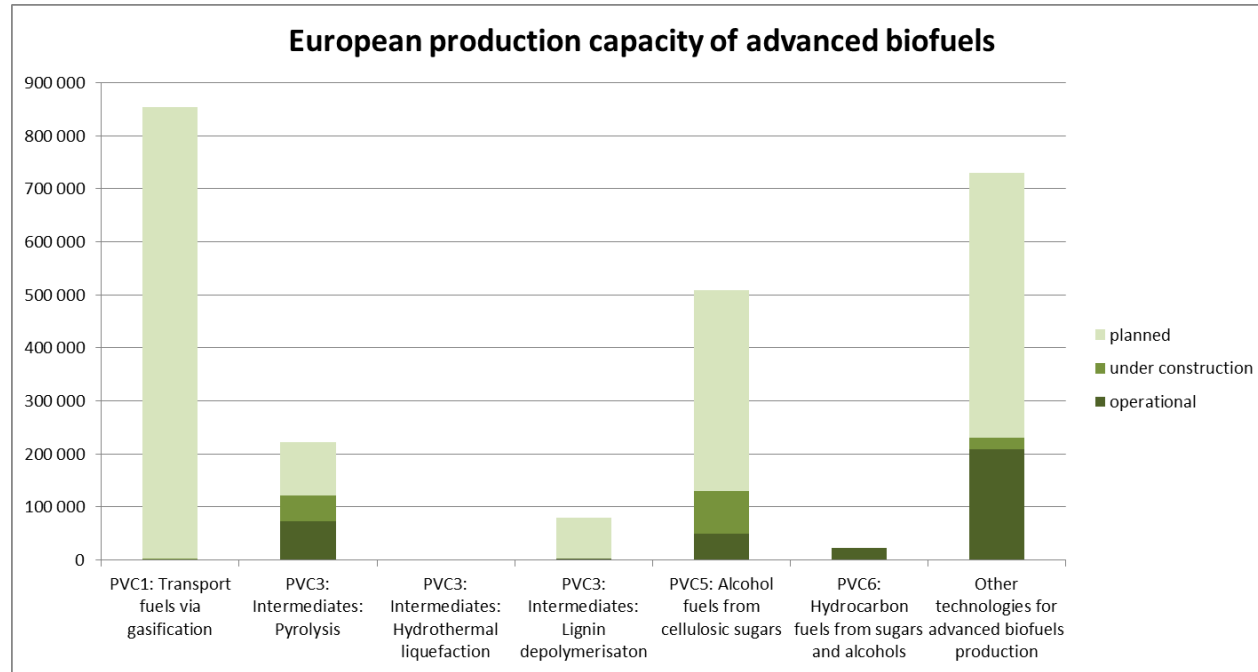
# Update on Biofuels Demonstration Plants

Most recent update:

European facilities for production of „advanced biofuels“,  
i.e. utilizing feedstock from RED II Annex IX Part A

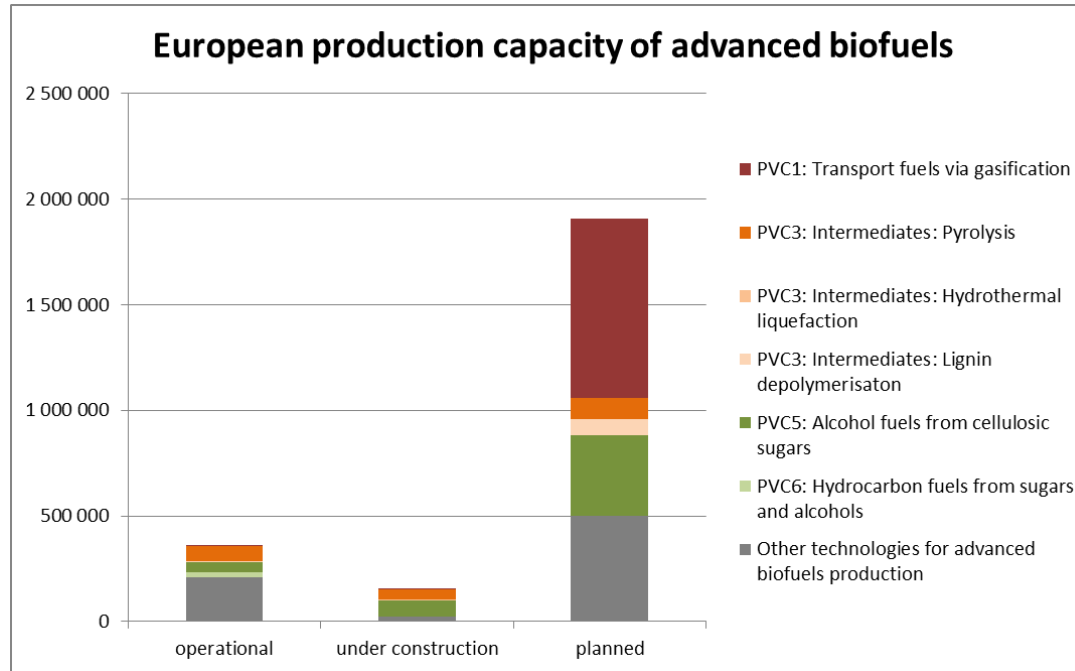


# European production capacity of advanced biofuels by pathway





# European production capacity of advanced biofuels by status



# **Project proposal | Assess successes and lessons learned for conventional / advanced biofuels deployment**

**Proposal presented at IEA TCP Bioenergy T39  
Business meeting | April 02, 2020**

**Franziska Müller-Langer et al.**

# Background

- Major challenges to achieving a CO<sub>2</sub> (GHG emissions) neutral society by 2050 and fulfilling sustainable development goals (SDGs) and IEA's Sustainable Development Scenario (SDS) >> Among others transport is proving to be an extremely difficult sector to decarbonize
- Transport biofuel production is expected to continue growing >> annual rates below 5% in the near future (once pandemic resolved!) versus required sustained levels of 10% until 2030 to get on track with SDS
- Despite billions of dollars of investments, ramped up production of low carbon advanced biofuels remains well below the levels needed
- Stronger policy support and a greater rate of innovation are required to reduce costs of development and scale up of sustainable advanced biofuel production, particularly for aviation, HDV and marine which are especially hard to decarbonize.
- Project seeks to analyze international progress to identify approaches to be most effective for broadly deployment to get transport decarbonization back on track with SDS goals.

# Purpose and objectives

- Evaluation of reasons underlying
  - the past and ongoing booms and busts cycles of biofuel technologies development, demonstration, deployment and replication
  - in order to identify the best policy framework conditions and measures for stimulating increased future markets for production and consumption of sustainable transport biofuels.
- Research question: **“What is required to re-stimulate vigorous biofuels development and scale up?”**

# Activities and expected results

- Review national programs of leading biofuels producer countries (specifically including at least the countries of Brazil, Germany, Sweden and the USA, each of which has substantial biofuels programs; compare and contrast different producer countries framework conditions and policy approaches and levels and rate of growth of biofuels production that these conditions have enabled.
- This assessment will highlight the most important factors that have been incorporated in the more successful national programs and also identify the balance between market-related versus technology-related policy instruments that have proven to be most effective.
- Case studies will also be provided to illustrate examples of successful progress in developing and scaling up conventional/existing and advanced/emerging biofuels production technologies.
- Meta analysis of existing publications on “Lessons learned biofuels” >> evaluation of most common reasons for success to identify measures for biofuel promotion

# Work packages

*„Lessons learned biofuels I“ (Triennium 2019-2021)*

## **WP 1 | Status quo biofuel projects**

T39 (Lead), T45

Overview TRL, capacities of biofuels projects

Wrap up national programs

Existing sustainability / certification schemes

## **WP 2 | Meta-analysis existing studies**

T45 (Lead), T39, T40

Inventory of studies, specifically addressing lessons learned biofuels

Screening with criteria to be defined

## **WP 3 | Case studies technologies**

T39 (Lead)

Success stories for dedicated technologies and regions, (e.g. US, EU, Brazil)

## **WP 4 | Case studies supply chains**

T40 (Lead), T45

Success stories for biomass supply chains

## **WP 5 | Synopsis / synthesis of key issues**

T39 (Lead), T40, T45

Conclusions, guideline „good to know“ for decision makers, identification of required actions for „Lessons learned biofuels II“

*„Lessons learned biofuels II“ (Triennium 2022-2024)*

As T41 intertask project incl. several Bioenergy TCP Tasks, (AMF?)

# Scope

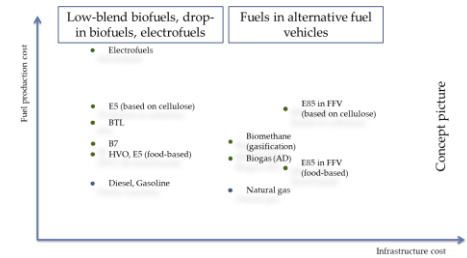
- **Participants:** IEA Bioenergy Tasks
  - T39 (transport biofuels) contributes expertise on technology development and market and policy issues for conventional and advanced transport biofuels.
  - T40 (trade/deployment) contributes expertise in feedstock supply and product distribution supply chains and markets
  - T45 (sustainability) >> contributes expertise on existing and future sustainability metrics being incorporated into biofuel policies, identification of “soft” criteria driving technological innovation
- **Deliverables:** Report and launch webinar, potentially workshop
- **Schedule:** Phase I 06/2020 to 09/2021 (Phase II next triennium)
- **Budget:** \$30k (Task 39) + \$xxk (Task 40) + \$yyk (Task 45) + \$zzk (Task 41 strategic fund) = \$wwk total >> strategic fund for Phase II
- (Project coordinator in T39: Franziska Müller-Langer & Tomas Ekbom)

# New idea for joint work | “Fuels and engines – benefits and costs”

**Idea presented at IEA TCP Bioenergy T39  
Business meeting | April 02, 2020**

**Franziska Müller-Langer, Dina Bacovsky**

# Idea



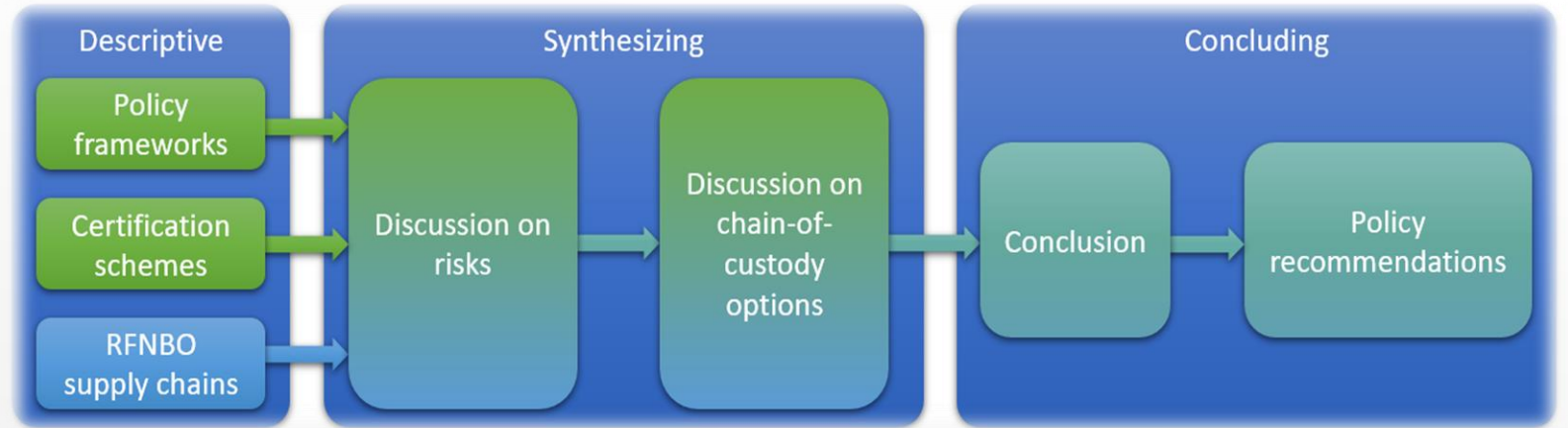
- **Objectives:** Support decision makers in deciding upon which fuels to push for
  - To provide an overview on fuel options in the near and long-term future
  - To identify low hanging fruits in terms of impact and costs
  - To establish the impact that certain fuels have on GHG emissions, local emissions, and energy efficiency
  - ...also for future engine concepts
  - Relevant aspects: Fuel production costs, Infrastructure build-up costs, Fuel applicability in existing engines, Fuel effect on local pollutant emissions of current and future engine+after-treatment systems, Fuel effect on energy efficiency, Fuel effect on well-to-wheel GHG emissions, Country-specific market situation
- **Participants:** TCP Joint work
  - Combustion TCP >> Gas Engines Task, System Analysis Task
  - IEA Bioenergy TCP Task 39 >> Biofuels, Renewable fuels for transport
  - Advanced Motor Fuels TCP >> Annex 28-2 Fuel Information System, New

# Integrity of certification framework for E-fuels

*Guaranteeing renewable energy (RE)  
consumption via E-fuels to  
decarbonize the transport sector*

Ted Knijn  
Utrecht University  
Internship project RVO

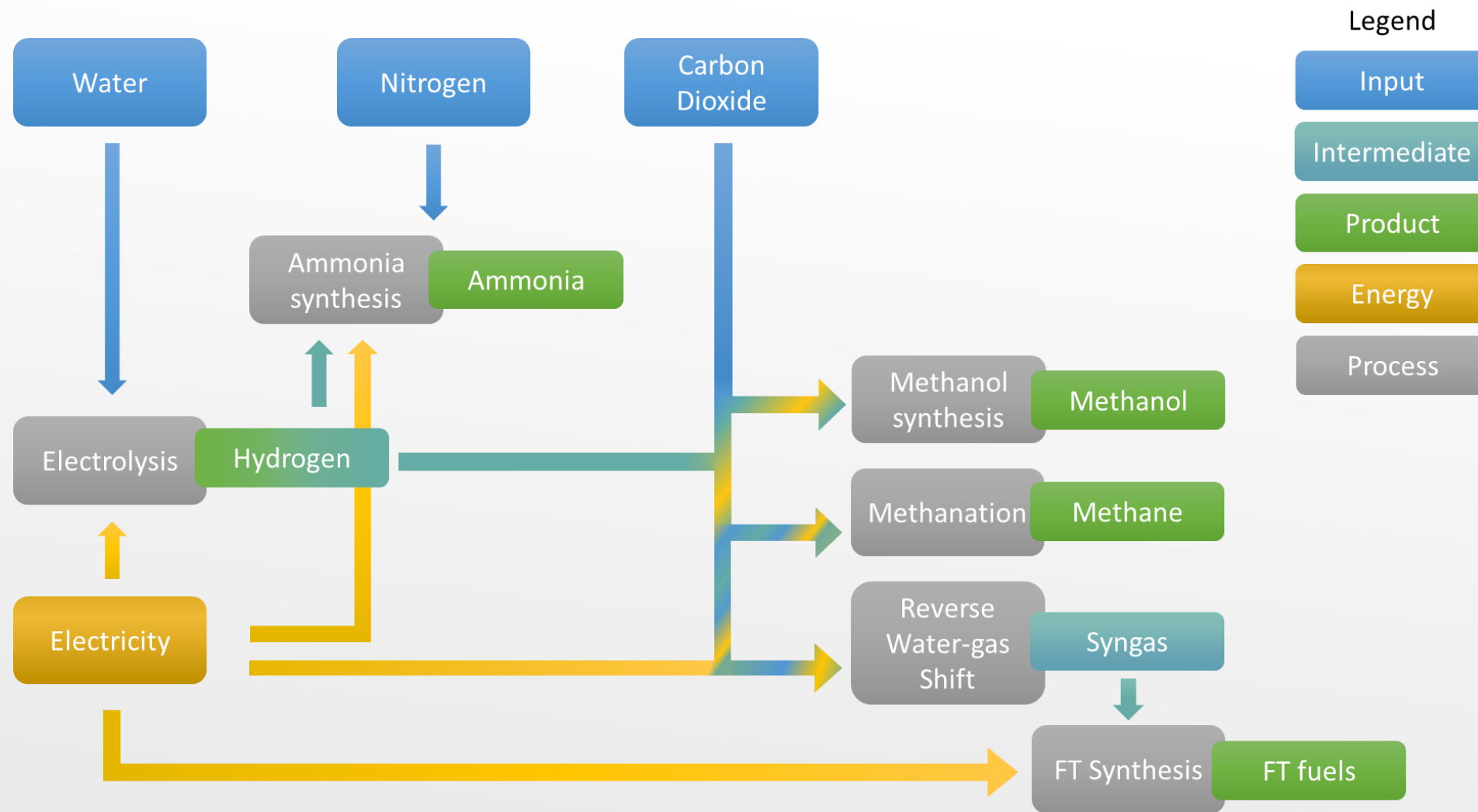
# Content



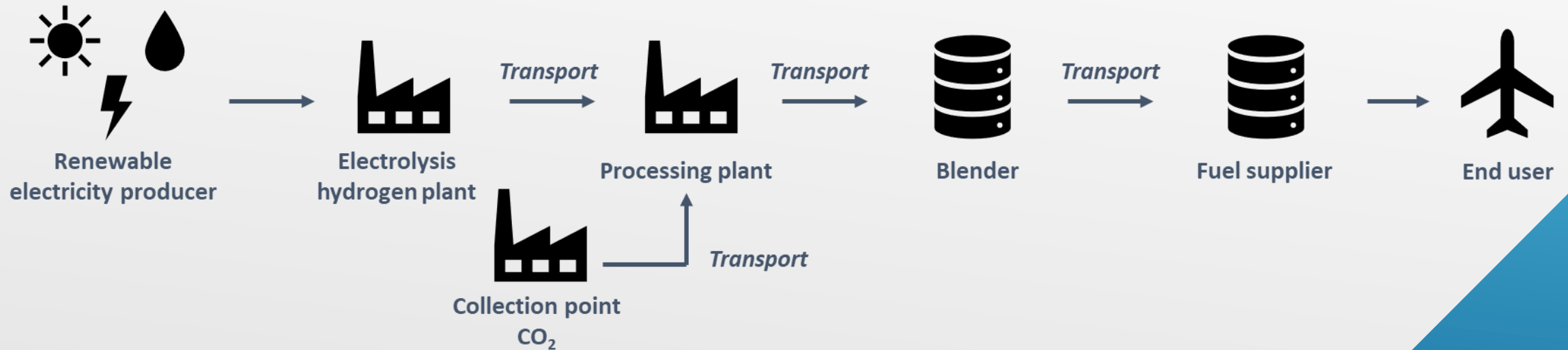
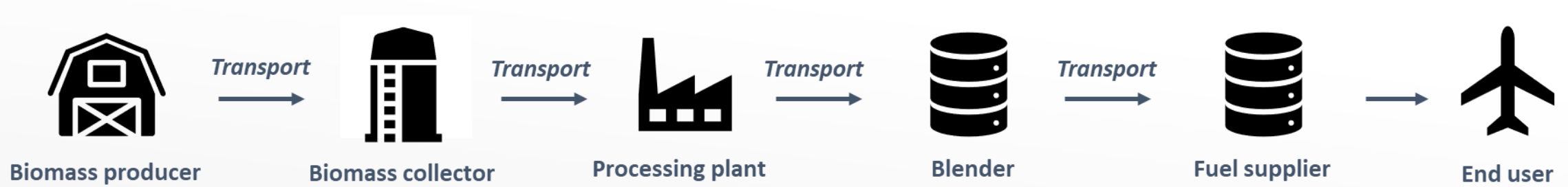
- ▶ E-fuel supply chains
- ▶ Policy frameworks for E-fuels
- ▶ Improvements to certification for E-fuels
- ▶ Conclusions and future work

# E-FUELS SUPPLY CHAINS





# WHAT ARE E-FUEL PATHWAYS?



# BIOFUEL VS E-FUEL SUPPLY CHAINS

- ▶ Low-carbon policy
  - ▶ North-American policies, such as CA's and BC's LCFS
  - ▶ Crediting low-carbon pathways
  - ▶ Definition based on **fuel pathway**
- ▶ RE consumption policy
  - ▶ EU policies, such as the REDII
  - ▶ Requiring consumption of additional renewable energy
  - ▶ Definition based on **energy input**
- ▶ Different definitions will not lead to commoditization

DIFFERENT DEFINITIONS...  
...DIFFERENT POLICY ORIENTATION

# POLICY FRAMEWORKS FOR E-FUELS





- ▶ EU-REDII: **Renewable** fuels of non-biological origin (RFNBOs)
- ▶ European countries have implemented RFNBO criteria differently
  - ▶ UK: Mass balance
  - ▶ NL: Physical segregation
- ▶ E-fuel certification allowed but “on hold” until **delegated acts**:
  - ▶ GHG emission savings calculation methodology
  - ▶ Additionality framework

## EU RENEWABLE ENERGY DIRECTIVE II



- ▶ Hydrogen pathways
  - ▶ Support of hydrogen as an **alternative for fossil fuels**
  - ▶ Focus on potential to reduce Carbon Intensity (CI)
- ▶ Other E-fuels not explicitly mentioned
- ▶ Relevant policy mechanisms
  - ▶ Book & claim for Zero-CI electricity for electrolysis
  - ▶ Smart electrolysis
  - ▶ Support of Hydrogen Refueling Infrastructure (HRI)

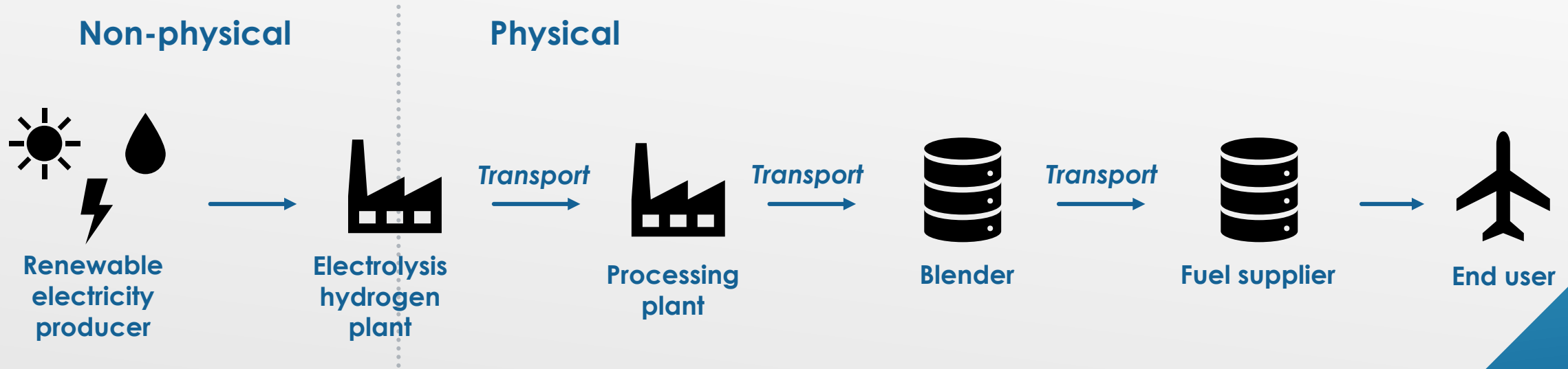
# CALIFORNIAN LCFS

# IMPROVEMENTS TO CERTIFICATION FOR E-FUELS



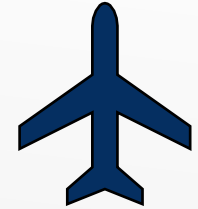
- ▶ Risks related to the **non-physical** part of the supply chain:
  - ▶ Criteria for information on used electricity
  - ▶ An **energy balance** should be added to E-fuel certification

- ▶ Risks related to the **physical** part of the supply chain:
  - ▶ Complexity and intractability
  - ▶ Fraud protection by incorporating E-fuel certification in **database**



# REDUCE RISKS RELATED TO RE IN E-FUELS

- ▶ Upcoming: International transport sectors
  - ▶ E-fuels can play important role in decarbonization
  - ▶ Aviation and maritime transport require an international framework
  - ▶ Scaling adds challenges to integrity of policy framework
- ▶ International database?



# INTERNATIONAL E-FUEL FRAMEWORK?

# CONCLUSIONS & FUTURE WORK



- ▶ E-fuels are defined differently
  - ▶ Different policy orientations
  - ▶ Renewable energy or Carbon intensity
- ▶ Improvements to E-fuel certification
  - ▶ An **energy balance** could overcome risks related to the **non-physical** part
  - ▶ A **database** could overcome risks related to the **physical** part

## CONCLUSIONS

- ▶ Harmonize definitions between policy frameworks
  - ▶ Standardization of pathways leads to commodities
  - ▶ Uniform commodities would stimulate international trade
- ▶ Harmonization of criteria for target compliance
  - ▶ Prevent double counting of RE and GHG emission reductions
- ▶ Develop integer framework for international transport sectors
  - ▶ Explore possibilities for a database

## FUTURE WORK

THANK YOU FOR YOUR ATTENTION

Several thin, white, parallel diagonal lines are positioned in the bottom right corner of the slide, extending from the right edge towards the center.

# *Update* **Biofuels for the marine shipping sector**

**Henning Jørgensen &  
Sune T. Thomsen**  
University of Copenhagen

UNIVERSITY OF COPENHAGEN



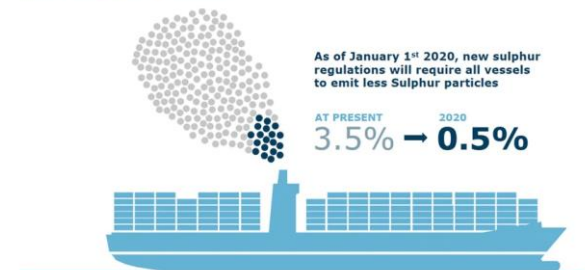
# Structure of report

Mostly follow outline of old report but update content

- Overview of the shipping sector
- Marine propulsion technology – **shortly address improvement in battery technology for short distance transport/commuting and for navigation purposes in harbours**
- Current marine fuels – including legislation, fuel specifications
- Marine biofuels and conversion technologies – **include power-to-X (?)**
- **Feedstocks for marine biofuels – supply and sustainability**
- **Techno-economic evaluation?**
- Marine biofuels deployment and implementation – **discussion of need for support actions, new specifications, rules, research**

In red new topics

IMO 2020 Regulations



# Conversion technologies

## Conventional biofuels

- Plant oils, biodiesel (FAME),
- HVO and HEFA – **Conventional/Advanced?**
- Bioethanol
- Biomethan

## Advanced biofuels

- Gasification (BtL) -> Bio-DME, Fisher-Tropsh
- Pyrolysis
- HTL
- Solvolysis (LEO)
- Emulsion biofuels
- Power-to-X

Align with Drop-in report on description of drop-in fuels – collaborate with Susan on co-processing aspects.

# Marine biofuels deployment and implementation

What are bottlenecks for implementation and deployment:

Some initial thoughts...

- Production capacity
  - Biomass logistic and availability
  - Upscale of technologies incl research
- Fuel logistics – drop-in and mixing issues
- Legislation
- Fuel specifications – align with Steve
- Global initiatives for GHG reduction targets, decarbonisation of shipping sector

# Plan for update

- Deadline early 2021
- April- scope report and agree on outline
- April - May – agree on collaboration with other tasks:
  - Task 34 - Direct Thermochemical Liquefaction
  - Task 45 - Climate and Sustainability Effects of Bioenergy within the broader Bioeconomy
- June-August – Writing first draft
- September-October – circulate and get feedback on first draft
- November-December – revise manuscript
- January – Approve final draft and executive summary
- February – report ready for sharing on members site

# IEA - Bioenergy Task 39

April 2nd, 2020

**Team:** Glaucia Mendes Souza, Heitor Cantarella, Luis Fernando Cassinelli, Luiz Augusto Horta Nogueira, Rubens Maciel Filho, *invitation to other IEA Task members*

**Collaborator:** Pablo Silva Ortiz

**The main objective of this proposal is to develop and implement a methodology to evaluate the biofuels production in emerging economies countries taking into account concepts of sustainability**

## **Specific objectives:**

- 1 - Selection of the countries that are considered as emerging economies with a large population and in average lower energy consumption compared to developed countries.
- 2 - Identification of official data source for each country in terms of energy production, energy demand as well as the production of biofuels.
- 3 - Database construction of relevant data (energy matrix, feedstock availability, the energy expenditure of production, net energy content, energy conversion efficiency, among others).
- 4 - Identification of possible raw-materials and conversion technologies.
- 5 – Evolve the analysis including sustainability (Energy and Exergy-based performance indicators).
- 6 – Evaluate how incentives can alter sustainability and process (using Renovabio as a case study).
- 7 - Generation of periodic reports, (twice a year?) and scientific papers.

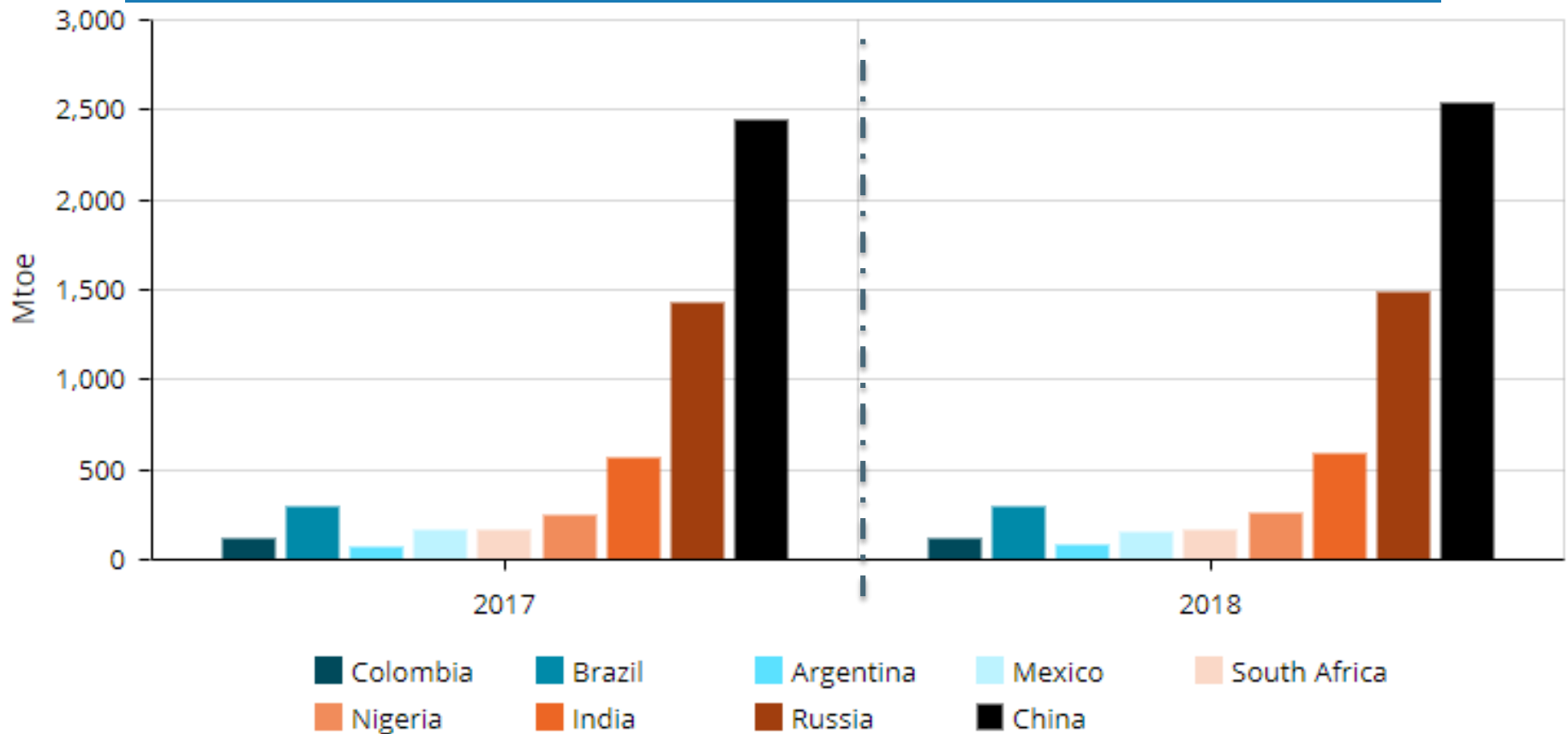
# Total Energy Production (Mtoe) | *Selected countries*



Benchmark countries

2017 - 2018

Growth of more than 10 % per year , even in adverse economic scenario



## Latin America

|  |           |                                                                                   |
|--|-----------|-----------------------------------------------------------------------------------|
|  | Brazil    |  |
|  | Argentina |  |
|  | Colombia  |  |
|  | Mexico    |  |

## Africa

|  |              |                                                                                   |
|--|--------------|-----------------------------------------------------------------------------------|
|  | South Africa |  |
|  | Nigeria      |  |

## Asia

|  |       |                                                                                     |
|--|-------|-------------------------------------------------------------------------------------|
|  | India |    |
|  | China |  |

## Europe

|  |        |                                                                                     |
|--|--------|-------------------------------------------------------------------------------------|
|  | Russia |  |
|--|--------|-------------------------------------------------------------------------------------|

## Key performance indicators (KPIs)

Total Energy Production (Mtoe)  
 Electricity domestic consumption (TWh)  
 Share of renewables in electricity production (%)  
 CO2 emissions from fuel combustion (MtCO2)  
 cNR: unit exergy cost of non-renewable (kJ/kJ)  
 cR: unit exergy cost of renewable (kJ/kJ)  
 cT: unit exergy cost total (kJ/kJ)  
 mCO2: CO2 emissions (gCO2/kWh)  
 Renewability exergy index  
 Global energy and exergy efficiency  
 Carbon Efficiency  
 Fuel selling price

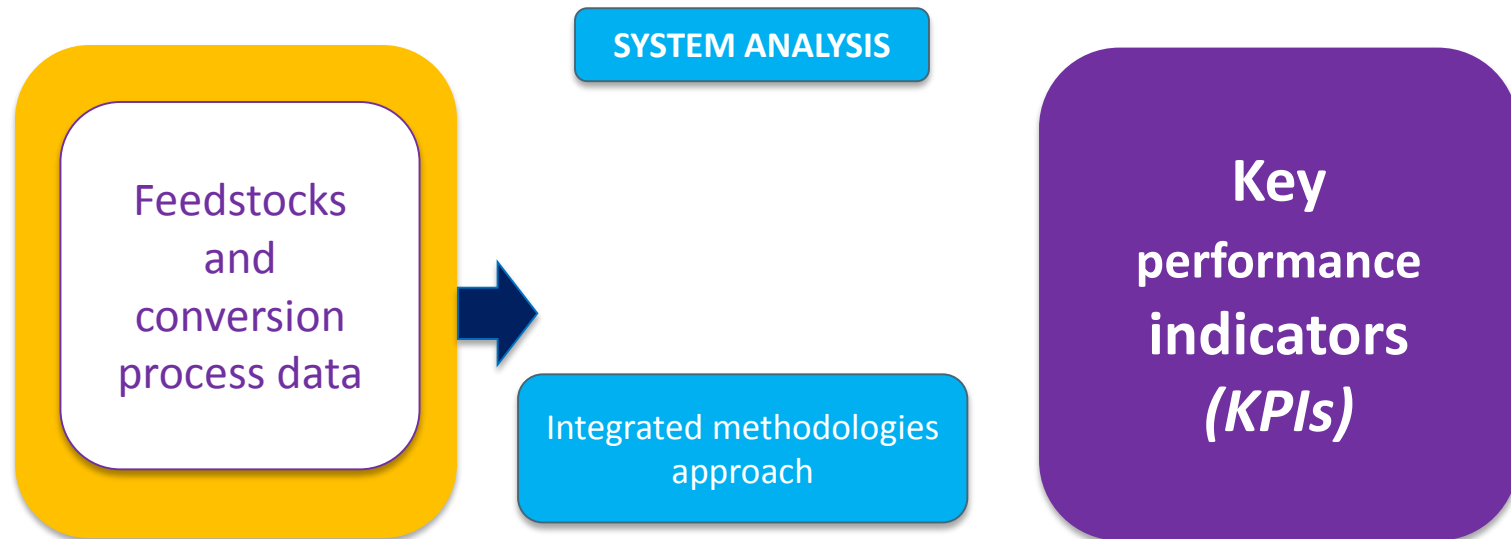
# Methodology: Techno-economic assessment and Life-Cycle approach together with Exergy Analysis

**Scope:** *Developing Countries with large populations and high energy demand.*



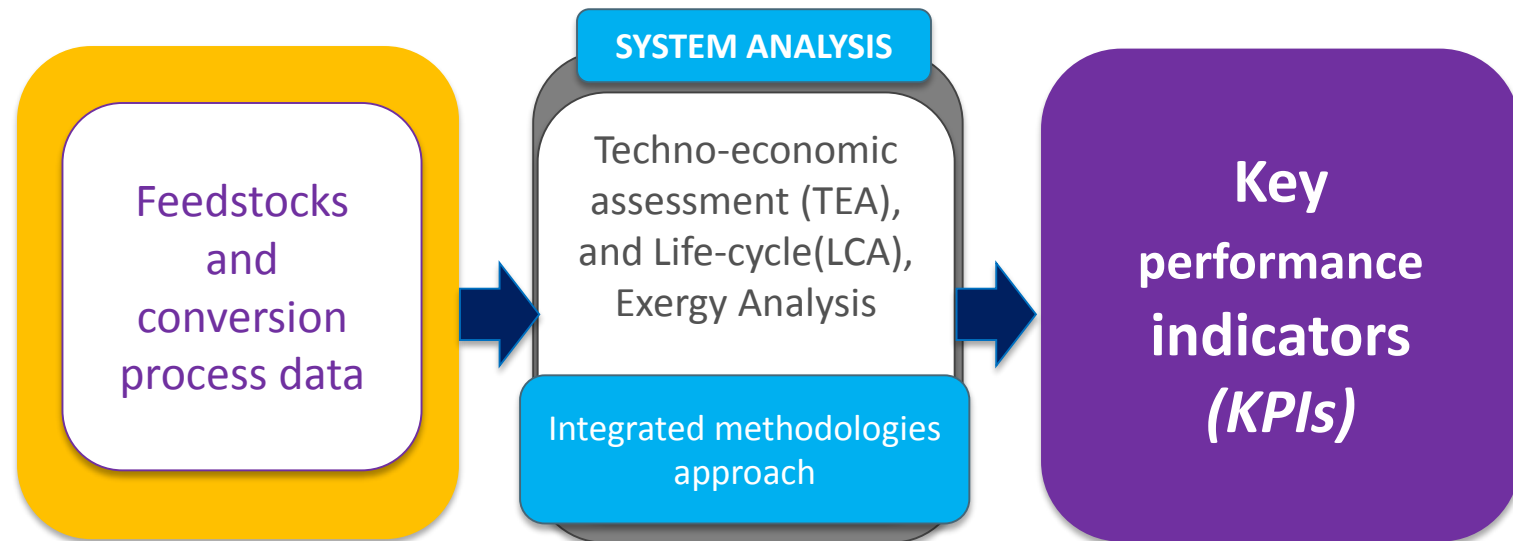
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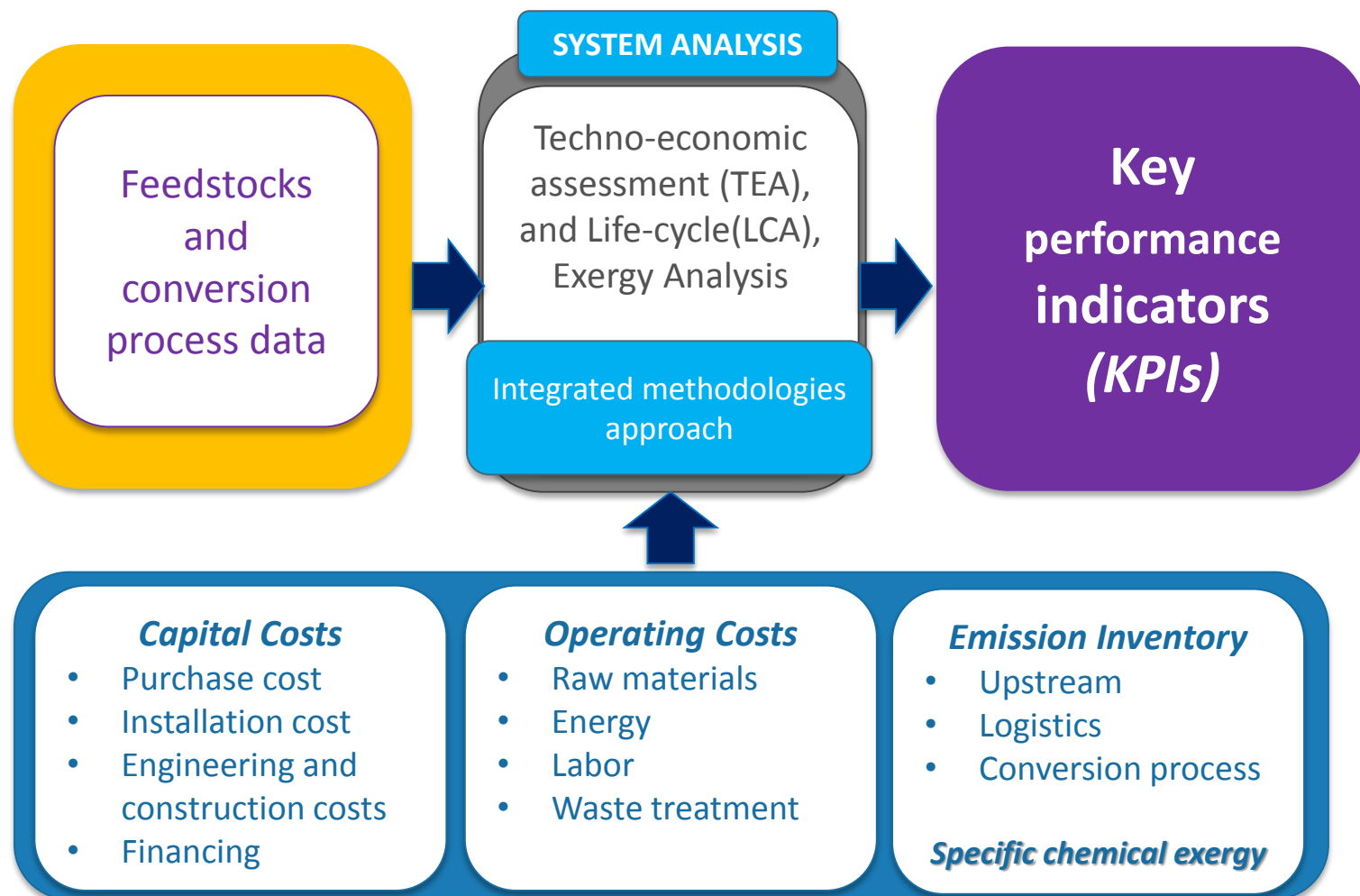
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# Methodology: Techno-economic assessment and Life-Cycle approach together with Exergy Analysis

**Scope:** *Developing Countries with large populations and high energy demand.*



# Conclusions

- ❖ The proposed approach coupling together Techno-economic Analysis, Life-Cycle, and Exergy appear to be a working tool to identify more clearly the most suitable energy source.
- ❖ As far as renewable energy is concerned, the procedure allows to identify beforehand the suitable feedstocks and possible conversion routes.
- ❖ CO<sub>2</sub> emissions due to energy generation, including fuels, is increasing around the world, but more drastically in countries with emerging economies. The share of renewables in electricity production (%) is still very low.

# Next Steps

- ❖ Database development.
- ❖ Update and expansion of the database of the energy matrix, including feedstock production and use for energy in each of the selected countries.
- ❖ Identification of possible raw-materials and conversion technologies in each of the selected countries.
- ❖ Evaluation of incentives using the Renovabio program as a case study.
- ❖ Generation of periodic reports and scientific papers.

# Data sources

## Latin America

|                  |                                                                   |                                                                                                                                                               |                                                                                                                                                         |
|------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Brazil</b>    | MME - Ministério de Minas e Energia                               | <a href="http://www.mme.gov.br/">http://www.mme.gov.br/</a>                                                                                                   |                                                                                                                                                         |
|                  | EPE - Empresa de Pesquisa Energética                              | <a href="http://www.epe.gov.br/pt">http://www.epe.gov.br/pt</a>                                                                                               |                                                                                                                                                         |
|                  | ANP - Agência Nacional do Petróleo, Gás Natural e Biocombustíveis | <a href="http://www.anp.gov.br/">http://www.anp.gov.br/</a>                                                                                                   |                                                                                                                                                         |
|                  | <hr/>                                                             |                                                                                                                                                               |                                                                                                                                                         |
| <b>Argentine</b> | Ministerio de Energía de la República Argentina                   | <a href="https://www.argentina.gob.ar/energia">https://www.argentina.gob.ar/energia</a>                                                                       |                                                                                                                                                         |
|                  |                                                                   | <a href="http://www.energia.gov.ar/contenidos/verpagina.php?idpagina=3483">http://www.energia.gov.ar/contenidos/verpagina.php?idpagina=3483</a>               |                                                                                                                                                         |
|                  |                                                                   | <a href="https://www.argentina.gob.ar/energia/hidrocarburos/balances-energeticos">https://www.argentina.gob.ar/energia/hidrocarburos/balances-energeticos</a> |                                                                                                                                                         |
| <hr/>            |                                                                   |                                                                                                                                                               |                                                                                                                                                         |
| <b>Colombia</b>  | MME                                                               | Ministerio de Minas y Energía - MinMinas                                                                                                                      | <a href="https://www.minenergia.gov.co/">https://www.minenergia.gov.co/</a>                                                                             |
|                  |                                                                   | Unidad de Planeación Minero                                                                                                                                   |                                                                                                                                                         |
|                  | UPME                                                              | Energética                                                                                                                                                    | <a href="http://www1.upme.gov.co/Paginas/default.aspx">http://www1.upme.gov.co/Paginas/default.aspx</a>                                                 |
|                  |                                                                   |                                                                                                                                                               | <a href="http://www1.upme.gov.co/InformacionCifras/Paginas/BECOENERGTICO.aspx">http://www1.upme.gov.co/InformacionCifras/Paginas/BECOENERGTICO.aspx</a> |
|                  | ANH                                                               | Agencia Nacional de Hidrocarburos                                                                                                                             | <a href="http://www.anh.gov.co/Paginas/inicio/defaultANH.aspx">http://www.anh.gov.co/Paginas/inicio/defaultANH.aspx</a>                                 |
| <hr/>            |                                                                   |                                                                                                                                                               |                                                                                                                                                         |
| <b>Mexico</b>    | SENER - Secretaría de Energía                                     | <a href="https://www.gob.mx/sener">https://www.gob.mx/sener</a>                                                                                               |                                                                                                                                                         |
|                  | SIE - Sistema de Información Energética                           | <a href="http://sie.energia.gob.mx/">http://sie.energia.gob.mx/</a>                                                                                           |                                                                                                                                                         |
|                  | FIDE - Fideicomiso para el Ahorro de Energía Eléctrica            |                                                                                                                                                               |                                                                                                                                                         |
|                  |                                                                   | <a href="http://www.fide.org.mx/">http://www.fide.org.mx/</a>                                                                                                 |                                                                                                                                                         |

# Data sources

## Africa

### *South Africa*

Department of Energy

<http://www.energy.gov.za/>

[http://www.energy.gov.za/files/energyStats\\_frame.html](http://www.energy.gov.za/files/energyStats_frame.html)

### *Nigeria*

Federal Ministry of Power, Works & Housing

<https://www.pwh.gov.ng/index>

## Asia

### *India*

Ministry of Power  
Ministry of New and Renewable Energy  
(MNRE)

<https://powermin.nic.in/>

<https://mnre.gov.in/>

### *China*

China Energy Portal

<https://chinaenergyportal.org/>

<http://www.stats.gov.cn/english/Statisticaldata/AnnualData/>

## Europa

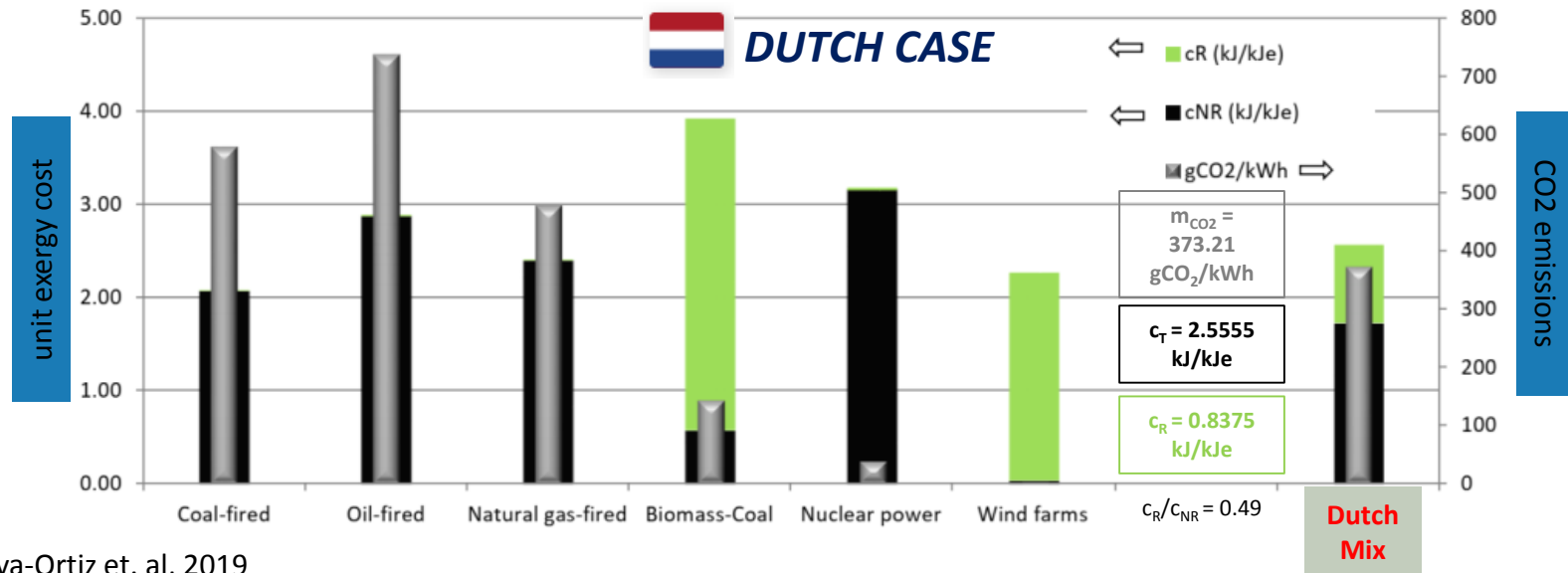
### *Russia*

Ministry of Energy of the Russian Federation

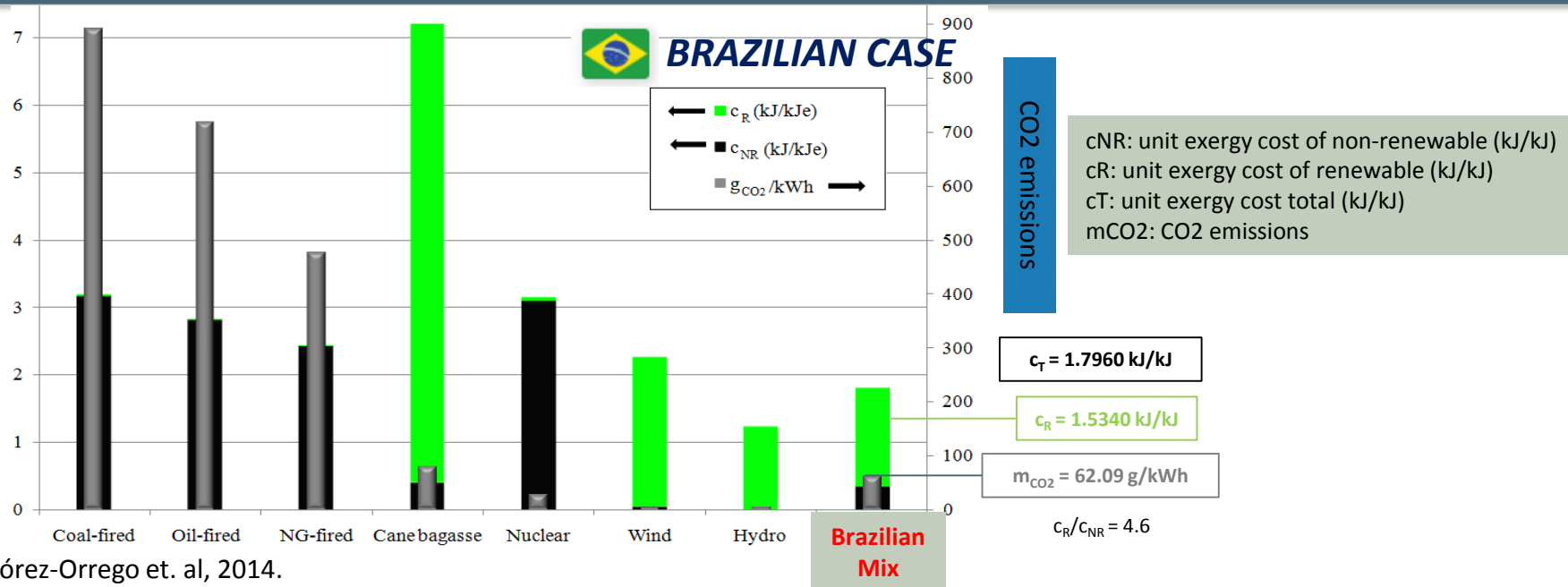
<https://minenergo.gov.ru/en>

<https://minenergo.gov.ru/en/activity/statistic>

# Unit exergy cost and CO<sub>2</sub> emissions of the electricity generation



Source: Silva-Ortiz et. al, 2019



Source: Flórez-Orrego et. al, 2014.

# Task 39 LCA Activities

**Don O'Connor**

(With Adrian O'Connell, Michael Wang, Antonio Bonomi)

**Virtual Business Meeting**

**4PM CET, 2 April 2020**

# Regional LCA Data

- In Brazil, RenovaBio applications are made public for 30 days for a public comment period.
- Applications contain information on energy and material use through the supply chain.
- Antonio has indicated that it has been their intention to prepare a report on the aggregate values that result from the RenovBio program but Antonio's view is that the public data has not yet been validated by the third party validators, some of the companies have redacted (poorly) some of the data, and some companies have used default values rather than actual values.
- Best to wait until these issues are resolved, although it is noted that once the applications are approved the data in the application is no longer publicly available.

# Summary Paper for Policy Makers

- Adrian looking at developing a summary paper for policy makers on the factors having the biggest impact on LCA results.
- It would discuss allocation issues, N<sub>2</sub>O emission variability, and possibly soil carbon changes.

# Co-processing

- Continue to follow the development of the co-processing LCA methodology.
- CARB approved one pathway in the US (tallow HT) but with some surprising results that couldn't be explained with the information that was made public.
- A second refiner has indicated their intention to begin co-processing later this year. Feedstock to FCC rather than HT and thus makes mostly gasoline. This is a much more complicated process to model.

# Land Use Change

- Provided feedback on the feedstock emissions used in recent Ricardo, IFEU, and E4tech presentation for the EU DG Clima.
- ILUC values from some of the models, with known issues, are again being used for other work.
  - Able to provide reports documenting the reason for different results from GTAP and Globiom.
- The issue of how to define the counterfactual case for residues was raised in the Ricardo report and the assumptions had a large impact on the results.

Sustainability assessment of biofuel pathways to  
identify key metrics beyond GHG reduction,  
spanning both feedstocks and conversion  
technologies

**IEA Bioenergy TCP Task 39 virtual meeting – 4pm CET, April 2<sup>nd</sup> 2020**

D. O'Connor, A. O'Connell, A. Bonomi, M. Wang

# Background

- Task 39 and its members continue to be involved in extensive<sup>1,2</sup> comparisons of different biofuel pathways and models
- All modelling requires simplifications, wish to discuss and consider more clearly some of the main factors which can influence LCA results
- Idea is to complete an overview report for policy makers which will help them understand how different choices or assumptions in some of these factors can significantly affect LCA results

(1) For example please see: Comparison of Biofuel Life Cycle Analysis Tools; Phase 2, Part 1: FAME and HVO/HEFA (Dec 2018), Phase 2, Part 2: biochemical 2G ethanol production and distribution (Dec 2019), and (2) “Policy Implications of Allocation Methods in the Life Cycle Analysis of Integrated Corn and Corn Stover Ethanol Production” (Canter et al, 2016)

# Proposed focus areas - 1

1. Soil carbon changes; discuss ranges and summarise effects on results
2. Soil N<sub>2</sub>O/N<sub>2</sub>O emission factors
3. Allocation approaches; discuss effect on results
4. Waste definitions, displacement, or “system boundaries”; some LCA systems consider avoided emissions, what about displacement?
5. Energy balance; a new fuel may have promising GHG reductions but may exhibit a relatively poor energy balance compared to alternatives
6. CO<sub>2</sub> input considerations for power-to-fuels
7. GWP factors
8. Accurate co-processing bio-component tracking/accounting, effect of renewable hydrogen in fuel production

# Proposed focus areas - 2

- Accurate co-processing bio-component tracking/accounting, effect of renewable hydrogen
- Data accuracy issues
- Water use
- Any other items to be add/delete?
- *Land use change (already long discussed and considered)*

# Next steps

- Decide priority areas
- Decide on output(s)
- Define approximate timeline
- Begin research
- Schedule a conference call to discuss progress