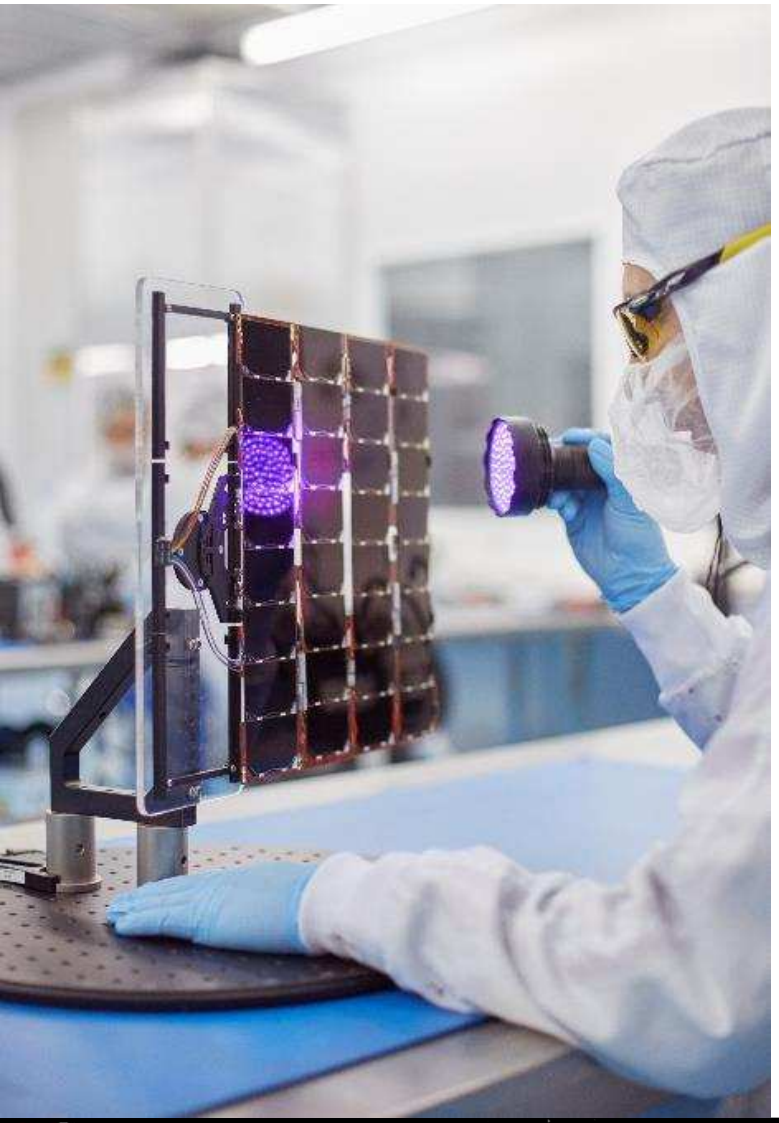


WHO WE ARE

DHV Technology is a Spain based international company that **designs and manufactures solar panels and other power subsystems for space applications**

DHV Technology supplies solar panels and fully customized solutions for the main international companies in the space sector.

Our facilities, with a total of **3700 m²**, consist of:

+ 1200 m² clean room
+ 1000 m² offices
+ 1500 m² warehouse and others

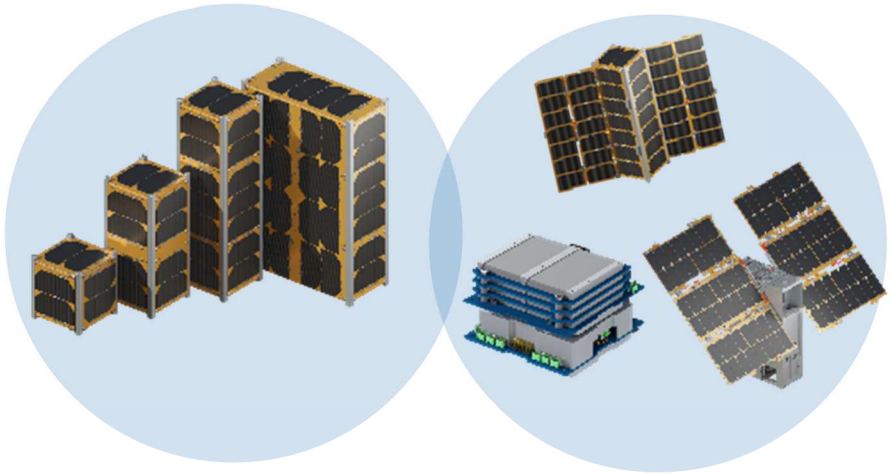
Tech Park of Andalusia
Severo Ochoa 13 – 29590 Malaga (SPAIN)

Results on Solar Array Technology Qualification for LEO SmallSat Missions using semi-automated processes

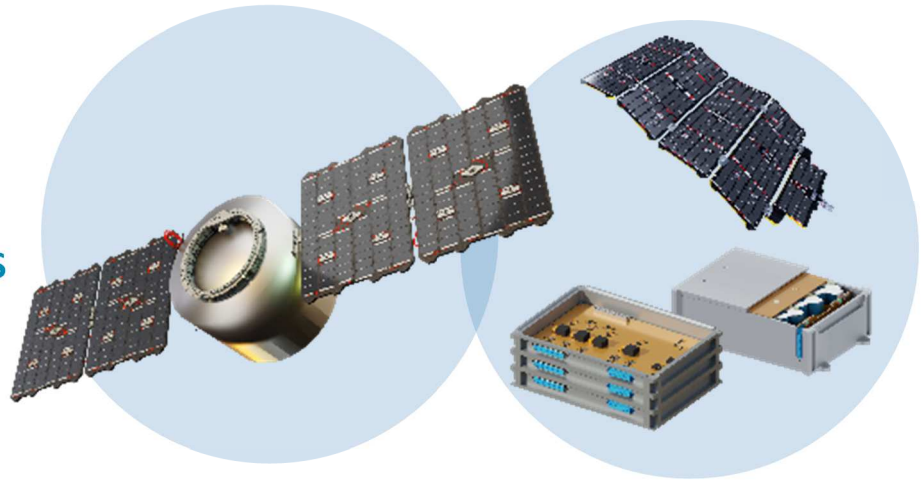
23-25th April 2024

Tech Park of Andalusia
Severo Ochoa 13 – 29590 Malaga (SPAIN)

POWER SOLUTIONS FOR CUBESATS

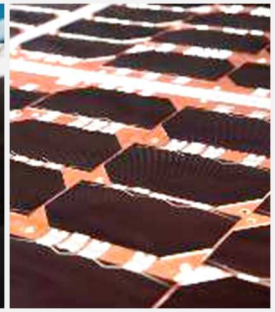


POWER SOLUTIONS FOR SMALLSATS



WHAT WE DO

- Designing customized products
- Constellation projects manufacturing
- Solar panels for SmallSats and CubeSats
- Deployable solutions



Tech Park of Andalusia
Severo Ochoa 13 – 29590 Malaga (SPAIN)

HERITAGE

250+
PROJECTS CARRIED OUT

3000+
ACCUMULATED DAYS IN ORBIT

200+
SATELLITES FLYING WITH OUR SOLUTIONS




SOLAR PANELS

Why are we carrying out this project?

BACKGROUND

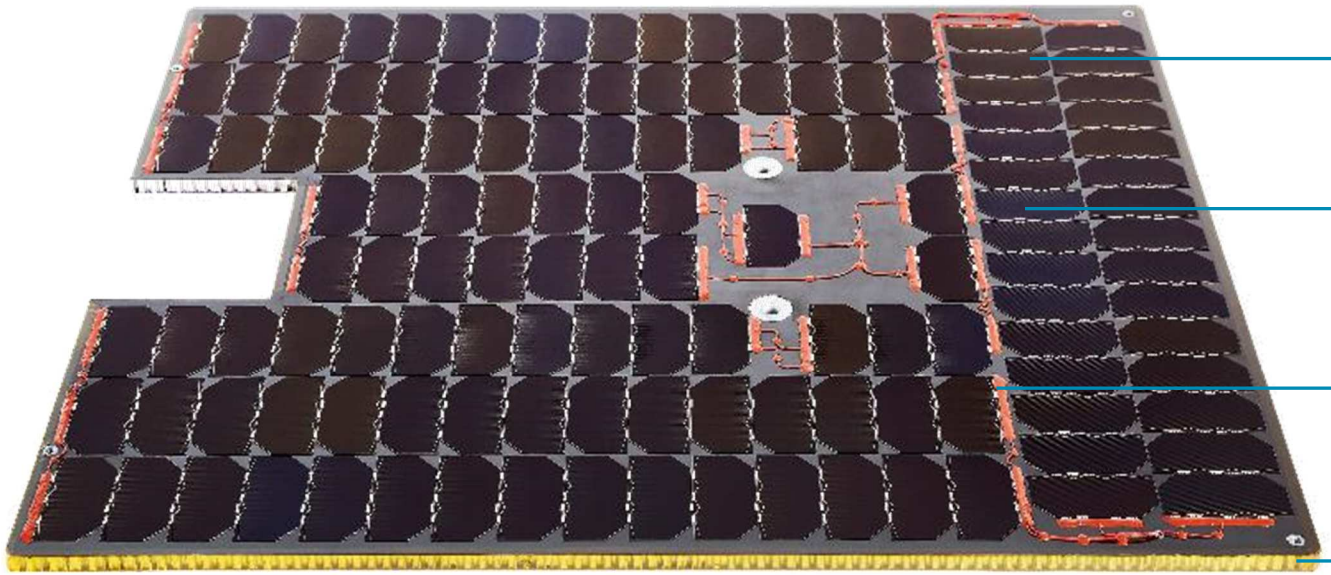
1. Welding and automation → Not enough information in life tests
2. Adhesion and encapsulant process → More RTV references to be tested
3. Electrical components → Increase possibilities to find reliable COTS
4. Thermal cycling tests already performed for 5 years in LEO (2013-2022)

In the meantime, discovering things from 2022 up to now…

1. CFRP substrates (plies, inserts, Titanium snubbers)
2. New silicone adhesives and encapsulants
3. Demonstrate survivability for more than 5 years in LEO
4. Standard Solar Array wing (substrates, hinges, springs)

SOLAR PANELS

Typical construction



Qualified solar cells
Multi-junction cells with 30% nominal efficiency and integrated bypass diodes

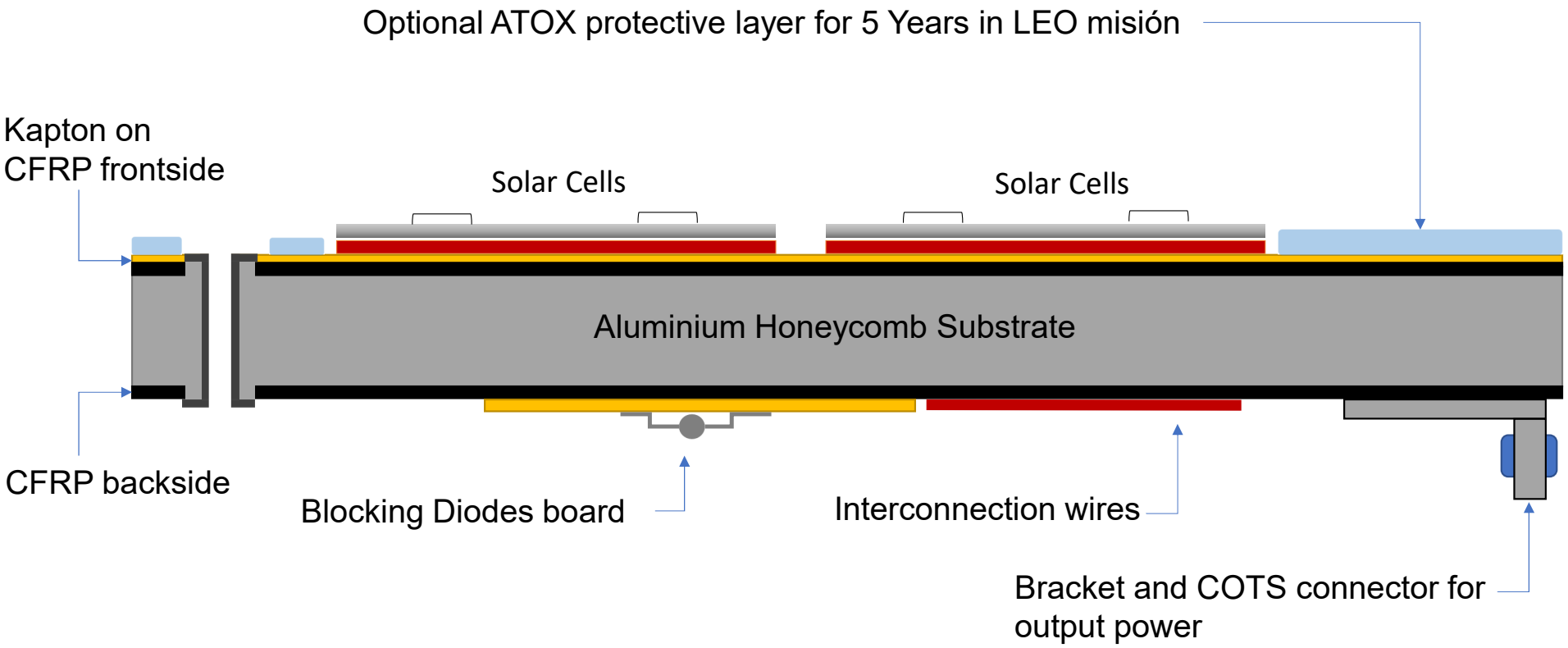
Laydown design
Design the most efficient configuration to provide the maximum power

ATOX protection for LEO
Welded connections protected with silicone.

Space qualified CFRP substrates
Customized substrate with different configurations

SOLAR PANELS

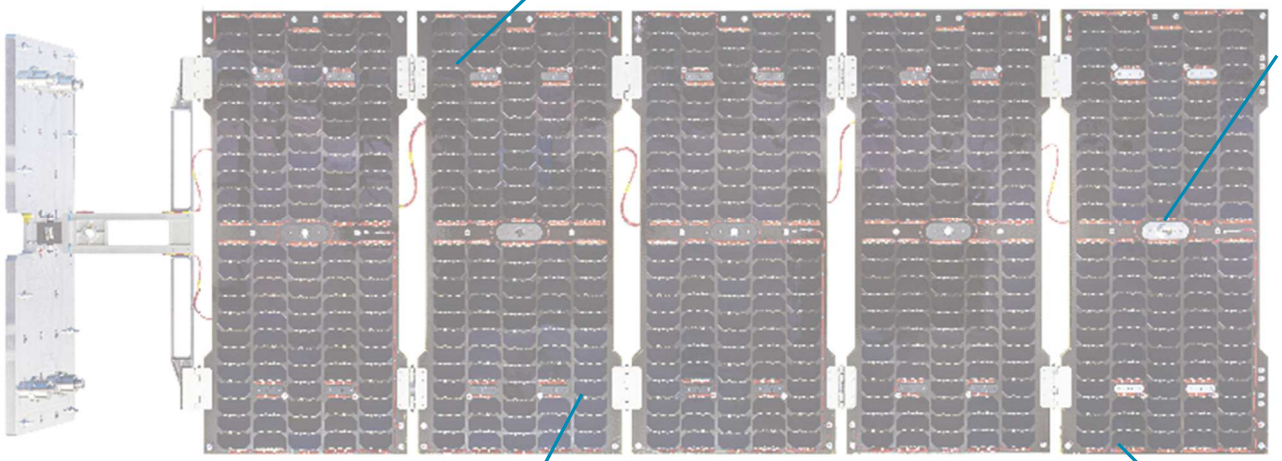
Stack-up



SOLAR PANELS

Deployables

Mechanisms design
Customized hinges are designed with different opening angles, configurable torsion springs, and latching systems.



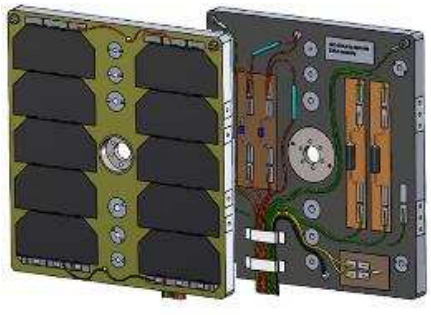
Deployment mechanism integration
HDRM integration and customized yoke design

Inserts integration
Additional integration of inserts for wiring and protection covers

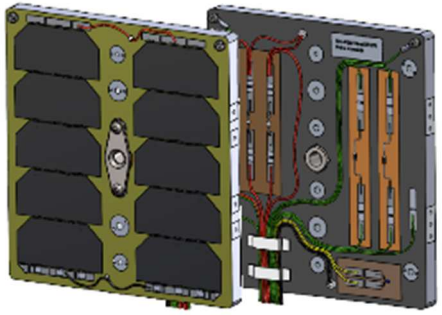
Electrical wiring
Space-qualified cables in compliance with ESCC standards.

DVT coupons designs

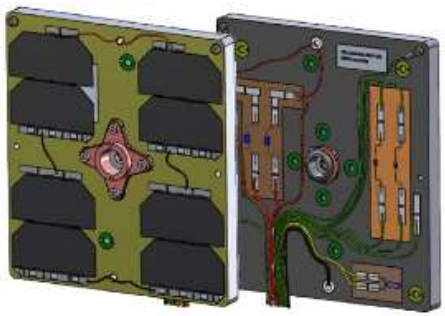
Three configurations for PVA. A fourth one to test additional items



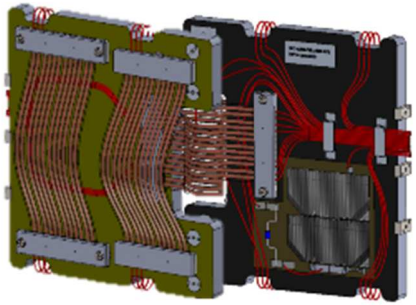
DVT-1



DVT-2



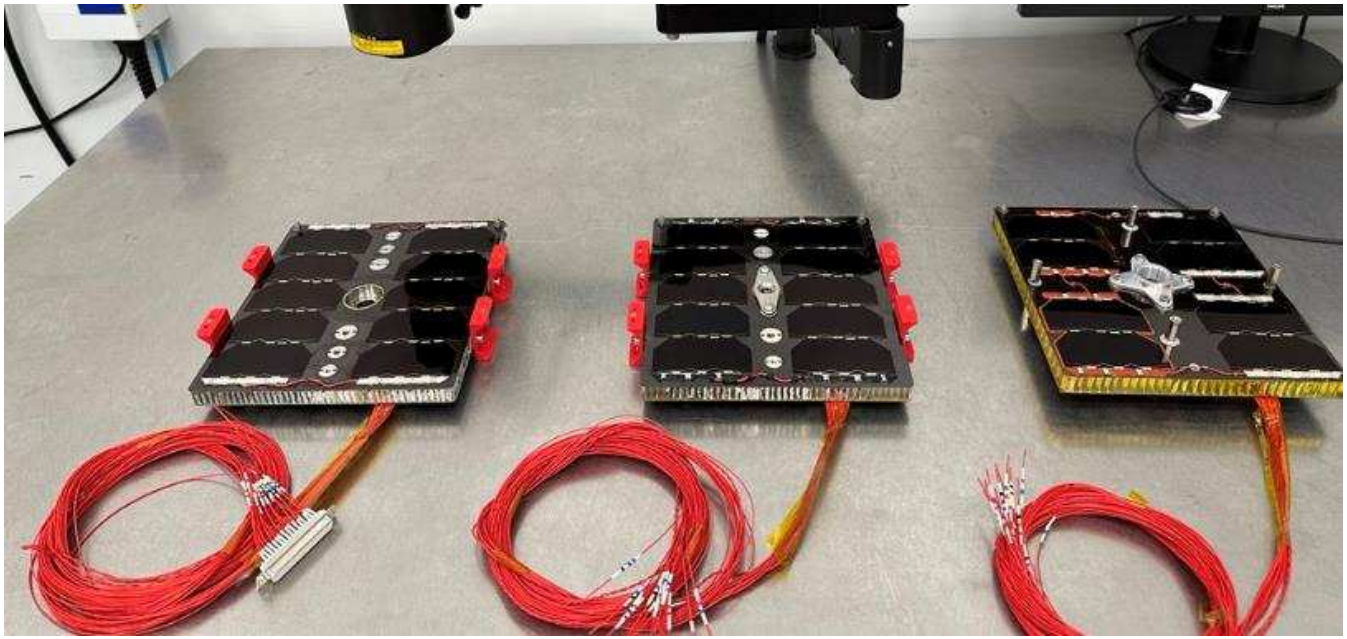
DVT-3

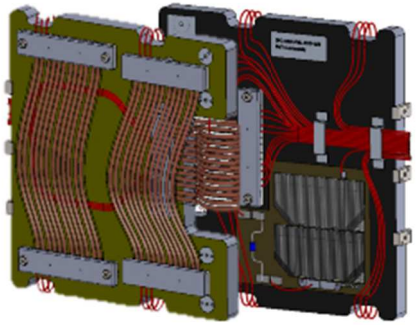


DVT-4

DVT coupons designs

Three configurations for PVA and mechanical elements. A fourth one to test additional items

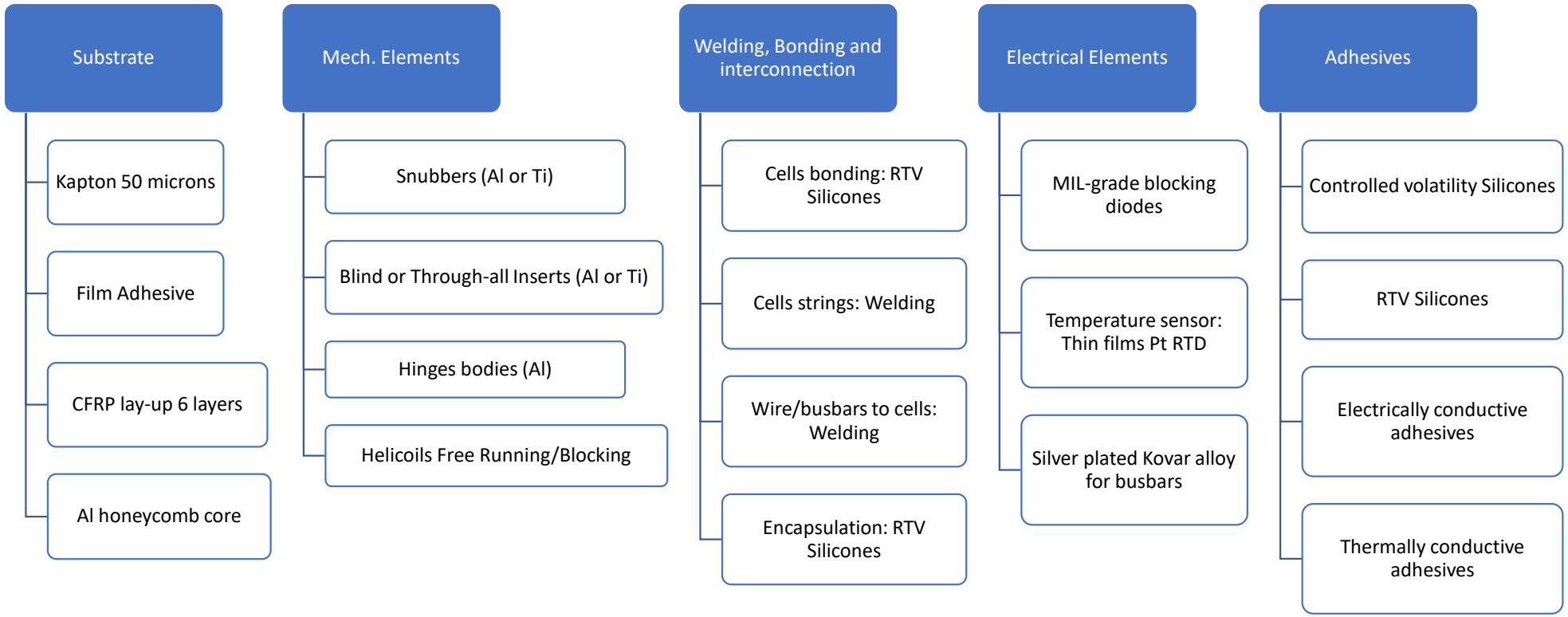




DVT-1 **DVT-2** **DVT-3** **DVT-4**

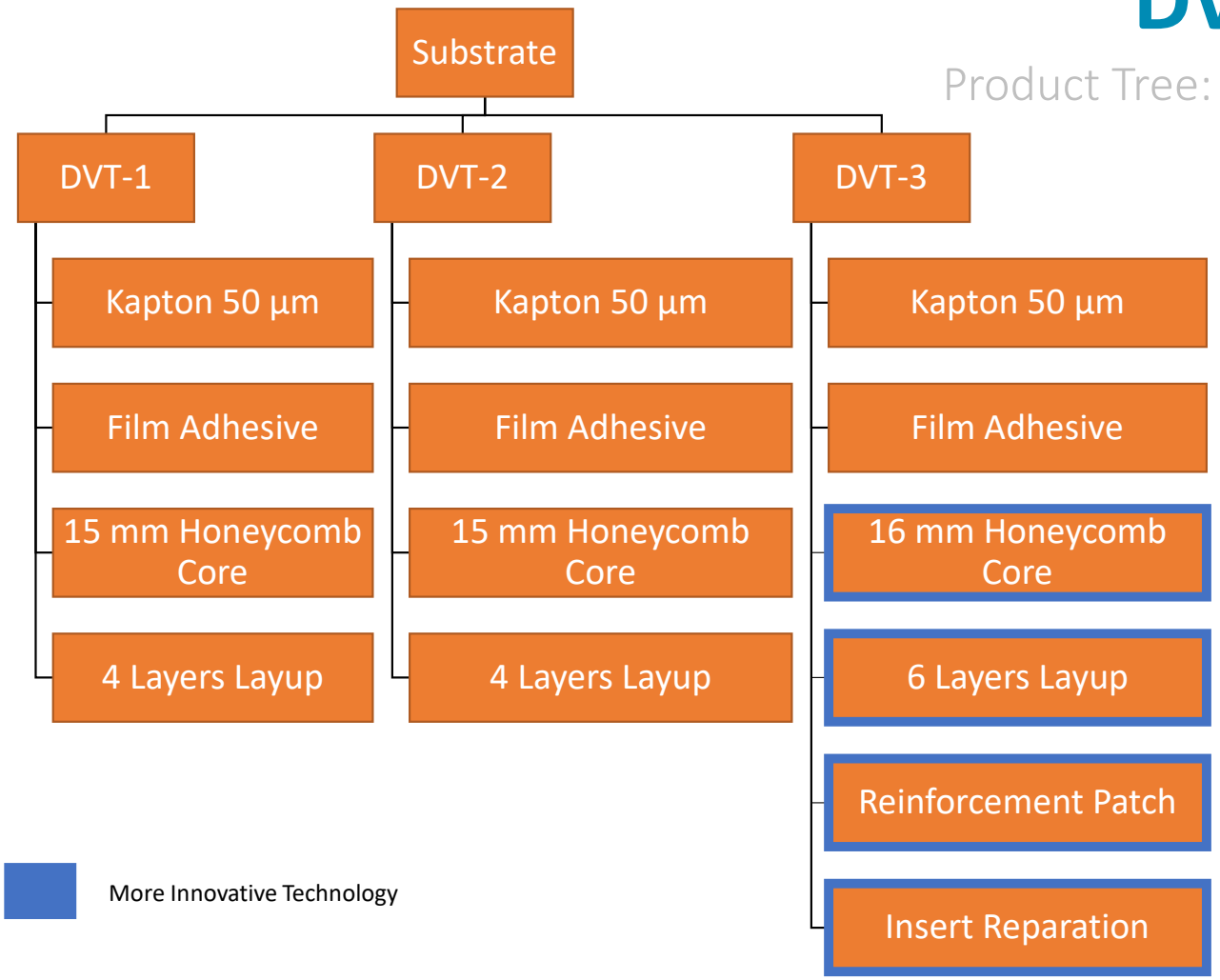
DVT coupons designs

Product Tree: Materials, process and components



DVT coupons designs

Product Tree: Materials, process and components



DVT-1

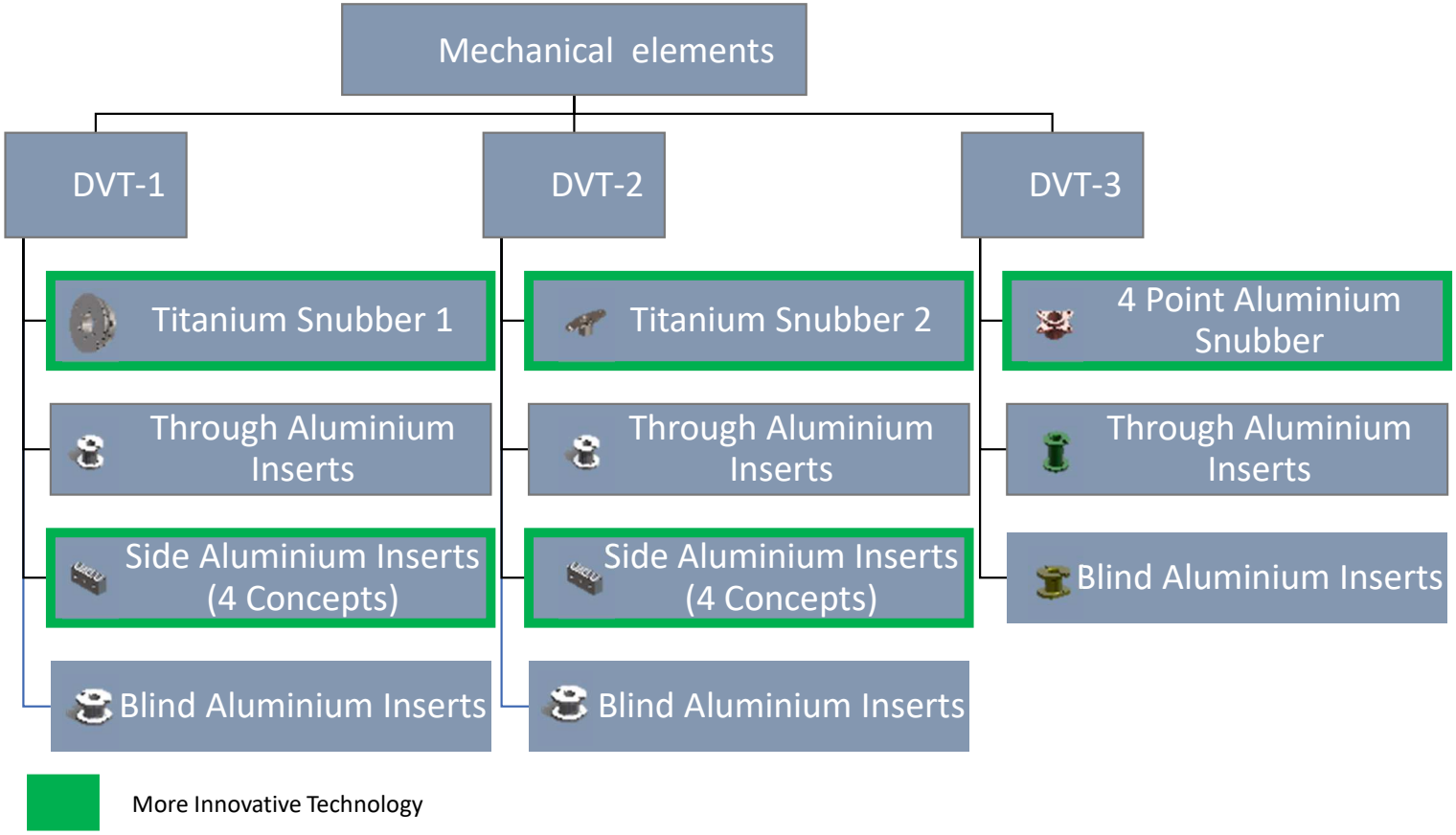
DVT-2

DVT-3

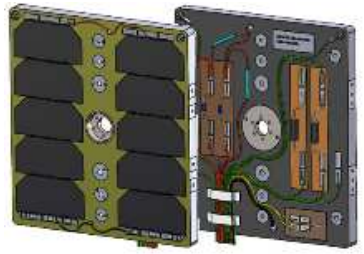
Tech Park of Andalusia
Severo Ochoa 13 – 29590 Malaga (SPAIN)

DVT coupons designs

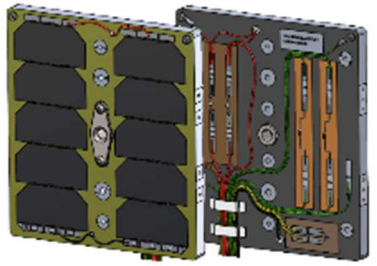
Product Tree: Materials, process and components



DVT-1



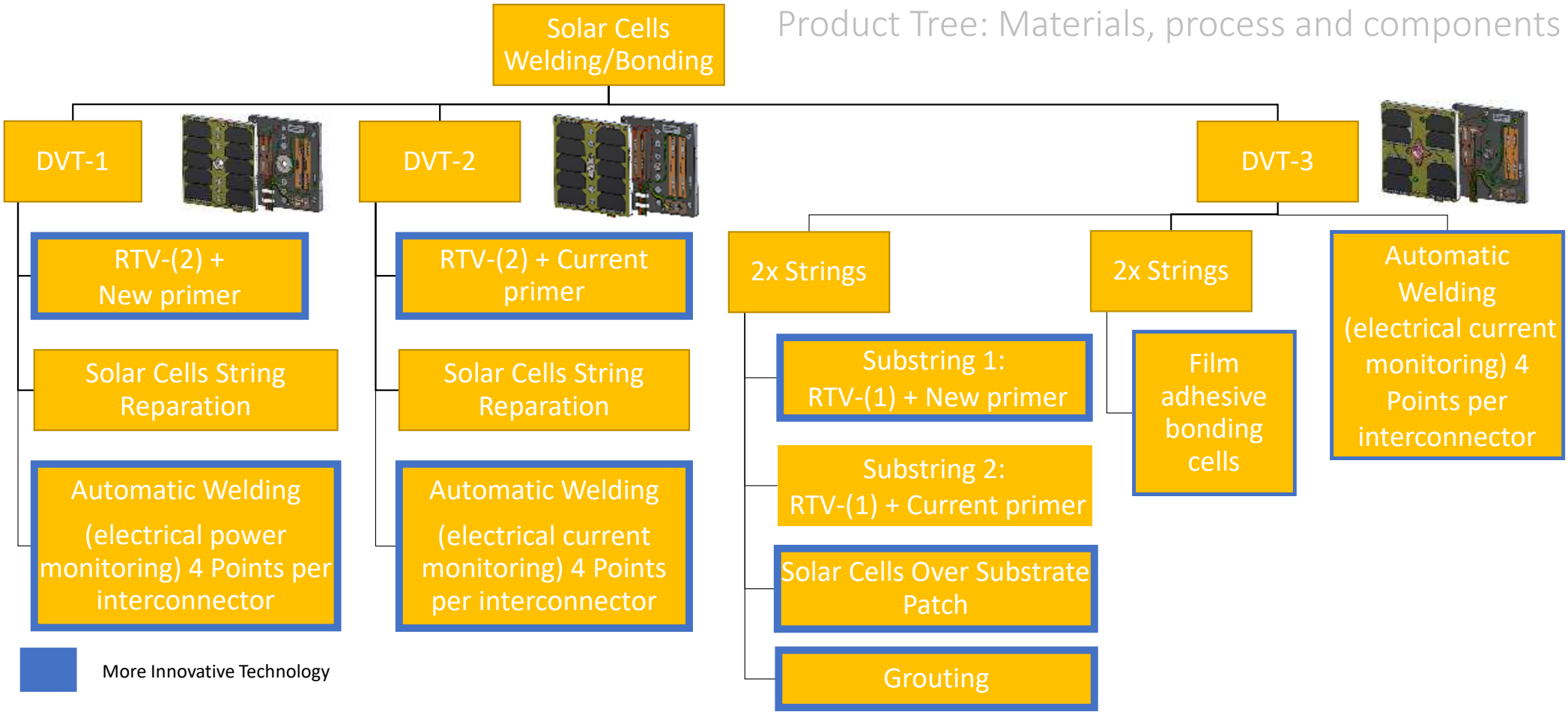
DVT-2



DVT-3

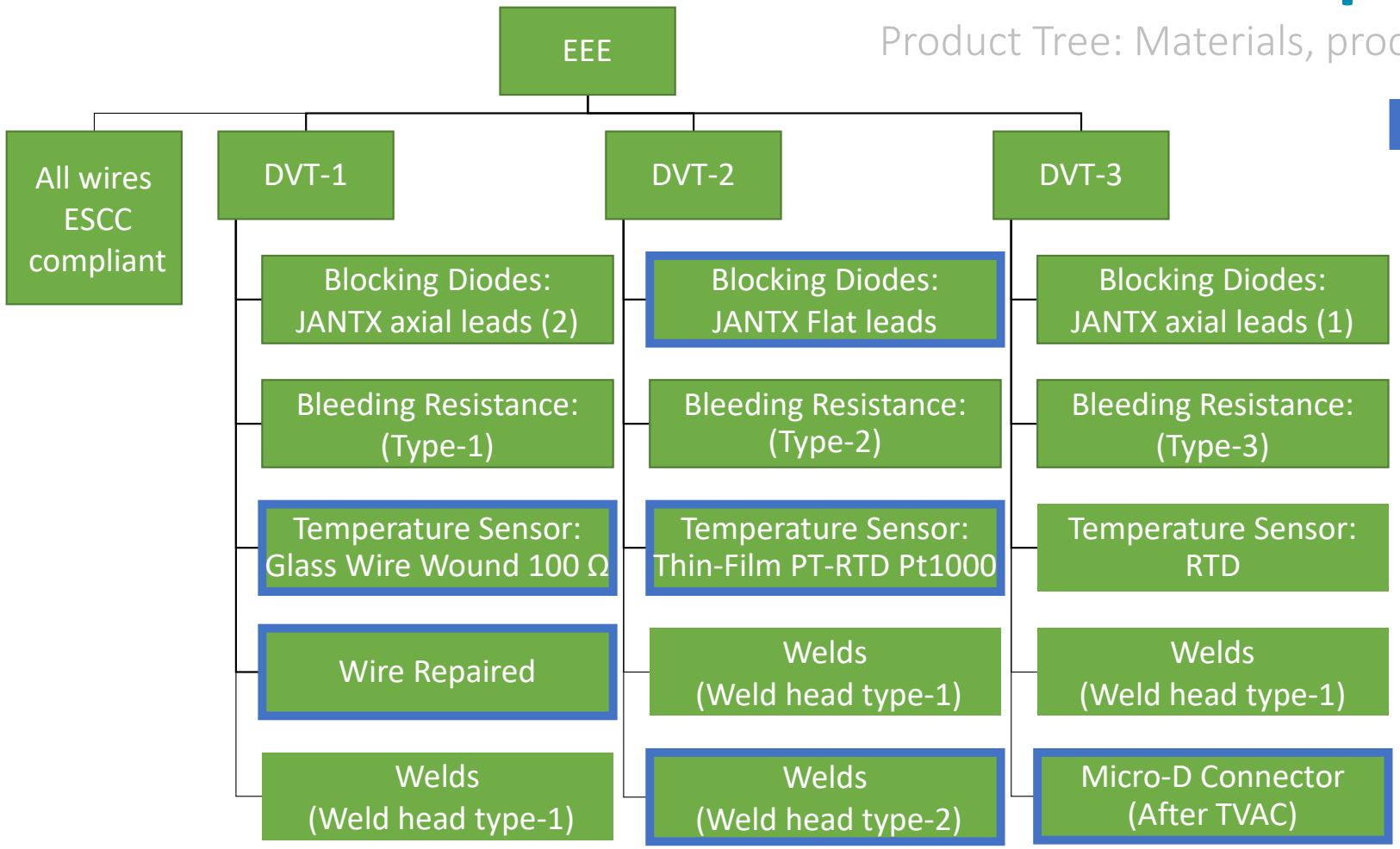
DVT coupons designs

Product Tree: Materials, process and components

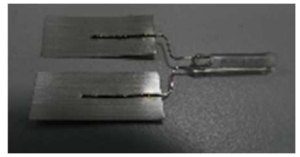


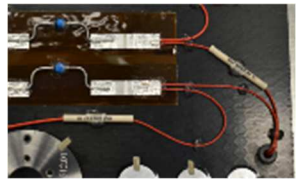
DVT coupons designs

Product Tree: Materials, process and components



More Innovative Technology





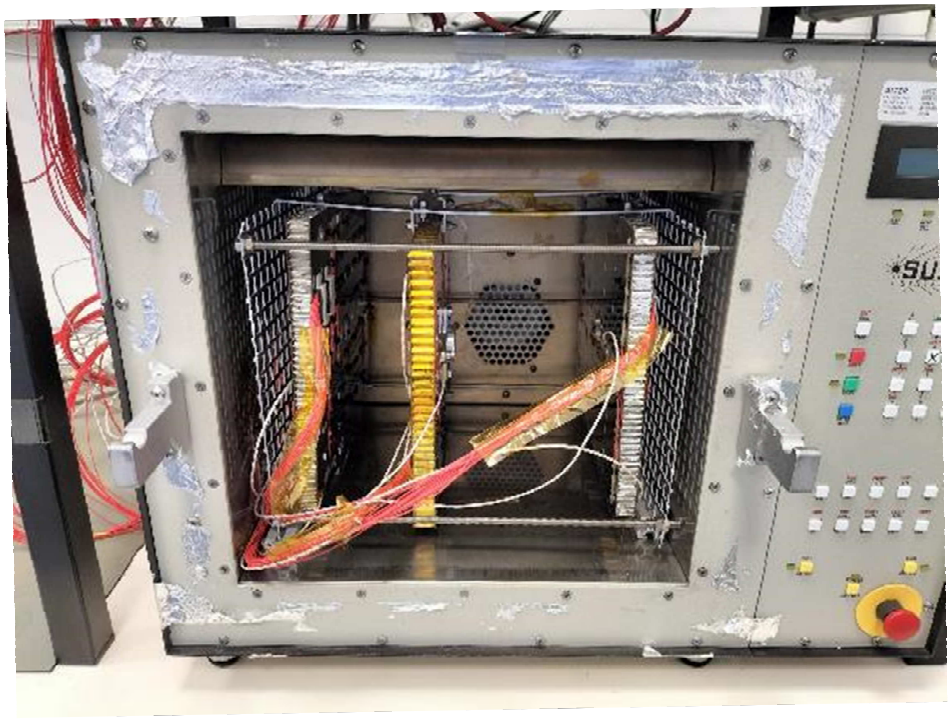
DVT coupons designs

Test sequence

DVT Coupons in the way to reach thousands of thermal cycles:

Sequence:

- Bakeout 24h at **+125°C**
- TVAC 10 cycles, **-142°C to +135°C**
- APTC 11,105 cycles, **-120°C to +125°C**
- TVAC 10 cycles**, -142°C to +157°C**



DVT coupons designs

Test sequence schedule

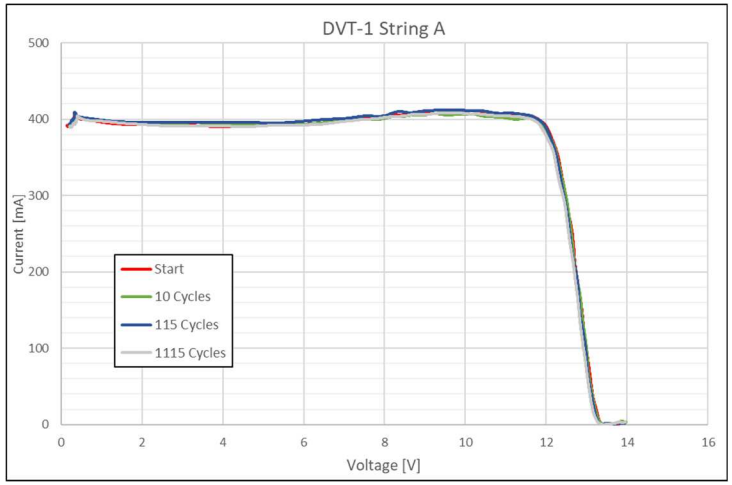
Block	Temp. [°C]	Cycles	Completion date/ estimated
Bake-Out + TVAC	-142, +135	10	Mar. 2023
Block 6: LEO 100 Cycles	-120, +125	115	May. 2023
Block 7: LEO 1,000 Cycles	-120, +125	1,115	Sep. 2023
Block 8.1: LEO 900 Cycles	-120, +125	2,015	Jan. 2024
Blocks 8.2 – 8.11: LEO 9,100 Cycles	-120, +125	11,115	Sep. 2024
Block 11: TVAC 10 Cycles	-142, +157	11,125	Oct. 2024

DVT coupons

Results

So far, so good:

- RTV-(2), a novel one (automated dosing)
- Novel priming method
- Automated cell string welding
- Solar Cells not damaged when placed over a substrate patch
- CFRP substrate layup and materials
- Titanium snubbers & Aluminium Inserts
- All EEE components except one bleed resistor
- Electrical Performance shows no power loss (less than 2%)



Performance opened to improvements:

- Film adhesive Solar Cells bonding → Cells broken but maintain strong adhesion
- Fast UV Curing adhesive → Detached all glue dots
- Cracks in conductive Adhesive → Grounding signal poor
- Bleed Resistor → Component failure
- Possible delamination in one aluminum insert → Under investigation

Factory automation Solar cells inspection and welding

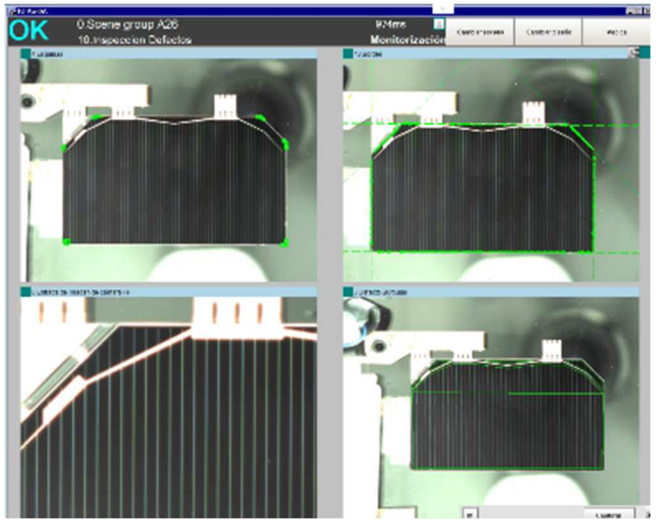
- Identification of defects and electroluminescence testing.

  Current capacity: 200,000 cells per year. Four different cell types.

- Automated Welding: 117,000 cells/ year current capacity.

  198,000 cells/year. Improvement with two welding heads

  270,000 cells/year. Improvement with three welding heads

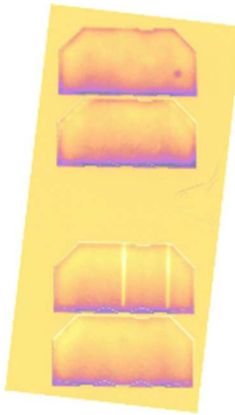


DVT coupons

Planning

Plans, most of them in 2024:

- ESD test qualification campaign in progress.
- New robust solar cells bonding process qualified.
- Commissioning automated cell welding process: increasing capacity and reliability.
- Automatic bonding cells process based on automated Pick&Place process (in progress, forecast Q1 2025)
- Targeted 30,000 thermal cycles in DVTs, five years in LEO,
- Reviewing performances, new materials, and processes.
- Thermal cycling campaign for GEO missions is almost finished.
- New in-house environmental testing capabilities: TVAC and APTC chamber.



DHV Technology

www.dhvtechnology.com

CONTACT

Ismael Sánchez
(Head of Product Development)
i.sanchez@dhvtechnology.com

Vicente Díaz
(Managing Director & Co-Founder)
v.diaz@dhvtechnology.com

ADDRESS

C/ Severo Ochoa 13
Tech Park of Andalusia
29590 Malaga (SPAIN)