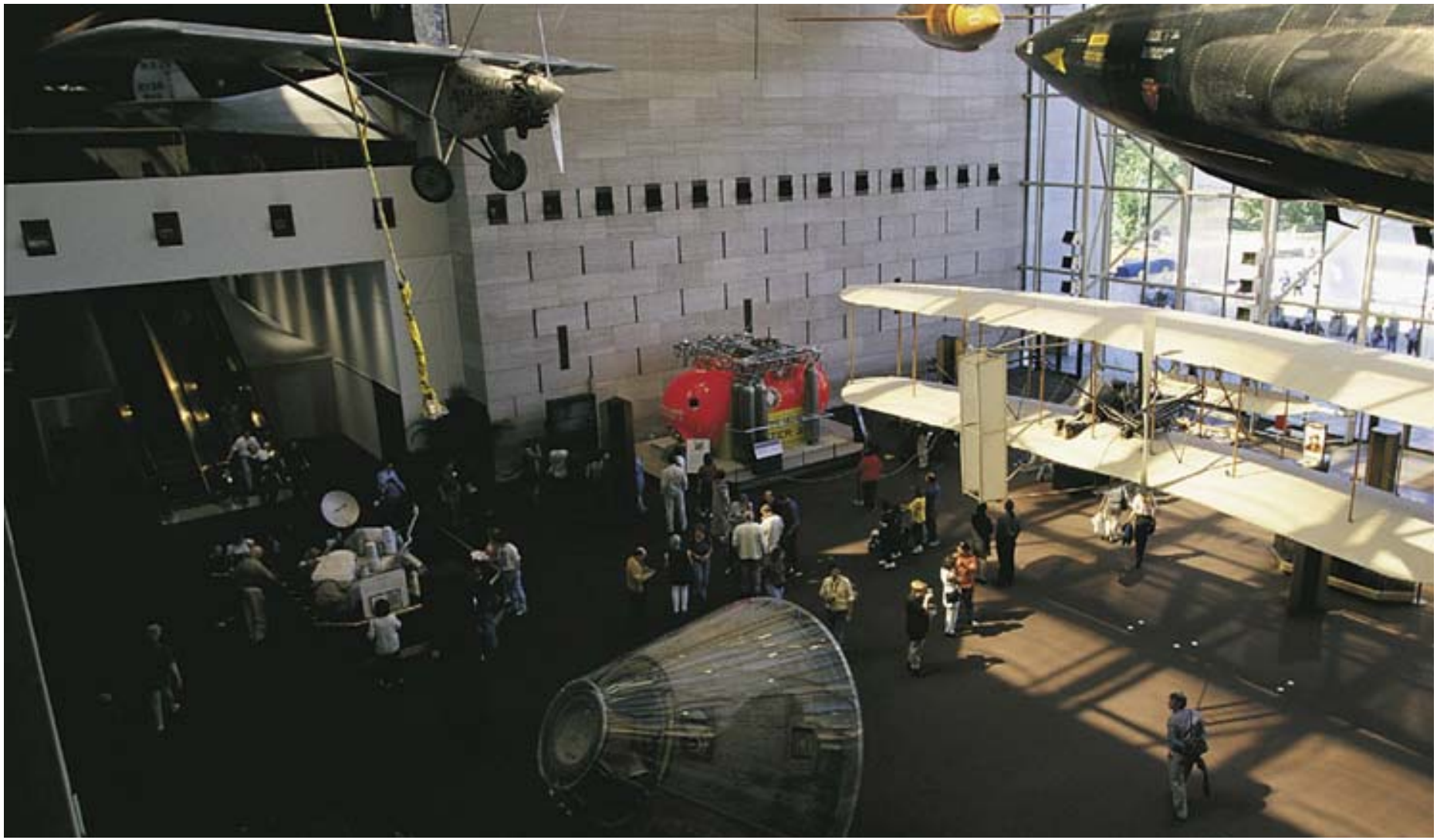
AROUND THE WORLD
WITH A SOLAR AIRPLANE

SOLARIMPULSE

Symposium Photovoltaïque National

25 novembre 2005



AROUND THE WORLD
WITH A SOLAR AIRPLANE

SOLARIMPULSE

Achieve a flight around the world with a solar powered airplane

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SOLARIMPULSE

Our objectives

- A **revolutionary airplane**, capable of taking off under its own power and of flying day and night **without fuel or exhaust pollution**.
- A **scientific adventure** in the service of the environment, rewriting the **history of aviation** with solar energy.
- A **communications platform** promoting sustainable development, by stimulating the **enthusiasm of the public** for renewable energies.
- A demonstration of the importance of **new technologies** for the future of our planet.

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A short history of solar flights…

Solar Challenger
262 km, 5 hrs,
2.5 KW

1981

Sunseeker
Eric Raymond
400 km

1990

Unmanned Helios
Aerovironment
30’000 m, 21 KW

2001

1983

Solair 1
Günter Rochelt
> 5 hrs, 2.2 KW

1996

Icare 2
Voit-Nitschmann
350 km, 3.5 KW

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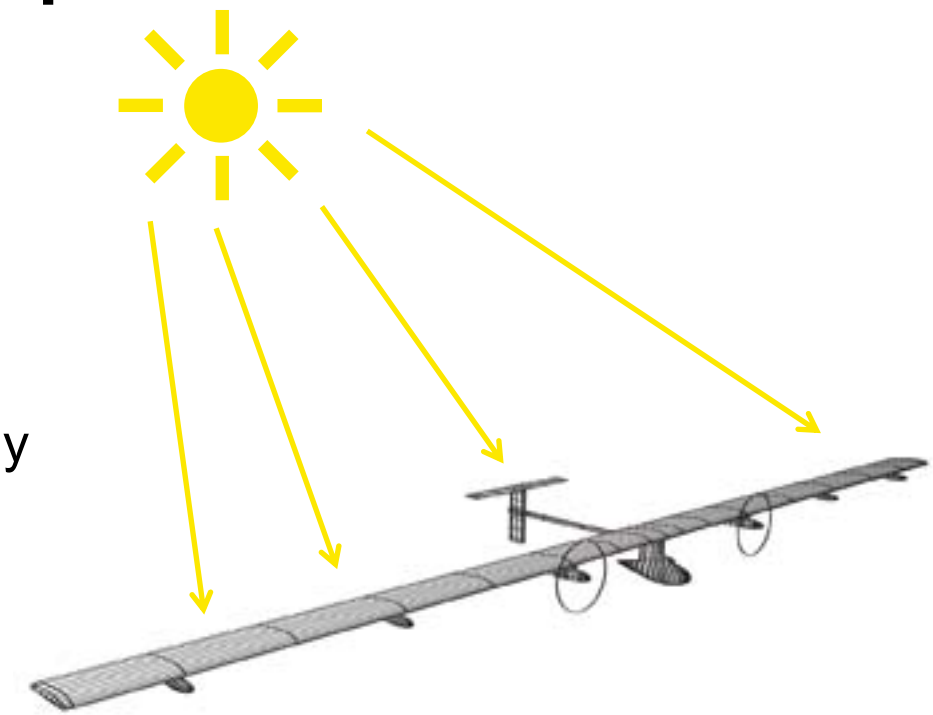
The challenge: how to keep flying during a full night?

A very low sink, a high performance electric propulsion and a light airplane

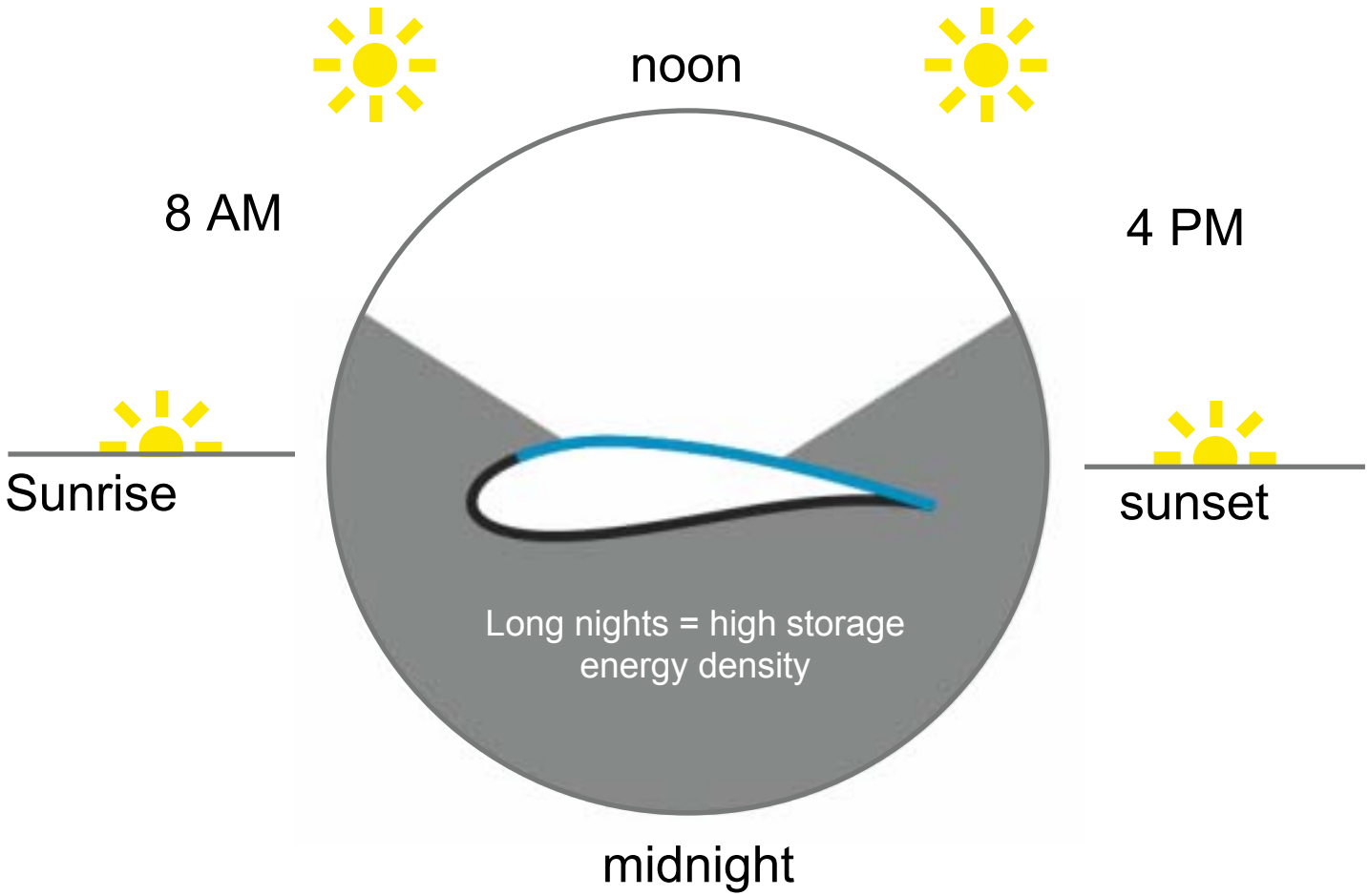
80 meters wingspan
220 m^2 of wing surface

Peak power : 40 kW at noon but only
10 kW (12 PS) over 24 hrs

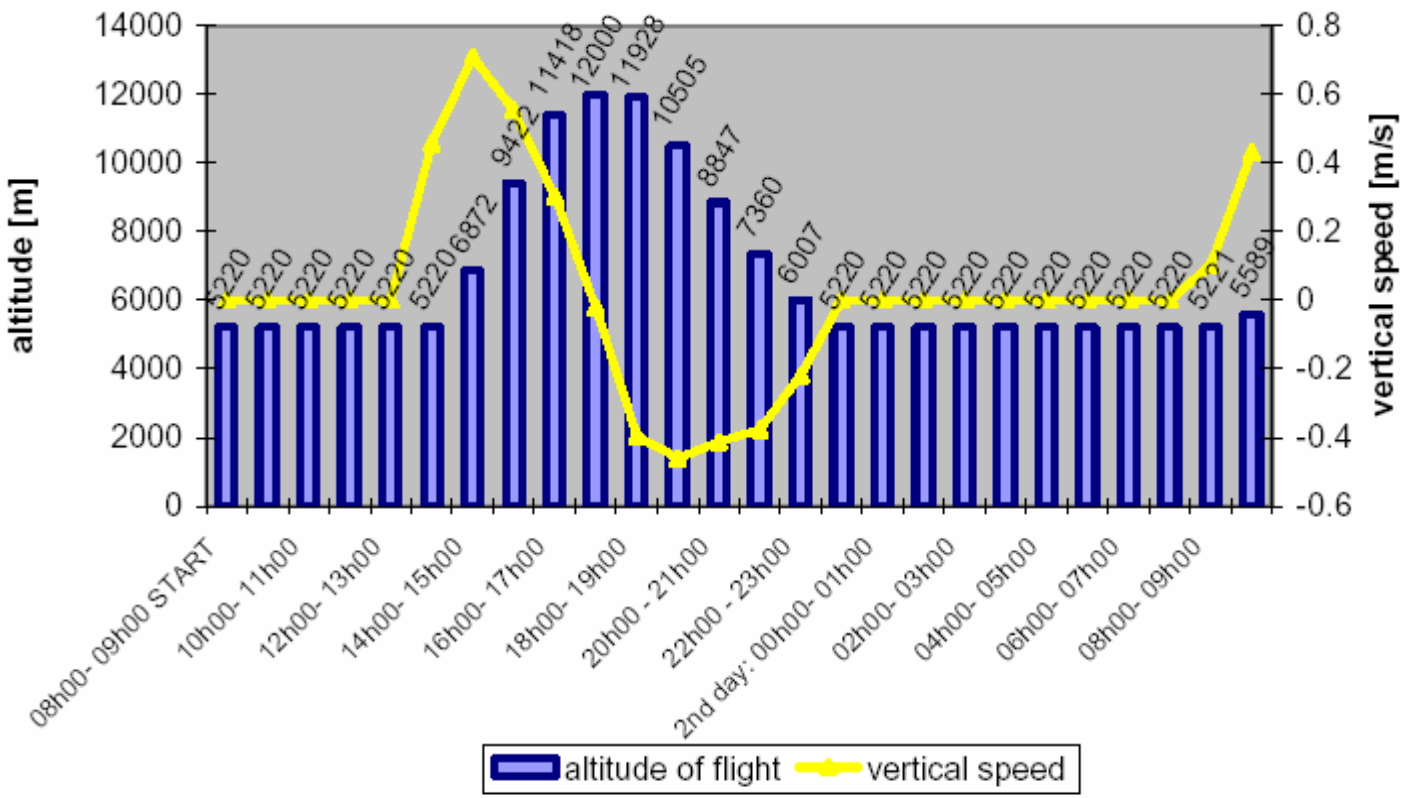


By comparison :
Wright Brothers (1903) : 12 PS

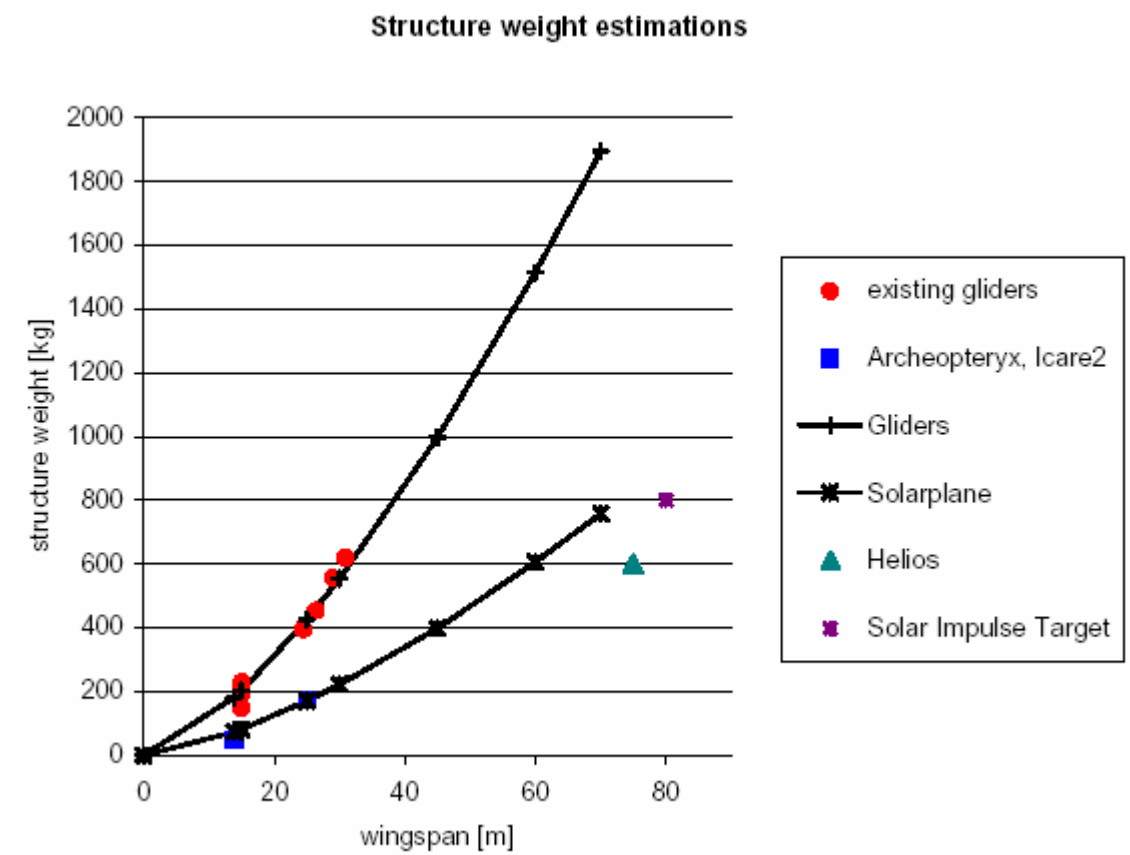
Long nights = high storage energy density



Energy stored in batteries and in altitude



Reduce airplane structure weight



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Provide a viable and safe environment for the pilot at 12’000 meters

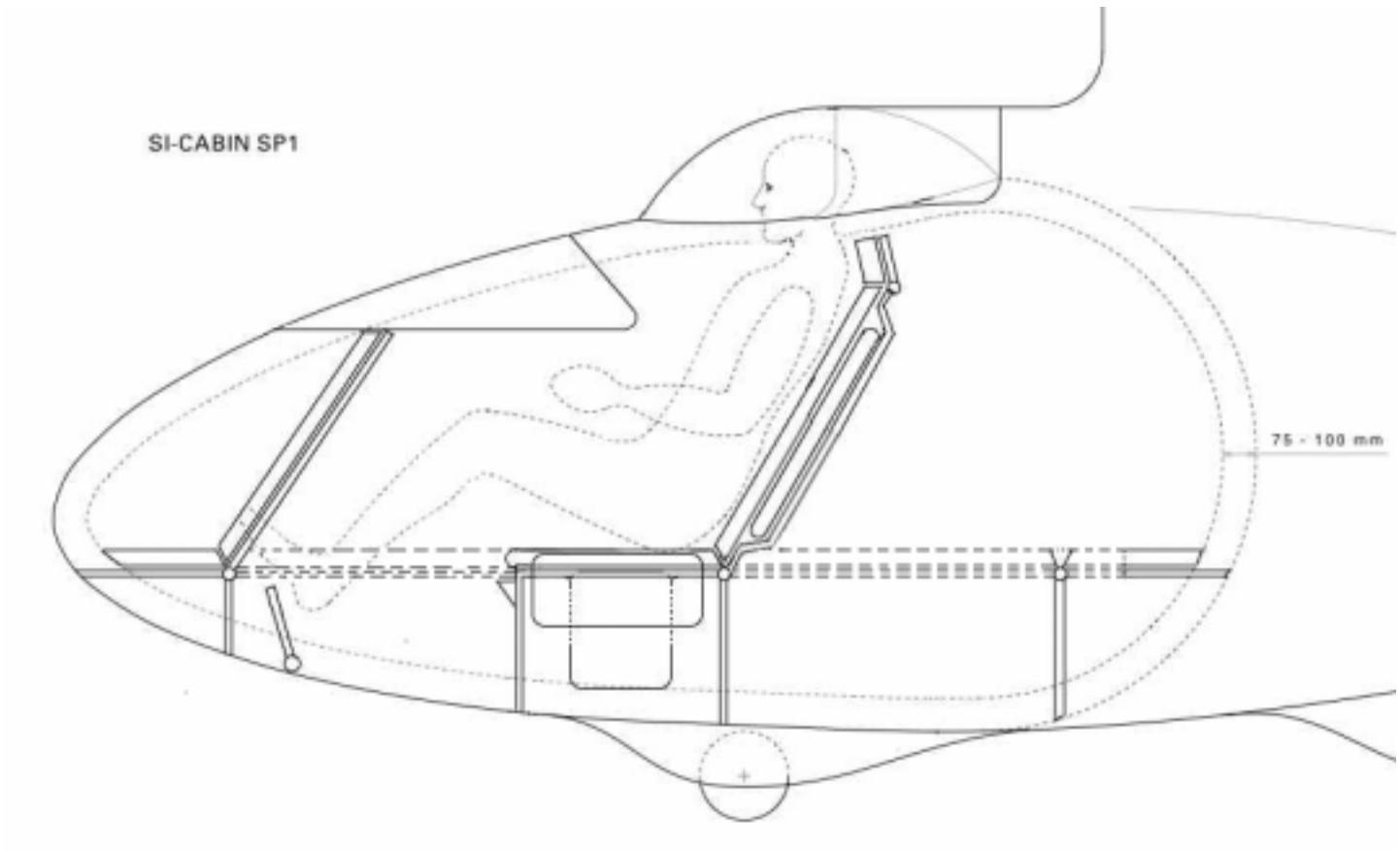
High altitude:	protection against irradiation
Low temperatures (-55 °C) :	energy recuperation for heating purpose extraction of humidity
Little oxygen :	light pressurization system with low energy consumption elimination of CO_2
Long flights duration :	automatic control and management of the airplane energy systems

Current situation

Aircraft Configuration

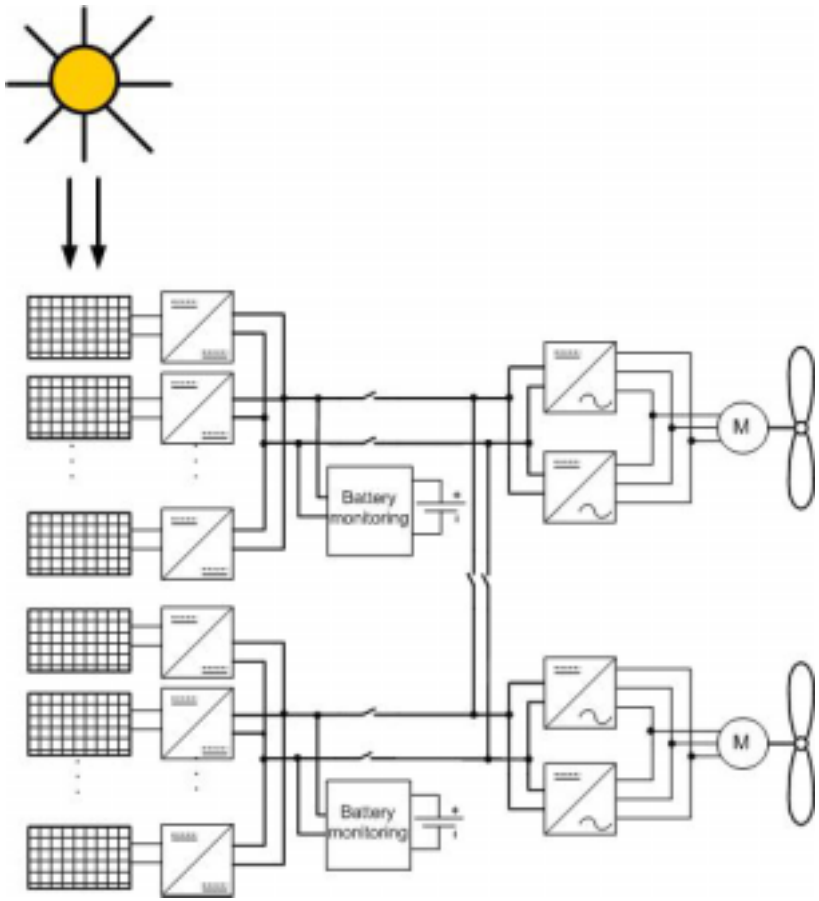
- Conventional configuration
- Main weight in wing (partially span loaded aircraft)
- Ultra low wing loading (8 kg/m^2)
- Design optimized for a single point: cruise speed 43 km/h
- Ultra light carbon laminate sandwich for wing and stabilizer surfaces

Single seated aircraft…



…With ergonomics optimized for a multi–days flight mission

Full electric propulsion



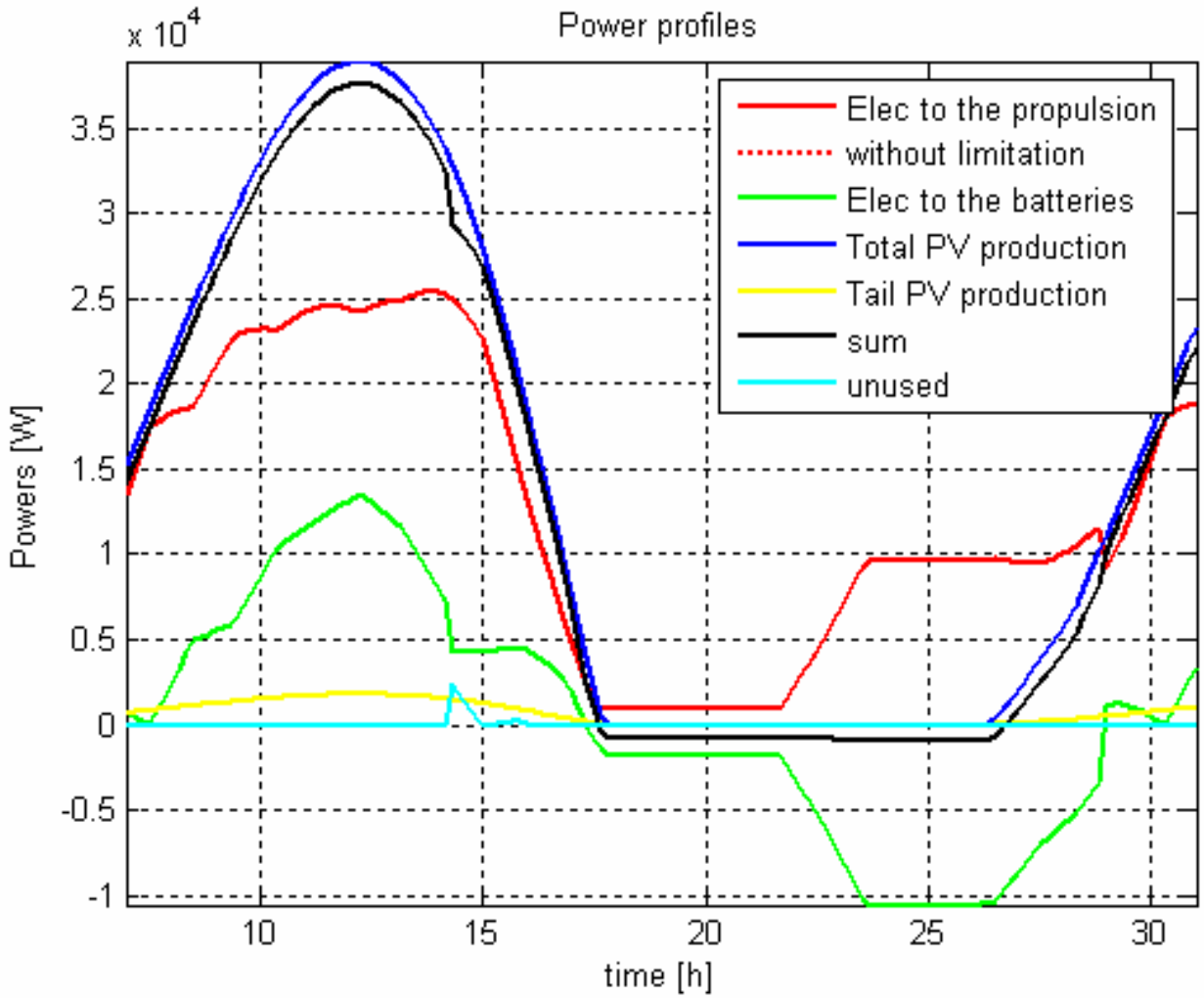
-PV cells on top of the wing and stabilizer surfaces with efficiency of ≈20%

-Li-Ion batteries ≥ 200 Wh/kg

-270 V power electric system, 28 V avionics

-DC brushless-sensorless electro motor with efficiency ≥ 95%

Typical Power Profile



Estimated Weights

• Structure with PV cells integrated and control rods	1475	kg
• Flight controls in cockpit + autopilot	10	kg
• Crew systems	20	kg
• Environmental control system (ECS) + oxygen	15	kg
• Avionics, Com, Nav, antennas	10	kg
• Rescue equipment	10	kg
• Batteries	400	kg
• Water and food for 5 days	20	kg
• Pilot and weight reserve	100	kg
• **Take off and landing weight**	**2060**	**kg**

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The time frame…

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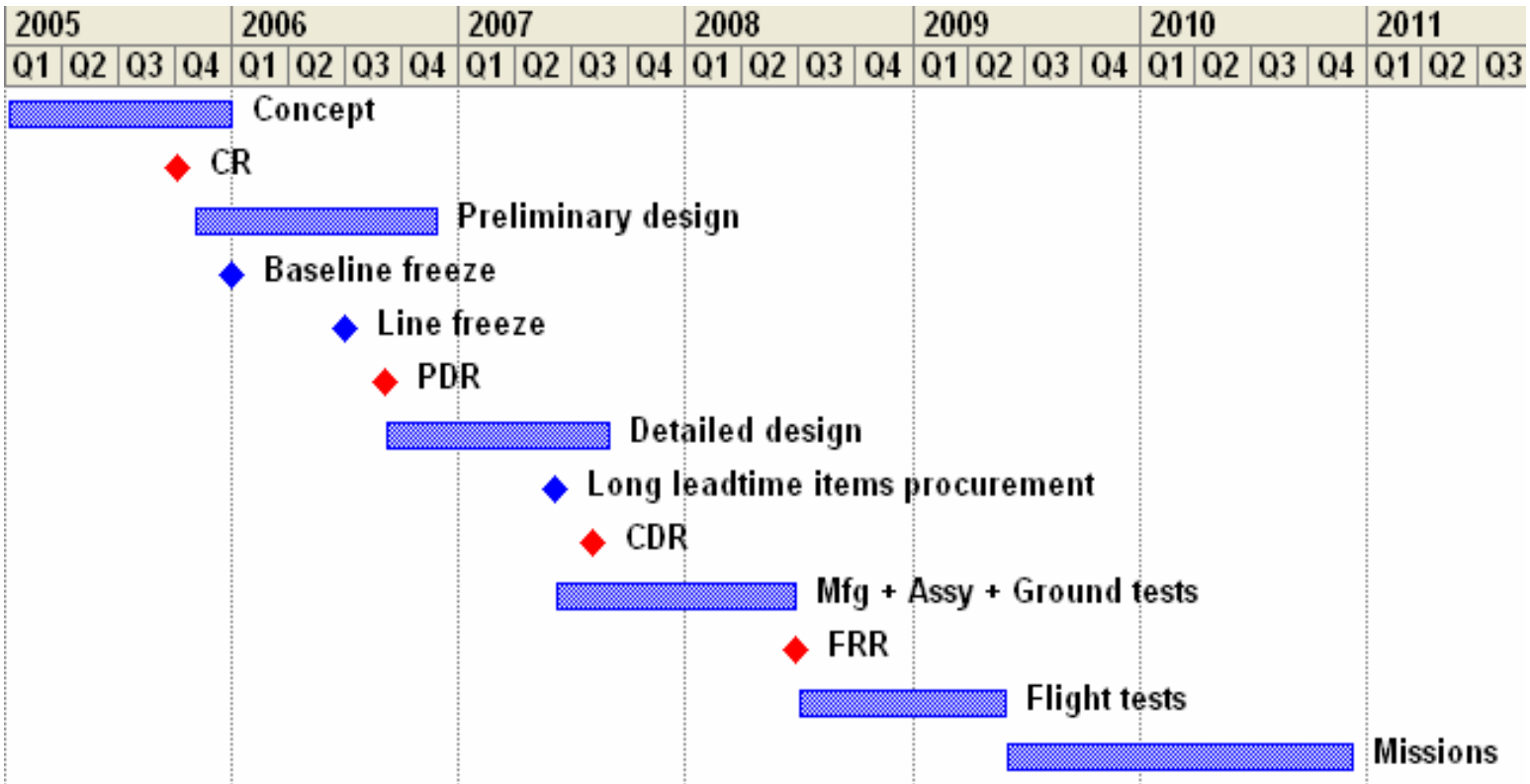
Overall SI Plan – Program Schedule



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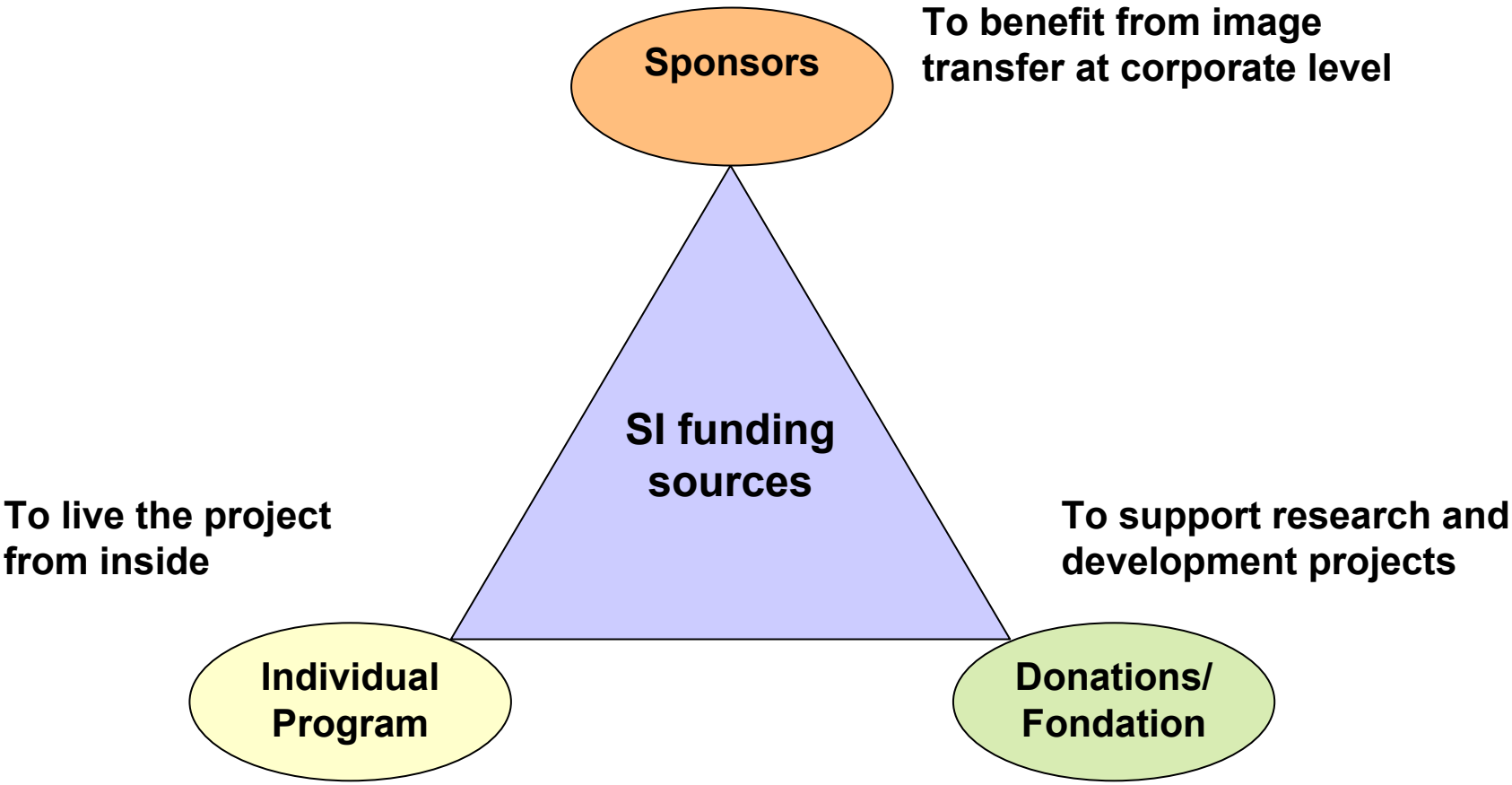
Our partners…

SI project financing



Official Sponsors

Main Partners
signed: **SOLVAY**

Engineering Partner
signed: **ALTRAN**

Official Supporters
signed: **SEMPER**

Service Suppliers
signed: **VICTORINOX**

Partners

Institutional Partners

-**EPFL** (Official Scientific Advisor)
-**ESA** (Technology Transfer Programme)
-**IMT** (Photovoltaics specialist)
-**ETHZ** (High RPM electric motors)
-**Fraunhofer** (solar cells technology)

Aeronautics Partners

-**DASSAULT** (Aeronautical Advisor)

Other Specialist Partners

-**Etel, Ruag, AeroFEM, RWE ,…**

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“Everything that is impossible remains to be accomplished”
(Jules Verne)