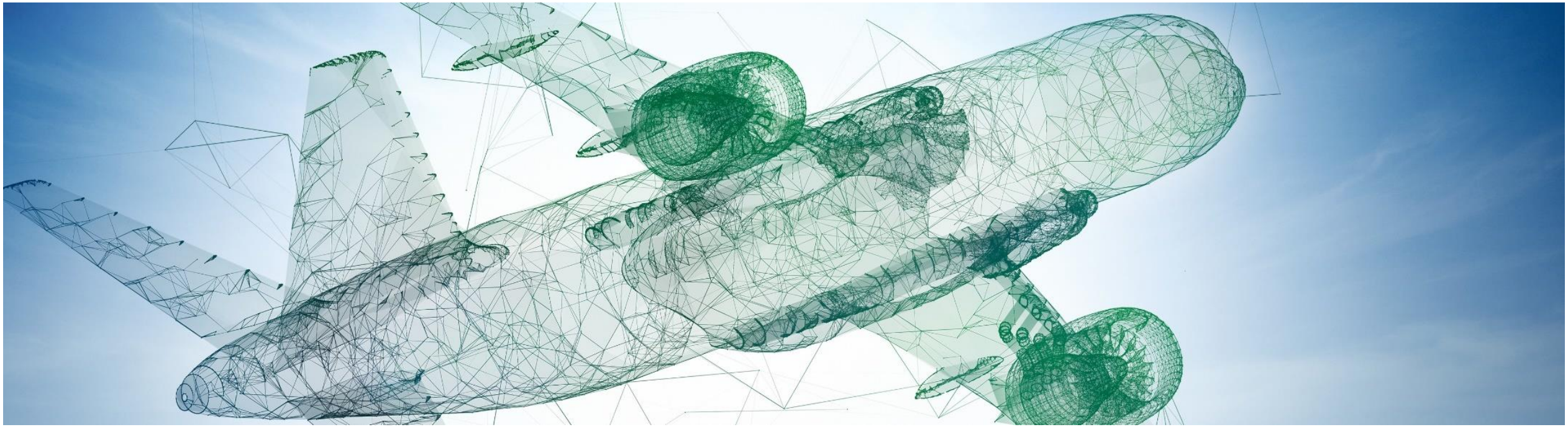


Evaluation of the Climate Impact of the Steam Injecting and Recovering Aero Engine

Regina Pouzolz, Oliver Schmitz, Hermann Klingels

13 – 15 October 2020, 3rd ECATS Conference

Concept Renaming

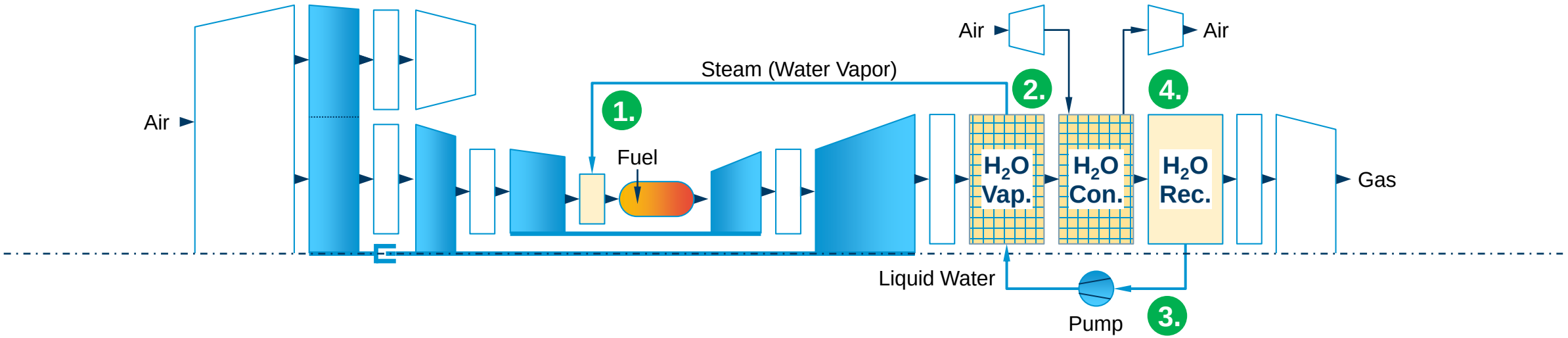
Name used in present ECATS paper:

Steam Injecting and Recovering Aero Engine (SIRA)

Concept name used from now on:

Water-Enhanced Turbofan (WET)

Principle of the Water-Enhanced Turbofan (WET)



1. Steam injection (up to 30% core flow) and wet combustion raise specific power, allow **small core** size and **reduce NO_x**
2. Steam is generated by exhaust heat to improve overall efficiency and ultimately **reduce fuel burn / CO_2 (-10% vs. GTF2)**
3. Pumping of liquid water is very efficient and reduces internal power demand, thus enabling **small core and high BPR**
4. Water condensation and recovery close the water loop and could **reduce creation of condensation trails**

The WET engine remains a gas turbine but enables climate-neutral flying when operated with sustainable fuel

The evaluation of the climate of a novel engine concept needs integration into an aircraft that is flown in an operationally representative setting

Evaluation methodology, tools and assumptions

PIANO

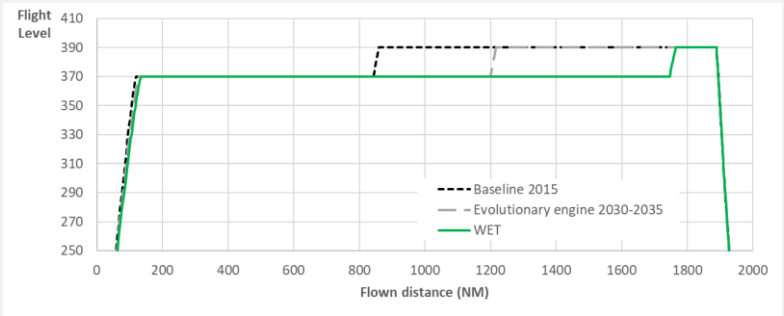
Aircraft Analysis

A320-type aircraft, Range 3420 NM, constant T/W and wing loading

	SFC	NOx	Contrails
Baseline 2015	Ref.	Ref.	Ref.
Evolutionary engine 2030-2035	-5 to -10%	Idem	Idem
WET	-19 to -28%	-90%	-90%

Mission Analysis

Choice of representative stage lengths:
500 NM
800 NM Reference
2000 NM



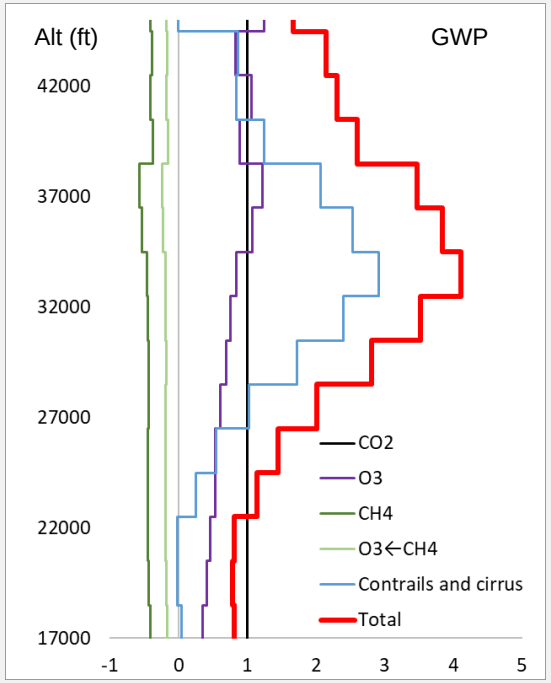
Emission estimation

Implemented in PIANO according to Boeing Method 2
Averaged on each mission segment
Baseline emission indices for PW1127 from ICAO Engine Emissions Databank

LEEA

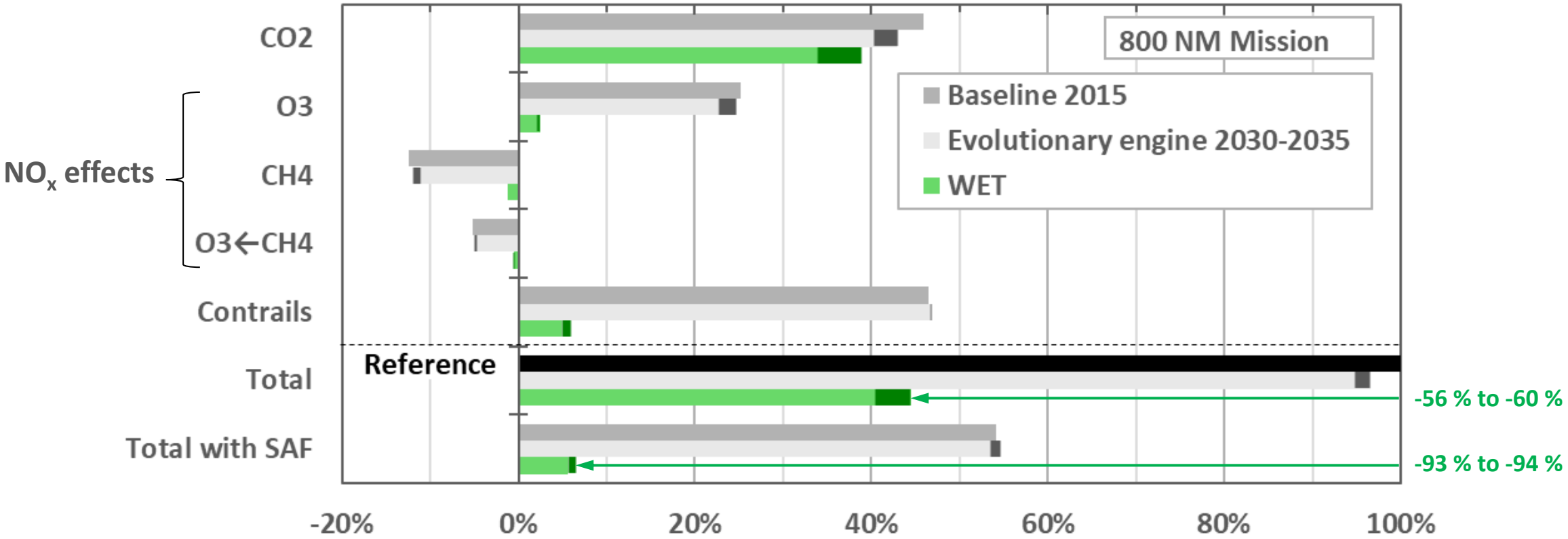
Climate impact evaluation

using LEEA project published in
Rädel et al., 2008 and
Köhler et al., 2008



The WET engine could reduce climate impact by 60% compared to today‘s aircraft, if standard jet fuel is used

Pulse Global Warming Potential over 100 years relative to Baseline aircraft on a 800 NM mission



Using sustainable fuels, the WET engine would yield almost complete avoidance of climate impact

Summary

MTU's **Water-Enhanced Turbofan (WET)** concept

- shows the potential to reduce CO_2, NO_x emissions, and contrail formation significantly,
- hence, could contribute substantially to achieve **climate-neutral flight,**
- and can be operated with conventional as well as many future fuels, i.e. **SAF and hydrogen.**

This presentation targets at

- increasing the WET concept's awareness and at motivating further research and proof of concept activities,
- stimulating the development of aircraft integration solutions, and
- fostering the discussion on climate impact evaluation.

Further intensive cooperation between atmospheric sciences and the aviation industry is required