European Commission

Development of outlook for the necessary means to build industrial capacity for drop-in advanced biofuels

Annex 6 Report on Task 6

Research and Innovation

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Development of outlook for the necessary means to build industrial capacity for drop-in advanced biofuels

Annex 6 Report on Task 6

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1.1. Introduction – purpose of the workshop

In the framework of Task 6 activities, the final consultation workshop took place in Brussels, on the 26th of September. The aim of the workshop was to discuss the Interim progress report Part I and the draft Interim progress report Part II, and to validate the results and conclusions of the work achieved within the duration of the project. Feedback received during the workshop will be considered by the project team and will then be incorporated into the final reports of the project.

Key industrial and research actors from the advanced drop-in biofuels value chain and market from the EU was the targeted audience to the workshop. During the workshop, the audience would engage with the project team to discuss and validate the information the project has generated during these months with regards to the actual industrial capacity and the required needs of the industry to deliver the volumes set by EU policy frameworks.

In an effort to enhance the credibility of the approach and the results of the project, five renown Thematic Experts were invited to participate in the workshop as 'external reviewers' for each of the five project tasks.

A workshop agenda and concept note were developed early enough in the project and distributed among the project Consortium and the Commission. It was decided that the workshop would have a hybrid format in order to also engage interested stakeholders who were not available to participate physically.

The workshop agenda and the concept note were prepared by the project team and agreed with the Commission before they were distributed to the targeted audience. Both documents can be found in Appendix 1.

The agenda was structured in a way that it would allow sufficient time to comment and discuss the results from each task and to answer to potential questions from the audience. Thus, a 40-minute time period was given after the presentation of each task for discussion. In order to have a comprehensive view of the core analysis of the study, Tasks 1, 2, and 3 were discussed first, followed by an overall discussion on resonance of these tasks by the workshop moderator. Tasks 4 and 5 were presented afterwards followed by a roundtable discussion of approximately an hour long, between the Thematic Experts and the Industry officials to validate the conclusions of the study.

During the workshop, the project team presented, via PowerPoint presentations, the findings of the analysis done, the assumptions and final outcomes. To enhance audience's participation in the workshop, the project team had prepared in advance a project synopsis, which was shared prior to the workshop. As a result, they were informed about the purpose and targets of the project, and the results and findings of the study, through the five different Tasks, which concluded to their engagement and active participation.

Their involvement was of high importance, as they commented on the work achieved and provided meaningful feedback based on their experience and knowledge. The highlights of the workshop, namely key messages, conclusions, brief description of the tasks and main comments and recommendations from the Thematic Experts were captured by the workshop rapporteur in a report.

Finally, a separate report including the responses by the Task Leaders to the comments of the Thematic Experts' made during the workshop was also prepared (see Appendix 2).

1.2. Workshop organization

For the workshop preparation, detailed discussions were held among the project team and the Commission, focusing on the organizational aspects of the workshop, and in particular the following:

- Determination of the material to be provided to the Thematic Experts and the other invited experts (audience) in the workshop
- Preparation for the panel discussion: the discussion in the panel will evolve around the main key message
- Development of key messages for each task around which the discussion in the workshop will evolve:
  - Development of the story line of the whole study,
  - Development of key messages per task
- Determination of the intervention of the audience during the workshop:
  - Questions after the presentation of each task (moderated by the thematic experts)
  - Open Q&A in the final panel discussion
- Collecting feedback from the audience during the workshop
  - Development of a series of questions presented on Slido real time within workshop execution
- Collecting feedback from the audience after the workshop
  - Kind request to the audience to provide written responses to the questions posed in the shared project Synopsis report, within a period of a week.
- Finalization of organizational details
  - Catering/coffee break
  - Registration – Open-up early to allow sufficient time for the security services at the EC buildings to perform the regular control
  - Test of the hybrid installation prior to the workshop

1.2.1. Role in the workshop

To ensure a smooth flow of the workshop, clear responsibilities were assigned to each of category of participants to the workshop, as summarized below:

Task Leaders

- Preparation of a PowerPoint for a 10-minute talk including the most important assumptions made to conclude the key messages of the tasks
- Support the Thematic Experts during the moderation of the discussion
- Active participation in the Roundtable discussion

Thematic Experts

- Review the material of the Task they were appointed to support – Participation in bilateral meetings with the study team a week before the workshop
- Preparation of a brief commentary on the task under their responsibility (via a PowerPoint presentation or simply via an oral intervention) for a 10-minute discussion on the specific task after the Task Leader's presentation
- Moderation of a discussion with the workshop audience for 30 minutes
  - Starting point of the discussion: the set of questions included in the project Synopsis (shared in advance to the participants)
- Participation in the Roundtable discussion as panellists, reflecting on the entire day
- Provision of written comments on the work of each task after the workshop

1.3. Stakeholders' engagement

The study foreseen the industrial capacity development for drop-in advanced biofuels in 2030 and in the longer term, 2050. Therefore, the engagement of different players of the biofuels industry and various companies/associations, was essential and necessary to collect insights and possible future projections. During the implementation of Task 3 (Analysis of capacity potential for the industrial supply of drop-in advanced biofuels), a survey was developed and distributed among a wide range of European and International identified stakeholders, including the industry, companies, associations, and universities. This wide range of stakeholders to whom the Task 3 survey was distributed, constituted the basis of the pool of experts to be invited in the study's final workshop. The target was to attract representatives from the key value chains of advanced biofuels, focusing on the relevant EU industry associations, key technology developers, renown universities and academic institutions.

Several efforts were made to approach the targeted stakeholders through e-mail exchanges and phone calls targeting to gather a critical mass of audience in order to gather and exchange views, knowledge, and information, in a European level, that would complement the project and eventually validate the results and provide any necessary feedback towards the study completion. For this reason, a registration form was also created to be able to monitor the attendance efficiently and in a timely manner.

In addition, a project synopsis document was created, incorporating summary and key messages from each task, along with key questions directed to the audience. The synopsis was shared only with the confirmed participants of the workshop. The goal was to provide them with a broader understanding of the work accomplished and to give them a set of

specific questions, for each task, to be able think about in advance and to provide their input and opinions, thus also facilitating the discussion during the workshop.

The final list of participants is available in Appendix 4.

1.4. Thematic Experts

According to the project's terms of reference, the consultation workshop should be complemented by five Thematic Experts allocated to each Task. The Thematic Experts are external experts to the Consultant, renown to their field, and would essentially act as a 'reviewer' of each task.

The following Thematic Experts were identified

- Thematic Expert 1 (Task 1): Sonia Yeh, Chalmers University
- Thematic Expert 2 (Task 2): Calliope Panoutsou, BP
- Thematic Expert 3 (Task 3): Eric van den Heuvel, Studio Gear Up
- Thematic Expert 4 (Task 4): Nylund Nils-Olof, VTT
- Thematic Expert 5 (Task 5): Uwe Fritsche, IINAS

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The Thematic Experts were asked to physically participate in the workshop as to provide initial input and reflections on the study results attracting the necessary feedback and the resonance of findings from the industrial stakeholders in technical, financial and policy aspects.

For this purpose, the Thematic Experts received prior to the consultation workshop the report of the Task they would review, the Project Synopsis, for their reference, while one-to-one meetings between the Task Leaders and the Thematic Experts were organized prior to the workshop date to coordinate the main messages of each Task in the best way possible, in order to have a fruitful and constructive discussion during the workshop.

After the realization of the workshop, the Thematic Experts were asked to provide their comments/feedback on their allocated Task, in order be considered and incorporated in the revised versions of Tasks 1-5 reports, that will eventually constitute the final project report.

1.5. Engagement tools

During the workshop, in order to engage with the audience as much as possible, and in the framework of gathering the most feedback, the **Slido platform** was used as an additional engagement tool. Slido is an online tool that gives the opportunity to the organizer of a meeting to create various polls and surveys to share during the meeting. Thus, a set of specific questions related to each Task was prepared, to create a poll. After the presentation and discussion of each Task, the questions were made available online for both virtual and physical participants to provide their answers, by entering a unique code to the platform.

1.6. Onsight engagement with the participants

Below, the set of questions along with a brief overview of the responses, are presented. See full report from Slido which is provided in Appendix 6. Furthermore, out of the 12 external experts who participated (both physically and virtually) 7 took part and responded to the questions of the poll.

1.6.1. Task 1

Questions

- Do you believe in a delayed deployment (until 2030) of electromobility and e-fuels? (delayed such that would favor biofuels uptake)
- How important is the role of the fast decarbonization of the electricity grid for the timely market uptake of advanced biofuels?
- How plausible do you think is the transition of demand for advanced biofuels from road transport to maritime and aviation after 2030?

Results

- The majority of the participants concluded that electromobility and e-fuels deployment will be delayed, favouring thus the uptake of advanced biofuels.
- The role of fast decarbonization of the electricity grid is positively important only for RFNBOs, not for all types of advanced biofuels.
- The transition of demand for advanced biofuels from road transport to maritime and aviation after 2030, is very likely

1.6.2. Task 2

Questions

- Do you find it useful and logical to work with three mobilisation scenarios that range in relation to both mobilisation factors and competing use levels?
- Did you expect higher or lower biomass availability for bioenergy from this study?
- Which scenario do you expect to become the most realistic in 2030?
- Which scenario do you expect to become the most realistic in 2050?
- Do you believe it will be realistic that more biomasses will become available over next 30 years from unused, degraded lands in the EU?
- Do you think it is realistic to mobilize new drop-in biofuels through technology development that can convert unused gaseous biomass resources, manure, and organic fractions in sewage sludge, to drop in fuels?

Do you think it would be good (in terms of biomass mobilization) for the sustainable performance of biofuels if less emphasis is placed on preventing ILUC and more on stimulating overall sustainable land management (e.g., **through win wins with carbon farming)?**

Results

- All of the responders found useful the idea of working with three mobilization scenarios
- Half of the participants expect higher biomass availability while the other half expect lower biomass availability
- Low and medium mobilization scenarios were the ones voted to be more realistic in 2030, while in 2050, the medium mobilization scenario was the dominant one
- Indeed, all participants vote positively that more biomasses will become available over the next 30 years from unused, degraded lands
- It is very possible and realistic to mobilize new drop-in biofuels through technology development that can convert unused gaseous biomass resources, manure, and organic fractions in sewage sludge, to drop in fuels
- All of the participants voted that it would be good to give less emphasis to prevent ILUC and more emphasis to stimulate the overall sustainable land management

1.6.3. Task 3

Questions

- What would be your merit order of investments?
- Where do you think cover crops would be used for?
- Which percentage of biomethane from AD would you expect to be available to the transport sector in 2030?
- Which percentage of biomethane from AD would you expect to be available to the transport sector in 2050?
- Do you think the resulting 2030 capacities of pathways are reasonable (in general)?
- Do you think the resulting 2050 capacities of pathways are reasonable (in general)?
- Do you think that the overall advanced biofuels and biogas capacity expansion in 2030 is reasonable?
- Do you think that the overall advanced biofuels and biogas capacity expansion in 2050 is reasonable?

Results

- Participants would invest probably in ATJ (Alcohol-to-Jet), gasification for the production of FT-SPK (Fischer-Tropsch Synthetic Paraffinic Kerosene), and HTL (hydrothermal liquefaction), and 2G ethanol, gasification for the production of biomethane, biomethane/DME (Dimethyl-Ether)/ammonia, ad pyrolysis

- Participants voted that cover crops will be used for HVO (Hydrotreated Vegetable) Oil production and not FAME (Fatty Acid Methyl Ester) production

- 5-10% of biomethane production from anaerobic digestion will mostly be available to the transport sector in 2030, while 10-15% will be available in 2050

- The resulting 2030 capacities of pathways are voted to be overestimated, while the opinions differ for 2050 capacities with half of the participants stating that they are reasonable and the rest that the capacities are overestimated

- The overall advanced biofuels and biogas capacity expansion for 2030 is believed to be overestimated, while the one for 2050 is reasonable

1.6.4. Task 4

Questions

- The gap analysis of the present work suggests that there will be no gap for 2050. Such a situation would directly enhance the security of supply in Europe. Do you believe that the importance of this aspect (i.e., the direct contribution of biofuels to the security of supply) has been appropriately acknowledged?

- There is an impressive lists of announced and planned projects for hydrogen production and various e-fuels. However, the installed capacities are still very low. Do you believe these projects will eventually materialize (all factors, e.g., regulatory frame, financing, etc., considered with the current level of knowledge)

- Availability of hydrogen produced from eligible renewable electricity sources is an important barrier to RFNBO capacity development. On the long run availability of CO2 will be more critical. Do you agree with this statement?

Results

- The gap analysis performed within the frame of the present work, suggests that there will be no gap between demand and supply for 2050 and this is believed, by half of the participants, that it has been acknowledged by the policy makers; the other half of the participants, believed that neither industry nor policy makers have acknowledged the direct contribution of biofuels to the security of supply

- Participants do not believe that hydrogen production and e-fuels projects will materialize in all factors

- Half of the participants agreed that the availability of CO2 will be more critical

1.6.5. Task 5

Questions

- Do you think that the EU policies and strategies will have an important impact on extra-EU biofuels market?
- Do you expect that EU-produced biofuel volumes could be exported to extra-EU regions? Or it is more likely that EU production will be sized to EU internal market?
- Further deployment of biofuels will entail a positive effect on the employment of the sector. Do you believe that this critical aspect, has been appropriately communicated to all actors?

Results

- It is believed that the EU policies and strategies will have a minor impact on extra-EU biofuels market
- It is believed that production will be sized to EU internal market
- It is not believed that it has been communicated to all actors that further deployment of biofuels will entail a positive effect on the employment of the sector

Appendix 1 Workshop agenda and concept note

Agenda

Time	Topic	Speaker
09:30 – 09:50	Opening remarks by the European Commission and CINEA	Maria Georgiadou, DG RTD Senior Expert Imke Lubbeke, CINEA Project Adviser
09:50 – 10:10	Presentation of the project objectives, approaches, and challenges	Theodor Goumas, EXERGIA Project Manager David Chiaramonti, POLITO Scientific Coordinator
10:10 – 10:20	Presentation on demand analysis related to scenarios, Task 1	Ioannis Tsiropoulos, E3M Task 1 Key expert
10:20 – 10:30	Comments on Task 1	Thematic Expert 1: Sonia Yeh, Chalmers University
10:30 – 11:00	Discussion on results – Comments – Responses to pre-set questions Moderator: Thematic Expert 1	
11:00 – 11:10	Presentation on feedstock resources potential, Task 2	Berien Elbersen, WENR, Task 2 Leader
11:10 – 11:20	Comments Task 2	Thematic Expert 2: Calliope Panoutsou, BP
11:20 – 11:50	Discussion on results – Comments – Responses to pre-set questions Moderator: Thematic Expert 2	
11:50 – 12:00	Presentation on Industrial capacity potential, Task 3	Dina Bacovsky, BEST Task 3 Leader
12:00 – 12:10	Comments Task 3	Thematic Expert 3: Eric van der Heuvel, Studio Gear Up
12:10 – 12:40	Discussion on results – Comments – Responses to pre-set questions Moderator: Thematic Expert 3	
12:40 – 13:00	Overall Discussion on resonance of Task 1, 2, 3 results Moderator: Kyriakos Maniatis, Independent Expert	
LUNCH BREAK (45 minutes)		
13:45 – 13:55	Presentation on synthesis of industrial capacity, Task 4	Martijn Vis, BTG, Task 4 Leader
13:55 – 14:05	Comments Task 4	Thematic Expert 4: Nylund Nils-Olof, VTT Technical Research Centre
14:05 – 14:35	Discussion on results – Comments – Responses to pre-set questions Moderator: Thematic Expert 4	
14:35 – 14:45	Presentation of analysis of socio-economic impact, GHG emissions and costs, Task 5	Matteo Prussi, POLITO, Task 5 Leader
14:45 – 14:55	Comments Task 5	Thematic Expert 5: Uwe Fritsche, IINAS
14:55 – 15:25	Discussion on results – Comments – Responses to pre-set questions Moderator: Thematic Expert 5	

Time	Topic	Speaker
COFFEE BREAK (15 minutes)		
15:40 – 16:50	Roundtable: Validation of conclusions on industrial development of drop-in advanced biofuels	Moderator: Kyriakos Maniatis Participants: 5 Thematic Experts and Industry Officials
16:50 – 17:00	Wrap-up, Next Steps	Maria Georgiadou, Imke Lubbeke, Theodor Goumas

Concept Note

The European Green Deal sets the ambitious goal of a climate-neutral European Union by reducing greenhouse gas emissions to at least 55% below 1990 levels by 2030. To achieve this target, at least a 29% share of RES (Provisional Agreement) in EU transport by 2030 is needed. Given the available technical and technological capabilities, drop-in advanced biofuels have an important role to play in the decarbonization of the transport sector, but often their ability to provide sufficient volumes in the near term is questioned. To analyze how much advanced biofuels production capacity could be available in Europe in 2030 and beyond, the European Commission, has commissioned the “Development of Outlook for the Necessary Means to Build Industrial Capacity for Drop-in Advanced Biofuels”.

The consultation workshop will last one day, following a participatory and interactive approach in order to facilitate the dialogue between the Commission, the consortium, and the representatives from key industrial and research actors from the advanced drop-in biofuels value chain research and industry with the objective to validate the plausibility of the project assumptions (scenarios), methodology, results, and conclusions. The full day workshop will be structured along the 5 core Tasks of the study, namely: 1) demand analysis related to scenarios, 2) feedstock resources potential, 3) industrial capacity potential, 4) synthesis of industrial capacity and 5) analysis of socio-economic impact, GHG emissions and costs. Following a short presentation and a dedicated Thematic Expert input to each of the Tasks, the stakeholder discussion will be moderated alongside pre-set questions. Finally, a roundtable with the participation of the Thematic Experts and competent industrial officials will be organized to examine the perspectives of the European drop-in advanced biofuels industry. The feedback provided by the workshop participants will be collected and is expected to produce considerable input to be incorporated in the Study.

Appendix 2 Responses to thematic experts' comments

List of comments from the workshop

The present document includes both oral and written comments/feedback made by the five different Thematic Experts, during the final consultation workshop, along with the responses of each Task Leader to these specific comments.

Comments on Task 1 by Sonia Yeh

Comment 1

Scenario Realism and Predictive Power: While the modelling is state-of-the-art, it is not predictive. The model operates under a framework that necessitates meeting policy goals at the least cost. As such, its primary utility lies not in prediction, but in illustrating the likely fuel mix in the transport sector if policy goals are met.

Response by the Task Leader

We agree with the remark, that the model does not produce short-term forecasts (i.e. it does not predict) but rather projects the evolution of the transport sector, and among others its fuel use into the future under a certain set of framework conditions and assumptions, assuming the attainment of policy targets.

We will highlight this in the report.

Comment 2

Top-Down vs. Bottom-Up Modelling: The choice of modelling approach can significantly impact the granularity and applicability of the findings. While top-down models offer a broader economic perspective, bottom-up models are more effective for understanding technology-specific challenges and opportunities.

Response by the Task Leader

Indeed, PRIMES and PRIMES-TREMOVE being a partial equilibrium model does not perform a closed-loop energy-economy analysis. Therefore, it does not point towards technology-specific challenges and opportunities outside the energy system, unless is linked with a general equilibrium macro-economic model (e.g., GEM-E3). We mention a couple of examples of limitations in the report (e.g., battery imports) that fall out of the scope of Task 1. Here to note, that by study design, other impacts (e.g., socio-economic impacts) were addressed in Task 5 using a different methodology.

We will stress further in the report that such analysis, i.e., providing insights by the linkage of PRIMES-TREMOVE with e.g., GEM-E3 is an important perspective that can complement this work in future endeavors.

Comment 3

Voluntary-Policy Gap: Examining the delta between industry voluntary commitments and the actual policy goals is crucial. This gap analysis can inform whether the industry realistically aligns with governmental objectives or if further interventions are required.

Response by the Task Leader

A bottom-up assessment of industry voluntary commitments would be very valuable to

assess ambitions against policy targets. In such way, areas and level of additional effort can be highlighted. An example was mentioned during the Workshop on Aviation industry commitments against the ReFuelEU aviation initiative. Here to note, that the study includes scenarios in which the transport sector overachieves certain targets in 2030 (e.g., ESR variants), which implies, in a stylised way, additional contribution of transport, that may come owing to voluntary commitments. While valuable, such an assessment lies out of scope of the study, but the remark provides a clear perspective for further work, which we will include it in the report.

Comment 4

Policy Synergies and Distractions: The policies often have multiple objectives—climate change mitigation, employment creation, etc. It's important to identify whether these goals are complementary or if they risk diluting the focus from primary objectives.

Response by the Task Leader

The modelling used in Task 1 includes energy and climate policies and instruments different in nature (e.g., taxes, subsidies, measures that remove barriers, technology/emission/performance standards, targets), thereby accounting for their interactions towards energy and climate goals. Furthermore, the transport sector is not assessed in isolation, but it considers the overall ambition of the EU Green Deal targets and the effort required from supply and demand sectors system in the set framework, as well as respective policies. As such, synergies and distractions of energy system policies are considered.

The interplay of energy and climate policies with other policies is not assessed as it requires an extension of the modelling framework and linkages with other models (e.g., as highlighted in our response to Comment 2, coupling with a macro-economic model).

We will make this remark also in the report.

Comment 5

Broader Policy Integration: Besides meeting biofuel-specific goals, the policies should be assessed for synergies with broader EU policies like the water directive, EU protein strategy, and biodiversity protection.

Response by the Task Leader

We agree that biofuels are at the intersection of many different policies/sectors ranging from energy, to forestry, agriculture, biodiversity, waste management, water, employment etc. The nexus of (bio-)energy with other sectors is a highly complex endeavour that is assessed in large-scale Horizon projects (e.g. water-food-energy in the GoNexus project, energy-materials in ForestNavigator). Such an assessment lies outside of the confines of the energy systems analysis and the scope of the assignment of Task 1. That said, Task 2 takes into account sustainability criteria that reflect also on biodiversity protection, etc.

In line with our response in other comments, we will integrate this perspective into the report of Task 1 as an additional stream of future work.

Comment 6

Complexity in Feedstock Classification: Advances in biorefinery technologies complicate the traditional food vs. non-food feedstock categorizations. This demands reevaluating what feedstocks are considered sustainable and effective for biofuel production.

Response by the Task Leader

In the report we mention the classification of biofuels in Task 1 is based on feedstocks that fall under different RED categories. We agree that, more often than not, technological advances on technology (e.g., biorefineries) and on feedstock (e.g. sequential cropping) may deem a re-assessment of feedstock categories necessary. The modelling in terms of bioenergy demand will not be affected by the feedstock classification; however, if classification changes the contribution of different biofuel sub-categories may be affected. While a re-evaluation of feedstock categories would serve as a model input stemming from other tasks, and this has been outside the objectives of Task 1, we will mention in the report the caveats from the evolving scenery on feedstock classification.

Comment 7

Price Competitiveness and Market Dynamics: Although the bottom-up model is proficient at summing up costs, it might not capture the complex market dynamics involving price competitiveness between incumbent fuels and biofuels. Real-world demand and supply estimates often hinge on the price differential between these alternatives, and how policy measures like carbon taxes or subsidies tip the balance. A more detailed simulation model considering factors like supply constraints and supply/demand elasticity could offer nuanced insights into market competition and pricing.

Response by the Task Leader

Being a structural market equilibrium energy systems model, PRIMES, through the iterative process of tis supply and demand-side modules estimates explicitly the level of energy prices (market clearing prices) by sector, including regulatory approaches for tariffs and prices (including carbon pricing schemes). For example, an increase in the carbon price sends a market signal on reduced competitiveness of fossil fuels against renewable alternatives. Particularly with biofuels, the biomass supply module estimates the price for the bioenergy/biofuel commodity taking into account the demand for bioenergy. Higher demand for bioenergy, may lead to higher biofuel prices as it would entail moving towards higher parts of the cost-supply curve. Another element is economy of scales and learning by doing that are also taken into account by the modelling when estimating prices. Therefore, the model considers factors of supply and demand and other market dynamics for the formation of different end-user prices by fuel type.

Comment 8

Regional differences: How individual countries perform, and how the policies are used in regional level?

Response by the Task Leader

We agree that regional analysis is required to bring to surface caveats and opportunities across different Member States. The modelling factors in Member State specificities several ways, among others to consider that: (a) each Member State is modelled separately, and the EU is a result of the aggregation of all EU Member States, (b) several policies and measures are included at the national level (as informed by NECPs, end-2019, as in the Reference scenario) with specificities as applicable (e.g. island countries), (c) is compatible and calibrated at a high sectoral level of detail as described in MS data and statistics, (d) supply characteristics of different countries is taken into account e.g. of biomass potential. However, a full-fledged analysis at a Member State level was not identified among the goals of the Task, which aimed to assess the demand potential for biofuels at an EU level. Nonetheless, this remark signals another opportunity for improved analysis and future work so as to look into disparities between Member States. We will include as such this opportunity in the report.

Comments on Task 2 by Calliope Panoutsou

Comment 1

It is important to provide a clear definition of the Technical potential. Is it also sustainable and what sustainability principles/ rules/ conditions does it include for agriculture and forestry?

Response by the Task Leader

I will make it more clear in section 3.5 in the general scenario description, in the updated synopsis and the updated Task 2 summary report. I will emphasize that it does take basic sustainability assumptions into account. The assumptions per biomass type in the tables A2-5, A2-6, A2-7 are all the assumptions made for all potentials, including the technical one.

Comment 2

I think there was a general feeling of a lack of understanding how (and which actions, e.g., the use of AI in forest management, etc.) Research & Innovation (R&I) helps increase the potential across the three scenarios from 2030 to 2050. For sure the very detailed work Berien and her colleagues have done includes it, but it would be helpful to provide a Table with these considerations and assumptions for agriculture and forestry.

Response by the Task Leader

I have added more explanation of how R&I helps to mobilize the potentials per type of biomass in the synopsis and in the task 2 summary. In the Task 2 extensive report this is already sufficiently described per biomass potential e.g., yield increases are related to new varieties and new field management methods, new harvesting technologies etc.

Comment 3

The conclusions point to degraded land- it would be helpful to have a map (MAGIC project under Berien's coordination, has delivered such information, maybe there is also more info that I am not aware of). Then add a couple of paragraphs or a table (whatever the team considers best) to explain i) how much land is now/ we expect later to become degraded, ii) how can R&I help to improve it and allow for dedicated crops cultivation, iii) which crops have so far been cultivated in marginal/ degraded land and what have been the recorded yield ranges (again there are plenty deliverables/ publications from the colleagues in MAGIC) and iv) what yield growth we can realistically expect per crop and timeline (2030- 2050) and what are the underlying R&I requirements to achieve these expected yields.

Response by the Task Leader

This is all described already in the Annex to the main task 2 report, but I will add part of the annex info to the main report. The total area available of degraded and abandoned land is quantified already in a table in the annex, I will move it too. I also added the information on area of degraded and abandoned land 2030 and 2050 in the Synopsis and in the Task 2 report. This is all new work; we did not use the S2BIOM data for it anymore.

Comment 4

A tricky one is the very high attention that the low and (less) the medium scenarios have given to competing uses. It would be helpful to provide a couple of paragraphs clarifying the assumptions behind the total numbers used as a given for biomaterials demand. And then to elaborate about the comment that Eric made, and Sonja partly touched on it as well). That circular economy and biorefining are key for the resource efficient use of the precious bio and natural resources. As such, it would be expected that going from 2030 to 2050 we will see

more complementarity and also see additional biomass streams coming into play from conventional crops processing.

Response by the Task Leader

Yes it is tricky., I already added an overview of the type of biochemical and materials that can be made of the different types of biomass to the Task 2 report. I will also include in the report comments about biochemical and biomaterial biomass demands in the future and the efficiencies expected.

Comments on Task 3 by Eric van der Heuvel

Comment 1

It would be valuable if in the report a reflection could be given from in 'outside-in' lens. The report provided valuable insights in how the industrial players expect the scale-up path from their own perspective from a current market perspective and a favorable market perspective. But that still is much based on the current understanding of the regulatory landscape. In my review I stressed that with ETS2, for instance, the demand for renewable fuels might be much higher towards 2030 and beyond) and that might require market players to rethink their production capacity scale up strategy.

Response by the Task Leader

I think the outside-in lens is applied in Task 1, so I will not include any further reflection on what future demand could be. But I will add a sentence that not only companies are well prepared to support rapid market roll-out but can also build partnerships to increase the pace even further if needed.

Comment 2

Furthermore, I highlighted that the report could provide more emphasis on the synergy potential between technologies, as to sharing the same technology for different feedstocks (such as FT for bio feedstocks and renewable electricity-based hydrogen or providing resulting CO2-output sources in one technology as input to other pathways (for RFNBO) as a means to enhance carbon utilization efficiency.

Response by the Task Leader

I will include some text

Comment 3

I noted that often the fuel suppliers are the ones affected by the national obligation to provide renewable energy, whereas the actual biofuel producers are not. This may create a gap in which the urgency is felt under the fuel suppliers more than among the producers.

Response by the Task Leader

I can add a remark. While biofuel producers are hoping for strong market signals and do feel urgency since they struggle with economics, Fuels Europe as the association of the fuel suppliers, i.e., the obligated parties is quite calm and says that they will provide as much fuel as needed. This is part of their interview, and I can make sure to highlight that remark.

Comment 4

An issue that I only as a side-remark placed at the meeting, but would like to include here, is that the industry parties that have been contacted in the process are focused on those that

are ‘known’ in Brussels and the academic bodies, are often those with vested interests that to me seem to hesitate to unconditionally shift to advanced biofuel feedstocks), or those that already are included in R&D trajectories . But beyond that there are a lot of companies that are not in the spotlight and on the radar but do have technologies (and operating facilities) worthwhile to understand their reproduction and scaling up potential, especially as the target intrinsic lingo-cellulosic or annex ix-A waste feedstocks.

Response by the Task Leader

Well, we reached out to 141 companies, plus we asked multipliers like associations to distribute the survey link, but the responses received all came from companies that already were on our radar. Anyhow, I can make sure to highlight my statement that any upcoming technologies are kind of included in the projections, since they will all be based on the existing feedstock base, and for 2050 we are using all feedstock. Sure, this can change the mix and probably the efficiency of biomass use, but this is all within sensitivity of the analysis.

Comments on Task 4 by Nils-Olof Nylund

Comment 1

The tables with the different scenarios for transport could include total amount of fuels as well as the relative contribution from renewable fuels.

Response by the Task Leader

The tables of Task 4 are already rather complex, and contribution biofuels versus renewable fuels is displayed in Task 1, so we have not changed this. However, may be considered in the final report, if E3Modelling agrees with it.

Comment 2

- the big challenge here is that vehicle CO2 regulations are based on tailpipe emissions, and there is no or limited incentives for vehicle manufacturers to produce alternative fuel vehicles,

- the lower carbon intensity of methane compared to diesel can give a benefit if you can maintain diesel-like efficiency for the gas engine,

- currently there are 400 hp+ tractors available from Iveco, Scania, and Volvo, but as the manufacturers are moving towards electricity, the questions that arises is how long they are willing or are able to continue with gaseous fuels?

- If ICEs running on RFNBO fuels will be allowed in the future, as you pointed out yourself, how can one make sure that a “dedicated” vehicle only runs on RFNBO fuel? Having dedicated dispensers communicating with the vehicle, marking the fuel with a dye, other options?

Response by the Task Leader

It is a point of attention, but not in the scope of Task 4, or the rest of the study. We trust a technical solution will be possible.

Comment 3

The title of the study says “advanced drop-in biofuels”.

- The report should define “drop-in”
- Drop-in in a way ties into the fuel quality directive and fuel standards, what you are allowed to use and where there are limitations
- The FQD basically only regulates properties which are important for emissions, whereas the fuel standards in a more comprehensive way cover performance, functionality, and safety
- Some of the tables include conventional biofuels as well as components which are not of drop-in type
- Solution infobox on what drop-in means, and at least some general remarks on fuel standards and compatibility will improve the report

Response by the Task Leader

To be tacked in the general introduction of the public final report

Comments on Task 5 by Uwe Fritsche

Comment 1

The socioeconomic analysis needs a bit of refinement, especially differentiating employment effects for the different feedstocks (at least giving ranges). It should be underlined that many biofuels have much higher employment effects than other renewable fuels, and that their production in the EU (instead of imports) imply very positive effects for European rural areas.

Response by the Task Leader

We have enriched the section description by adding the following sentence: “The current analysis considers the differences in terms of employment, related to the different feedstock production chain. The overall employment effect, for the modelled scenario, may differ over time, as function of the adopted feedstock to fuel mix. It is worth to stressing that, when compared with other renewable energy production chains, the biofuels offer significant advantages in terms of employment, as the feedstock production part has a significant positive impact.”

Comment 2

To ensure further EU leadership in advanced biofuels (both feedstocks and conversion), the EU should create a significant investment support package for the key options needed beyond 2030 to avoid entering the “valley of death” (which implies losing all the potential benefits from previous R&D funding).

Response by the Task Leader

We added the following sentence to the conclusions of the report: “The investigated KPIs clearly show the potential related to deployment of additional EU advanced biofuels production capacity. However, this potentially needed additional capacity will be deployed appears, the EU leadership in advanced biofuels (both feedstocks and conversion) must be promoted, also to capitalize the significant R&D expertise existing in the region. Support to investment is particularly relevant needed for to achieving the 2030 results, and beyond”.

Comment 3

If we look up to 2030 and 2050 and assume the same socioeconomic structure it's strange. Especially in terms of the GDP contribution. The GDP hopefully by 2030 and definitely by 2050 will look a lot different than the one chosen in Task 5 analysis, for reference. That should be explained. It should be made clear that this is a methodological problem which we can't avoid.

Response by the Task Leader

We have tried to address that by incorporating a sentence in the task report, in the section explaining the Contribution to GDP KPI methodology. Indeed, it is true that the GDP estimation used in this work does not specifically incorporate the assumptions made for the different scenarios evaluated in this analysis; this couldn't be avoided since no specific assessment has been performed in this study. Anyway, the latest official projections available, used for the EU 2020 REF Scenario, have been incorporated; they still extensively take into account the effects of the many existing policies with regards to the decarbonization of the EU economy, for year 2030 and 2050.

Comment 4

GHG reduction potentials were based only on regulatory framework information while they should be also based in science. At least an indication of what would be the additional savings considering a better database, should be included. On the other hand, if a full life cycle analysis is performed, it would result in a loss of some savings because additional emissions would be allocated to electric fuels. So, an explanation is needed.

Response by the Task Leader

We added some sentences to the report, both in the methodology, in the results and in the conclusions, trying to address the point and further clarify it; a summary of them is reported here. We feel that the use of a consistent set of default values is a guarantee for the robustness of the evaluations, and therefore for the derived conclusions. Anyway, it is indeed worth stressing that the Carbon Intensity of the REDII default values represent a conservative figure. Actual values, resulting from the certification of real industrial processes, are significantly lower; this potentially has a direct impact on the quantitative GHG saving resulting from the use of such fuels. Moreover, we consider these CI values as stable overtime but innovations such as the use of green hydrogen and renewable electricity in the biofuels making are already happening, which would lower the Carbon Intensity of the MJ of finished fuel.

Appendix 3 Biography of Thematic Experts

Task 1 – Sonia Yeh

Dr. Sonia Yeh is a Professor in Transport and Energy Systems in the Department of Space, Earth, and Environment. Her expertise is in energy economics and energy system modelling, alternative transportation fuels, sustainability standards, technological change, and consumer behaviour and mobility. Throughout her work, she has advised and worked broadly with U.S. state and international advisers, policymakers, a wide range of stakeholder groups and academic researchers in developing climate policies toward reducing the environmental impacts and GHG emissions from transport. She served as Fulbright Distinguished Chair Professor in Alternative Energy Technology in 2016-2017 and received Håkan Frisinger Award by Volvo Research and Educational Foundations in 2019. She is an adjunct professor at the Department of Engineering and Public Policy, Carnegie Mellon University, and a Senior Editor for Energy Policy journal since 2018. Dr. Yeh has worked extensively with international researchers, stakeholder groups, and governance bodies and regularly advises, collaborates and provides inputs to international organisations including the International Energy Agency (IEA), the United Nations Framework Convention on Climate Change Conferences of the Parties (UNFCCC COP)(working with national and local governments developing tools to develop transport strategies for the Nationally Determined Contributions NDCs), International Transport Forum-OECD, the World Bank, and the Asian Development Bank, etc. Dr. Yeh funded and co-leads the International Transportation Energy Modelling (ITEM) project https://transportenergy.org , participated by academic institutions, international and national energy agencies, major oil companies, and NGOs coordinating research on future scenarios, big data and research needs on Evs, MaaS, and policy needs to promote low carbon transitions in transport. She is a contributing author of Transport chapter in the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report.

Task 2 – Calliope Panoutsou

Dr Panoutsou is a Senior Research Fellow in the Centre for Environmental Policy at Imperial College London, the Chair of Biomass availability and supply in the European Technology and Innovation Platform for Bioenergy (http://www.etipbioenergy.eu/) and a member of the Scientific Committee of the Bio-Based Industries Joint Undertaking (https://www.bbi-europe.eu/). She has given advice to the Office of UK National Statistics for the inclusion of bioeconomy data and indicators to the National Materials Datahub; the International Energy Agency for biomass, bioenergy, and biofuels; UNDP, World Bank, Nordforsk for bioeconomy research in Scandinavia; and the Joint Research Center (JRC) of the European Commission. She has co-authored the JRC latest publications on Future transitions for the Bioeconomy towards Sustainable Development and a Climate-Neutral Economy29. Her work integrates natural sciences with economic and socio-economic approaches and policy analysis. She is currently leading research on how biomass can be integrated to climate and energy policies in Green Deal in four Horizon 2020 projects: Magic (www.magic-h2020.eu); BIKE (www.bike-biofuels.eu), BioMonitor (www.biomonitor.eu) and GOLD (started May 2021). She has published more than 60 peer review articles and a book on Modelling and Optimization of Biomass Supply Chains: Top Down and – Up Assessment for Agricultural, Forest and Waste Feedstock (2017)30.

Task 3 – Eric van der Heuvel

Eric is an international expert on sustainable energy, low carbon solutions, bio-based society, and bioenergy with experience in consultancy, intermediate Netherlands government agency, a technology company, and a downstream oil and gas corporate. On March 2015 Eric van den Heuvel founded studio Gear Up, an independent firm supporting organizations

in the transition to a low carbon economy, by providing strategic advice, process and project management services and guiding and facilitating stakeholder involvement processes. Furthermore, the studio develops own concepts in the field of renewable fuels, alternative fuels, and the circular economy. Projects he is involved include among others the management of the Netherlands Platform Sustainable Biofuels, assisting the European alternative and Renewable Transport Fuels Forum, providing strategic support to various international operating companies active in renewable fuels, and providing strategic advice to Netherlands Ministries and the European Commission. Eric has a strong track record of building and maintaining collaborative operations and building strong national and international networks. In his projects he investigates interaction between and solutions for technology, innovation, policy, and societal needs. His education at the Eindhoven University of Technology and the post-graduate Diploma Programme on Strategy and Innovation at the University of Oxford Saïd Business School helped him to develop a strategic orientation to business development, helpful for understanding innovation and market deployment strategies.

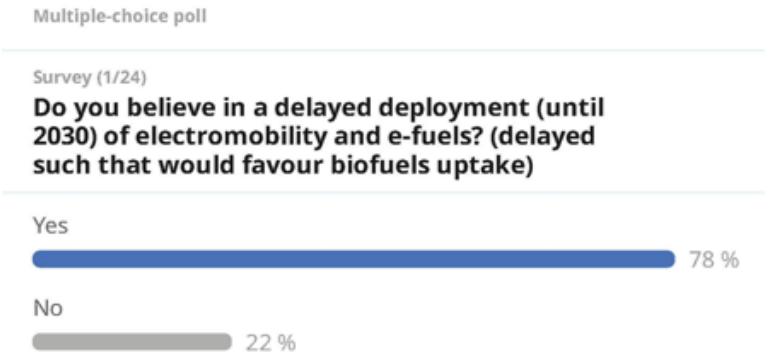
Task 4 – Nylund Nils-Olof

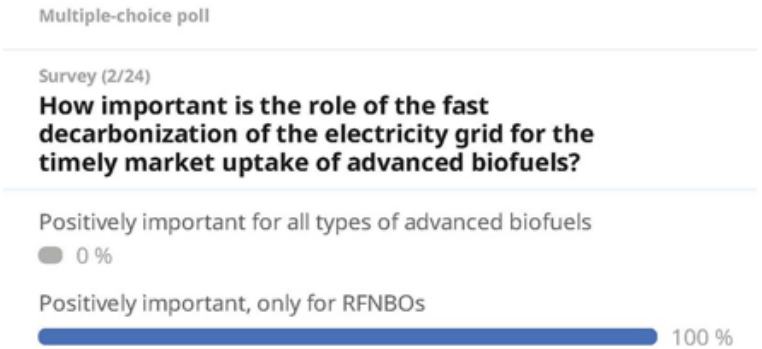
Nils-Olof Nylund has a Doctor of Technology degree in mechanical engineering (internal combustion engines) from Helsinki University of Technology. He is currently Research Professor for Energy Use in Transport and Engine Technology at VTT Technical Research Centre of Finland Ltd. He is manager of the Finnish research programme TransSmart on smart and sustainable mobility. He has been working with alternative fuels since 1979 and has been the Finnish delegate to IEA Advanced Motor Fuels (AMF) since 1990. Since 1998, he has been either Chairman or Vice Chairman of AMF. In addition, he also was the IEA EUWP Vice Chairman for Transport from 2007 to 2016.

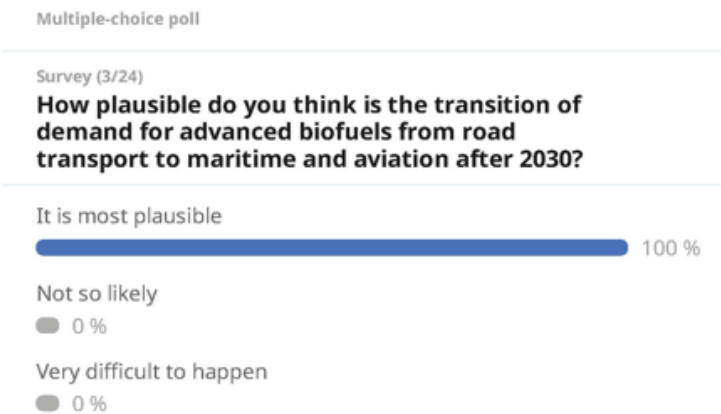
Task 5 – Uwe Fritsche

Mr. Fritsche studied applied physics at the Technical University Darmstadt and worked since 1984 as a scientist at Oeko-Institut where he headed the Energy & Climate Division in Darmstadt until 2010. After that, he focused on international activities and projects concerning sustainable biomass. In 2012, he co-founded IINAS and works there as Scientific Director. His expertise is material-flow and life-cycle analysis of energy, materials, and transport systems, and in developing sustainability scenarios with respective models and databases. Since January 2019 he is Task Leader of IEA Bioenergy Task 40 (Deployment of biobased value chains), Co-Leader of IEA Bioenergy Task 45 (Climate and Sustainability Effects of Bioenergy within the broader Bioeconomy) and contributes to the Global Bioenergy Partnership by leading its Task Force of Sustainability's Environment Subgroup.

Appendix 4 Slido Results







Multiple-choice poll

Survey (5/24)

Did you expect higher or lower biomass availability for bioenergy from this study?

Multiple-choice poll

Survey (6/24)

Which scenario do you expect to become the most realistic in 2030?

Multiple-choice poll

Survey (7/24)

Which scenario do you expect to become the most realistic in 2050?

Multiple-choice poll

Survey (8/24)

Do you believe it will be realistic that more biomasses will become available over next 30 years from unused, degraded lands in the EU?

Multiple-choice poll

Survey (9/24)

Do you think it is realistic to mobilize new drop-in biofuels through technology development that can convert unused gaseous biomass resources, manure, and organic fractions in sewage sludge, to drop in fuels?

Yes
100 %

No
0 %

Partially
0 %

Multiple-choice poll

Survey (10/24)

Do you think it would be good (in terms of biomass mobilization) for the sustainable performance of biofuels if less emphasis is placed on preventing ILUC and more on stimulating overall sustainable land management?

Yes
100 %

No
0 %

Multiple-choice poll

Survey (11/24)

What would be your merit order of investments?

Anaerobic digestion + upgrading, and HVO/HEFA
0 %

2G ethanol, gasification for the production of biomethane, gasification for the production of biomethanol/DME/ammonia, and pyrolysis
50 %

ATJ, gasification for the production of FT-SPK, and HTL
50 %

RFNBOs
0 %

Multiple-choice poll

Survey (12/24)

Where do you think cover crops would be used for?

FAME production
0 %

HVO production
100 %

Multiple-choice poll

Survey (13/24)

Which percentage of biomethane from AD would you expect to be available to the transport sector in 2030?

Multiple-choice poll

Survey (14/24)

Which percentage of biomethane from AD would you expect to be available to the transport sector in 2050?

Multiple-choice poll

Survey (15/24)

Do you think the resulting 2030 capacities of pathways are reasonable (in general)?

Multiple-choice poll

Survey (16/24)

Do you think the resulting 2050 capacities of pathways are reasonable (in general)?

Multiple-choice poll

Survey (17/24)

Do you think that the overall advanced biofuels and biogas capacity expansion in 2030 is reasonable?

Multiple-choice poll

Survey (18/24)

Do you think that the overall advanced biofuels and biogas capacity expansion in 2050 is reasonable?

Multiple-choice poll

Survey (19/24)

The gap analysis of the present work, suggests that there will be no gap for 2050. Such a situation would directly enhance the security of supply in Europe. Do you believe that the importance of this aspect has been appropriately acknowledged?
(1/2)

Multiple-choice poll

Survey (20/24)

There is an impressive list of announced and planned projects for hydrogen production and e-fuels. However, the installed capacities are still very low. Do you believe these projects will eventually materialize in all factors?

Multiple-choice poll

Survey (21/24)

Availability of hydrogen produced from eligible renewable electricity sources is an important barrier to RFNBO capacity development. On the long run availability of CO2 will be more critical. Do you agree with this statement?

Multiple-choice poll

Survey (22/24)

Do you think that the EU policies and strategies will have an important impact on extra-EU biofuels market?

Multiple-choice poll

Survey (23/24)

Do you expect that EU-produced biofuel volumes could be exported to extra-EU regions? Or it is more likely that EU production will be sized to EU internal market?

Multiple-choice poll

Survey (24/24)

Further deployment of biofuels will entail a positive effect on the employment of the sector. Do you believe that this critical aspect, has been appropriately communicated to all actors?

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The workshop validated the results and conclusions of the work completed during the project implementation. It primarily targeted key industrial and research stakeholders within the EU's advanced drop-in biofuels value chain and market. Participants engaged with the project-team to examine and corroborate the findings, specifically those concerning current industrial capacities and the industry's requirements to meet the volumes prescribed by EU policy. Feedback received during the workshop was considered by the project team and incorporated into the final report of the project.

Studies and reports

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