market up

The market uptake of transport research and the role of actors and regions

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Aviation Bio Fuels show case

Market-up is funded by the European Commission DG Research under the 7th FP

SEVENTH FRAMEWORK PROGRAMME

INTRODUCTION TO SHOW CASE

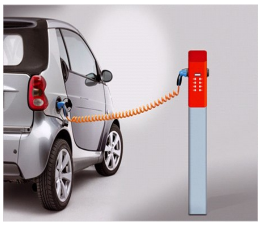
Due to the continuously increasing volume of traffic in aviation the reduction of greenhouse gas emissions is an important issue for the aviation industry and will become even more important in future. One step to reach this aim is the use of biofuels. Jetfuels produced by using the Fischer-Tropsch synthesis ('Biomass-to-Liquid') or hydroprocessed oils ('Hydrotreated Renewable Jet') are attractive to the aviation industry as these fulfil the demands for reduced greenhouse gas emissions on the one hand and are fully interchangeable with fossil jetfuels on the other hand. Furthermore, their feedstocks are able to be produced in a sustainable way regarding land use changes

Knowledge development within the aviation biofuels innovation system is very promising as well as the influence on the direction of search and experimentation activities by the actors within the system. Furthermore, the legitimation of this green alternative to conventional fossil aviation fuels is at a high level, though there is a lack of economic acceptance due to the high costs of aviation biofuels compared to fossil jetfuels. As the system is in the formation phase, market formation and resource mobilisation are at a low level. Also significant positive externalities have not yet arisen from the system.

This document is a summarized non-technical paper covering the various aspects connected with use of **bio fuels in aviation**

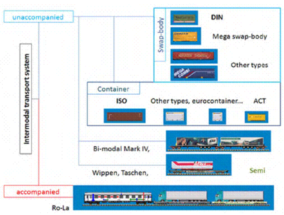
Market-up project aims to identify barriers (both social and technical) and drivers for the market uptake of transport research results. Via this identification process the project aims to contribute to the increased role of the transport sector in delivering a low carbon economy, in the search of tools to achieve two main goals: that research results are uptake by the market and that European research supporting covers all actors, including the weakest ones.

This show case is one of the seven cases assessed in Market-up. Other show cases include:



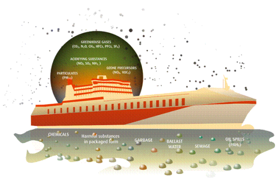
Electromobility

Intermodal VEL Wagon



Maritime and IWT Container Transferium

Cargo Sprinter: rail door to door solutions



Deployment of Green Technologies within the Maritime Sector: SO2 Abatement Technology

Bio fuels for Land Transport

CASE DESCRIPTION

This case identifies a lack of resources to set up large-scale production of aviation biofuels as the most pressing blocking mechanism for the system. The low production capacity leads in turn to a lack of cost-competitiveness which causes again a weakness in provision of resources. Furthermore, there is fierce competition for the limited supply of biomass resources and biofuel between the aviation industry and other energy-intensive industries (surface transport, electricity etc.). Inducement mechanisms regarding the aviation biofuels innovation system are for instance the carbon reduction goals formulated by consumers and politics. Also institutional stimuli such as the introduction of the Emission Trading Scheme to aviation play an important role.

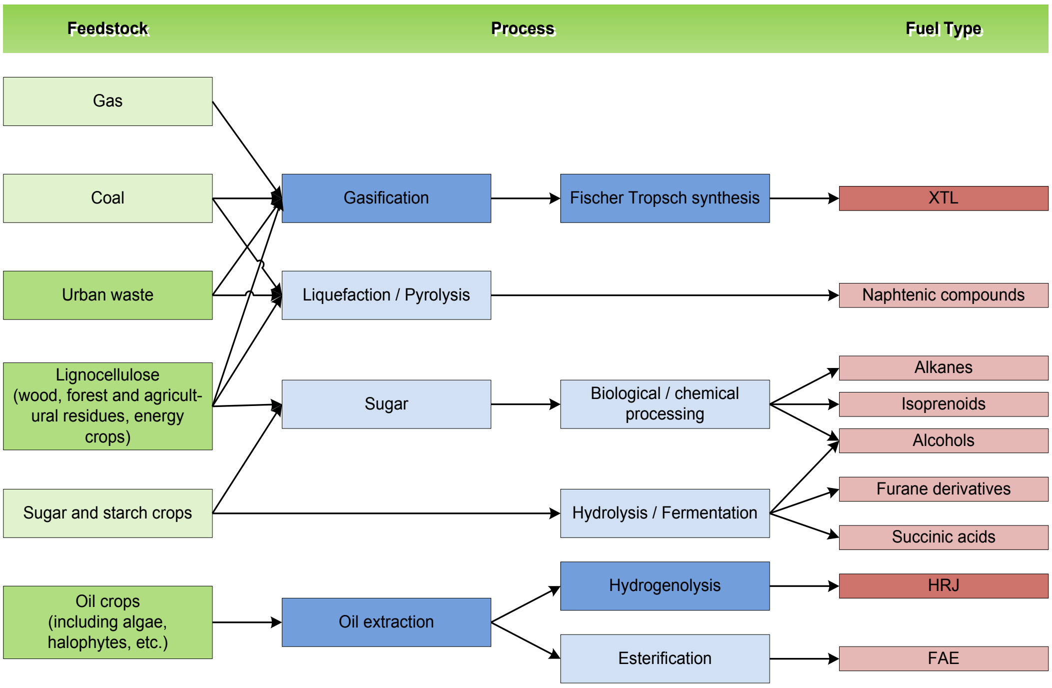
ABOUT THE ASSESSMENT

This assessment was undertaken by applying the Transport Innovation System (TIS) analysis. This method was developed by a group of Swedish researchers led by Ms. Anna Bergek (for more information consult the paper referenced as Bergek et al, 2008) and aims to provide a practically useful analytical framework that allows for the assessment of an innovation system performance as well as the identification of factors influencing performance of those innovations. The assessment is based on a scheme of analysis that consists of six steps:

Step 1 – The starting point of analysis: defining the TIS in focus
Step 2 – Identifying the structural components of the TIS
Step 3 – Mapping the functional pattern of the TIS
Step 4 – Assessing the functionality of the TIS and setting process goals
Step 5 – Identify inducement and blocking mechanisms
Step 6 – Specify key policy issues

Step 1 – Starting point of the analysis: defining the TIS in focus

This TIS analysis focuses on the knowledge field of biofuels for aviation. The range of applications concentrates on the aviation branch while the main focus lies on commercial aviation, i.e. subsonic planes propelled by jet engines in Member states of the European Union.

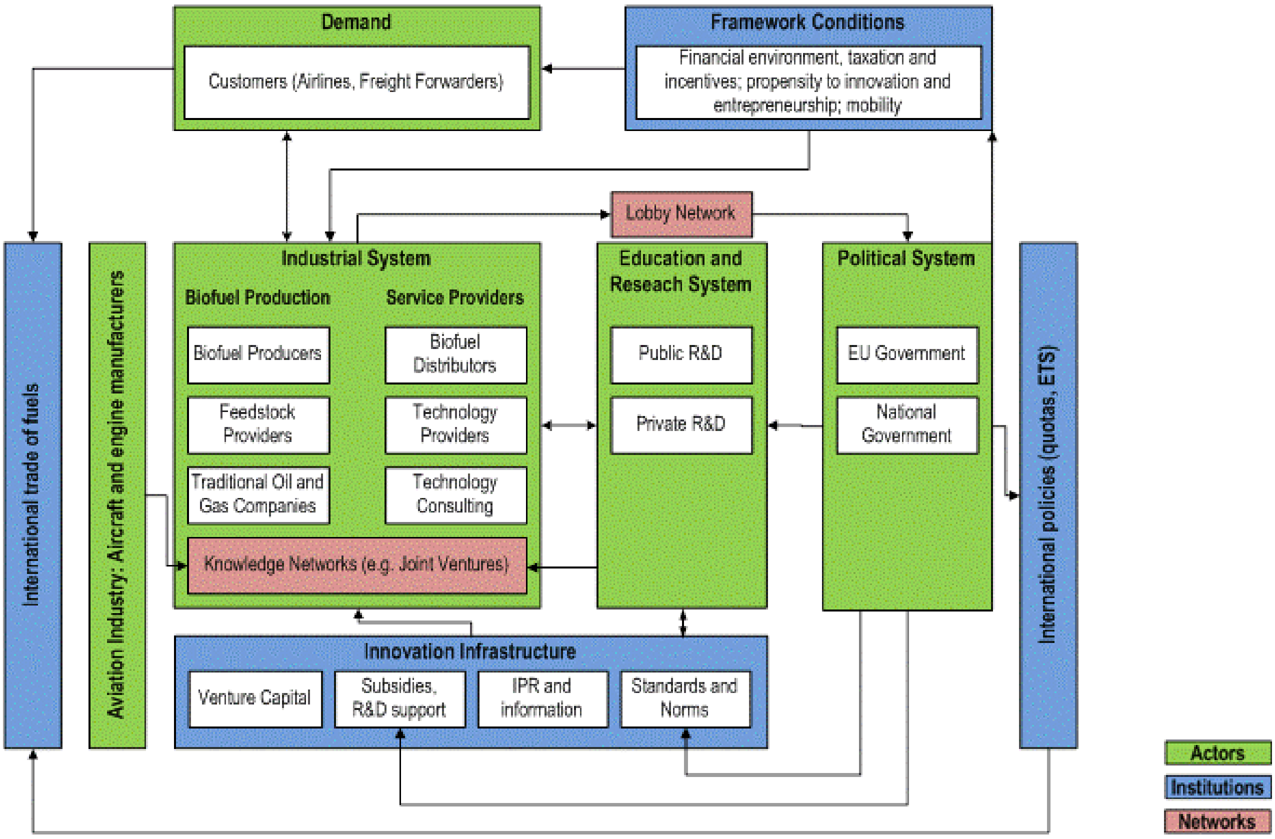


Important characteristics refers to the “Second generation” and “Drop-in” .

Industrial focus:
- (potential) producers,
- (potential) raw material providers
- research organisations

Step 2 – Identifying the structural components of the TIS

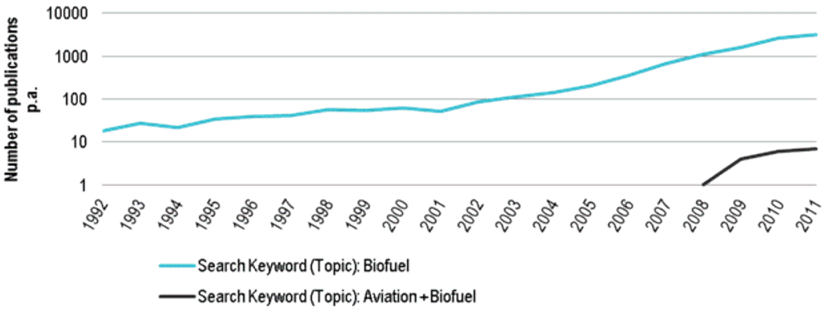
The Figure schematically presents the relevant structural elements of the innovation system, including an identification of the most relevant actors, existing networks and institutions

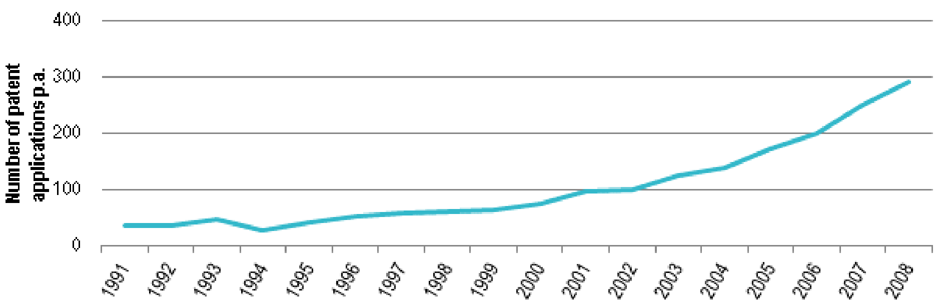


Step 3 – Mapping the functional pattern of the TIS

Knowledge development and diffusion

Publications p.a.
(Source: Web of knowledge):



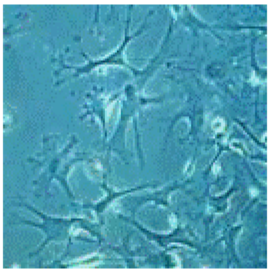


Worldwide patent applications p.a. (Source: PATSTAT):

Influence on the direction of search:

International Air Transport Association (IATA):

- "An average improvement in fuel efficiency of 1.5% per year from 2009 to 2020;
- A cap on aviation CO2 emissions from 2020 (carbon-neutral growth);
- A reduction in CO2 emissions of 50% by 2050, relative to 2005 levels."



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Advisory Council for Aeronautics Research and Innovation in Europe (ACARE):

- „In 2050 technologies and procedures available allow a 75% reduction in CO2 emissions per passenger kilometre to support the ATAG [Air Transport Action Group; author's note] target and a 90% reduction in NOx emissions. [...] These are relative to the capabilities of typical new aircraft in 2000. [...]
- Europe is established as a centre of excellence on sustainable alternative fuels, including those for aviation, based on a strong European energy policy.
- Europe is at the forefront of atmospheric research and takes the lead in the formulation of a prioritised environmental action plan and establishment of global environmental standards."

Entrepreneurial experimentation:

- 28 demonstration and pilot plants in Europe:
  - Private and public funding: approx. 1.7 billion Euro
- According to renewablejetfuels.org, most companies dealing with biofuels, especially (potential) biofuel producers, feedstock and technology providers and biofuel distributors, were founded within the past decade
- Six processing pathways:

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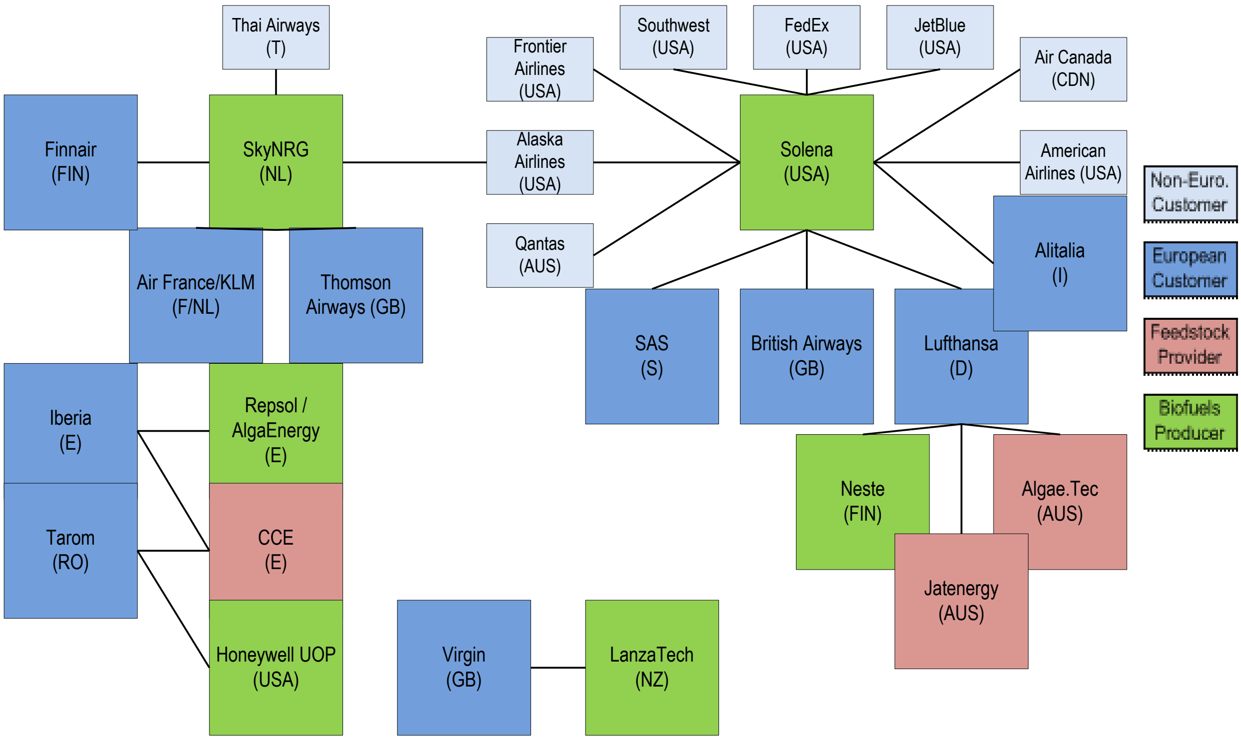
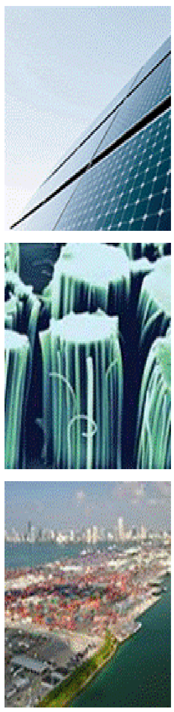
Market Formation

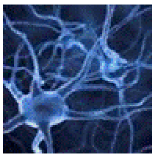
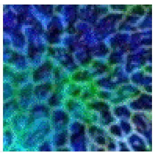
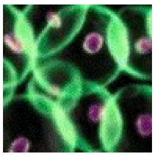
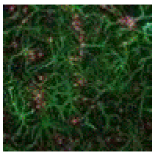
- Aviation biofuel market is still a nursing market with no considerable market share
- IATA predicts 3 to 6% market share by 2020 worldwide
- Buyer-supplier networks (derived from press statements):
  - Institutional stimuli:
  - In the beginning of 2012, aviation was included into the Emission Trading Scheme
- 7th Framework Programme and Horizon 2020: overall research budget of 129 billion Euro
- No information about budgets



Legitimation

- Standardisation and certification of safety and sustainability is most important at the moment.
- Social acceptance is high
  - high awareness about pollution
  - dependant on additional ticket fares
  - dependant on the kind of feedstock used
- Economic interest is high:
  - dependant on the fuel price
  - dependant on legislation
  - demand exaggerates production capacity at the moment
- Political acceptance is high
  - demanding goals for aviation biofuels
  - specific actions: research funding, Emission Trading Scheme



Resource mobilization

- The cumulative investments for facilities and infrastructure needed to produce biofuels range from approximately 160 billion Euro up to 700 billion Euro. The aviation share of these costs ranges between 30 and 180 billion Euro.
- Approx. 1.7 billion Euro are already invested into biofuel pilot and demonstration plants. Most of these funds were invested within the past ten years.
- Rising number of new research projects and companies entering the system imply a rising number of employees within this system.
- Resource Mobilisation is taking up momentum, but is still far away from the growth phase.

Development of positive externalities:

Positive externalities arising from the system in the form of pooled labour markets or specialised intermediate goods and service providers have not yet arisen, because the system is in the formation phase with limited resources. In a later phase those will possibly arise.

Knowledge externalities regarding aviation biofuels formed through the emergence of knowledge networks like the SWAFEA and the ALFA-BIRD projects. Buyer-supplier alliances are likely to develop knowledge externalities as well

Step 4 – Assessing the functionality of the TIS and setting process goals

This step looks into the assessment of the seven functions of innovation presented in Step 3 and provides an overall assessment of how the innovation system is performing. The Table represents the key conclusions from the evaluation

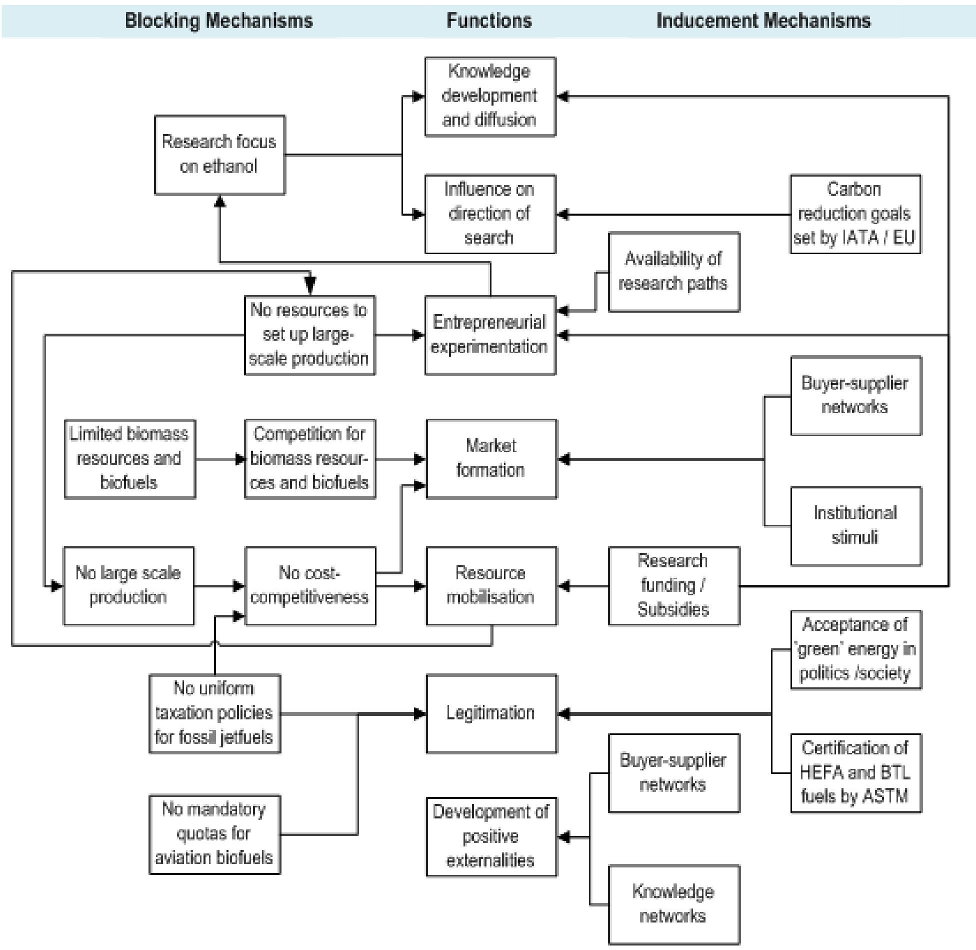
Function	Assessment
Knowledge development and diffusion	☺
Influence on the direction of search	☺
Entrepreneurial experimentation	☺
Market formation	😐
Legitimation	☺
Resource mobilisation	☹
Development of positive externalities	☹

Process / Policy goals:

- set up large scale production plants and find arable land sufficient for biofuel feedstocks
- support further development and large-scale production of HRJ and BTL pathways
- promote research regarding jatropha and camelina and (in the long term) algae
- encourage investors to provide start-ups intending to scale up their production with venture capital
- offer credits at low interest rates via state owned banks
- make biofuels more attractive to the aviation industry by drastically reducing their costs
  - allow tax reductions or exemptions for the use of biofuel
  - subsidise the production of biofuels and required feedstocks.
  - create clear conditions (e.g. define feed-in quotas for biofuels) in order to ease decisions for potential investors.
- ensure sustainability and safety of aviation biofuels.
  - Initiate a European certification or standardisation process

Step 5 – Identify inducement and blocking mechanisms

Key inducement and blocking mechanisms are below illustrated.



Step 6 – Specify key policy issues

Monetary and non-monetary policy issues are summarised. The issues are divided into the economic activities 'feedstock production', 'biofuel production' and 'biofuel use'. Regarding monetary activities, special attention should be given to SMEs (e.g. spin-offs from universities and research institutes) as these represent the largest fraction within biofuel producers and feedstock growers.

		Economic activity influenced by policy		
Policy Issues		Feedstock production	Biofuel production	Biofuel use
	Monetary activities	• Provide research funding on 2nd generation biofuel feedstocks (e.g. jatropha, camelina and algae). • Provide subsidies for feedstock production, especially to SME.	• Provide research funding on 2nd generation bio jetfuels (BTL, HEFA / HRJ). • Provide funds / credits to scale up production capacities. • Provide subsidies for aviation biofuel production, especially to SME.	• Provide subsidies for the use of bio jetfuels. • Start taxation of fossil jetfuels.
	Non-monetary activities	• Improve infrastructure in rural areas suitable for feedstock production. • Identify areas meeting the requirements of 2nd generation biofuel feedstocks and large enough for large scale production of these feedstocks.	• Develop standardisation / certification processes ensuring the safety and sustainability of biofuels. • Encourage venture capitalists and investors to invest into biofuel companies. • Set up research projects to promote knowledge exchange.	• Define a feed-In quota for bio jetfuels. • Promote the use of 2nd generation biofuels primarily in air transportation.

Key Sources Used

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A complete version of this case can be found in Deliverable D31 available from project

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Consortium

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www.tis.pt

Fraunhofer Institute for Systems and Innovation Research (DE)
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www.ua.ac.be/tpr

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