CLEAN TECH AVIATION

Meet Clean Tech Aviation

Retrofits the existing General Aviation aircraft engines and Transport aircraft Auxiliary Power Units ** (APU) and design using **LNG as transition energy towards zero emissions**.

Develops a **LNG* Fuel tank** on use and storage of LNG with a gasifier use of LNG and in the 2th stage a **cryogenic energy** injection combined with the combustion energy *(Bio Natural Gas).

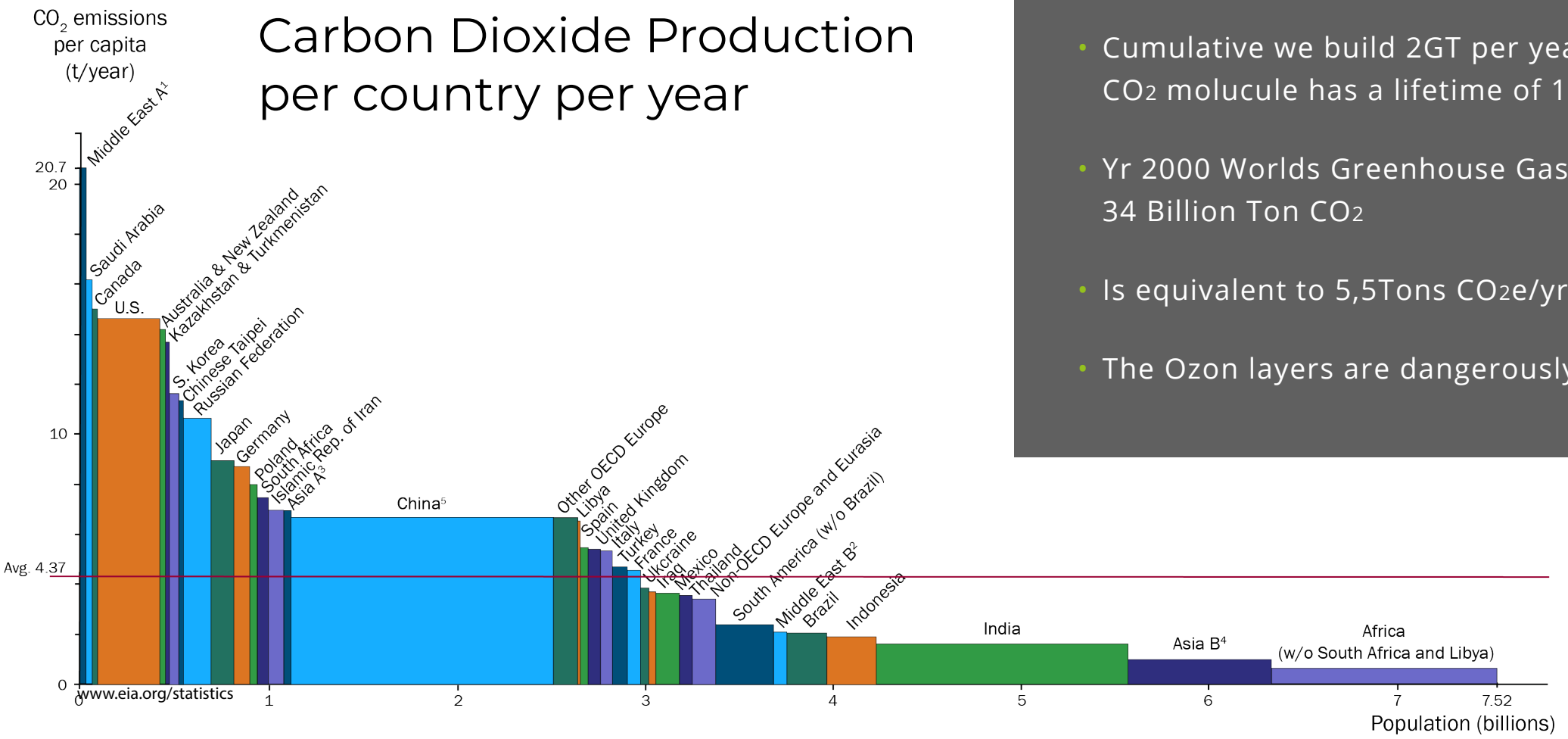
Reduces in phase 1 **CO2 emissions** (footprint) with 25% while simultaneously reducing fuel price costs (OPEX) with 35% and in phase 2 reduce emissions to 88% using BIO LNG.

CTA foresees that the 1st operational step for business aviation is the use of LNG as alternative fuel in the aircraft Auxiliary Power Units (APU).

Because the unit has less essential properties than the main engines of an aircraft and is therefore more suitable for modification, before storing and using LNG as main fuel for the whole aircraft.

Problem

Carbon Dioxide Production per country per year

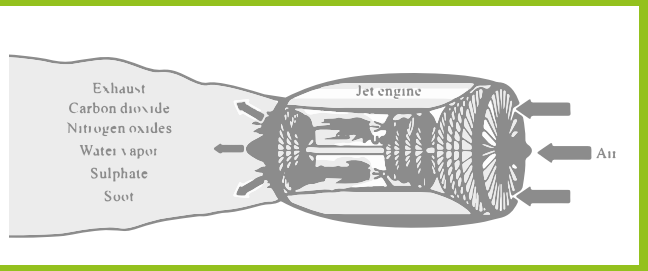


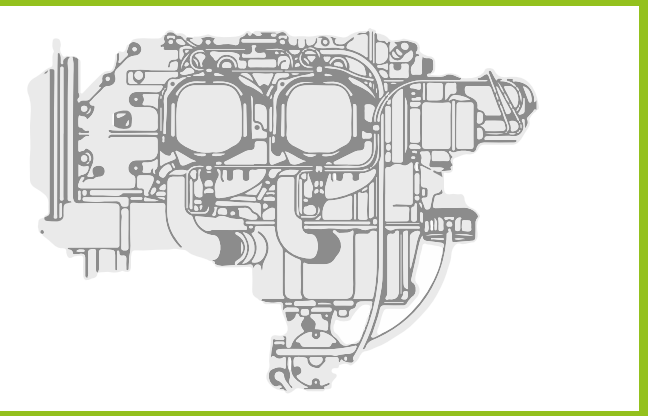
- Worldwide Aviation industry produces 8 Gigaton Carbon dioxide per year
- The Oceans absorbs 6GT per year
- Cumulative we build 2GT per year and each CO_2 molucule has a lifetime of 100 years
- Yr 2000 Worlds Greenhouse Gas emissions: 34 Billion Ton CO_2
- Is equivalent to 5,5Tons CO_2e/yr/person
- The Ozon layers are dangerously affected

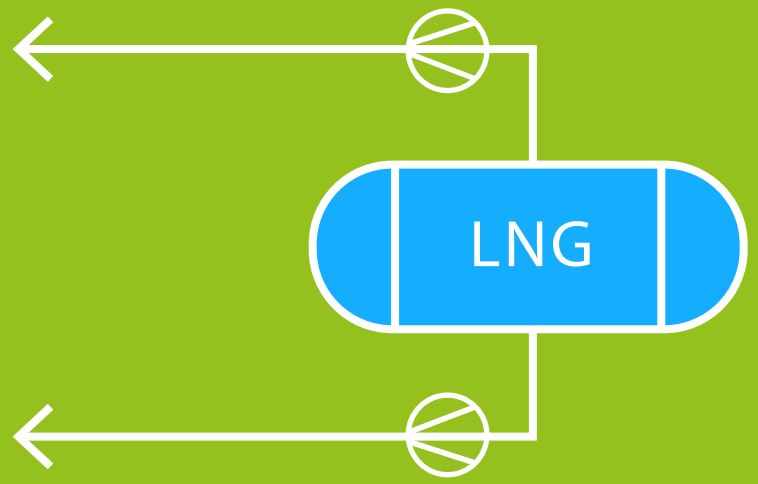
Solution

Direct LNG fuel injection using cryogenic energy

Innovation with direct LNG injection in combustion chamber as radical innovation process:







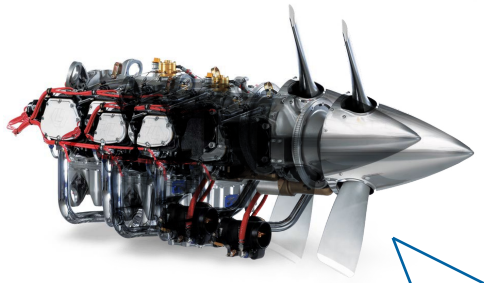
- 35% less costs
- 98% less NOX
- 25% to 88% CO_2 reduction
- 100% lead & zero SOX
- Less noise

Solution

Liquid Natural Gas of – 162 degree celcius in an aviation fuel tank stored & gassified injected in the engine.

Scientific support program with TU Braunschweig & Hanze, DnvGL, NLR-DLR & Lycoming engines USA.

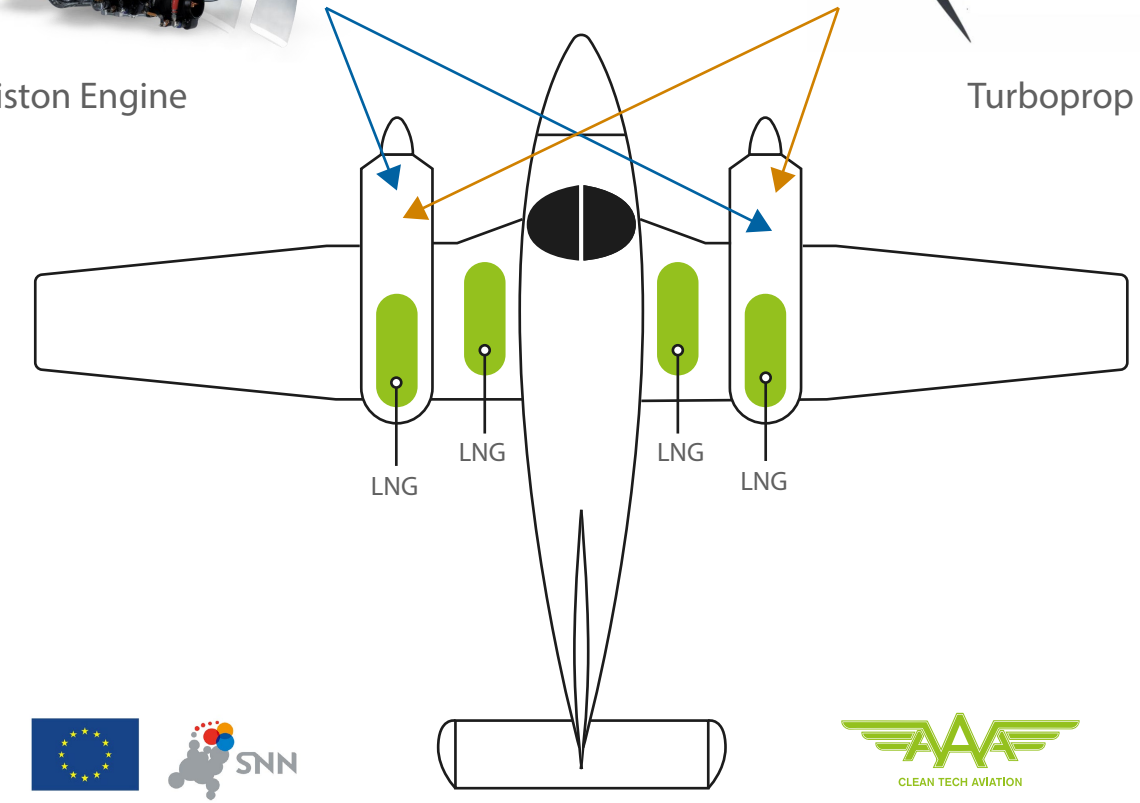
LNG fuel tank design & development with Composite material.



Piston Engine

or

Turboprop

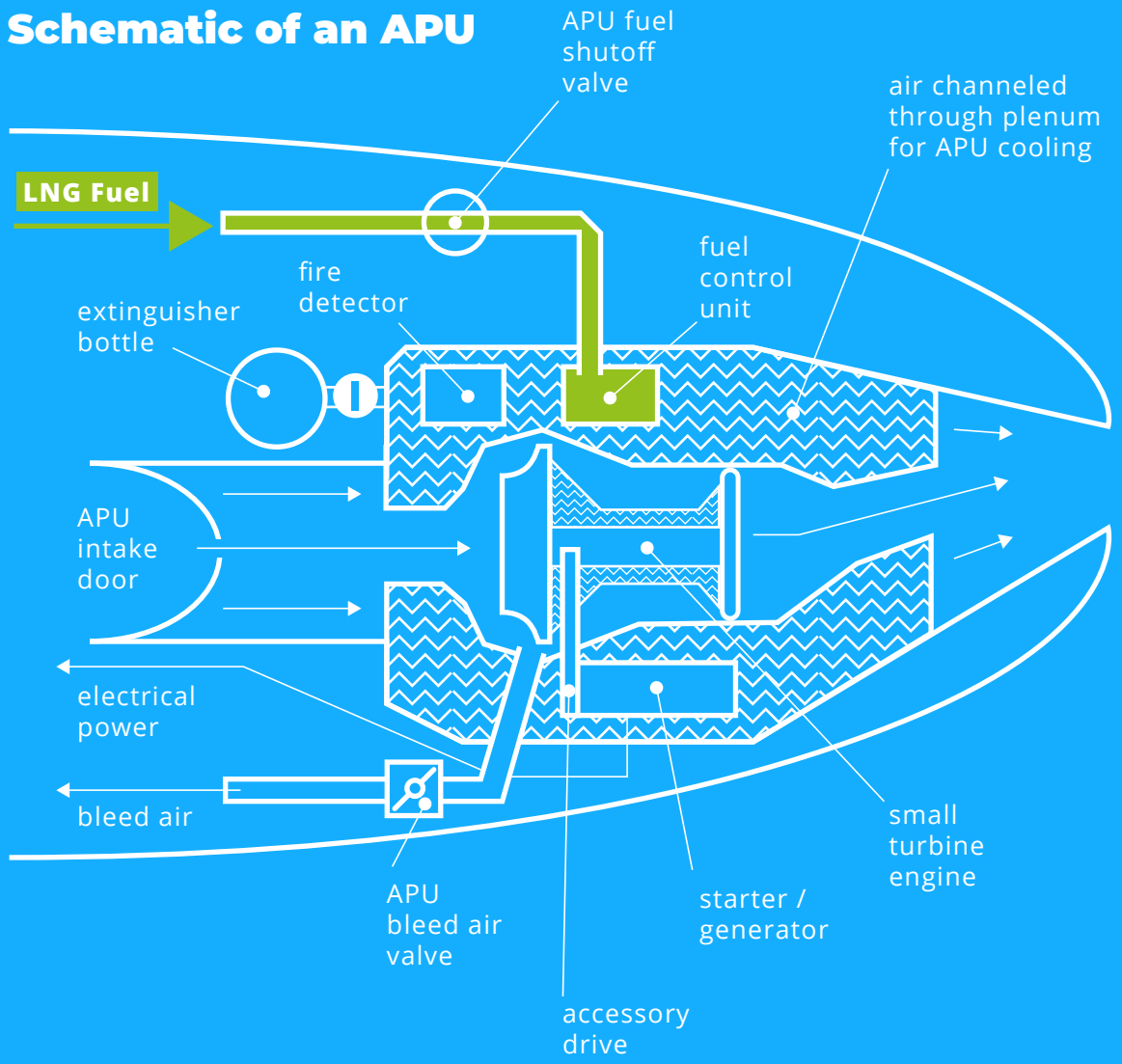


SNN

Solution

Direct LNG fuel injection on the APU using cryogenic energy on an EGTS

Schematic of an APU



Solution

CTA has:

- developed the technical solution for the aviation engines and fuel tanks using LNG and its cryogenic energy solution

- established a partner consortium covering the total value and logistic value chain

- backed up by the manufacturing industry controlling 60% of the market

- Natural gas:
  - available on Earth with a wide range and availability, making it less sensitive to political influences and price increases
  - available as low and high calorific gas
  - As a fossil fuel, it is 35% cleaner compared to current fossil fuels
  - 52c per kg is 75% calorific value of the fossil fuel in terms of energy volume, therefore a comparative cost price of +/- 70 eurocent / kg.
  - difficult form of storage and low temperature of 162 degrees °C, however at ambient pressure.

Business model

Product / Service Definition

Engine Retrofitting

Licensens Fee/Engines

STC Fuel Certification

Parts Sales & Distribution

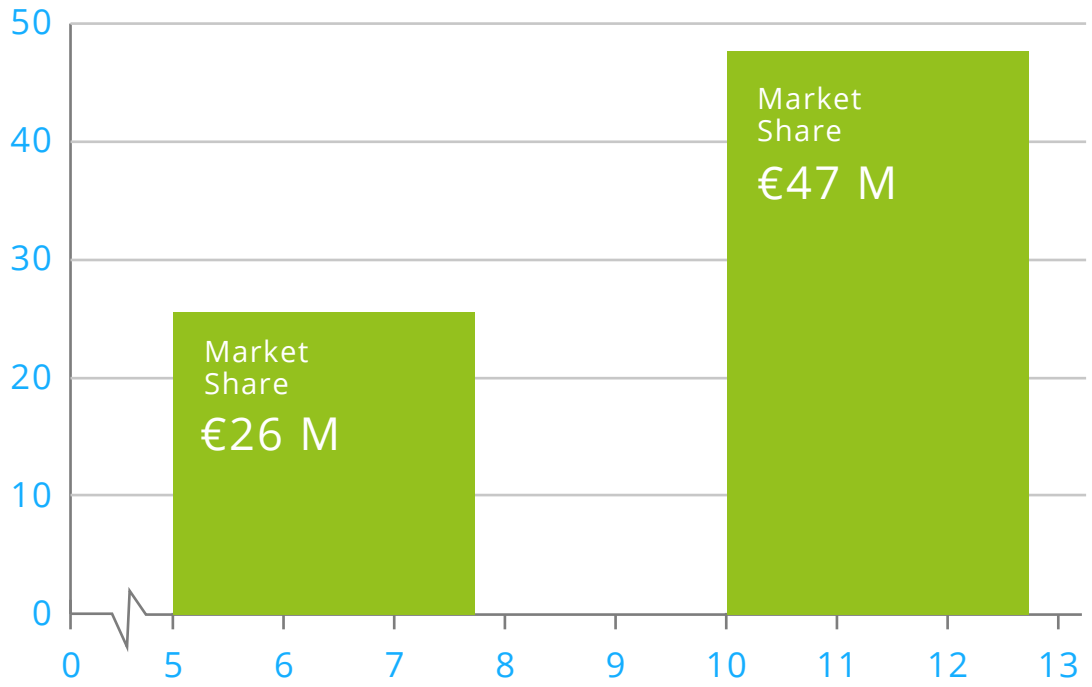
Training Engineers

Training Crew

STC License: ca.$35.000

Target market

TAM
€10.102 M



After 5 years

(Based on CTA EU markets estimates 0,5% market penetration and on 72 license partners & 973 retrofitted engines)

Aimed Market Share

4 -5 %

Based on BA & GA & Turboprops

Next Markets

Military Aviation

3-5 years

Transport Aviation

3-7 years

Go to Market

Focus on existing aircrafts using the fossil fuel
supply/ engine / aircraft industry as partners

CTA GmbH is a base platform together with CTA Ruber Acia Inspirations and the USA partners.
Lycoming has committed to invest 3.5 Mio in the launch on the USA market after certification EASA + FAA

For large aviation as an R&D unit link to Honeywell and Boeing / Airbus
with the Hybrid APU solution

Use the existing communication channels
from the aircraft engine manufacturers to the MRO´s (Maintenance and Repair Organizations) and FTO's (Flight Training Organizations)

CTA will realize the composite tanks from its own development
together with its partners and then set up its own factory for all different GA aircraft types (411.000 GA aircraft worldwide and 122.000 in Europe).

R&D Timeline

Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q3 2020	Q1 2021	Q3 2021	Q3 2022
FD	TD	Safety	Retrofit piston Engine on LNG usage	Engine duration Lab tests	assembly piston engine and fuel tank & fuel system in aircraft & flight tests	Certify Innovation with FAA & EASA	Green Flight
FD	TD	Safety	Build GA LNG fuel tank & Transport aircraft APU tank	Composite LNG fuel tank lab tests	Assembly LNG Fuel system & Functional tests		Factory composite LNG fuel tanks
FD	TD	Safety	Retrofit hybrid APU engine on usage of LNG & kerosine	Engine duration Lab tests	assembly APU engine & LNG fuel tank in aircraft, taxi and flight tests	Certify APU innovation with FAA & EASA	Green Taxiing

TD = Technical Design / FC = Functional Design / GA = General Aviation / APU = Auxillary Power Unit / LNG = Liquid Natural Gas

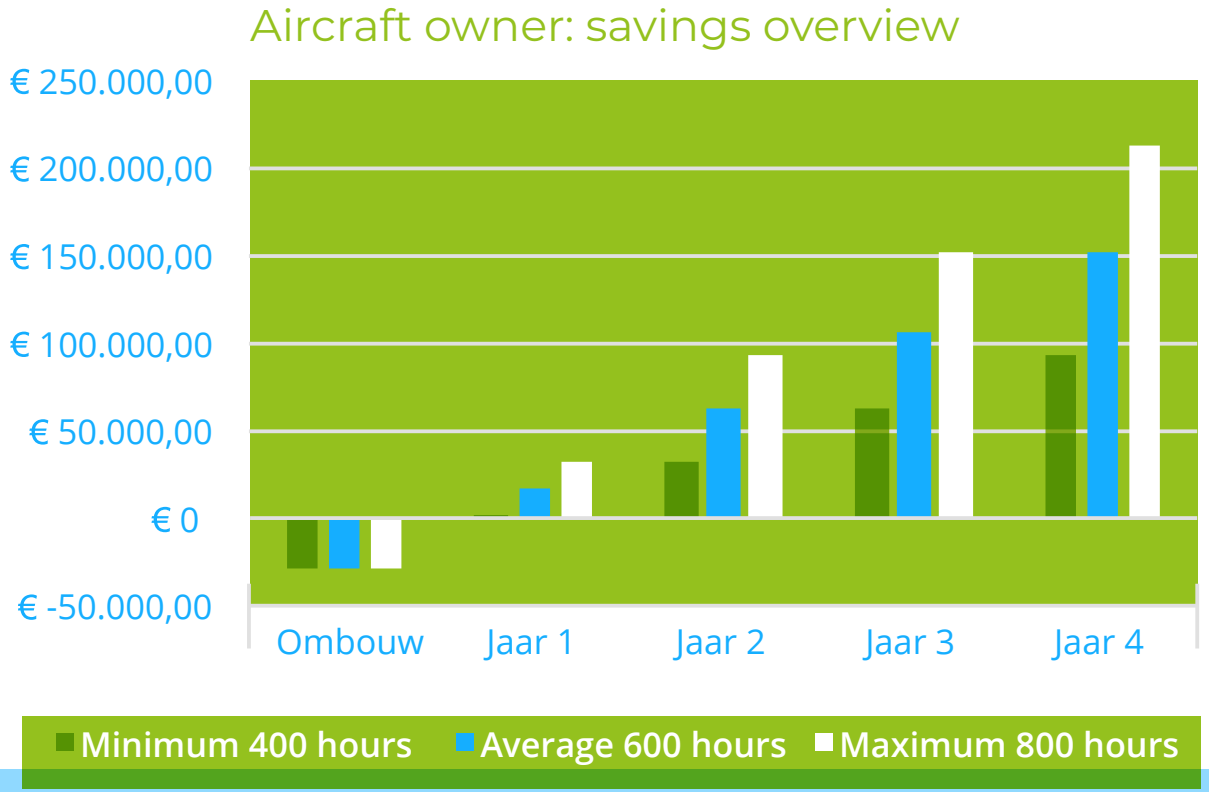
Business Case (1)

Capital Asset Pricing Model (CAPM) for professional flight schools and business owners

Remarks

Capital Asset Pricing Model (CAPM)
for professional flight schools and business owners

ROI with CNG/LNG fuel price € 1,45 /ltr and € 1,55 cost reduction



400 hrs/year private owner

600 hrs/year shared owners

800 hrs/year flight schools

Business Case (2)

- Cost of Retrofitting: ~ € 30.000 – € 45.000
  (including parts, retrofit, training and engine Supplemental Type certificate (STS) license)
- Model of reduced fuel price by € 1,55c from 3.00 euro per liter to € 1,45 per kg
- Payback period for retrofitting is < 1 year and thereafter saving the operator 50 % on its OPEX fuel costs per aircraft (50 % x €90.000 = € 45.000)
- OPEX costs owner are being reduced due to less wear and tear on critical engine components like valves and cylinders by use of cleaner CNG/LNG fuel
- Emission penalties will lead to additional incentives for switch to natural gas engine solutions
- NPV of 21% value reduction incorporated

Competition

Now 2 fuels are in use:

1. **Avgas**
   100 and 130 Low lead: an upgraded and aviation-grade automotive fuel type.

2. **Kerosene**
   an aviation-refined and upgraded diesel fuel.

Other competitors / initiatives / fuels:

Compressed Natural Gas initiative
started in the USA in 2013 with application of CNG in an external attached fuel tank on a Huskey GA aircraft. The engine on the aircraft used was a Lycoming I O – 360. Aviation legislation requires a completely redesigned airworthiness test for a solution that changes the shape of an aircraft. Covers an average of 1000 hours of test flying, which negated the business case for this startup.

Diesel Fuel
Diesel engines have been placed in limited numbers of GA aircrafts. However, diesel is cheaper, but not cleaner.

Ethanol fuels
application in Embraer General Aviation spray aircraft used. Cleaner in terms of emissions and cheaper, however, due to serious freezing phenomena when using this fuel in temperatures +5 - 15 degrees and at a height not safely applicable > 1000 m

Gas to Liquid (GTL)
(Fossil kerosene blended with 50% synthetic GTL allowed) but not cheaper

Power to Liquid (PTL)
Extraction of CO_2 out of free air requires enormous electrical powerplant for production makes PTL 6 times more expensive than fossil kerosene

Sustainable Aviation Fuel (SAF)
Complex feedstock supply lines and is 3 times more expensive

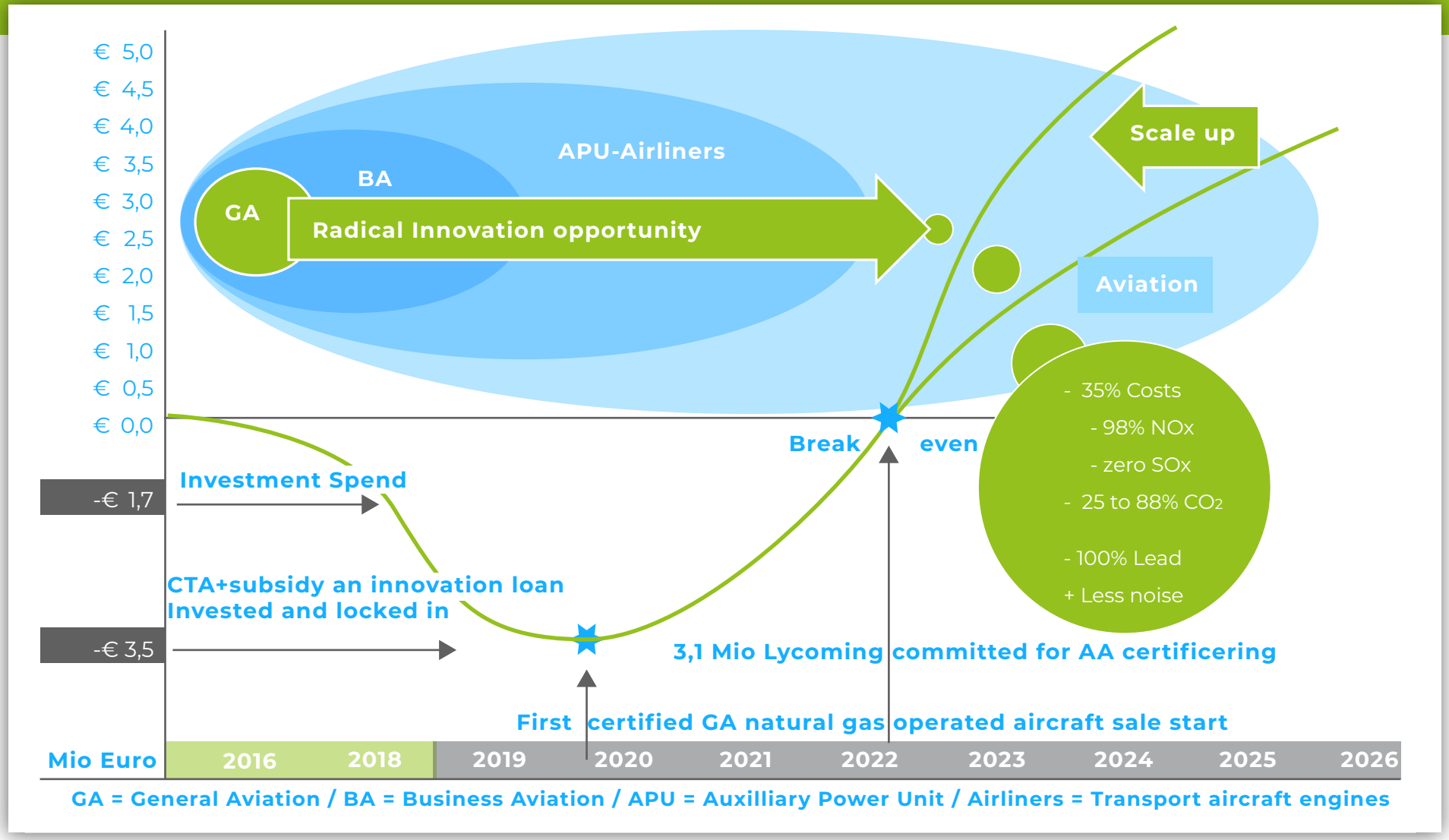
Competition Matrix

Standard and alternative fuels (the heat value of each fuel is the amount of heat released during its combustion and is as such a comparison of energy power)	**Heat Value in MJ/KG**	**Risk aspects and drawbacks**	**Net Price per L/kg**	**World wide available**	**Emission factor % versus fossil fuels**
Aviation Gasoline (Avgas) containing Led (100 LL and 130LL)	44-46	Global reservoirs lifetime limited and ongoing market prsessures & huge negative climate impacts	**€ 2,4**	V	Basis
Automotive fuel (Mogas)	44-46	Only approved on recreational light aircraft engines (Rotax) and below 3000 m	€ 1,5	limited	Basis
Aviation Kerosine	42-46	Global reservoirs lifetime limited and ongoing market pressures & growing negative climate impacts	**€ 1,5**	V	Basis
Battery power	-	Weight penalty & Range limits	-	No	zero
Ethanol	28	Freezing at altitude	€ 1,5	Brazil	70%
Methanol	22,7	Freezing & extreem toxic fumes	€ 1,5	No	70%
Sustainable Aviation Fuel (SAF)	42-46	Complex and costly feedstock supply chains	€ 3,0	No	80%
Gas To liquid (GTL) Fischer Tropsch (50% blend allowed in Kerosine)	42-46%	Complex and costly feedstock supply chains	€ 4,0	limited	80%
Power to Liquid (PTL) extracting CO2 out of the free air and manufactor back to fuel	42-46%	Expensive and complex production plant and requires enormous electricity	€ 6,0	No	zero
Compresed Natural Gas (CNG)	42-55	High pressure tank of 300-700 Bar unusable is shape and altitude effects	€ 1,2	V	75%
Liquid Natural Gas (LNG) (contains 600x the volume of CNG)	42-55	fuel storage requires insulation materials due to minus 162 degree temp of LNG	**€ 0,5**	**V**	**75%**
Bio LNG	42-55		€ 1,0	limited	**12%**
Hydrogen gas (Grey)	120-142	only 50% efficient in combustion engines	€ 4,0	limited	zero
Hydrogen particles (Grey)	120-142	energy content 90% of kerosine and then ideal for hydrofuelcel to electricity	€ 4,0	No	zero

Timeline (1)


PREPARATIONS
PARTNERS
R&D
Fuel Tank Build &
Engine Duration tests
and dynamic flight test
CERTIFICATION
PRODUCTION
2009
2015
2016
2017
2018
2019
2020
2021
2022
2023

Timeline (2)


€ 5,0
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€ 2,0
€ 1,5
€ 1,0
€ 0,5
€ 0,0
APU-Airliners
BA
GA
Radical Innovation opportunity
Scale up
Aviation
- 35% Costs
- 98% NOx
- zero SOx
- 25 to 88% CO2
- 100% Lead
+ Less noise
Break even
Investment Spend
-€ 1,7
CTA+subsidy an innovation loan
Invested and locked in
-€ 3,5
3,1 Mio Lycoming committed for AA certificering
First certified GA natural gas operated aircraft sale start
Mio Euro
2016
2018
2019
2020
2021
2022
2023
2024
2025
2026
GA = General Aviation / BA = Business Aviation / APU = Auxilliary Power Unit / Airliners = Transport aircraft engines

Partners

Status

- In partner contract
- Under final partner contract development
- Targeted partner
- Grants used

Advisors

Investorready
Eura AG- Germany
Ruber Acia
Venturelab
RVO
GasUnie
GasTerra

R&D partners

Clean Tech Aviation BV
Hanze University
NLR
Lycoming Engines USA
Textron Aviation USA
IFAS University
DLR
DnvGL
Torrgas
Clean Tech Aviation GmbH

Under Development

Solid Hydro Re.Gen.
Consortia
Cooperation
Holthausen

Targeted potential partners

Honeywell
Boeing
Saffran
KLM
Lufthansa
Nayak.Aero
Aerodata.AG

Founding Fathers Investors

Aviation Inspirations H
> 91%

Xegasus Aviation Investments > 9%

Grants

SNN €502K
Niedersachsen Aviation
Nbank €1 Mio
RVO-WBSO – €600k
SNN MIT research - €75k
Gasunie – €90k
Gasterra – €90k
Small Scale LNG – €200k

CTA Project Management team

CTA Non-Executive Boardmember

Director Airport Teuge & Twente
M. de Groot

Co –Owner CTA /and future CEO
Investor Xegasus Aviation
investment company /
chemical background
Eric Tierie

CTA Non-Executive Boardmember
Former Royal Dutch Air Force
Chief of Staff
LT General bd A. Schnittger

CTO & Statutory Director
with MBA background

in stby mode

Owner CTA Investor AIH BV
PE CEO – COO/testpilot
CTA BV/ GmbH
B.W.A. Cappelle

CMO

Owner WBSO consulting office
H. Helmus

PHD Student

Carolina Maria Orsini

Compliance manager
with H2O background

In Standby mode

Turbine & Piston licenced engineer

in Stby Mode

Engineering & Project Manager
Aircraft engineer MSc in Aeronautical
and BSc in Electrical / Electronics
T. Rodriguez

Assistant engine engineer

E Donk

Engine testlab operator /
Copilot

H. Ten Voorde

Financial Plan

	2020-2021	2021-2022	2022-2023	2023-2024
EBITDA	€ 709.950,00	€ 1.071.690,00	€ 985.996,50	€ 775.686,00
Sales / Revenues	€ -	€ 8.000	€ 1.222.315	€ 2.730.530

Investment Proposal

Preference for a mandatory convertible loan of €500.000

Mandatory conversion at 30-06-2022 or at >1 mio round

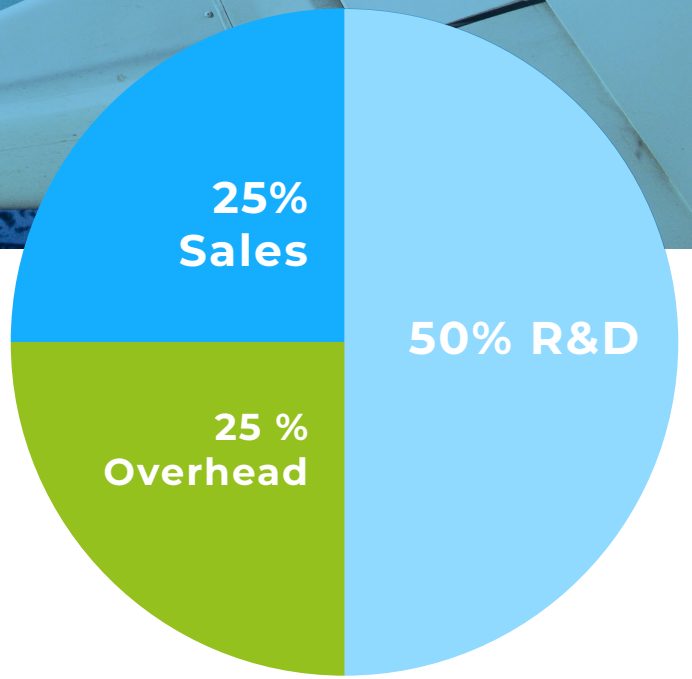
8 % interest to be converted at conversion date

25 % discount

Minimum ticket: €50.000

Direct investment in shares is possible on request

Use of funds



Entrepreneur already invested €500K in company

50% financial investment,

50% hardware investment