IEA Bioenergy
Technology Collaboration Programme

Task 39
IEA Bioenergy

Lessons learned success stories in biofuels

Intertask project T39, T40 and T45

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Stockholm, 8 Nov 2021

Project update: Significant achievements / results

- This is an InterTask project between T39 (Project coordinator), T40 and T45 to evaluate reasons underlying the past and ongoing boom and bust cycles of biofuel technologies development, demonstration, deployment and replication.
- This study will identify technology successes and the best policy framework conditions and measures for stimulating increased future markets for production and consumption of sustainable transport biofuels.
- Well-attended kickoff meeting held 23 Sept, 2020: The project team identified markers to serve as guides to compare projects and plants. SVEBIO and Bioenergy 2020 both have databases of such plants that will be used.
- The project aims to answer two research questions: “What is required to re-stimulate vigorous biofuels development and scale up?” and “What are key factors for the success of sustainable advanced biofuel projects?”

Project update: Forthcoming activities / issues

Until next ExCo meeting, the project will work on, or have concluded, these WPs:

1. **Status quo biofuel projects:** Overview of conventional biofuel capacities, including a brief summary of the development and status of advanced fuel projects worldwide. Issues related to governance of biofuel development, e.g., mapping and inventory of existing policy instruments.
2. **Meta-analysis on existing studies:** A comprehensive summary of the main findings and lessons learned regarding successes and failures for biofuel projects in the analysed studies and according to the defined criteria.
3. **Case studies technologies:** Brazil, Germany, Sweden and the USA. Each studied for two cases, i.e., biofuel projects or plants. Analysis of each country policy in terms of successes or lessons in terms of the projects and plants.
4. **Case studies supply chains:** Success stories and insights about future potential developments with assessment thereof. Biomass fractionation methods and lessons and successes in sustainability standards and certification of international supply chains.

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Project update: Activities and expected results | WPs

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

WP 1 | Status quo biofuel projects
T39 (Lead), T45
Overview TRL, capacities of biofuels projects, Wrap up national programs
Existing sustainability / certification schemes

WP 2 | Meta-analysis existing studies
T45 (Lead), T39, T40
Inventory of studies, specifically addressing lessons learned biofuels
Screening with criteria to be defined

WP 3 | Case studies technologies
T39 (Lead)
Success stories for dedicated technologies and regions, (e.g. US, EU, Brazil)

WP 4 | Case studies supply chains
T40 (Lead), T45
Success stories for biomass supply chains

WP 5 | Synopsis / synthesis of key issues
T39 (Lead), T40, T45
Conclusions, guideline „good to know" for decision makers, identification of required actions for *„Lessons learned biofuels II"*

WP 6 | Project manage-ment and dissemi-nation
T39 (Lead)

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

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

Research question (T39):
"What is required to re-stimulate vigorous biofuels development and scale up?"

Research question (T45):
"What are key factors for the success of sustainable advanced biofuel projects?"

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Time schedule (updated and prolonged)

Work package / project month	1 March	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	July		Sept		Nov		Jan		March		May		July		Sept		Nov		Jan		
WP 1 | Status quo biofuel projects	2020						2021														
WP 2 | Meta-analysis																					
WP 3 | Case studies technologies																					
WP 4 | Case studies supply chains																					
WP 5 | Synopsis																					
WP 6 | Project m. dissemination																					
Project meeting (webconf)			PM			PM			PM							PM			PM		
Workshop with external																	WS				
Reports																	R1	R2		R3	SR

R1, x | WP-related report; SR | summary report; WS | Workshop with external

R1 = WP 2
R2 = WP 4
R3 = WP 1 + 3 + 5

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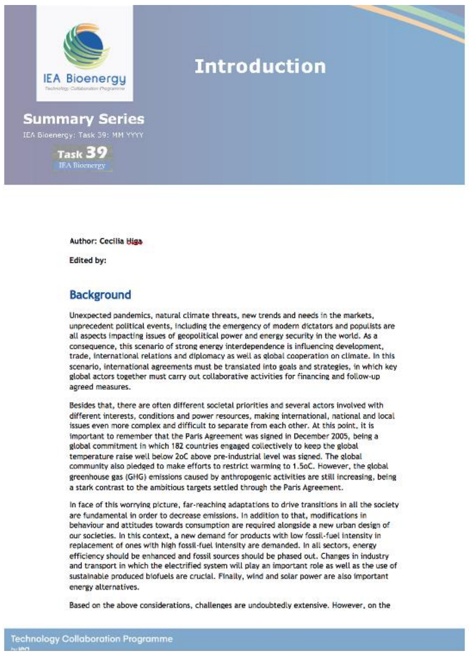
WP 1 | Work progress & reporting

Status quo biofuels projects

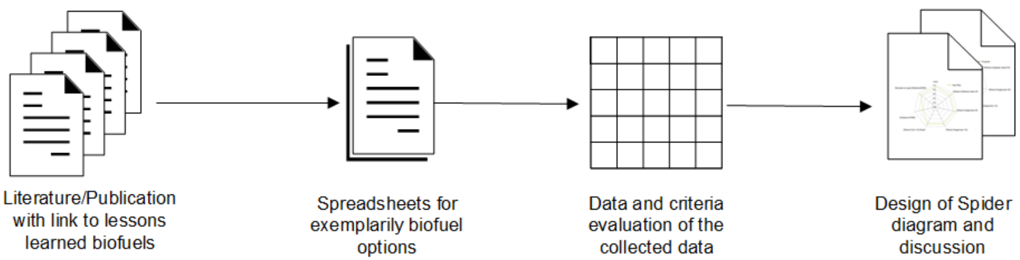
The draft report will be ready for review around start Nov



WP 2 | Work progress & reporting

Meta-analysis existing studies

- Preparation of template from spreadsheet for biofuels evaluation
- Literature review and biofuels evaluation
- Defining of criteria for integrated evaluation
- Creation of spider diagram for the evaluation

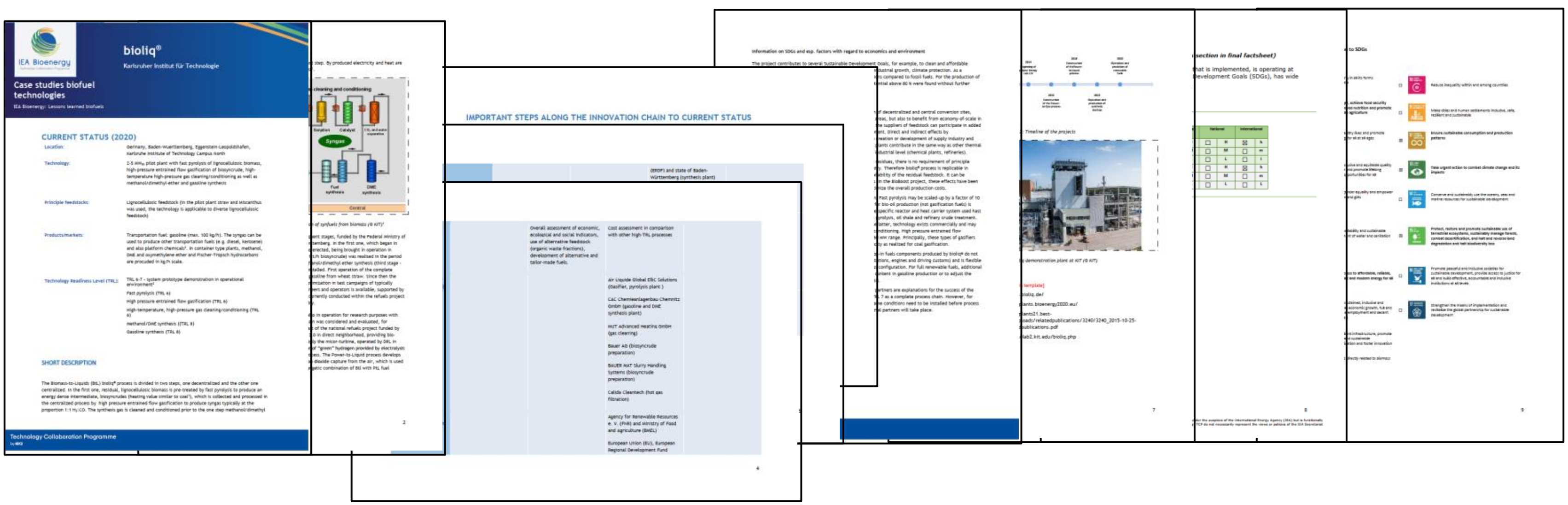


Ethanol (Sugarcane 1G)		Answer	Unit	Space for commentary / annotations	Literature for specific information
Biofuel/Biofuel Technology:	Technology used to produce the liquid biofuel	Ethanol (Sugarcane 1G)			
Source:	Please indicate from the OneNote list which article/publications is/are the source of information	11	Link to the list	If multiple, please indicate which	
Location:	Country, region, city where it is considered a success	Brasil		May apply to other countries that produce sugarcane	
TRL (Technology Readiness Level)	Success story should at least be TRL 7 TRL 7 - system prototype demonstration in operational environment TRL 8 - system complete and qualified TRL 9 - actual system proven in operational environment	9			
Biofuel main use		Light vehicle			
Principle feedstocks:	Type of feedstock	Sugarcane		If more information available, please indicate here	
	Please indicate if domestic or imported	Domestic			
	Feedstock availability	High			
	Feedstock yield	High		80 t stock/ha	
	Planted area	High		10 Mha (approximately half to produce sugar and half to produce ethanol)	
	Soil-climate requirements	Medium		Sugarcane requires at least 1000 mm of rain (or need irrigation). Feedstock production requires proper agronomic practices, such as fertilization, weed control etc)	
Products:	If commercial production include output (m3/yr, t/yr, other)	33.2 million	m^3/yr		
	Biofuel yield (per unit feedstock, land, etc.)	6.8	m^3/ha		
	Co-products - low value	Yes		Vinasse (fertilization, biogas)	
	Co-products - medium value	Yes		Bagasse, harvest residues (heat, electricity);	
	Co-products - high value	Yes		Chemicals (citric acid, others)	
Economics:	Economics considered?	Yes			
	Biofuel production costs (or sales cost)?	Yes		0.53 US$/L (Nov 2020) (24.2 US$/GJ) At the mill 0.33 to 0.39 US$/L (15.05 US$/GJ to 17.8 US$/GJ) (2020 Source: ÚNICA (Sugarcane Industry Association) www.unica.com.br. Accessed on 3Dec2020).	Source: ÚNICA (Sugarcane Industry Association) www.unica.com.br. Accessed on 3Dec2020 --> The ethanol density and net
	CAPEX available?	Yes		??	
	OPEX available?	Yes		??	
Public policies:	Does any mandate supported the introduction?	Yes		At least 27% of ethanol in gasoline in all Brazil. 100% ethanol also available at gas stations	
	Does it require subsidies?	Yes		Consumer tax lower than that of gasoline in most States in Brazil	
	Are relevant laws and regulations?	Yes		Minimum requirement of ethanol in gasoline (see above). Taxes (see above). Renovabio rewards biofuel producers that prove to reduce GHG emission.	
	Does it have public acceptance?	Yes		Ethanol is available at all gas stations in Brazil. >40% of biofuel used in light vehicles	
Environmental impact:	GHG Emissions (g CO2e/MJ or another unit)	23	g CO_{2e}/MJ	Cradle to whell LCA. Avoided 70 to 90% GHG emissions compared to gasoline. Recent legislation (Renovabio, 2017) stimulates reduction of GHG associated with biofuels.	
	Competition with food?	No		Although land could be use to produce other things and sugar is a food, the amounts of land available in Brazil makes food competition irrelevant	
	Land requirement?	Medium		High yielding crop.	
	Air quality impact?	Yes		Negative impact due to pre-harvest burning, now legally phasing out; Positive: cars using ethanol decreases urban air pollution	
	Water usage?	Yes		Feedstock production is mostly rainfed (except in Northeast Brazil and partially in Central Brazil). Water is also required for sugar/ethanol production but amounts are being reduced. Water use in industry is regulated in some parts of Brazil	
	Land impact?	Yes		Large farms; risks of erosion during some stages of feedstock production. Proper agronomic practices are required to control negative impacts. The Brazilian Forest Code establishes that at least 20% of the land in private properties must be set aside as legal reservation (native species) promoting biodiversity, land and water preservation. Zoning establishes areas in which sugarcane cannot be cultivated.	
	Sustainability issues: additional remarks			Many positive issues: cycling of by-products (vinasse, industry residues) in the field are commom practices in the sugarcane industry. Retention of harvest residues (8-15 t dry matter per hectare) helps to recycle nutrient in increase soil C sequestration.	
Employment:	If available, please describe jobs created and/or indication of employment number related to a project	Yes	Direct Jobs	More than 1 million jobs in the sugar/ethanol mills (2012). 27% of the agriculture jobs (2012) (Moraes et al., 2015)	Acording to IRENA, in 2018 there wer 216 100 jobs in sugarcane cultivation and 158 Source: Moraes, M. A. F. D., Oliveira, F. C. R., and Diaz-Chavez, R. A. (2015). Socio-
		Yes	Indirect Jobs	Many (??) jobs created in the whole chain	
Implementation potential:	Please indicate if it is low, medium or high and if this is at local/regional, national or international level	High International		Implementation viable in many coutries of the tropical-subtropical zones. More than 100 countries in the world cultivate sugarcane to produce sugar. The same industry, with few modifications, can produce ethanol.	
Replication potential:	Please indicate if it is low, medium or high and if this is at local/regional, national or international level	High		The technology to produce ethanol is not complex and can be replicate in countries that produce sugarcane. The large scale of the Brazilian model may not be replicated in all countries.	
Scale-up potential:	Please indicate if it is low, medium or high and if this is at local/regional, national or international level	High International		Is it feasible to scale-up this technology/ biofuel? (if presently used in small scale or pilot plants)	
Contribution to Sustainable Development Goals:	Please indicate the contributions to SDGs	Please fullfill the table below with the contribution to SDGs			
Additional remarks:	Any additional information or constraints that should be mentioned here?	???		We can comment on the reasons why ethanol is not used in Guatemala (Horta)	
Info provided by & date:	Who filled in this template?	Heitor Cantarella & Others, 3 Fev2021			

WP 3 | Work progress & reporting

Case studies technologies

- Specific case studies will be made for Brazil, Germany, Sweden and the USA. For each country minimum two cases (biofuel projects/plants.
- Preparation of templates done by DBFZ
- Sending of draft case studies to project and/or network partners
- Explanation of development of the technology



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WP 4 | Work progress & reporting

Assess successes and lessons learned for biofuels deployment

The main objectives are:

- Provide insight about future potential developments of international (advanced) biofuel trade and its interaction with local/domestic markets (linked to IEA Bioenergy Task 40 Regional Transitions project).
- Assess successes, failures and learnings of existing feedstock supply chains (linked to T40 Regional Transitions project). Compare the failures of large-scale mobilization and utilization of agricultural residues by pioneer biorefineries and successes of plantations supplying woody biomass to large pulp mills in Brazil.
- Assess potential development of biomass fractionation methods to provide conversion-ready feedstocks and co-products.
- Lessons and successes in sustainability standards and certification of international supply chain (insights from IEA Bioenergy Task 40 and H2020- ADVANCEFUEL)

WP 5 | Work progress & reporting

Synopsis synthesis of key issues

- Providing a synopsis of this study based on the WP 1 – 4 results -> Conclusions about “successes and lessons learned on biofuels deployment” Link to WP 6/workshop in 11/2021
- Answer the project key questions:
  “What is required to re-stimulate vigorous biofuels development and scale up?”
  “What are key factors for the success of sustainable advanced biofuel projects?”
- From WP 3 e.g. “Important steps along the innovation chain to current status” incl. driving frame conditions, driving factors
- Developing a kind of “guideline/good to know” brief for decision and policy makers >> key messages of the WP are important
- Additional outlook-oriented parts of this work package include identifying objectives for further – and in terms of dedicated questions – more detailed aspects of “Assessing lessons learned for renewable fuels”.
- Possibility to extend and continue work in WP 2 Meta-analysis for Phase II, not excluding HVO-based biofuels for case studies of lipids supply chains, as this increases rapidly.

WP 6 | Work progress & reporting

Project management / Reporting

- The project has had five progress meetings including this one and is scheduled for one or two more thereafter.
- The project has made three progress report presentations to ExCo with latest in October 2021. These have been given by Jim McMillan.
- ExCo88 - Intertask Lessons learned biofuels 1-page status report
- The project have had three internal workshops (WP 2)
- We have had several Project management meetings.
- The project is planning for one external workshop 25 Nov 2021.
- The deliverables will be three reports (R1-3) and one Summary (S)

External workshop 25 November 2021

Goal: provide workshop among industry and decision-makers presenting and discussing project results for WP 5

1. Format: Co-organizing with IEA TCP Task 33 and Swedish Centre for Gasification with physical and digital participation, aim: 80-100 people
2. Location and time: Saltsjöbaden, Stockholm prel. 09:30 -17:00
3. Marketing and invitation and registration done by SVEBIO assisted by others
4. Tentative program: introduction and series of presenters of projects followed by work groups discussing laid out questions and final presentation with general discussion and conclusions.

Thanks! Questions?

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