ADVANCEFUEL

Setting up the common framework for ADVANCEFUEL project

D1.3 Framework for WP2-6

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Abbreviations

BFB : bubbling fluidized bed
BMEP : break mean effective pressure
BTE : brake thermal efficiency
BTL : biomass-to-liquid
BSFC : brake specific fuel consumption
CAPEX : capital expediters
CFB : circulating fluidized bed
CHP : combined heat and power
CNG : compressed natural gas
DFB : dual fluidized bed
DME : dimethyl ether
EFA : energy flow analysis
FAME : fatty acid methyl ester
FFV : flexible fuel vehicle
FT : fischer-tropsch
FT-SPD : fischer-tropsch hydroprocessed synthetic paraffinic diesel
GHG : greenhouse gas
GTL : gas-to-liquid
HRD : hydroprocessed or hydrotreated renewable diesel
HRJ : hydroprocessed or hydrotreated Renewable Jet
HVO : hyrotreated vegatble oil
ICE : internal combustion engine
IGCC : integrated gasification combined cycle
iLUC : indirect land use change
KPI : key performance indicator
LCA : life cycle assessment
LHV : lower heating value
LNG : liquefied natural gas
MFA : material flow analysis
NEDC : new European driving cycle
OPEX : operational expenditures
R&D : research and development
RED : renewable energy directive
SI : spark ignition
SNG : synthetic natural gas
SPD : synthesized paraffinic diesel
SRC : short rotation coppice
SPK : synthesized paraffinic kerosene
SRP : short rotation poplar
TRL : technology readiness level
WLTP : worldwide harmonized light vehicles test procedure
WP : work package
TtW : tank-to-wheel
WtT : well-to-tank
WtW : well-to-wheel

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Introduction

The overarching goal of the Horizon 2020-funded EU project **ADVANCEFUEL** is to facilitate the market roll-out of advanced liquid biofuels and other liquid renewable fuels (further jointly addressed as “RESFuels”) in the transport sector between 2020 and 2030. The project will provide the market stakeholders with new knowledge, tools, standards and recommendations to remove the most prominent barriers and detect development opportunities for their commercialisation.

This document aims to set a common analytical framework that systematically guides the research to be conducted in work packages (WPs) 2 to 6. It aims at creating the coherence between the WPs that focus on different steps of the considered biofuels' value chain and the integrated assessment work package (WP6). More specifically, this document:

- defines the main focus of this project and introduces the system boundaries,
- presents a general framework that structures the analyses steps,
- defines the main interactions and the possible risks, and
- introduces the key terminologies and definitions that are used within the different WPs.

The report consists of four chapters. Chapter two details the project focus and sets the boundaries of this project. Chapter three focuses on the general framework and introduces the main interactions and the possible risks in the execution of the project. Chapter four introduces the main definitions that will be used across the project.

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ADVANCEFUEL project focus and the project boundaries

The **ADVANCEFUEL** project aims at increasing the market uptake of liquid advanced biofuels and other liquid renewable fuels, jointly referred to as 'RESFuels'.

- **Liquid advanced biofuels** are defined as all liquid biofuels produced from lignocellulosic biomass, through thermochemical or biochemical pathways, in which the latter includes a cellulose hydrolysis step. The lignocellulosic biomass includes feedstocks as specified in Annex IX of the EU renewable energy directive proposal (COM (2016) 767 final/2)[1] (hereafter referred to as the REDII proposal).
- Advanced biofuel conversion pathways are at different stages of technological maturity. The main focus is on **the demonstration and (near-) commercial scale technologies**. There is less attention to technologies that are at the research and early prototype stage.
- While advanced gaseous fuels are part of the study they are considered as intermediates rather than the end products.
- **Other liquid renewable fuels** are essentially all renewable fuels that do not have biomass as feedstock basis. These include liquid fuels produced from hydrogen and CO_2, provided that the hydrogen is generated from renewable resources, i.e. by using renewable power for the electrolysis of water to gain hydrogen for further processes. Also direct 'solar fuels' can be included in this definition

The definition of RESFuels in this project slightly differs from the coverage of the advanced fuels introduced in the REDII proposal. The main differences are summarised below.

- The REDII proposal includes both liquid and gaseous fuels, whereas the focus in this project is limited to liquid fuels. Thus, WP 2 to 5 will focus on the feedstock and conversion technologies that result in renewable liquid fuels to replace fossil-based liquid fuels.
- The REDII proposal also includes renewable electricity and waste-based fuels. These fuels are excluded in this study. Nevertheless, the integrated assessment (WP6) includes the implications of electrification in road transport on liquid advanced biofuels.

Figure 1 illustrates the schematic overview of the RESFuels coverage within the **ADVANCEFUEL** project.

[1] Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources (recast)

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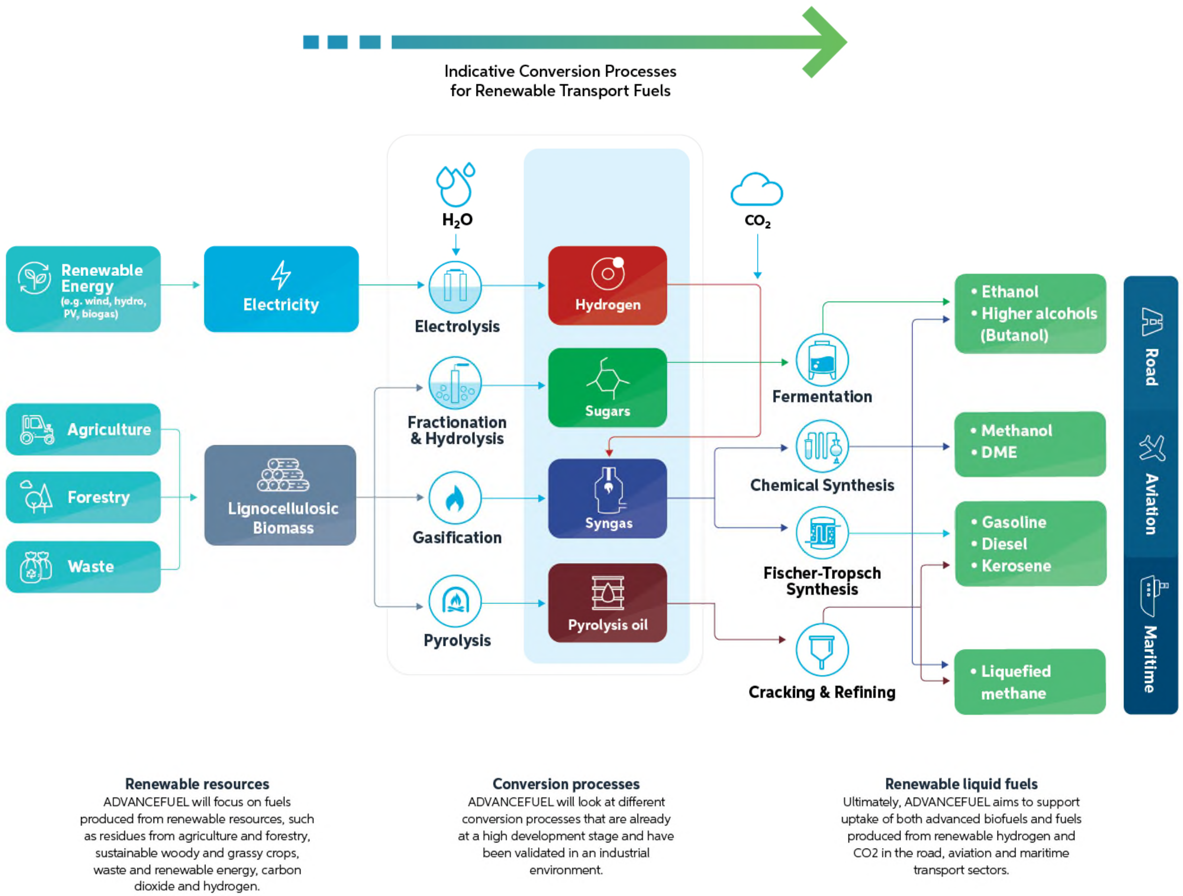

Figure 1 ADVANCEFUEL project main focus (feedstock-to-renewable fuels pathways)

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The main feedstock focus is lignocellulosic biomass that originates from agriculture, forests and waste. Table 1 introduces the feedstock categories, which are included in this project.

Table 1 Categorisation of lignocellulosic biomass feedstock

Biogenic wastes	Agriculture	Forestry
Biomass from roadside	Processing crop residues	Processing residues
	• e.g. husk (rice, coconut, coffee, bagasse, grape marcs) and wine lees, nut shells	• e.g. wood chips, sawdust, trimming, cut-offs, liquor (black and brown), fibre sludge
Organic waste from industry	Harvesting crop residues	Low-value woods
• e.g. bulk transport packaging, recovered post-consumer wood residues (construction and demolition debris) (excluding wood which goes to non-energy uses), molasses	• e.g. corn stover, straw (wheat, rice, cassava), empty palm fruit bunches	• e.g. low-quality stems and stumps which have no current market
Biomass from landscape management	Lignocellulosic fractions of agroforestry systems	Forest residues
• e.g. leaf fall and grass clippings	• e.g. orchards, shrubs and trees (for productive, diverse, ecologically-sound and healthy land use)	• e.g. thinning, clearing, logging from conventional harvest operations
Biomass fraction of mixed municipal solid waste, excluding separated household waste subject to recycling	Grassy Energy crops • e.g. ryegrass, switchgrass, miscanthus, giant cane and cover crops before and after main crops	Industrial round wood and pulpwood
	Woody energy crops • e.g. short rotation coppice (SRC), willow, short rotation poplar (SRP))	

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Common analytical framework of the project

1.Main stages of the framework

The ADVANCEFUEL project consists of 9 work packages (WPs) with several interlinkages. Figure 2 illustrates the project structure. A common analytical framework is established in consideration of the 9 WPs. This framework consists of four main steps:

- Identifying the main barriers
- Defining the scope of the problem and assessing the possible ways forward
- Identifying scenarios
- Examining the effects in all domains (socio-economic and environmental).

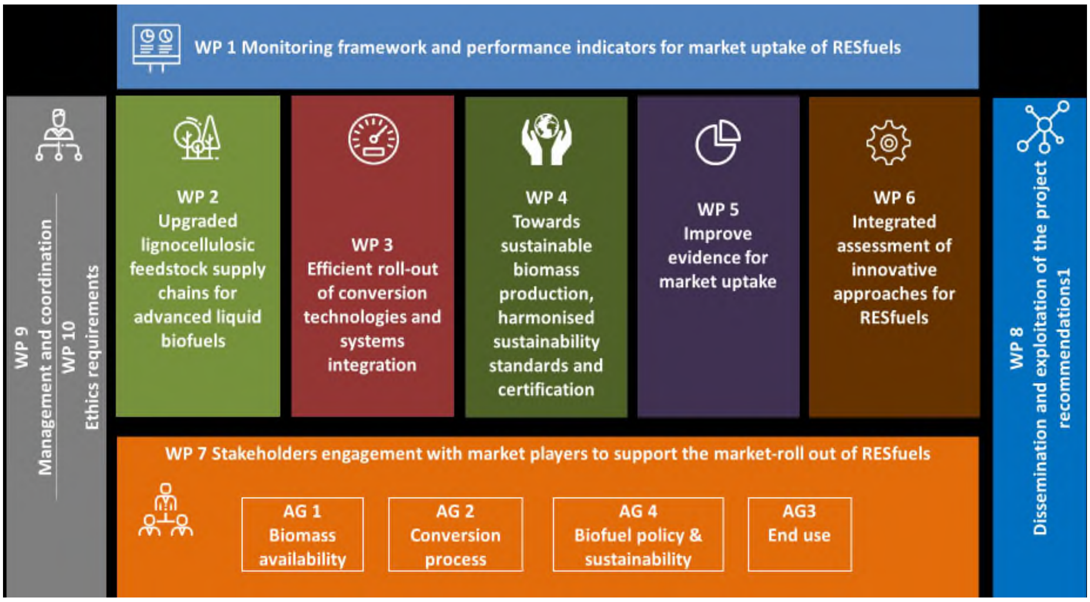

Figure 2 ***ADVANCEFUEL*** *project approach*

Identifying the main barriers

Development and deployment of large scale RESFuel projects face serious challenges. The conversion technologies are in different stages of maturity and they face different technical challenges hindering their further development. Their large scale commercialisation depends on overcoming these challenges. WP1, Deliverable 1.1 summarises the technical, economic, social, environmental and regulatory barriers to advanced biofuels. Through consultations these barriers will be prioritised and serve as input to the following WPs.

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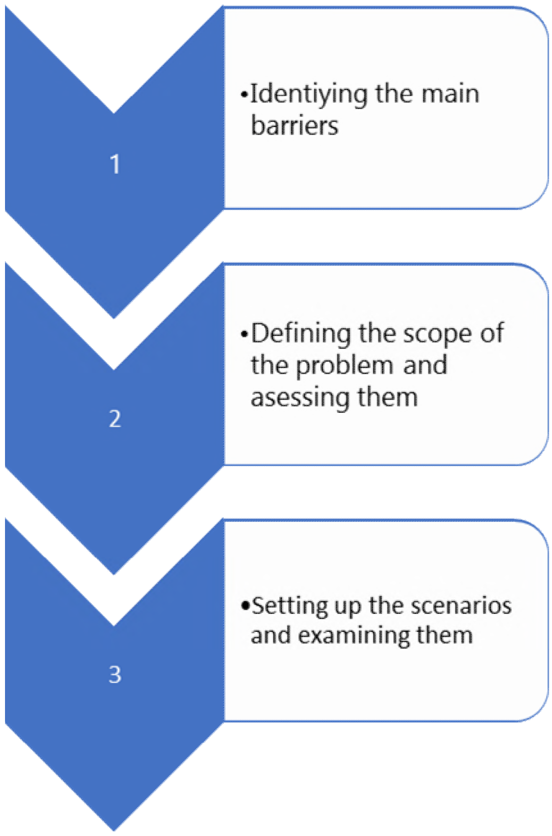
Defining the scope of the problem and assessing the possible ways forward

Identifying main barriers help to frame the scope of the assessment in different WPs. The assessment covers the complete value chain; feedstock supply, conversion processes and end use. Additionally, sustainability and certification requirements across the value chains are analysed in detail. Assessments, in general lines, include:

- Identifying the innovative approaches to overcome the key barriers through stakeholder involvements (interview, questionnaire, dedicated workshops), literature and internal discussions within the project consortium
- Analysing these innovative approaches
- Defining the expected time frames to implement them (2020, 2030 and/or 2040).



Identifying scenarios and examining the effects

There is a dedicated work package, WP6, that focuses on the integrated assessment of different innovative approaches using inputs from other WPs for different steps of the biofuels' value chains. WP6 integrates the proposed solutions and provides insights in the full-chain fuel costs, taking into account the feedstock costs and potentials, logistics, technology performance and market demand. The assessment is done using various demand and supply scenarios that take into account socio-economic as well as environmental aspects. The overall objective of this exercise is to define strategies for the future development of RESFuels.

2. Harmonisation of the project work and the main interlinkages

There are many interlinkages and interdependencies among the different WPs. Therefore, a harmonised working structure that is agreed up on by all WP leaders is obligatory for the success of this project. In order to streamline the working processes and increase the coherence, the information flows between work packages are prepared for each WP and presented in Annex 1. These information flows are structured as follows:

- Per WP, information and data needed from other WPs are presented,

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- Outputs of the corresponding WP are then established which should serve as input for other WPs.

Table 2 gives an overview of the key outputs from work packages that are needed as input for other work packages. The expected month of delivery is compared with the month when this information is needed by other work packages. It also indicates possible tensions that may occur in the course of the project due to potential interferiences of the concerned subtasks' timelines. The colour coding is used to indicate whether the planning is smooth or whether there may be some tensions. Green means the work is scheduled in time to feed-in to other WPs. Blue colour means the work is scheduled just in time but attention is needed not to cause any delays. Red colour highlights critical phases in the project, where WP-specific timeliness/schedules require harmonisation.

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Table 2 Overview of outputs of work packages and month of delivery (left three columns) and months when needed as input for other work packages, right eight columns. On the right part a colour coding is used: green means on time, blue means just in time and attention is needed, red colour highlights critical phases in the project.

Output from WP			Input for other WPs as indicated by month needed								Clarifications
WP	Output ID	Month	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	
1	Barriers background document	4		6	6	6	6	6			
	Monitoring framework and the KPI's	4		6	6	6	6	6			
	A common framework with definitions	6		6	6	6	6	6			
2	Relevant results for KPI quantification	12,20	18,30								
	Identification of innovative crop rotation schemes	18					18				
	Domestic feedstock availability (cost-supply) up to 2040	12				13		14			
	Import scenarios including cost-supply of biomass/biofuel import potential	9						14			
	Innovative crop rotation schemes (with cost-supply data)	20					20	20			
3	Relevant results for KPI quantification	18, 30	18,30								The KPI quantification of WP3 is set at the same data of the WP1 deliverable.
	Requirements on biomass quality for the different processes	10		10							
	Advanced biofuel conversion system characteristics over time (efficiency, CAPEX, OPEX etc.)	13						20			
	Estimation of potential increase in TRL level can be achieved and the probability for this to happen within a 5-10 year period	24						20			The modelling will use this information to update the techno-economic data. There is a risk that the info may be too late
	Financial risk and instruments for	24						24			

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	financing demonstration and piloting										
	Options for greening of the fossil fuel infrastructure	18						20			
	Possible timelines for implementation of biomass conversion technologies and associated requirements on R&D, financial support and policies	20, 32						20			This info will be highly relevant for the modelling. The timely deliverable is of high importance.
4	Relevant results for KPI quantification	18, 30	18,30								The KPI quantification is set at the same data of the WP1 deliverable.
	Feedstock and location specific environmental impacts (database, report)	30						26			The assessment results will be relevant in defining the policy recommendations in WP6. An early first draft from WP4 is essential
	Relevant sustainability indicators of innovative crop schemes	12						20			
	Environmental and socio-economic performance of advanced fuel production systems	24						26			
	Life cycle GHG performance per supply chain (feedstock + conversion combination)	34						26			Advisable to incorporate the GHG emission results to WP6. This will require an early analysis from WP4.
5	Brief description of Best Practice (in a set format)	18, 36						20			
	Relevant results for KPI quantification	18, 30	18,30								The KPI quantification of WP3 is set at the same data of the WP1 deliverable.
	List of relevant gaps in current policy formation	30						26			WP6 will define policy recommendations. Relevant gaps in current policy formation can help defining these recommendations.
	Technical limitations end use: RESFuels possible per engine type, blending limitations							20			An agreement needs to be done between WP5 and WP 6.

	Numerical tools for fuel and fuel blend properties	33									
6	Relevant results for KPI quantification	26, 30	18,30								The GHG emission and employment effects of selected value chains will only be informed in month 30. Month 18 will not include this KPI.
	Development pathways for RESFuels	26									
	Market segmentation, end uses and policy recommendations	26							27		
7	Stakeholder workshop for an early recording of stakeholder requests and for mutual discussions about key barriers	6	6								Barrier prioritisation should be based on a dedicated workshop results. However, it was not possible to implement the original planning of holding a workshop at that early stage of the project. Hence, the respective report D 1.1 remains a working document until M12.
	Workshop on biomass availability	12				12					Unless the workshop is organised early in the month, it may be late to contribute to the final deliverable
	Workshop on RES fuel conversion technology solutions	17		22							
	Workshop on RESFuel sustainability	22						24			
	Workshop on RESFuel market roll out	27						26			
8	The stakeholder mapping and Communication Plan	3	4	4	4	4	4	4	4		
	additional plan on communication tools and channels	6	6	6	6	6	6	6	6		

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Foreseen risks and the actions to overcome them

Table 2 illustrates the main risks in red. The risks and the suggested solutions are summarised below.

1. The annual quantification of KPIs

The key performance indicators (KPIs) are suggested to be quantified annually and at the defined months 18 and 26. Two groups of KPIs are identified. The first group relates to the project monitoring. The KPIs are designed based on the main goals of the different WPs to monitor the progress in each WP. However, the planning in each WP in general is not established in the same months of 18 and 26 for the KPI quantification. Therefore, the quantification of WP related KPIs will be limited in month 18. The second group of KPIs that focuses on monitoring of the European RESFuel market will be updated both in month 18 and month 26.

2. Estimation of potential increase in TRL level

Integrated assessment in WP6 applies the RESolve-Biomass model. This model currently covers the technologies that have high technology readiness levels (TRL). The information from WP3 on possible TRL increases may have consequences to updating the RESolve model and including other technologies. An update will be needed when necessary. However, the original timing of this task in WP3 happens somewhat later. To avoid this inconsistency, a timely agreement between WP3 and 6 will be necessary.

3. Feedstock and location specific environmental impacts.

The assessment report in WP4 is planned at a later stage than the integrated assessment. The integrated assessment and the policy recommendations in WP6 can make use of the main finding from WP4. Draft results of the assessment in WP4 will be made available in an earlier stage to feed in to the recommendations of the integrated assessment.

4. Life cycle GHG performance per supply chain (feedstock + conversion combination)

WP4 sets the greenhouse gas (GHG) emission performance at a later stage than the integrated impact assessment in WP6. It is, however, advisable to incorporate the GHG emission calculations in WP6. This will require implementing the GHG performance in WP4 at an earlier stage. To this purpose, the draft report and appendix (Excel based GHG footprint calculation tool) will be made available in Month 24.

5. List of relevant gaps in current policy formation

Integrated assessment in WP6 will result in policy recommendations. It is advisable to include the conclusions of WP5 related to the gaps in current policy formation (which have originally been scheduled at a later date) to these recommendations. A first draft report focusing on the gaps in current policy formation will be made available in Month 24 for WP6.

6. Dedicated stakeholder workshop for identification and prioritisation of barriers.

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The initial stakeholder workshop planning was too optimistic. It was not realisable (in regard to already presentable results) to organise the first workshop in M6. Therefore, this task is postponed to a later stage. In the meantime, presentations at other conferences and online surveys are used to gather feedback on the identified key barriers.

7. Report on review of standards and certification schemes
As part of an exhaustive review of standards for biofuels and related certification schemes, a consultation with various stakeholders is carried out given the changing legislation at EU and national level. As the consultation requires several months of interviews, follow-up discussions, and also a consultation summary, it is proposed to deliver the report in month 14 instead of the planned month 12.

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Main definitions

In chapter two, the project focus and system boundaries are described and the terms liquid advanced biofuels, other liquid renewable fuels, lignocellulosic biomass and the considered conversion processes are explicitly defined. Here definitions with respect to feedstock supply potential, infrastructure and specifications, conversion technology parameters and efficiencies, sustainability performance, and end use specifications and infrastructure are provided. The definitions also include the respective nomenclature and data requirements. Where applicable, the definitions are compatible with previous research work in the FP7 S2BIOM[2] project, covering the whole biomass delivery chain - from primary biomass to end-use of non-food products, and from logistics and pre-treatment to conversion technologies). They also consistent with the definitions in the EU Directives and strategies on biofuels (e.g., from the Directives 2009/28/EC, 2009/30/EC, known as Renewable energy Directive (RED), to the REDII proposal and recent amendments of it as adopted by the European Parliament in January 2018).

1. General definitions

For assessing the overall efficiency of the RESFuel value chains the project adopts the concepts of Well-to-Wheel (WtW) analysis. WtW focuses on the energy use and GHG emissions in the production of fuel and its use in the vehicle or engine. The system boundaries of the WtW analysis are equivalent to those of a cradle-to-grave Life Cycle Assessment (LCA), which is performed as part of the sustainability assessment of the project (WP4). However, the inventories in WtW analysis do not include those related to feedstock supply and conversion technology facilities and vehicles, consumption of other materials and water, and end of life disposal. It should be stressed that care must be taken when comparing WtW performance from various other LCA studies since these studies may apply different approaches. Another challenge is to account for future development of technologies.

The WtW analysis is divided into two sections. The well-to-tank (WtT) accounts for the energy expended and associated emissions to deliver the finished fuel in the fuel tank and is used to compare different conversion technologies, namely with respect to the energy requirement to produce one unit of fuel. The tank-to-wheel (TtW) refers to the final conversion of the fuel in the vehicle.

The WtW total energy [MJ_{input}/MJ_{out}] refers to the total fossil and renewable energy used to produce 1 MJ_{out} at the crankshaft of the engine, on lower heating value (LHV) basis. The calculation of the total WtW energy is based on the WtT energy expended [MJ_{eq}/MJ_{fuel}] (i.e. same units as the cumulative energy demand in LCA) and the TtW energy consumption in the engine, as calculated by Edwards et al., (2014).

[2] http://www.s2biom.eu/en/about-s2biom.html

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The WtW GHG emissions represent the total grams of CO_2 equivalent emitted in the process of producing 1 MJ_{out} from the engine, and are expressed in [gCO_2eq/MJ_{out}]. The interpretation of the results of the WtW analysis may require a transformation of the unit basis to consider specific end uses of the fuel (e.g., in light-duty or heavy-duty vehicles, powertrains, etc.) and be expressed, for instance, in MJ/km and MJ/(t*km) or gCO_2eq/km and gCO_2eq/(t*km), respectively. The end uses of the fuel are further discussed in the definitions in section 4.2.4.

Based on the WtW analysis, an additional indicator for the assessment of the overall value chain of the RESFuel is the biomass impact (BI), expressing the WtW emissions reduction from a "reference" fuel alternative (e.g. natural gas, diesel, kerosene, methanol) per MJ of biomass [$gCO_2eq/MJ_{biomass}$] (Alamia et al., 2016). Here, the following assumptions are made:

- a mix of renewable and fossil energy is present either in the market, in the fuel blend or in the combustion process also in the medium-long term
- biofuel availability is limited by the amount of sustainably grown biomass

The inventory analysis for the WtW and BI efficiency metrics, although not as comprehensive as for LCA, should comply with the standards of LCA to be performed in WP4. This will harmonise the two types of calculations for the common part of the inventory analysis, namely the direct energy use and GHG emissions.

The assessment of the RESFuel technologies with respect to efficiency, sustainability and economic aspects is performed in an environment of national support policies which should be predictable, stable and avoid frequent or retroactive changes. In this context, they should be cost effective and economically sustainable (REDII proposal).

RESFuel technologies will be investigated and assessed as standalone value chains as well as in the context of integrated bio-refineries, involving potentially synergies with circular economy and bio-economy to ensure the most valuable use of feedstocks.

National legislations and strategies supporting the bio-fuel market will be assessed under consideration of resource efficiency and optimised use of biomass.

2. Terminologies and definitions in the biofuel production value chain

Feedstock supply

WP2 focuses on biomass potential analysis and the assessment of innovative cropping systems. The definitions and terminologies used in WP2 are presented below

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Table 3 Main terminologies that will be used in WP2

Terminology	Definition
Theoretical potential	Biomass supply according to biological and physical principles = maximum availability of biomass.
Technical potential	Part of the theoretical potential, which can be used when technical and ecological restrictions are considered.
Economic potential	Part of the technical potential, when economic criteria are being used.
Sustainable potential	Part of the technical potential without any negative social, ecological and economic costs considering the technological and the market development.
Innovative cropping systems	Cropping systems, which have not been widely implemented nor studied in detail and thus not considered by peer-review publications.
Lignocellulosic material	Material composed of lignin, cellulose and hemicellulose such as biomass sourced from forests, woody energy crops and forest-based industries' residues and wastes.
Agricultural residues	Residues that are directly generated by agriculture; they do not include residues from related industries or processing.
Arable land	Land worked (ploughed or tilled) regularly, generally under a system of crop rotation. Crop rotation is the practice of alternating annual crops grown on a specific field in a planned pattern or sequence in successive crop years so that crops of the same species are not grown without interruption on the same field. Normally the crops are changed annually, but they can also be multiannual. To distinguish arable land from permanent crops or permanent grassland, a threshold of five years is used. This means that if a plot is used for the same crop for five years or more, without in the meantime removing the preceding crop and establishing a new one, it is not considered arable land.
Biofuel pellet	Biofuel pellet is a densified biofuel made from pulverised biomass with or without additives usually with a cylindrical form, random length typically 3,15 mm to 40 mm, and broken ends. The raw material for biofuel pellets can be woody biomass, herbaceous biomass, fruit biomass, or biomass blends and mixtures. They are usually manufactured in a die. The total moisture of biofuel pellets is usually less than 10 % of mass as received.
Bio-waste	Biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers

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	and retail premises and comparable waste from food processing plants.
Forestry residues	Residues that are directly generated by forestry; they do not include residues from related industries or processing.
Marginal land	Land on which cost-effective food and feed production is not possible under given site conditions and cultivation techniques (Wicke, 2011).
Non-food cellulosic material	Feedstocks mainly composed of cellulose and hemicellulose, and having a lower lignin content than ligno-cellulosic material; it includes food and feed crop residues (such as straw, stover, husks and shells), grassy energy crops with a low starch content (such as ryegrass, switchgrass, miscanthus, giant cane and cover crops before and after main crops), industrial residues (including from food and feed crops after vegetal oils, sugars, starches and protein have been extracted), and material from biowaste.
Energy crops	Non-food herbaceous and woody crops that are established and managed under an intensive short-rotation regime, typically on agricultural land. Crops considered are most often fast growing woody (willow, poplar) or herbaceous crop types (switchgrass, miscanthus).
Short Rotation Coppice (SRC)	Wooded areas managed for growing wooded plants, where the rotation period is 20 years or less. The rotation period is the time between the first sowing/planting of the trees and the harvest of the final product, where harvesting does not include normal management actions like thinning.
Safeguards for biotic energy sources	Safeguards for protecting biodiversity, preventing depletion of ecosystems and any diversion from existing uses with negative direct or indirect on biodiversity, soil or greenhouse balance (i.e., according to REDII proposal).
Indigenous feedstocks	Feedstocks that contribute to decreasing imports from third countries (i.e., preferred according to REDII proposal).

A well characterised feedstock for a conversion technology comprises the following information:

- Biomass input common for the technology used
- Traded form of biomass (i.e., as also identified in D 2.1 of S2BIOM (Vis et al,. 2015)
- Maximum moisture content (% wet basis)
- Minimum bulk density (kg/m^3, wet basis)

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- Maximum ash content (weight %, dry basis)
- Minimal ash melting point (= initial deformation temperature) (°C)
- Maximum allowable content of nitrogen (weight %, dry basis)
- Maximum allowable content of chlorine (weight %, dry basis)
- Maximum allowable content of lignin (g/kg dry matter)
- Minimum allowable content of cellulose (g/kg dry matter)
- Minimum allowable content of hemicellulose (g/kg dry matter)
- Minimum biogas yield (m^3 gas / t dry biomass)

A well characterised feedstock for inventory analysis in the context of WtW and sustainability assessment comprises the following information:

- Yield / annual growth rate ($t\ ha^{-1}\ y^{-1}$)
- Harvesting cycle and time of first harvest
- Fertiliser (N, P, K) and other inputs (pesticides, etc.) ($kg\ ha^{-1}\ y^{-1}$)
- Diesel and other energy requirements of cultivation and harvesting ($MJ\ t^{-1}$)
- Water use ($l\ ha^{-1}\ y^{-1}$)
- Composition when harvested (wt%)
    - Moisture content
    - Lignin
    - Hemicellulose
    - Cellulose
    - Chlorine content
    - Ash content
    - Nitrogen content
- For residues: sustainable removal rate ($kg\ ha^{-1}\ y^{-1}$)
- Effects on water quality
- Biodiversity impact when harvested (qualitative)
- Soil (erosion, nutrients, soil organic carbon) and change when harvested (SOC: $t\ C\ ha^{-1}$)

Biomass-to-fuel Conversion technologies

Table 4 Main terminologies that will be used in WP 3

Terminology	Definition
TRL	Technology Readiness Level.
Process complexity	Complexity of operating individual process units and complexity of the overall process design.
MFA/EFA	Material and Energy Flow analysis.
Process investment and operating cost	Typical CAPEX/OPEX estimations based on process scale, MFA/EFA results and average European prices for equipment, material, and energy.
Maximum allowable payback period	Upper limit for the typical economic metric of payback period, as also suggested in REDII proposal particularly for lignocellulosic biomass.
Synergistic or Added Value Potential	Potential additional benefits for value maximization from co-products and/or integration potential.

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Fuel specifications	Fuel quality, alkali index, max moisture.
On-site infrastructure	Existing on-site infrastructure (and know-how) that can be used (fuel handling, utility networks).
Off-site supporting infrastructure	Existing off-site supporting infrastructure that can be used (e.g., harbours for fuel supply).

A conversion technology is defined as well characterised when the following data is available:

- TRL and level of commercial application
- Detailed description of the operating principle
- Detailed description of the input specifications
- Material efficiencies and closed mass balance (e.g., less than 5% error)
- Energy efficiencies and closed energy balances (e.g., less than 5% error)
- Lifetime of the equipment and investment costs
- Number of typical full load hours per year
- Labour requirements of typical installation (expressed in full-time equivalent (FTE)

Sustainability performance

Table 5 Main terminologies that will be used in WP 4

Terminology	Definition
Sustainable production (UN, 2018)	Production of biomass which responds to demand while minimising the use of natural resources and toxic materials as well as the emissions from waste and pollutants over the life cycle of product so as not to jeopardize the needs of future generations.
Sustainability requirement	The overall sustainability condition that a national initiative or a certification scheme requires biomass producers and suppliers to comply with in order to receive sustainability certificates or subsidies. The requirements do not include specific details but indicate a sustainability goal that needs to be achieved. For example, the annual average GHG emissions should meet or be below the target set by a national scheme (with no exact thresholds mentioned).
Sustainability criteria	A sustainability condition which is more specific compared to the term sustainability requirement. The criteria indicate a clear obligation for solid biomass suppliers and generators to comply with a sustainability requirement. For example, for biomass used to generate electricity in 2015, the relevant GHG emission threshold is 79.2 g CO_2eq/MJ electricity.
National verification body	An appointed national organisation which assesses the established sustainability proofs submitted by biofuel suppliers/third part verifiers.

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Certification scheme (EC, 2018)	Voluntary schemes for verification of compliance with EU sustainability criteria/requirements and other relevant biomass certification systems. Each scheme may have different focuses, e.g. one scheme certifies greenhouse gas footprints, another verifies some or complete set of environmental and social criteria.
Third party verification	An independent body that verifies data delivered by biomass producers and suppliers in order to assure that biomass use complies with established sustainability requirements.
Greenhouse gas footprint	An approach to measure greenhouse gas emitted along the supply chains of biomass.
Sustainable supply chain	A supply chain in which sustainability performance (environmental, social and/or economic indicators) is implemented in each process of the chain.
Socio-economic performance (SPTF, 2018; Srebotnjak, 2018)	Social-economic performance is defined as the effective implementation of accepted social values and economic benefits along the supply chains.
Environmental performance (Srebotnjak, 2018)	Assessment of the track record of biomass producers and suppliers against specified objectives of environmental quality and resource use efficiency.
Harmonisation	A process of creating common standards established in national initiatives and certification schemes.
Alignment	An arrangement/ agreement between national policy makers and related stakeholders on a number of similar sustainability criteria and/ or requirements which have various sustainability compliance levels.
Life cycle assessment (EPA, 2018)	A life-cycle assessment (LCA) is a tool that can be used to evaluate the potential environmental impacts of a product, material, process, or activity. An LCA is a comprehensive method for assessing a range of environmental impacts across the full life cycle of a product system, from materials acquisition to manufacturing, use, and final disposition.
Indirect land use change (iLUC) (JNCC Report, 2011, Valin et al., 2015)	Occur when existing cropland is used for biofuel feedstock production, forcing food, feed and materials to be produced on new cropland elsewhere. Because iLUC occurs through global market mechanisms with many direct and indirect effects, it can only be modelled, not measured.

End use in engine/ vehicle technologies

Table 6 Main terminologies that will be used in WP 5

Terminology	Definition

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BMEP	Break[3] mean effective pressure [MPa or kPa] – is a measure of an engine's capacity to do the work. BMEP represents the average pressure acting on a piston from the top to the bottom of each power stroke, which produce brake power output. Break mean effective pressure is the universal load indicator of combustion engines. This is the way to make the load of the engines of difference sizes comparable with each other.
BSFC	Brake Specific Fuel Consumption (g/kWh) is the fuel way of expressing the fuel consumption irrespective of the engine size. BSFC is reversely proportional to BTE and LHV.
BTE	Brake Thermal Efficiency – represents overall performance of an engine. BTE is mechanical power output of the engine divided by the fuel energy input (lower heating value (LHV) *fuel mass flow). Brake thermal efficiency varies largely depending on engine type, engine load or BMEP, engine speed or mean piston speed, used fuel and engine combustion system.
C_m	Mean piston speed [m/s] – the average speed of the piston in an internal combustion engine, engine speed parameter irrespective of the engine size. It is a standard measure for comparing the drives of various engines.
CI engine	Compression Ignition engine, diesel engine
FAME diesel (Biodiesel)	Renewable diesel produced from Fatty Acid Methyl Esters
HVO diesel	Renewable diesel produced from Hydrotreated Vegetable Oils and animal fats
Fischer-Tropsch synthetic diesel	Liquid hydrocarbons (from a mixture of carbon monoxide and hydrogen) produced by a process of chemical reactions.
Paraffinic diesel	Paraffinic high cetane number diesel fuel produced from synthesis or hydrotreatment process.
SPK	Synthesized Paraffinic Kerosene – synthetic fuel composed mainly of isoparaffins, normal paraffins and cycloparaffins.
Biomethanol	Methanol produced from biomass feedstock.
Biobutanol	Butanol produced from biomass feedstock.
Bio-DME	Dimethyl ether produced from biomass feedstock.
Bio-ethanol	Ethanol produced from biomass feedstock.
Bio-hydrogen	Hydrogen produced from biomass feedstock.
NEDC	New European Driving Cycle – introduced in 1990 and was intended to reflect typical usage of a car in Europe from the perspective of emissions and fuel economy.
WLTP	Worldwide harmonized Light vehicles Test Procedure –

[3] The word "brake" is related to extraction, by use of for example dynamometer (electrical brake) to measure the engine parameters.

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		introduced in 2015, is a global harmonized standard that determinates the emissions and fuel consumption from light-duty vehicles. In comparison to NEDC, WLTP represents better real driving by testing on longer cycle distances, higher average speeds, testing influence of optional equipment of the car, longer cycle time, 4 more dynamic phases and different gear shift points for each vehicle.
European emission standards		Presents the acceptable top limits for exhaust emissions of new vehicles sold in EU and EEA countries. European emission standards are applied to passenger cars, light commercial vehicles, trucks and buses, large goods vehicles and non-road mobile machinery.
	Euro 7	Estimated introduction year – 2020 – 2021
	Euro 6	Introduced in September 2014
	Euro 5b	Introduced in September 2011
	Euro 5a	Introduced in September 2009
	Euro 4	Introduced in January 2005
EN 590		EN 590 is the European standard for automotive diesel fuel
EN 228		EN 228 is the European standard for automotive gasoline fuel
EN 14214		EN 14214 is the European standard for FAME – biodiesel. This standard defines bio-diesel as pure (96,5%) FAME fuel
EN 15940		European standard for paraffinic diesel fuel from synthesis or hydrotreatment.
CEN/TS 15293		Standard proposal for high ethanol concentration (E85) automotive fuels for spark ignition engines.
E5		Gasoline fuel blended with 5% of ethanol (volume based) EN 228
E10		Gasoline fuel blended with 10% of ethanol (volume based) EN 228
E85		Gasoline fuel blended with 85% of ethanol (volume based). Usable only in flexible fuel vehicles (FFV). CEN/TS 15293
B7		Diesel fuel blended 7% of FAME-biodiesel (volume based) EN 590
ED95		Ethanol based diesel fuel blended with ignition improvers. 95% Ethanol. Can be used in dedicated vehicles/engines.
H7		Diesel fuel blended with 7% of HVO
M5		Gasoline fuel blended with 5% of methanol (volume based)
Bi-fuel		Bi-fuel engine (or vehicle) is a SI engine able to run with gasoline or liquid petroleum gas (LPG) or methane.
Dual fuel		Dual fuel (DF) engine (or vehicle) is a CI engine able to run with diesel + methane.

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ICE	Internal Combustion Engine
SI engine	Spark Ignition engine, gasoline engine
Specific emissions	Depending on engine type given in g/kWh or g/km for hydrocarbon, carbon monoxide, nitrogen oxides, particulate matter and carbon dioxide
Drop in fuel	Fuel than can be used as such or as a blend in normal CI or SI engines
Dedicated Vehicle	Vehicle that has been adapted to high concentration alternative fuels
Flexible Fuel Vehicle (FFV)	Flexible Fuel Vehicle (car that is able to use gasoline or gasoline ethanol blends up to E85)
Blending walls	Technical limitations for component concentrations, (e.g., according to EU Fuel Quality Directive 2009/30/EC, maximum 10% (vol.) of ethanol in gasoline (E10), maximum 7% (vol.) of FAME biodiesel in diesel fuel (B7))
Current technologies	Existing commercial technologies in road and marine traffic: - light duty vehicles with SI engine, using gasoline - light duty vehicles with CI engine, using diesel fuel - light duty Flexible Fuel Vehicles (FFV) with SI engine, using gasoline ethanol blends up to E85 - light duty Bi-fuel vehicles with SI engine and separate fuel systems for both gas (CNG, LPG or biogas) and gasoline - heavy duty vehicles with CI engines, using diesel fuel - marine vessels with CI engine, using marine diesel oil or heavy fuel oil - marine vessels with dual fuel engines using LNG and diesel - marine vessels with lean burn SI engines using LNG
Future technologies	Future engine technologies of 2020 are considered to cover those where prototypes have already been demonstrated, although not in commercial use yet. These technologies are included in the modelling, provided that there are proper performance data available. Technologies of 2030s are still on the research stage in 2018 and excluded from the modelling work. 2020s: - dedicated SI engines tuned for E100 or M100 - dedicated CI engines tuned to utilize paraffinic high cetane number fuels (BTL, GTL, HVO) - heavy duty DME engine using neat DME - heavy duty ED95 engine, close to CI engine (ED95 fuel includes ignition improvers)

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	- marine methanol M100 CI engine using a high reactivity fuel (diesel) pilot - dual fuel engines for heavy duty using either gas (CNG, LPG or biogas) or alcohol as low reactivity fuel and diesel or DME or other high reactivity fuel 2030s: - light duty vehicles with dual fuel engines using either gas (CNG, LPG or biogas) or alcohol or other low reactivity fuel and diesel or DME or other high reactivity fuel - light duty and heavy duty vehicles with methanol M100 CI engines with high reactivity fuel pilot ignition - light duty and heavy duty vehicles with Reactivity Controlled Compression Ignition (RCCI) engines using two fuels: high reactivity fuel and low reactivity fuel, several fuel options may be valid - light duty and heavy duty vehicles with Spark Assisted Compression Ignition (SACI) engine using gasoline or other low reactivity fuel 2040s: - Vehicles with fully flexible high efficiency engines using advanced fuels

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Conclusions

This document presents the common analytical framework of the **ADVANCEFUEL** project. The framework first introduces the main focus in regard to the feedstock categories and the RESFuel conversion technologies that will be analysed. The considered biomass-based feedstock concentrates on lignocellulosic resources derived from biogenic waste, agriculture and forestry. The project's focus further extends to other liquid renewable fuels that do not have biomass as feedstock basis (but for instance renewable hydrogen and CO_2). RESFuel conversion technologies comprise the demonstration and (near-) commercial scale technologies. Only fuels that are in liquid form are included in this project. Next to advanced biofuels, renewable power-to-liquid technologies are within the scope of this project.

In a second step, the working principals of the project are presented. These are identification of the main barriers to RESFuels, assessment of the possible solutions, identification of scenarios and the impact analyses of different solutions in an integrated manner.

Furthermore, the working process and the interlinkage of the different WPs has been examined closely in order to point out which project output is needed for the further progress of other tasks. A good harmonisation of the respective timelines in each WP at an early stage will increase the successful implementation of the projec's outline. Detailed input-output tables show the general working structure and highlight critical phases, which demand special attention and close cooperation of the concerned project partners (including potential adaptations of timelines).

Finally, the main definitions that will be used in each WP are introduced. These definitions aim at a common understanding and use of the terminology across the project WPs.

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Annexes

Input-Output schemes per WP

In this section first the input requirements are briefly presented per WP. Next the outputs for other WPs are given. The input requirements are then clarified in more detail to get a common understanding.

WP 1 Monitoring framework and performance indicators for market uptake of RESFuels

WP1 focuses on the barriers to market uptake of RES fuels, the monitoring framework and the key performance indicators. It establishes the basis for a more detailed analysis in the following WPs. Therefore, this WP has strong interlinkages with all of the following WPs.

Table 7 presents briefly what inputs from other WPs are needed for WP1 and Table 8 introduces the main outputs of this WP (as inputs to other WPs).

Table 7 Presentation of all relevant input to WP1

From	Output ID	Month required	Inputs to WP1	Method
WP7	O7.1	6	1. Stakeholder engagement in identifying key barriers	Workshop
WP8	O8.1	4	2. The stakeholder mapping and Communication Plan	Table with contact details
WP2-7	O2.1, 3.1, 4.1, 5.2, 6.1	6	3. Feedback on KPI's	A draft framework
WP2-7	O2.1, 3.2, 4.2, O6.1	17,18	4. Relevant results for KPI quantification	A template will be provided

Table 8 Presentation of output from WP1 to other WPs

Outputs from WP1	To	Output ID	Related to task	Month
1. Barriers background document	WP2-WP7	O1.1	1.1.3	4/5
2. Monitoring framework and selection of KPI's	WP2-7	O1.2	1.2.1	6
3. A common framework with definitions	WP2-6	O1.3	1.3	6

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4. A stakeholder workshop: content related support of workshop organisation	WP7	01.4	All	5

WP2 Upgraded lignocellulosic feedstock supply chains for advanced liquid biofuels

WP2 identifies and analyses the potential for upgrading feedstock production and supply, as well as devises pathways for improving the feedstock supply chain for advanced liquid biofuels. This WP has strong linkages with WP3, WP4 and WP6.

Table 9 presents briefly what inputs from other WPs are needed for WP2 and Table 10 introduces the main outputs of this WP (as input to other WPs).

Table 9 Presentation of all relevant input to WP2

From	Output ID	Month needed	Inputs to WP2	Method
WP1	O1.2	6	1. KPIs related to feedstocks supply	Report
WP3	O3.2	9	2. Parameters for technology-specific feedstock requirements in terms of physical and chemical properties	Criteria, parameters
WP4,5	O4.3 O5.6	7	3. Requirements from standards and certification schemes	Criteria, parameters
WP8	O8.1	4	4. The stakeholder mapping and Communication Plan	Table with contact details

Table 10 Presentation of outputs from WP2 to other WPs

Outputs from WP2	To	Output ID	Related to Task	Month
1. Relevant results for KPI quantification	WP1	O2.1	--	18,30
2. Analysis of innovative crop rotation schemes	WP3, 4,6,7	O2.2	2.2.2	20
3. Domestic feedstock availability (cost-supply curves)		O2.3	2.1.1	5
4. Import scenarios including cost-supply of biomass/biofuel import potential		O2.4	2.1.2	9
5. Feedstock (including intermediates) – Advance Fuel Technology matrix (suitability)	WP6	O2.5		13
6. Physical properties of feedstocks and intermediates	WP6	O2.6		13

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WP3 Efficient roll-out of conversion technologies and system integration

WP3 identifies and analyses barriers for large scale ramp-up and deployment of RESFuels with respect to technical innovations, production processes and system integration.

Table 11 presents briefly what inputs from other WPs are needed for WP3 and Table 12 introduces the main outputs of this WP (as input to other WPs).

Table 11 Presentation of all relevant input to WP3

From	Output ID	Month needed	Inputs to WP3	Method
WP1	O1.1	6	1. Key barriers to biofuels	Report
WP2	O2.3		2. Biomass sustainable supply potential, including quality (e.g. Alkali index)	Technology assessment
WP8	O8.1	4	3. The stakeholder mapping and communication plan	Table with contact details

Table 12 Presentation of output of WP3 to other WPs

Outputs from WP3	To	Output ID	Related to task	Month
1. Relevant results for KPI quantification		O3.1	--	18,30
2. Requirements on biomass quality for the different processes	WP2,6	O3.2	3.1	10
3. Advanced biofuel conversion system characteristics over time (efficiency, CAPEX, OPEX etc.)	WP4,6	O3.3	3.1	13
4. Needs for development and innovations. Estimation of potential increase in TRL level can be achieved and the probability for this to happen within a 5-10 year period	WP5,6	O3.4	3.2	24
5. Financial risk and instruments for financing demonstration and piloting	WP6	O3.5	3.2	24
6. Options for greening of the fossil fuel infrastructure	WP6	O3.6	3.3	18
7. Possible timelines for implementation of biomass conversion technologies and associated requirements on R&D, financial support and policies – short, medium and long term.	WP5,6	O3.7	3.4	20,32

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8. The stakeholder workshop: content related support of workshop organisation	WP7	O3.8	All	16

WP4 Towards sustainable biomass production, harmonised sustainability standards and certification

The objective of WP4 is to assess current and future sustainable production of RESFuels and test its performance in view of sustainability criteria and certification schemes and standards to safeguard and stimulate sustainable production.

Table 13 presents briefly what inputs from other WPs are needed for WP4 and Table 14 introduces the main outputs of this WP (as input to other WPs).

Table 13 Presentation of all relevant input to WP4

From	Output ID	Month needed	Inputs to WP4	Method
WP7	O7.3	22	1. Stakeholder validation to proposed options for harmonization of sustainability criteria across sectors and for the entire EU	Workshop
WP2.1	O2.3	13	2. Advanced biofuel feedstock types and their potential per region/location over time	Input modelling (GIS)
WP2.2	O2.9	13	4. Performance of SRC (yield, fertilizer use, environmental impacts)	
WP2.2	O2.2	13	5. Type of innovative crop schemes (feedstock type, management, location)	Report (review/ analysis)
WP2.3	O2.3	13	6. Feedstock supply chains (locations of supply/demand, transport logistics)	Input to GHG-LCA, S-LCA (Excel)
WP3.1	O3.3	13	7. Advanced biofuel conversion system characteristics over time (efficiency, CAPEX, OPEX etc)	Report
WP8	O8.1	4	8. The stakeholder mapping and communication Plan	Table with contact details

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Table 14 Presentation of output from WP4 to other WPs

Outputs from WP4	To	Output ID	Related to task	Month
1. Relevant results for KPI quantification	WP1	O4.1	-	18,30
2. Feedstock and location specific environmental impacts (database, report)	WP6	O4.2	4.3	30
3. Relevant sustainability indicators of innovative crop schemes	WP1.3	O4.3	4.4	12
4. Environmental and socio-economic performance of advanced fuel production systems	WP1.2, 6 WP6	O4.4	4.4.2	24
5. Life cycle GHG performance per supply chain (feedstock + conversion combination)	WP5,WP6	O4.5	4.4.3	34
6. The stakeholder workshop: content related contribution to workshop organisation	WP7	O4.6	All	21

WP5 Improved evidence for market uptake

The core objective of WP5 is to improve evidence regarding the future market uptake, which is available to policy and industry. It analyses the role that RESFuels will play in the aviation, marine and road transport sectors for 2020 and towards 2030 in terms of market size; future demand and market growth rates; current policy landscape and gaps, best practices as well as fuel blending issues that are related to end use.

Table 15 presents briefly what inputs from other WPs are needed for WP5 and Table 16 introduces the main outputs of this WP (as input to other WPs).

Table 15 Presentation of all relevant input to WP5

From	Output ID	Month needed	Inputs to WP5	Method
WP2-4	O2.2, O3.4, O4.5	7	1. Identification of innovations addressed across the value chains in Work Packages 2, 3 and 4 and to which extent they have any best practices in terms of market uptake and policy interventions at EU and international level; e.g. which best practices promote the uptake of lignocellulosic crops and other innovative crop schemes (Task 2.2).	Questionnaire

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WP2-4	O3.6	7	2. Identification of current policy mechanisms & gaps	
WP8	O8.1	4	3. The stakeholder mapping and Communication Plan	Table with contact details

Table 16 Presentation of output from WP5 to other WPs

Outputs from WP5	To	Output ID	Related to task	Month
1. Brief description of Best Practice (in a set format)	WP6	O5.1	5.2	18,36
2. Quantification of KPIs	WP1.2	O5.2	5.2	18, 30
3. Brief description of policy mechanism (typology, duration, main aim, part of the value chain)	WP6	O5.3	5.3	18
4. List of relevant gaps in current policy formation	WP6	O5.4	5.3	30
5. Technical limitations at end use: RESFuels possible per engine type, blending limitations, extra costs wrt reference fossil comparator[€/GJ or €/l]	WP6.1,6.2	O5.5	5.4	
6. Numerical tools for fuel and fuel blend properties	WP6.5	O5.6	5.4	33
7. The stakeholder workshop: content related contribution to workshop organisation	WP7	O5.7	All	26
8. Market volumes	WP6	5.8	5.1	18

WP6 Integrated assessment of innovative approaches for RESFuels

This WP aims to provide useful scenarios and sensitivity analysis of the future role of RESFuels, exploring the full width of possible future exploitations. This WP brings together all the relevant outputs from the previous WPs and conducts an integrated analysis. As such, it depends strongly on the timely delivery of the other WPs' outputs.

Table 17 presents briefly what inputs from other WPs are needed for WP6 and Table 18 introduces the main outputs of this WP (as in out to other WPs).

Table 17 Presentation of all relevant input to WP6

From	Output ID	Month needed	Inputs to WP6	Method
WP2	O2.3	14	1. Lignocellulosic feedstock availability in the form of cost supply data Units:	Tables or a report

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			• Availability [PJ] or [kt as received] • Cost/price [€/GJ] or [€/t as received] • Cost of logistics to next step in the chain need to be separated. • Geographical resolution: Member States lower resolution also possible.	
WP2	O2.4	14	2. Import scenarios: biomass potential (raw, intermediate or final product) per source regions (for continent or country) and associated costs. See description of O2.3 in this table.	Tables or a report
WP2	O2.5	13	3. Feedstock (including intermediates) – RESFuel Technology matrix (suitability) A matrix that shows the allowed combinations of feedstock (incl. intermediates like wood chips) that can be applied for each advanced RES fuel technology. This is to make sure that all feedstocks are included and also to make sure that feedstocks are excluded that are not suitable (technically or from a sustainability perspective)	A matrix
WP2	O2.6	13	4. Physical properties of feedstock and intermediates: The following physical properties are needed: • -LHV [GJ/t as received] • -moisture content [%, mass based] • -bulk density [t/m^3] These properties are relevant for two reasons: • -for transport of those properties • -to make sure the same values are used in the consortium (harmonization	Table
WP3	O3.3	14	5. Techno-economic data of conversion technologies: Technologies that are to be included according to O3.3, should be accompanied with techno-economic parameters so that they are included in the scenario modelling. • CAPEX [€/unit of output] • OPEX [€/(unit of output * year)] • Ratio's input/outputs (conversion efficiencies) life time [yr] • Economic costs/benefits of inputs/outputs outside of the biobased market segments [€/unit] Values should be given either for 2020, 2030, 2040 or for the first commercial plant complemented with learning rates.	Tables or a report
WP3	O3.5	13	6. Identification of technologies and feedstocks to include based on TRL, costs and other • A list of all technologies (including feedstocks) that are likely to play a role in the transport sector within the timeframe 2040/2050.	Tables or a report

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WP3	O3.3	13	7. Physical properties of new RESFuels: The following physical properties of feedstocks and intermediates are needed: • LHV [GJ/t] • bulk density [t/m^3]	Table
WP3	O3.4-O3.5	14	8. Possibly more biorefinery routes (see techno-economic data of conversion technologies): The introduction year of the first commercial plant is important because it will have an important impact on the results for import years like 2030.	Tables or a report
WP3	O3.6	14	9. Greening of fossil fuel infrastructure: Overview of most important locations and their RESFuel outputs with volumes. • Overview of most important locations and their RESFuel outputs with volumes. Initially to get an understanding if exiting fossil infrastructure and refineries should be included in the scenario modelling	Report
WP3	O3.7	14	10. Biomass-process implementation time line: introduction year of the first 'commercial' plant	Tables or a report
WP4	O4.5	17	11. GHG factors: Avoided GHG emissions per feedstock, technology combi	Tables
WP5	O5.8	13	12. Market volumes: total fossil + RESFuel demand per modality per country. Modalities: cars+ motors; busses; trucks; EU aviation; shipping. Also split for type of fuel consumed (i.e. for cars diesel/gasoline ratio)	Report
WP5	O5.1	20	13. Best practices (input for T6.4)	Report
WP5	O5.3	10	14. Policy instruments: quantitative information/assumptions is important	Tables or a report
WP5	O5.5	8	15. Technical limitations end use: RESFuels possible per engine type, blending limitations, additional cost in comparison to the reference [€/GJ or €/l]	Tables or a report
WP8	O8.1	4	16. The stakeholder mapping and communication plan	Table with contact details

Table 18 Presentation of output from WP6 to other WPs

Outputs from WP6	To	Output ID	Related to task	Month
1. KPI's - Cost reduction figures - Contribution of different types of RESFuels in 2030 and 2040	WP1	O6.1	6.2	18,30

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2. Development pathways for RESFuels Input biomass [PJ] per conversion technology	WP4	O6.2	6.2	26
3. Market segmentation, end uses and policy recommendations	WP7	O6.3	6.4	30

WP7 Stakeholder engagement with market players

This WP is designed to increase the stakeholder involvement. The main objectives are to receive required feedback on strategies to reduce/remove barriers in the RESFuel market, validation of results regarding to plausibility and usefulness of project outcomes and implementation of the project results, achieving their acceptance and maximizing the capacity building among the stakeholders.

Table 19 presents briefly what inputs from other WPs are needed for WP7 and Table 20 introduces the main outputs of this WP (as in out to other WPs).

Table 19 Presentation of all relevant input to WP7

From	Output ID	Month needed	Inputs to WP7	Method
WP1	O1.4	6	1. The stakeholder workshop: content related contribution to workshop organisation	Workshop
WP2	O2.11	12	2. The stakeholder workshop: content related contribution to workshop organisation	Workshop
WP3	O3.8	17	3. The stakeholder workshop: content related contribution to workshop organisation	workshop
WP4	O4.6	22	4. The stakeholder workshop: content related contribution to workshop organisation	workshop
WP5 & 6	O5,7, O6.3	27	5. The stakeholder workshop: content related contribution to workshop organisation	workshop
WP8	O8.1	4	6. The stakeholder mapping and Communication Plan	Table with contact details

Table 20 Presentation of output from WP7 to other WPs

Outputs from WP7	To	Output ID	Related to task	Month
1. Organisation of a key stakeholder workshop (M6) for an early recording of stakeholder requests and for mutual discussions about key barriers	WP1	O7.1	1.1	6
2. Organising a workshop on biomass availability	WP2	O7.2	2.1	12
3. Organising a workshop on RES fuel conversion technology	WP3	O7.3	3.1	17

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4. Organising a workshop on RESFuel sustainability	WP4	O7.4	4.1	22
5. Organise a workshop on RESFuel market roll out	WP5, WP6	O7.5	5.1, 6.4	27

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