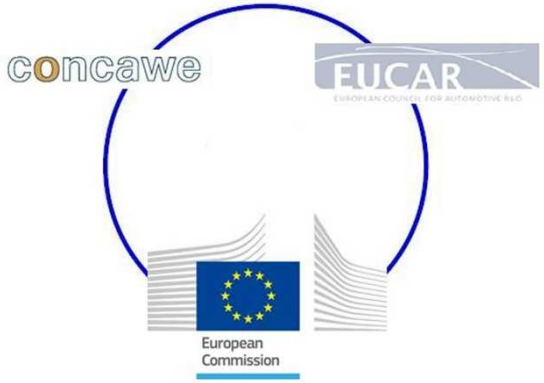
JEC Well-to-Wheels: considerations on methodology choices



Session: Well-to-Wheels/life-cycle analysis of fuels and vehicles comparing methodologies

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Overview

- Background of JEC activities
- Objectives
- Setting the boundaries of JEC WTW analysis
  - Scope
  - Time horizon (established vs. promising technologies)
- Methodological choices
  - Marginal approach
  - Co-product treatment
- Wrap-up: key messages

JEC WTW

Background

- JRC: Joint Research Centre of the European Commission
- EUCAR: European Council for Automotive R&D
- CONCAWE: the oil companies' European association for environment, health and safety in refining and distribution

2000-2014: Projects Completed

- Well-to-Wheels (WTW) Studies:
  - Version 1 (2004)
  - Version 2a and 2b (2007)
  - Version 3c (2011)
  - Version 4 (2013): WTT and TTW Reports and Appendices
  - Version 4a (2014) full set of reports: WTT/TTW/WTW and appendices
- Impact of ethanol on vehicle evaporative emissions (SAE 2007-01-1928)
- Impact of oxygenates in gasoline on fuel consumption and emissions (2014)
- JEC Biofuels Study for a 2020 time horizon (2011); revised analysis (2014)

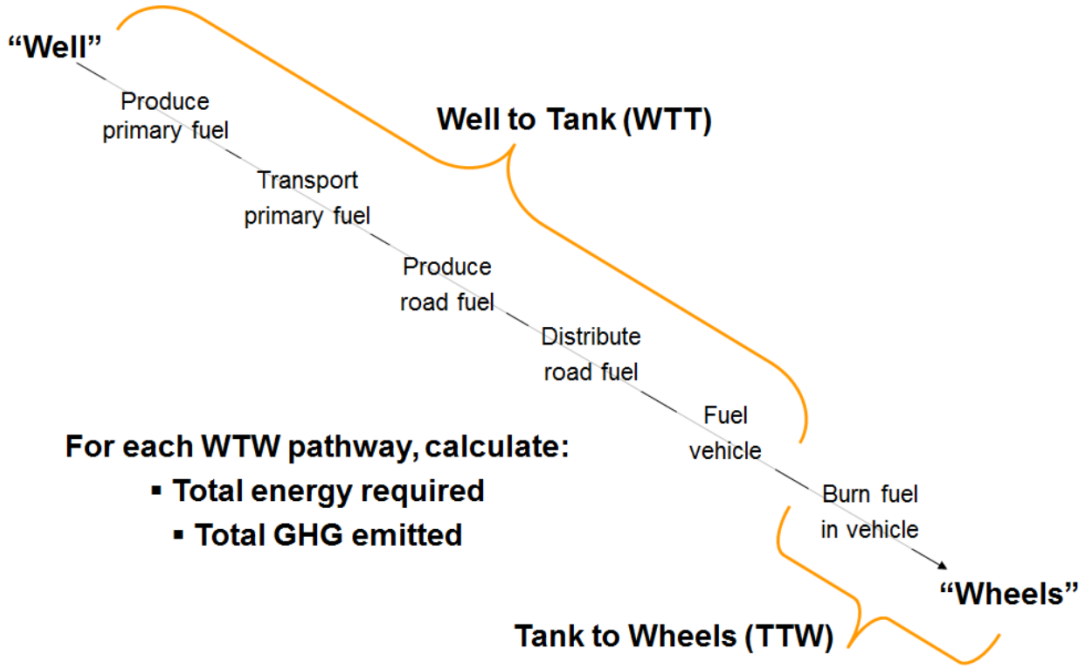
2015-17: Projects in Progress

- WTW Version 5
- Alternative Transportation Fuels: regulatory development (+) scenario analysis

JEC WTW

European Commission

Objective



Establish in a transparent and robust manner

a consensual well-to-wheels analysis of

energy use

and

GHG emissions assessment

of a wide range of

automotive fuels and powertrains

relevant to Europe

at

a given time horizon

[V4a (=) 2020+]

JEC WTW System Boundaries

European Commission

Scope:

JEC WTW pathways are representative of an average or typical* EU situation:

* Implicit assumption:
Impacts are the same impact wherever they occur.
☑ True for GHG emissions acting at global scale
☒ False for other metrics (air pollution or water use): effects heavily dependent on local conditions

Time horizon: [V4a (=) 2020+]
Emerging technologies → uncertainty accounted for via:
(1) Performance figures (=) Variability (min-max) ranges
(2) Alternative options (=) distinct/additional pathways

WTT

- Input data are *generally* European:
  - Biofuels come mostly from EU crops
  - Typical transport distances and modes
  - Oil supply (crude mix) and refining (refinery configuration)
  - EU emissions used for fertilizers and chemicals applied also abroad
- Some pathways involve a different geographic scope

TTW

- Set of market requirements assumed for all vehicle technologies/configurations:
  - Vehicle performance criteria and qualitative characteristics (comfort, driveability, interior space)
  - EU regulatory framework on pollutant emissions
  - Drive cycle for vehicle type-approval in the EU

Marginal/ incremental approach:

Aim: to assess the marginal impact of extra (or less of) any given fuel.

The marginal/incremental approach is instrumental to:

- Guide judgements on the potential benefits of substituting conventional fuels/vehicles by alternatives;
- For future fuels: understand where the additional energy resource would come from (if demand for a new fuel were to increase).

☑ Marginal refining emissions (Concawe EU refinery model)
Marginal natural gas
Marginal processing of biofuel (new bio-refinery)

☒ Average emissions as proxy:
EU electricity emissions
Crops cultivation: marginal emissions for *extra* crop:
from yield intensification
expansion onto marginal cropland

Co-product treatment:

Accounting for co-products: wherever possible substitution (displacement or system expansion) method should be used [ISO 14044].

A given (fuel) production process may produce multiple products besides fuel.

- ↳ Substitution approach: products displaced by non-fuel products are determined
- ↳ Energy use and emissions burdens of producing the otherwise displaced products are estimated.
- ↳ Estimated energy use and emissions burdens are credits subtracted from the total energy use and emission burdens of a fuel production cycle
- ↳ Net GHG emissions are attributed to the produced fuel considered.

☑ Closer representation of “real-life”: economic choices of stakeholders

☒ Uncertainty: outcomes dependent on fate of co-products

Example

European Commission

Methodology choices

Substitution vs. allocation by energy content

Choice of co-product treatment method dependent on purpose of exercise:

JEC WTW: scientific advice on transportation fuel options

- impacts of co-products depend on
- *what the coproduct substitutes*

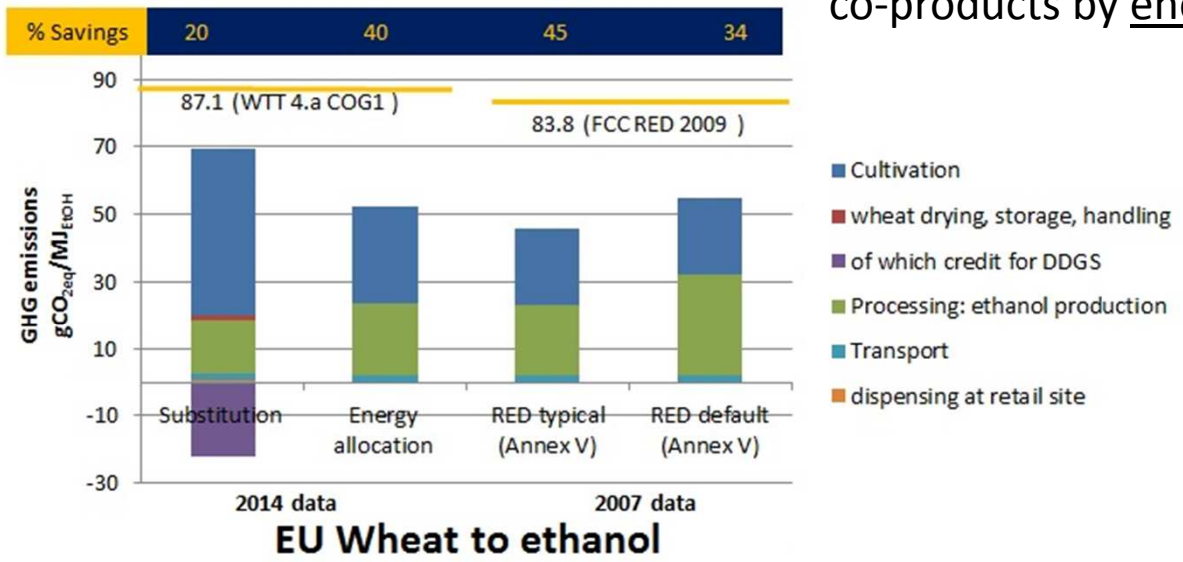
↳ Substitution method

≠

EU RED*: mandatory target/reporting

- clear cut assignment of emissions between economic sectors (+)
- ease of implementation (+)
- no "perverse" incentives (=)

↳ GHG emissions allocation to co-products by energy content



EU Wheat to ethanol

* Directive 2009/28/EC of 23 April 2009

JEC WTW

Key messages

System boundaries

- Comparability between pathways at regional scale (Europe)
- Time comparability: robustness check as/if technologies become established

Methodology choices

- Marginal approach: reflecting rational choices of economic operators
- Co-product treatment: fit for the purpose of the exercise

Additional considerations

☒ Land Use changes are not included:

- Direct Land Use Change can be estimated (IF the field/area from which any "new" batch of biofuel comes is known)
  - ↳ dLUC emissions can be evaluated separately and added.
- If crops or cropland are diverted from other production to biofuels, then Indirect Land Use Change emissions result: iLUC occurs outside the product system assessed.
  - ↳ iLUC is projected/assessed with economic models (commodity prices across economic sectors are affected by biofuel production).
  - ↳ The WTW methodology

☑ Transport applications may not maximise GHG reduction potential of alternative/renewable energy sources (limited availability/capacity to exploit)

- ↳ The WTW methodology is adaptable to estimate alternative uses of primary energy sources (e.g. road fuels and *"what if we produced electricity instead"…)*

Thank you for your attention ☺

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http://iet.jrc.ec.europa.eu/about-jec

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