



CONFERENCE ON AVIATION AND ALTERNATIVE FUELS

Mexico City, Mexico, 11 to 13 October 2017

Agenda Item 3: Challenges and policy making

GUIDANCE ON POTENTIAL POLICIES AND COORDINATED APPROACHES FOR THE DEPLOYMENT OF SUSTAINABLE AVIATION FUELS

(Presented by the ICAO Secretariat)

SUMMARY

This paper describes the progress on the development of a “*Guidance on Potential Policies and Coordinated Approaches for the Deployment of Sustainable Alternative Aviation Fuels*” by the ICAO Committee on Aviation and Environmental Protection (CAEP) and invites States to evaluate the proposed qualitative methodology for the assessment of effectivity of alternative fuel policies.

Action by the Conference is in paragraph 4.

1. INTRODUCTION

1.1 Since the first ICAO Conference on Aviation and Alternative Fuels (CAAF/1) in 2009, ICAO has actively encouraged Member States and industry in the promotion and harmonization of initiatives that encourage the development of sustainable aviation fuels (SAF).

1.2 At ICAO’s 39th Assembly, Resolution A39-2 requested Member States to “set a coordinated approach in national administrations for policy actions and investment to accelerate the appropriate development, deployment and use of clean and renewable energy sources for aviation, including the use of sustainable alternative fuels, in accordance with their national circumstances”.

1.3 For the purpose of this request, it is understood that *coordinated approaches* are desired for the development of policy alignment with common elements and similar general requirements, based on lessons learned and best practices from already implemented policies, which have been demonstrated to be feasible, effective, and cost-efficient.

1.4 Different States and authorities have developed, are currently developing, or potentially will develop diverse support instruments for the deployment and use of SAF.

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1.5 Some of those existing instruments and policies, when demonstrated to be effective, can serve as references for other Member States when aiming to implement similar policies. Positive and negative lessons learned from the implementation of existing frameworks can help the establishment of further appropriate SAF-related policy actions.

2. ICAO CAEP WORK ON POLICIES

2.1 The CAEP/10 meeting, in February 2016, tasked the CAEP Alternative Fuels Task Force (AFTF) with a new work stream addressing the development of a “*Guidance on Potential Policies and Coordinated Approaches for the Deployment of Sustainable Alternatives Aviation Fuels*” (herein after called as “Guidance on Potential Policies”). The objective is to create guiding principles and recommendations to support adoption of national/regional policies.

2.2 Specifically, this work will provide robust information concerning the effectiveness of different policy mechanisms, including benefits and externalities, acknowledging that it is unlikely that the application of a policy will have exactly the same result State to State.

2.3 A first objective of the task is to outline policy instruments incentivizing deployment of sustainable alternative fuels (not only for aviation), as well as barriers or disincentive mechanisms grouped in different types or categories with similar characteristics and nature.

2.4 As a second step, the work should identify “potential policies” which have been demonstrated to be feasible, effective, and practical. Such identification is to be done through CAEP assessment based on best practices, lessons-learned, and proven positive results from the implementation of such policy instruments, which might include policies developed for other sectors, applicable to air transport.

2.5 Finally, such analysis shall identify elements that may benefit from improved coordination among States, and the development of “guiding principles” to facilitate the implementation of those policies and incentive mechanisms by States or regions, using effective policy approaches when considered beneficial.

3. WORK PROGRESS

3.1 Literature Review:

3.1.1 An initial collection of literature was performed, composed of 57 research papers from various sources. 23 of them have a primary focus on the US or EU, while the majority of the remaining papers focus on Brazil, Australia, China, and Canada. 12 out of 57 papers specifically address aviation fuels policy, while the remaining papers focus on road transport or all modes of transport. A list of the documents included in the literature review is included in Appendix C.

3.2 Policy categories:

3.2.1 Policy options have been initially clustered into the following categories:

- Volume linked support
- Subsidies
- Assistance for establishment of production
- Assistance for research and development

3.2.2 Policy measures that primarily focus on a macro category have been nested with a linked description. In total, 14 policy measures have been described. This is seen as an initial assessment and in no way an exhaustive list. The type of support mechanism, the policy measure and the associated description can be viewed in Appendix A.

3.3 Qualitative Metrics:

3.3.1 The AFTF Policies Expert Group propose the following set of qualitative metrics as a “check-list” instrument for States planning to review or implement SAF policy actions, as requested by Assembly Resolution A39-2. A description of each element is included in Appendix B.

- Flexibility
- Certainty
- Financial costs and benefits
- Price sensitivity to externalities
- Ease of implementation
- Contribution to Sustainable Aviation Fuel deployment and GHG reduction
- Unintended consequences
- Robustness of policy

3.3.2 States can therefore have in one hand a repository of identified policy options applied in different contexts/regions and also a set of qualitative metrics as a tool to evaluate the feasibility, effectiveness, and practicality of applying such options on their national contexts and conditions.

3.3.3 As a next step it is proposed to “test” its applicability by requesting experts from different States to evaluate the effectiveness of existing policies -not only in the aviation industry but in other transportation sectors- from their own States/Regions.

3.3.4 In parallel, CAEP AFTF experts are also planning to identify possible specific regional case studies of policy application to be assessed through economic modelling and extract possible lessons learned to be included in a final guidance.

4. **ACTION BY CAAF/2**

4.1 The CAAF/2 is invited to:

- a) request States to provide examples of successful bioenergy and sustainable aviation fuels policy implementation case studies; results and possible lessons learned which could be useful to other Member States and current CAEP work; and
- b) encourage States to test the applicability of the qualitative metrics proposed in paragraph 3.3.1. as a “check-list” instrument.

APPENDIX A

POLICY OPTION TYPE OF MEASURES

Types of Support	Measures	Description
Volume-linked support	Import tariff	Duties levied on imported biofuels. Lowering import tariff will increase import volume, whereas increasing tariff will reduce import volume. Tariff affects domestic price elasticity and market distribution (boosting domestic producer).
	Target	Percentage or volume of renewable energy (or biofuels) consumption (for all sector/ for specific sector) set to be achieved at specific timeframe. The amount indicated as a target is used as reference only. It may be gradually increased over time.
	Mandate	Mandatory consumption of a fixed amount of specific biofuel type (e.g. 2nd generation biofuels). The amount indicated (either percentage or volumetric) in a mandate is binding.
	Blending obligation	Obligation for fossil fuel producer to blend xx% of biofuels content to convention fuel (e.g diesel) sold in the market. It is also possible for a country to apply an indicative blending obligation (more flexible in its application and less binding).
	Quota Mechanism	A cap or minimum level of biofuels that must be used in a specific sector (e.g. road transport).
Subsidy	Excise tax credit	Excise taxes are taxes paid when purchases are made on a specific good, such as fuel. Excise taxes are often included in the price of the product. As for biofuels, blenders benefitting from excise tax credit for each unit produced (in gallons).
	Input subsidy (e.g. feedstock)	Payment made to feedstock farmers aimed at incentivizing production. Subsidy may also be given in a form of fertilizer supplies, water supplies, etc.
	Output based subsidy	Payment made to producer based on how many gallons of biofuels they produced (also called as per gallon subsidy).
	GHG emission level based subsidy	Financial incentive given on a basis of GHG unit displaced
	Green vehicles subsidy	Tax credit for consumers purchasing eco-friendly vehicle (applicable to road transport)
Assistance for Establishment of Production	Capital grant	Subsidy given to biofuel-specific capital supporting a range of production facilities, re-fuelling or blending infrastructure, or purchase of alternative fuelled vehicles.
	Loan guarantees	A loan guaranteed by a third party in the event that the borrower defaults. The loan is often guaranteed by a government agency which will purchase the debt from the lending financial institution and take on responsibility for the loan. Loan guarantees are given mainly for production facilities.
	Crop insurance	Crop insurance contract is a commitment between insured farmers and their insurance providers. Under the contract, the insured farmer agrees to insure all the eligible acreage of a crop planted in a particular region. The insurance provider agrees to indemnify (that is, to protect) the insured farmer against losses that occur during the crop year.
Assistance for R&D	Tax credit for investment in technology	Tax credit given to total investment made in research and development technology. It is applicable to technological goods specified by the government (usually comes in a form of a list). Government may set the eligibility criteria for this, e.g. minimum and maximum costs for the projects, project timeline, etc.

APPENDIX B

QUALITATIVE METRICS AS A “CHECK-LIST” INSTRUMENT

Flexibility:

Characteristics of this style of policy will demonstrate scope for adjustment to different situations and priorities. Policies with higher flexibility may be able to evolve or adapt quickly. It is possible special authority may be assigned to monitor and evaluate the policy on an on-going basis

Certainty:

These characteristics relate to the time frame, legal conditions and/or political decisions. Greater policy certainty can be associated with more economic value being ascribed to a particular policy. In some cases policy certainty can be linked to the security level for investors. Lower certainty policies may have the inverse effect for investors and provide less incentive for capital investment.

Financial costs and benefits:

Policy effectiveness should consider costs and benefits (including social costs). Policies that rely on government financial support should be assessed on the benefits they deliver towards the stated policy objective or for the government.

Price sensitivity to externalities:

The sensitivity of a policy to externalities should be understood before implementation to ensure unintended impacts are not experienced. Price based policy can be less volatile if a floor and ceiling price is established. The higher the sensitivity to externalities, the more potential unintended consequences.

Ease of implementation:

Policy implementation can be affected by administrative, governance and procedural issues. The number of agencies involved in implementing or administering a policy can impact effectiveness. States should be conscious of the relationship within their State of local, regional and national jurisdictions.

Contribution to Sustainable Alternative Fuel deployment and GHG reduction:

Contribution to deployment will be higher if a policy is designed to ensure a specific quantity of biofuels are delivered into a system and if it is supported by a set of legal instruments. Contribution to deployment will be lower if no specific amount of deployment is targeted or mandated; and not supported by any legal basis. Policy that incentivises higher verified GHG achievement relative to the conventional fuels that is being replaced may be more effective. Similarly, policy that considers, respects and addresses social and economic consequences may deliver broader economic benefit relative to policies that focus singularly on environmental achievement.

Unintended consequences:

Effective policies need to address the risk that implementation of the policy could lead to unintended consequences. These consequences can be economic, environmental or social. The most effective policy will have mechanisms to recognise and mitigate the impact of unintended consequences.

Robustness of policy:

Effectiveness of a policy can be influenced by how robust the policy is. Robust policies are ones, that once implemented, have a regulating system to ensure that its objectives are achieved and appropriate procedures have been followed.

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APPENDIX C

POLICY MEASURES LITERATURE REVIEW

No	Title	Author	Year of Publication	Journal Title/ Publisher
1	Development of renewable energy in Australia and China: A comparison of Policy and Status	Yaping Hua, Monica Oliphant, Eric Jing Hu	2015	Renewable Energy 85
2	Prospect of Biofuels as an Alternative Transport Fuel in Australia	A.K.Azad n, M.G.Rasul,M.M.K.Khan,SubhashC .Sharma,M.A.Hazrat	2014	Renewable and Sustainable Energy Reviews 43
3	Towards a Sustainable Strategy For Road Transportation in Australia: The Potential Contribution of Hydrogen	Paul Maniatopoulos, John Andrews, Bahman Shabani	2015	Renewable and Sustainable Energy Reviews 52
4	Assessing the impact of environmental innovation in the airline industry: An empirical study of emerging market economies	Wei Yan, Zhijian Cui, María José Álvarez Gil	2016	Environmental Innovation and Societal Transition
5	Aviation Biofuel From Renewable Resources: Routes,opportunities, and challenges	Thushara Kandaramath Hari, Zahira Yaakob, Narayanan N. Binitha	2014	Renewable and Sustainable Energy Reviews
6	Biomass Production for Sustainable Aviation Fuels: A regional case study in Queensland	Helen T.Murphy, Deborah A.O'Connell, R. John Raison, Andrew C.Warden, Trevor H. Booth, Alexander Herr, Andrew L. Braid, Debbie F. Crawford, Jennifer A.Hayward, Tom Jovanovic, John G. McIvor , Michael H. O'Connor, Michael L. Poole, Di Prestwidge, Nat Raisbeck-Brownf, Lucas Rye	2015	Renewable and Sustainable Energy Reviews 44
7	Lead markets in 2nd generation biofuels for aviation: A comparison of Germany, Brazil and the USA	Jonathan Köhler, Rainer Walz, Frank Marscheder-Weidemann, Benjamin Thedieck	2013	Environmental Innovation and Societal Transitions 10
8	A review on present situation and development of biofuels in China	Hao Chen, Meng-long Xu, Qi Guo, Lu Yang, Yong Ma	2015	Journal of the Energy Institute 89
9	Scenario analysis of CO2 emissions from China's civil aviation industry through 2030	Wenji Zhou, Tao Wang, Yadong Yu, Dingjiang Chen, Bing Zhu	2016	Applied Energy 175
10	An overview of biofuels policies and industrialization in the major biofuel producing countries	Yujie Su, Peidong Zhang, Yuqing Su	2015	Renewable and Sustainable Energy Reviews 50
11	Biofuel subsidies versus the gas tax: The carrot or the stick?	Diya B. Mazumder	2014	Energy Economics 44
12	Global Scenarios for Biofuels: Impacts and Implications	Mark W. Rosegrant, Tingju Zhu, Siwa Msangi and Timothy Sulser	2008	Review of Agricultural Economics 30
13	International trade in biofuels: an introduction to the special issue	Rainer Zah, Thomas F. Ruddy	2009	Journal of Cleaner Production 17
14	Second-best biofuel policies and the	Harvey Lapan,Gian Carlo Moschini	2011	Journal of

No	Title	Author	Year of Publication	Journal Title/ Publisher
	welfare effects of quantity mandates and subsidies			Environmental Economics and Management 63
15	The Taxation of Fuel Economy	James M. Sallee	2011	Tax Policy and the Economy 25
16	Biofuel futures in road transport – A modeling analysis for Sweden	Martin Börjesson, Erik O. Ahlgren, Robert Lundmark, Dimitris Athanassiadis	2014	Transportation Research Part D 32
17	Biofuels in Brazilian Aviation: Current scenario and prospects	Paulo André Cremonez, Michael Feroldi, Amanda Vianade Araújo b, Maykon Negreiros Borges, Thompson Weiser Meier, Armin Feiden, Joel Gustavo Teleken	2014	Renewable and Sustainable Energy Reviews 43
18	Biofuels: Opportunities and Challenges in India	Mambully Chandrasekharan Gopinathan and Rajasekaran Sudhakaran	2009	In Vitro Cellular & Developmental Biology Plant
19	Economy-wide impacts of biofuels in Argentina	Govinda R. Timilsina, Omar O. Chisari, Carlos A. Romero	2013	Energy Policy 55
20	Jet biofuels in Brazil: Sustainability challenges	Marcia A.F.D. Moraes, Andre M. Nassar, Paula Moura, Rodrigo L.V. Leal, L.A.B. Cortez	2014	Renewable and Sustainable Energy Reviews 40
21	Promoting Biofuels Use in Spain: A cost-benefit analysis	Marta Santamaría, Diego Azqueta	2015	Renewable and Sustainable Energy Reviews 50
22	Comparison of fixed versus variable biofuels incentives	Wallace E. Tyner, Farzad Taheripour, David Perkis	2010	Energy Policy 38
23	Targets and Mandates: Lessons Learned from EU and US Biofuels Policy Mechanisms	Jadwiga Ziolkowska, William H. Meyers, Seth Meyer, and Julian Binfield	2011	Agrobiotechnology Management and Economics
24	Biofuels in aviation: Fuel demand and CO2 emissions evolution in Europe toward 2030	Marina Kousoulidou, Laura Lonza	2016	Transportation Research Part D 46
25	Study of the current incentive rules and mechanisms to promote biofuel use in the EU and their possible application to the civil aviation sector	Hazariah M. Noh, Arturo Benito, Gustavo Alonso	2016	Transport Research Part D 46
26	Distributional Implications of U.S. Ethanol Policy	Bruce A. Babcock	2008	Review of Agricultural Economics, Vol. 30
27	Second generation biofuels and bioinvasions: An evaluation of invasive risks and policy responses in the United States and Canada	A.L. Smith, N. Klenk, S. Wood, N. Hewitt, I. Henriques, N. Yana, D.R. Bazely	2013	Renewable and Sustainable Energy Reviews 27
28	The Impact of advanced biofuels on aviation emissions and operations in the U.S.	Niven Winchester, Robert Malina, Mark D. Staples, Steven R.H. Barrett	2015	Energy Economics 49
29	US biofuels subsidies and CO2 emissions: An empirical test for a weak and a strong green paradox	R. Quentin Grafton, Tom Kompas, Ngo Van Long, Hang To	2013	Energy Policy 68
30	Climate-neutrality versus carbon-neutrality for aviation biofuel policy	Philip Krammer, Lynnette Dray, Marcus O. Köhler	2013	Transportation Research Part D 23

No	Title	Author	Year of Publication	Journal Title/ Publisher
31	Stepping Up but Back : How EU policy reform fails to meet the needs of RE actors	Evanthie Michalena and Jeremy M. Hills	2016	Renewable and Sustainable Energy Reviews
32	Biofuel Development in China and Its Potential Impact	Tian Fuqiang	Not specified	International Commission on Irrigation and Drainage
33	Biofuels - At What Cost? Government support for ethanol and biodiesel in China		2008	IISD Paper
34	The effects of China's biofuel policies on agricultural and ethanol markets	Shuyang Si, James A. Chalfant, C.-Y. Cynthia Lin Lawell, and Fujin Yi	2015	University of California Davis Faculty Paper
35	Biofuel Economics in a Setting of Multiple Objectives & Unintended Consequences	William K. Jaeger and Thorsten M. Egelkraut	2011	Renewable and Sustainable Energy Reviews. 15(9)
36	Analysis of Biofuels Policy in the Nordic Countries	Dorothy Sutherland Olsen, Antje Klitkou and Annele Eerola & VTT colleagues		TOP NEST
37	Aviation Biofuel Production in Sweden	Ben Fethers	2014	IIIEE
38	Biofuels in Canada: Tracking progress in tackling greenhouse gas emissions from transportation fuels	Jeremy Moorhouse and Michael Wolinetz	2016	Clean Energy Canada
39	Cellulosic biofuels market uncertainties and government policy	Wallace E Tyner	2010	Future Science
40	Biofuels, Policy Options, and Their Implications: Analyses Using Partial and General Equilibrium Approaches	Farzad Taheripour and Wallace E. Tyner	2008	Journal of Agricultural and Food Industrial Organization
41	Policy Options for Integrated Energy and Agricultural Markets	Wallace E. Tyner and Farzad Taheripour	2008	Purdue University Paper
42	Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy		2011	The National Academy of Sciences
43	The Integration of Energy and Agricultural Markets	Wallace E. Tyner	2009	International Association of Agricultural Economists
44	The US Ethanol and Biofuels Boom: Its Origins, Current Status, and Future Prospects	Wallace E. Tyner	2008	BioScience
45	Transatlantic Platform For Action On The Global Environment	Catherine Bowyer, Malcolm Fergusson, Christine Erickson, Melanie Nakagawa	2008	IIEP and NRDC
46	Growing Complexities: A Cross-Sector Review of U.S. Biofuels Policies and Their Interactions	Joshua A. Blonz, Shalini P. Vajjhala, and Elena Safirova	2008	Resource for the Future
47	Options to increase EU biofuels volumes beyond the current blending limits	Bettina Kampman, Ruud Verbeek, Anouk van Grinsven, Pim van Mensch, Harry Croezen, Artur	2013	TNO Innovation

No	Title	Author	Year of Publication	Journal Title/ Publisher
		Patuleia		
48	Biofuels—At What Cost? A review of costs and benefits of Spain's biofuel policies	Chris Charles, Alicia Natalia Zamudio, Tom Moerenhout	2013	IISD
49	Inventory of Biofuel Policy Measures and their Impact on the Market	Luc Pelkmans, Leen Govaerts, Kris Kessels	2008	ELOBIO
50	Cautionary Tales for Biofuel Policy Reformer	Ivetta Gerasimchuk, Richard Bridle, Chris Charles and Tom Moerenhout	2012	IISD
51	State and federal subsidies to biofuels: magnitude and options for redirection	Doug Koplouw	2009	International Journal of Biotechnology
52	Marginal abatement costs for greenhouse gas emission reduction in transport compared with other sectors	Richard Smokers, Ab de Buck, Margaret van Valkengoed	2009	CE Delft
53	Regional differences in China's CO2 abatement cost	Xiaoping He	2015	Energy Policy Journal 80
54	Integrated assessment of energy efficiency technologies and CO2 abatement cost curves in China's road passenger car sector	Bin-Bin Peng, Ying Fan, Jin-Hua Xu	2016	Energy Conversion and Management 109
55	The Cost of Abating CO2 Emissions by Renewable Energy Incentives	Claudio Marcantonini and A. Denny Ellerman	2013	European University Institute
56	A Marginal Abatement Cost Curve Model For The UK Aviation Sector	Mike Holland, Mike Mann, Malcolm Ralph, Bethan Owen, David Lee, Gareth Horton, Neil Dickson, Sujith Kollamthodi	2009	EMRC and AEA
57	Sectoral Emission Reduction Potentials and Economic Costs for Climate Change	Bart Wesselink, Yvonne Deng	2009	Ecofys
58	Government policies and drivers of world biofuels, sustainability criteria, certification proposals and their limitations	Timothy D. Searchinger	2009	Biofuels: Environmental consequences and interactions with changing land use
59	Are technology myths stalling aviation climate policy?	Paul Peeters, James Higham, Diana Kutzner, Scott Cohen, Stefan Gössling	2016	Transportation Research Part D: Transport and Environment
60	Assumptions in the European Union biofuels policy: frictions with experiences in Germany, Brazil and Mozambique	Jennifer Franco, Les Levidow, David Fig, Lucia Goldfarb, Mireille Hönicke, Maria Lusía Mendonça	2010	The Journal of peasant studies
61	Globiom, the basis for biofuel policy post-2020	Jos Dings	2016	Transport & Environment
62	The land use change impact of biofuels consumed in the EU Quantification of area and greenhouse gas impacts	Hugo Valin, Daan Peters, Maarten van den Berg, Stefan Frank, Petr Havlik, Nicklas Forsell, Carlo Hamelinck, Johannes Pirker, Aline	20105	Transport & Environment

No	Title	Author	Year of Publication	Journal Title/ Publisher
		Mosnier, Juraj Balkovic, Erwin Schmid, Martina Dürauer and Fulvio di Fulvio		
63	The EU system for the certification of sustainable biofuels	European Court of Auditors	2016	European Court of Auditors
64	Three routes forward for biofuels: Incremental, leapfrog, and transitional	Geoff M. Morrison, Julie Witcover, Nathan C. Parker, Lew Fulton	2016	Energy Policy
65	Finding effective pathways to sustainable mobility: bridging the science-policy gap	Scott A. Cohen, James Higham, Stefan Gössling, Paul Peeters	2016	Journal of Sustainable Tourism
66	Eco-skies, the global rush for aviation biofuel	Lukas Ross, Anuradha Mittal, Frederic Mousseau	2013	The Oakland Institute
67	Agrofuels in planes, heating the climate at a higher level	Evert Hassink, Christopher Whelehan, Iris Maher	2012	Friends of the Earth Netherlands
68	Biokerosene : take-off in the wrong direction	Geert Ritsema, Claudia Theile, Arief Zayyin, Fitri Anya, Helen Burley, Agnes de Rooij	2012	Friends of the Earth Netherlands
69	Flying in the face of the facts	Friends of the Earth Europe	2011	Friends of the Earth Europe
70	Study of the current incentive rules and mechanisms to promote biofuel use in the EU and their possible application to the civil aviation sector	Hazariah M. Noh, Arturo Benito, Gustavo Alonso	2016	Transport & Environment
71	Climate-neutrality versus carbon-neutrality for aviation biofuel policy	Philip Krammer, Lynnette, Marcus O. Köhler	2013	Transportation Research Part D: Transport and Environment

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