



LEUPHANA

Inkubator



**ICAO AVIATION AND SUSTAINABLE
ALTERNATIVE FUELS
WORKSHOP**

ICAO Headquarters, Montréal, Canada

18 to 20 October 2011

Bio Aviation Fuel Feedstock Supply – Challenges, Strategies and Recent Developments

Montreal, October 19, 2011



EUROPÄISCHE UNION
Europäischer Fonds für
regionale Entwicklung

Agenda



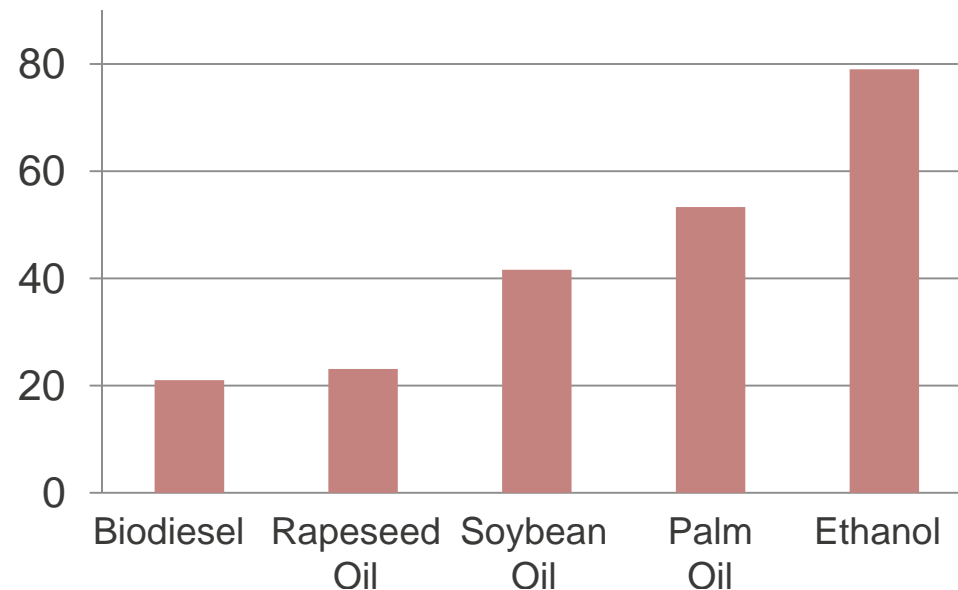
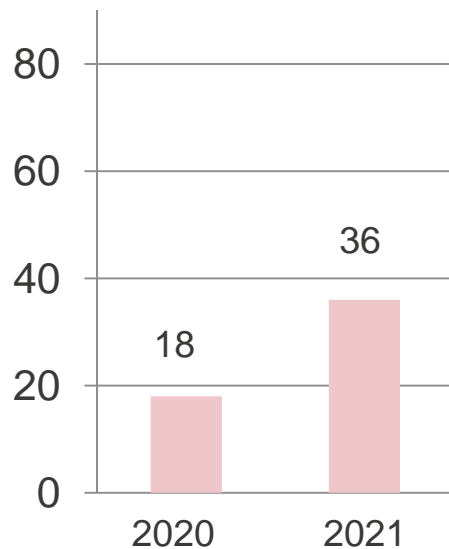
- 1. The deployment challenge – Bio aviation fuel feedstock supply and the need for vegetable oils**
- 2. The Platform for Sustainable Aviation Fuels – Concepts for sustainable feedstock supply**
- 3. Our study “Growing oil on trees” – Recent developments in alternative feedstock projects**



The deployment challenge: Carbon neutral growth by 2020 means 18 m t of biojet, and this may double every year thereafter

Carbon neutral growth could result in a 6% biojet blending need by 2020/21 (million t):¹⁾

How that compares to current volumes in related markets: Global production 2010/2011 (million t):



1) Assuming appr. 300 m t global jet fuel demand by 2020 (represents a 4% growth p.a. from today = 200 million t), from 2020, a 3% p.a. fuel demand growth and 50% carbon reduction of the bio aviation fuel is assumed

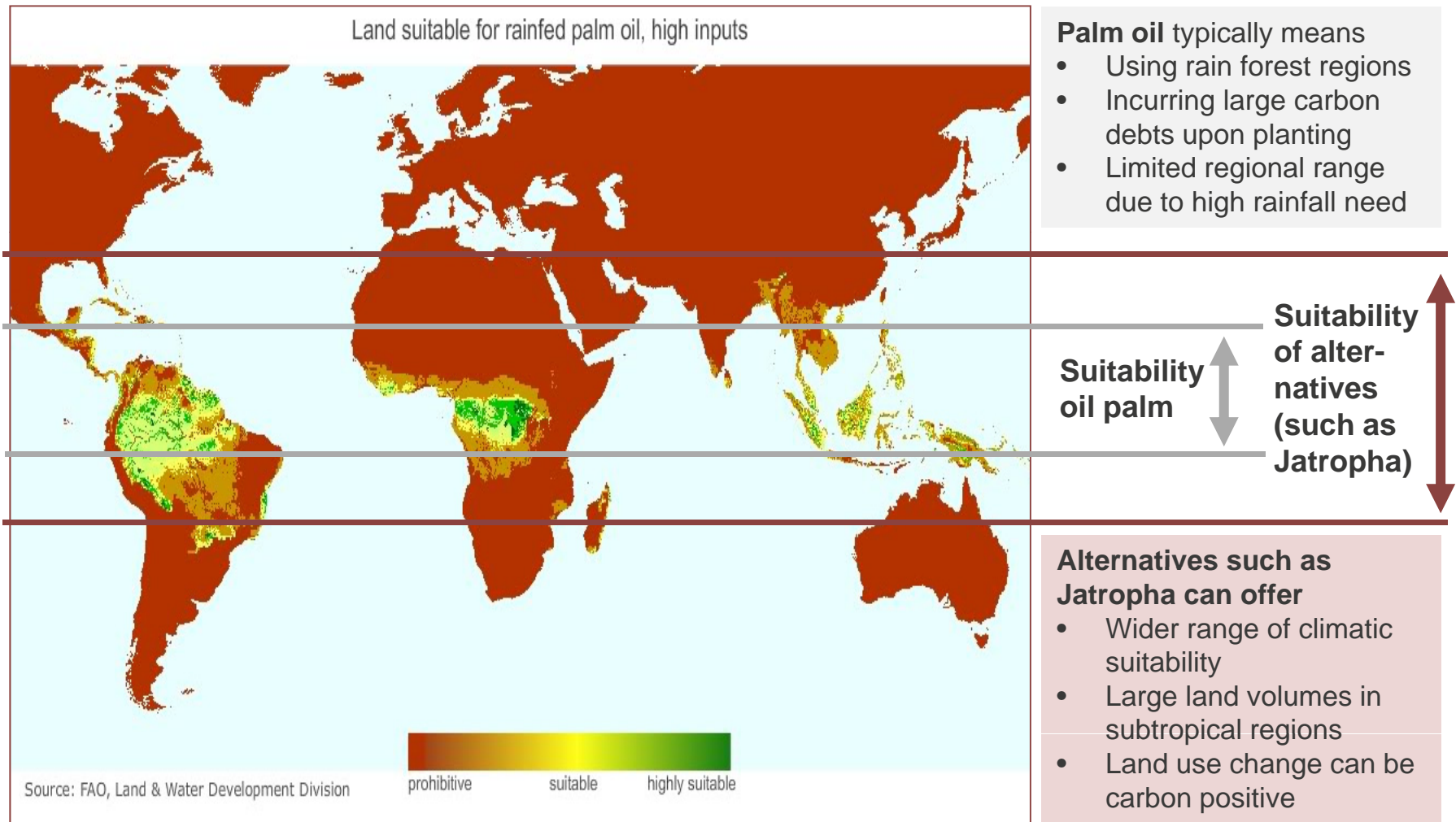


HRJ represents the only pathway ready for larger scale deployment by 2020 – But this means we need vegetable oil feedstock!

Technology Pathways	Feedstocks	Status	Readiness for large scale deployment
Hydrogenated Renewable Jet Fuel (HRJ) / Hydroprocessed fatty acid esters and fatty acids (HEFA) Synthetic Paraffinic Kerosene (Bio-SPK)	▪ Vegetable oils	▪ Proven technology	Yes
	▪ Waste oils	▪ Large scale deployment done	Yes
	▪ Halophytes	▪ Early R&D stage for halophytes, algae and pyrolysis	No
	▪ Algae oils		No
	▪ Pyrolysis oils		No
Biomass to Liquid (BTL)	▪ Cellulosic biomass	▪ Proven technology only for synthesis	No
	▪ Agricultural waste		No
	▪ Municipal waste	▪ R&D stage for gasification of biomass	No
Alcohol/Isobuthanol to jet fuel conversion or Direct Sugar to Hydrocarbon Process (DSHC)	▪ Sugars / starches (via ethanol)	▪ R&D stage – piloting pending	No
	▪ Cellulosic Biomass (cellulosic ethanol)		No
	▪ Waste (via ethanol)		No



Where can the feedstock come from? Palm oil is not the solution as it is mostly not sustainable – That’s why we need alternatives!





The Platform for Sustainable Aviation Fuels was created to develop concepts for sustainable feedstock production for aviation biofuels

Platform for Sustainable Aviation Fuels

Yale University


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UNIVERSITÄT LÜNEBURG

 University of
South Australia

Research project: Development of sustainable feedstock concepts for aviation biofuels

Ecological Sustainability

Economic Sustainability

Social Sustainability

EU funding for 2011-2013: EUR 2.5 million

Commercialization with industry partners
such as





The issues and topics we are dealing with – mainly focusing on sustainable feedstock development

Focus on upstream / feedstock	Because it is too often ignored in biojet discussions!
Focus on innovative concepts	We have not used the full potential of agriculture!
Field trials	Concepts need to be proven in practice!
Potential analysis	We need to create huge volumes – somewhere!
Sustainability assessments	We need comparable standards!
Business case development	Concepts need to be economically viable!
Project development	We need to start deployment now!
Industry partnerships	The value chain experts have to come together!



The Platform is currently focusing on vegetable oil production with annual and perennial plants and alternative concepts



Northern Hemisphere

- Focus on annual oil plants, specifically **Camelina sativa** and one other crop
- Companion planting / intercropping or as a catch crop and use of fallow land
- **Field trials** in Germany, Ukraine, Romania

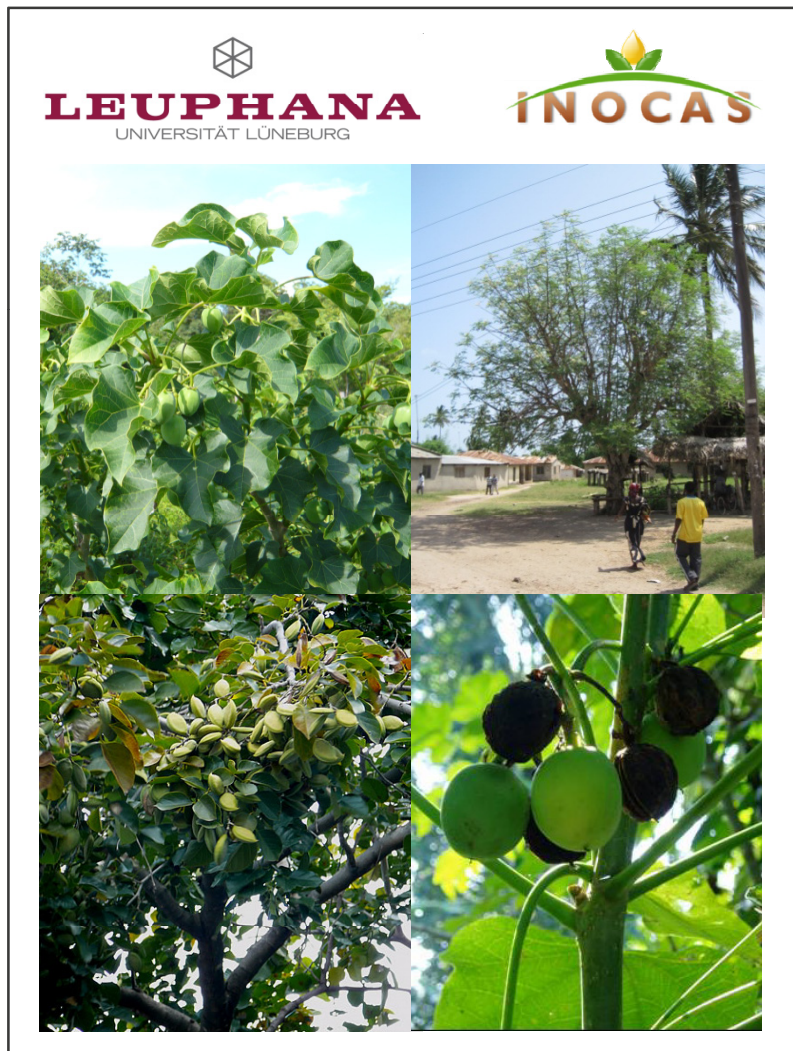


Southern Hemisphere

- Focus on agroforestry and silvopastoral systems with perennial crops, specifically **Jatropha** and **Acrocomia**
- Cultivation of **trees/palms** in deforested areas and integration of smallholders (rural development), current focus on **Brazil / Paraguay**



Our first project: The study “Growing Oil on Trees” will serve as an updated overview on alternative oil tree projects and their potential

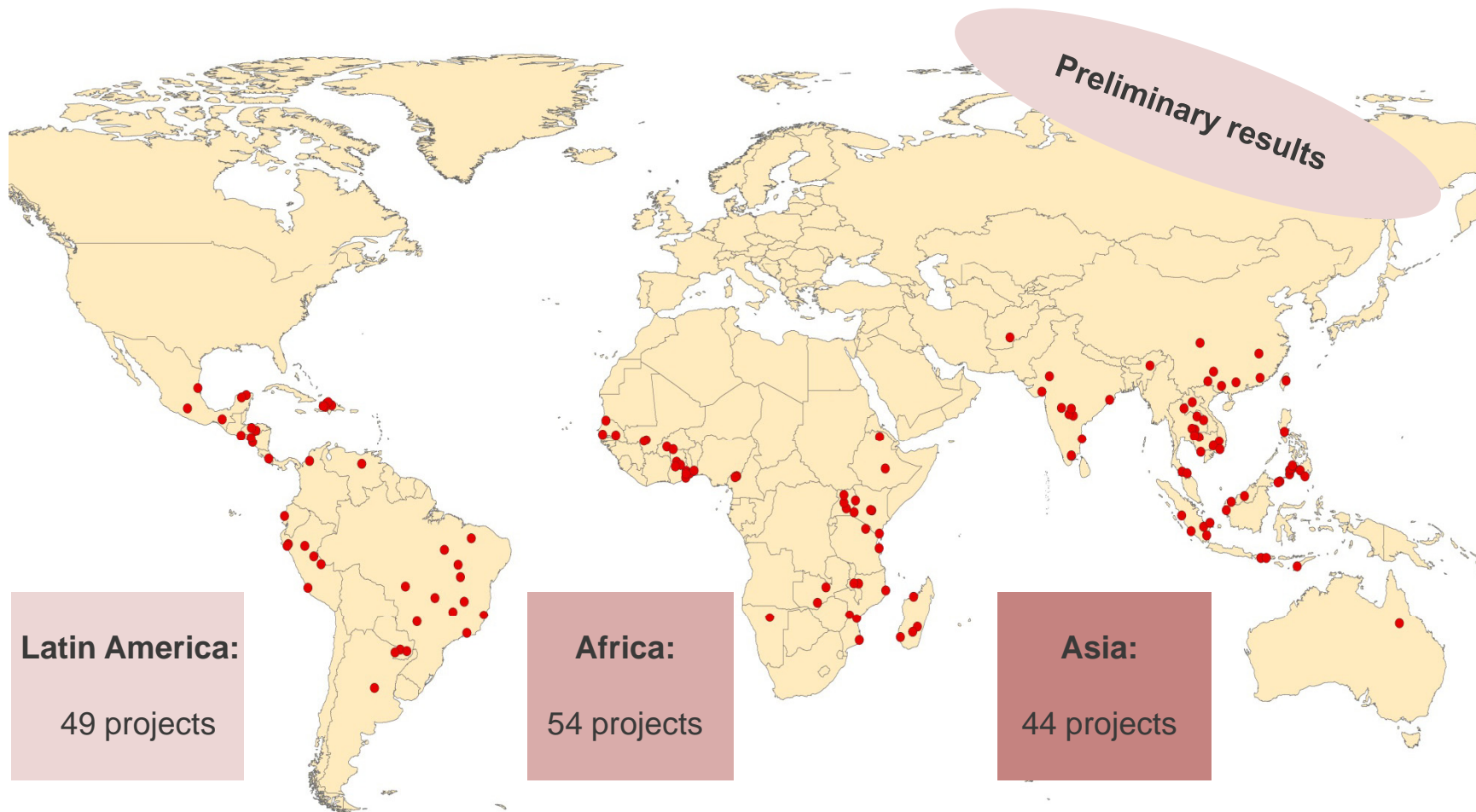


Study „Growing oil on trees“

- Joint project of Leuphana’s **Platform for Sustainable Aviation Fuels** and **INOCAS**
- **Global survey** on Jatropha and other alternative oil bearing tree projects, based on > 180 interviews with industry experts and projects
- **Main aspects covered** by the study:
 - Existing plantations and projections until 2015
 - Agronomy aspects
 - Sustainability of plantations
 - Oil production today and projection until 2020
 - Economics, finance and Investment
- We show here **preliminary results** – full publicly available general study will come out end of 2011; INOCAS will publish an additional analysis of economics and investment aspects

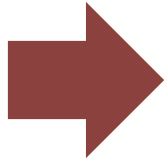


In course of the study, we have identified and interviewed approximately 150 sub-tropical oil tree projects around the world

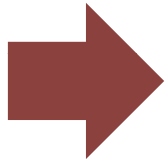




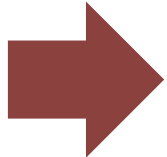
Key preliminary findings of our study demonstrate the mid- to long term potential of the Jatropha industry



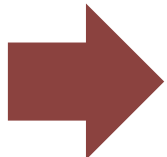
GLOBAL PLANTATIONS: In 2011, a total of approximately 1 million ha of plantation exists, the largest part in Asia (specifically India, Indonesia, Malaysia and China). In 2015, plantation size may reach approximately 3 million ha globally.



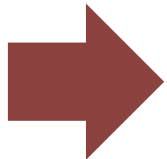
OIL PRODUCTION: Currently, only small amounts of Jatropha oil are produced (2011 roughly 15,000 t). If the projected growth path can be maintained, this volume can grow to almost 3 million t in 2015 and to more than 5 million t by 2010.



AGRONOMY: Most projects work in suitable conditions (rainfall > 800 mm), and only one third of all projects still work with wild seed material, others use selected or purchased improved seeds or have their own breeding program



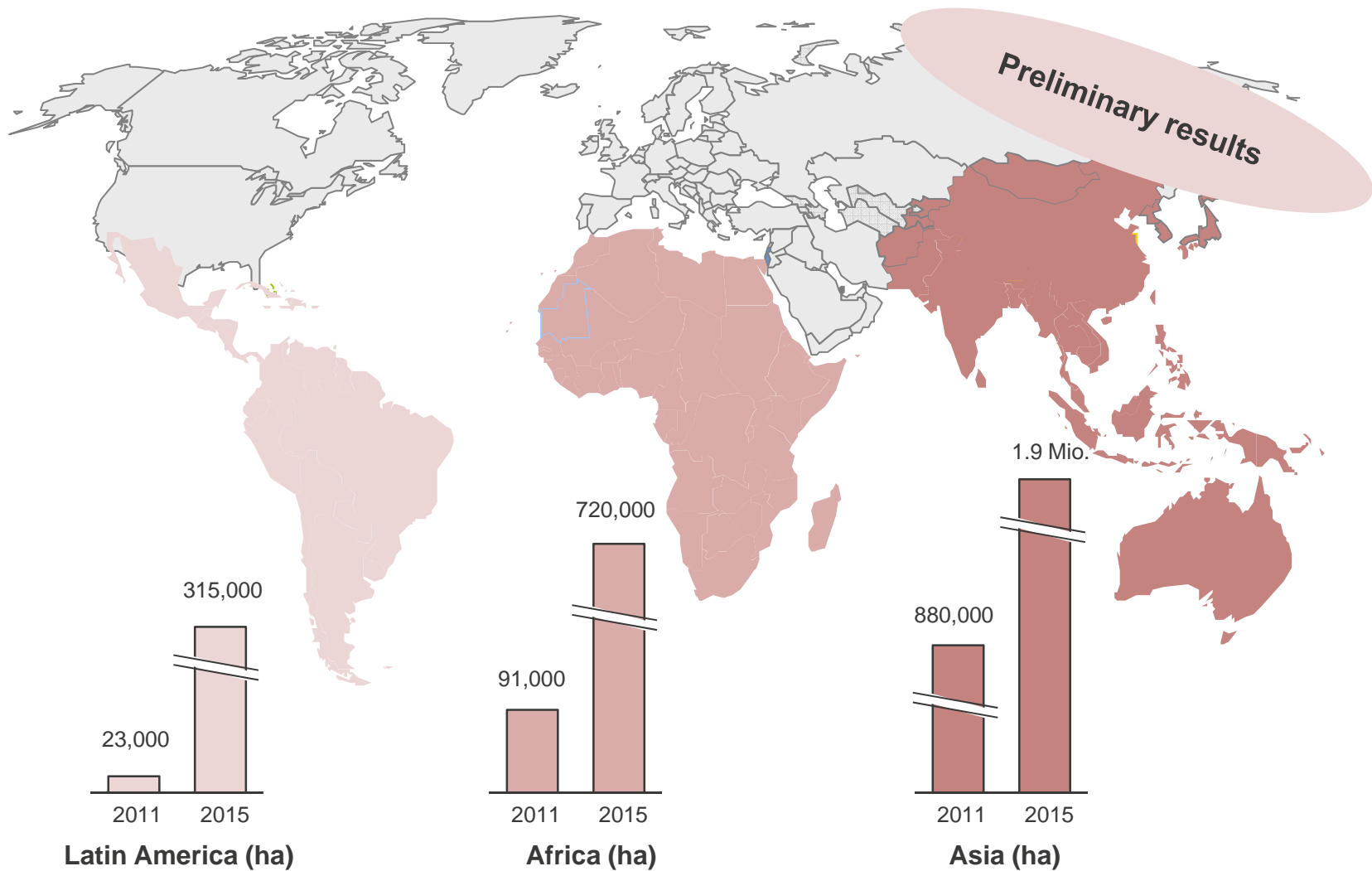
SUSTAINABILITY: Promising results, as only a minority of projects removed primary or secondary forest, and more than 50% works on former unused land. Yet only a few projects yet have started sustainability certification (such as RSB or ISCC)



FINANCE & INVESTMENT: To establish one ha of plantation, on average appr. 1,000 USD are required, plus on average 330 USD per ha p.a. for maintenance. In total, to reach 3 million ha by 2015, appr. 1.1 bn USD in investment will be needed.



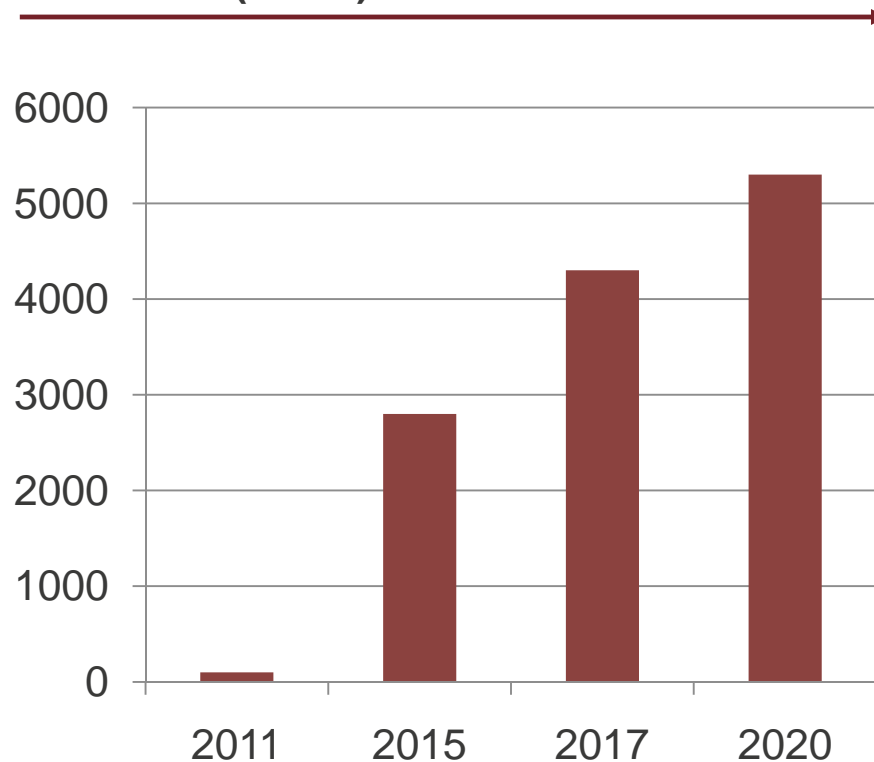
Although with the smallest number of projects, Asia has much larger projects and leads the global Jatropha acreage currently





If the aviation sector wants to tap into Jatropha oil as a resource, strategic sourcing efforts are required

Projected Jatropha oil availability
2011-2020 ('000 t)



What this implies for the airline industry

- Jatropha oil can become a **relevant feedstock** in the coming years
- **But:** Extensions of farms require significant investment – we assume appr. 1.1 bn USD until 2015 to realize the 2015-2020 volumes
- To secure feedstock supply for the aviation sector, **strategic feedstock investments** should be facilitated
- **Feedstock supply platforms** can be established by the industry for this purpose – significant oil price hedging and cost savings potential



Thank you for your attention!



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