GANOMIC

EPIC Worshop

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CONSORTIUM & PROJECT INTRODUCTION

- GaN in One Module Integrated Converter

CONSORTIUM WORK PACKAGE

WP1- Consortium Management
WP2- Requirement ,plans, exploitation and dissemination

WP3-High Frequency Resonant Soft-Switching Isolated 7.5kW Converter

SAFRAN, Ampere, LN2, cnrs

WP4- Digital command & SW integration

SAFRAN

WP5-3D Embedding structure & packaging

SAFRAN, TU berlin

WP6- 7.5kW Breadboard anode module PPU integration & tests

SAFRAN, SITAEL

MAIN OBJECTIVES

1. Improvement of power performances (power level and power by weight) : **Single 7.5 kW building block power module.**

2. High output voltage management : **up to 600V.**

3. Modularity and configurability : **Generic Anode discharge power module with Software digital robust & adaptive control loops.**

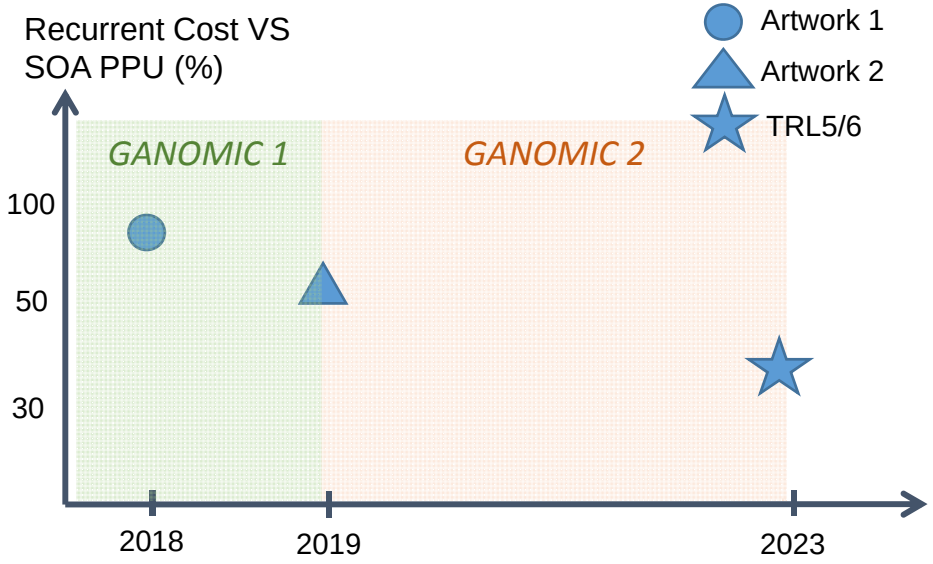
4. Shrink cost: **recurrent cost divided by 3 (at PPU level).**

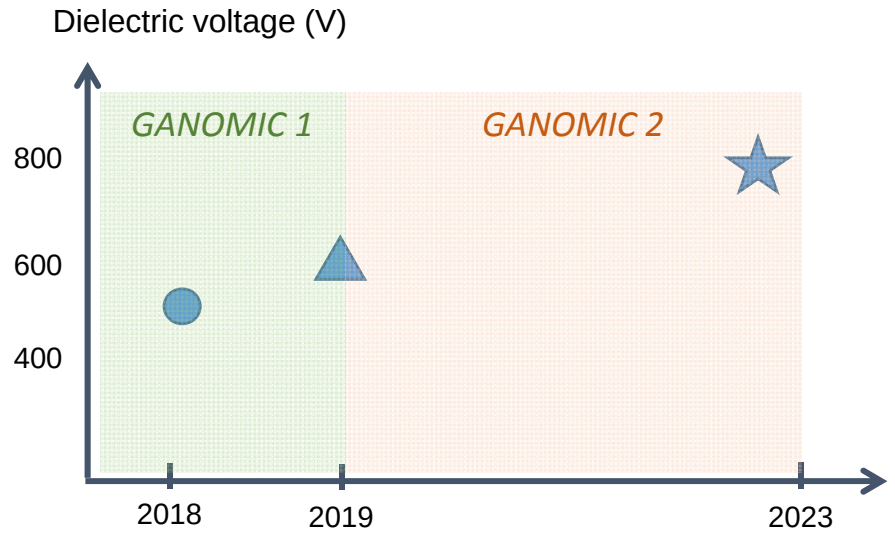
Key design drivers of anode module

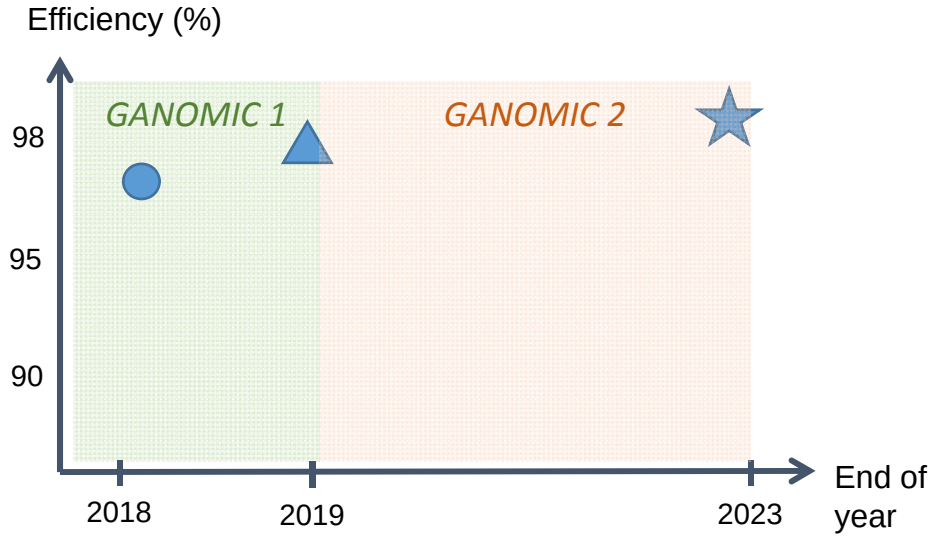
Efficiency > 98% (ie < 150W @ 7.5kW)	• New converter topology • Advanced modulation control for soft-swiching • New planar transformer architecture
Power density > 2kW/kg*	• GaN transistors (primary & secondary) • High switching frequency (>500kHz) • PCB embedded packaging technology
High dielectric voltage > 600V	• PCB embedded packaging technology • New planar transformer architecture • New ceramic capacitors dielectric material
Cost divided by 3 at PPU level	• Reduced Bill of material • Full digital integration of all control loops • PCB embedded packaging technology

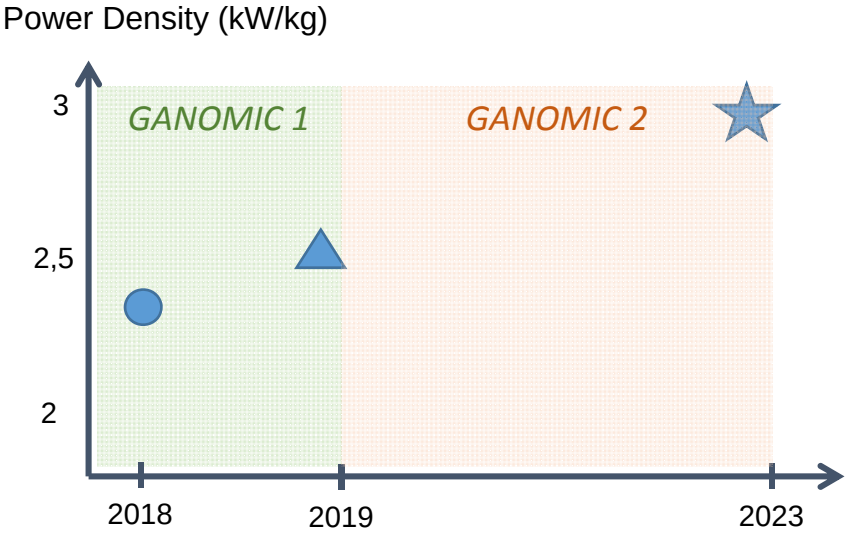
** baseplate, Input & Output Filters included*

KDDs progress





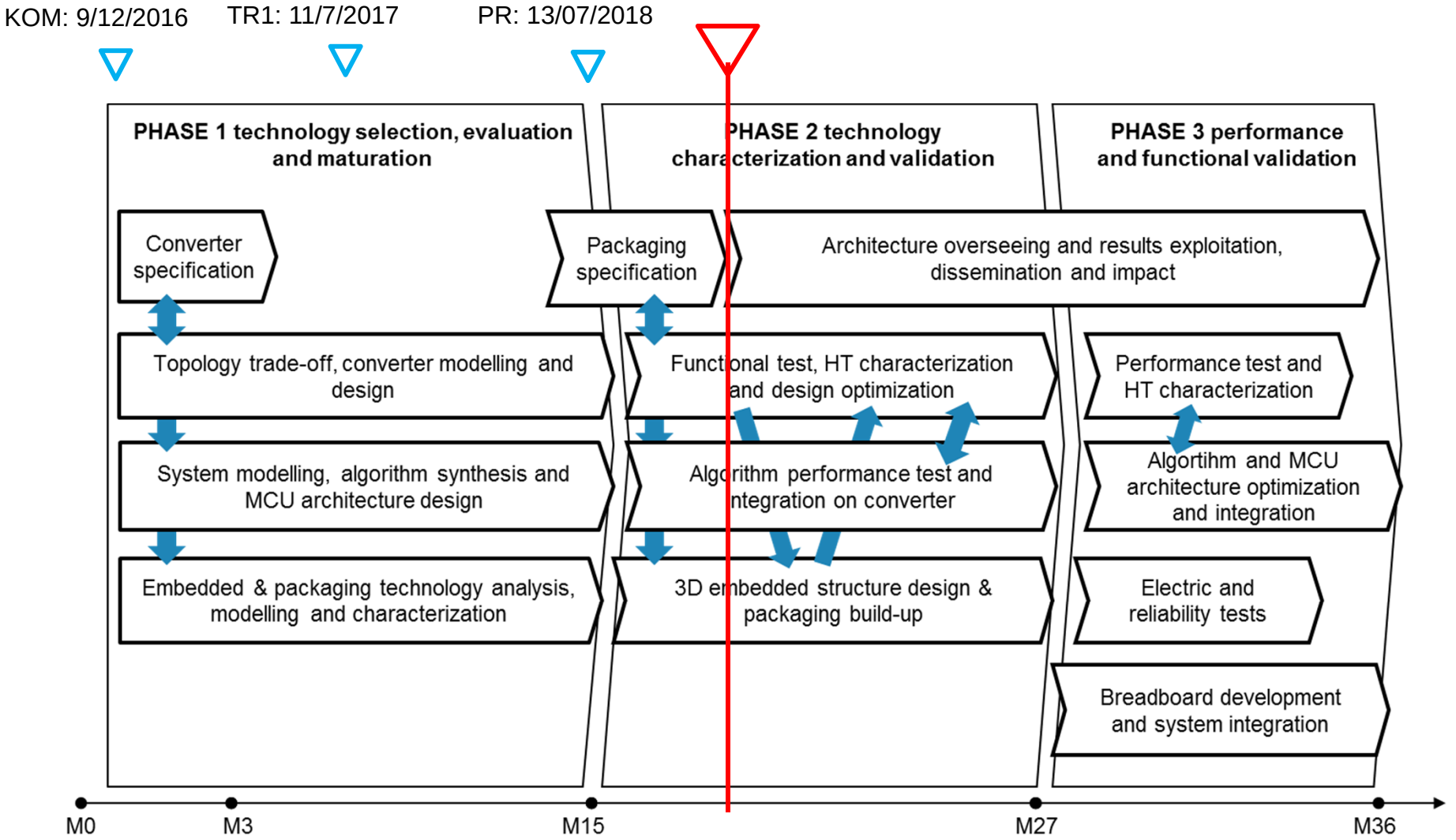




KEY TECHNOLOGY ROADMAP

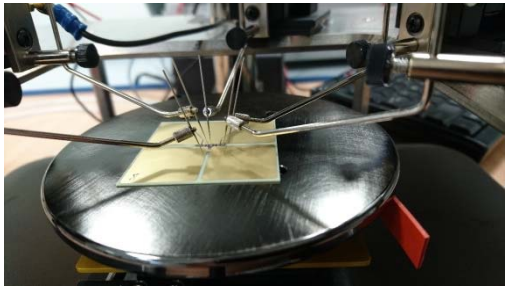
Individual technologies	State of the art starting TRL			estimated Starting TRL for GaNOMIC / space application	GaNOMIC PROJECT	target TRL by end of GaNOMIC 2019
	2016 TRL	Domain	justification			
High power resonant topology High frequency soft-switching power converters	4	Aeronautics	Sagem/ UCBL AMPERE Road Map lab Démonstrator running successfully at lower power	3.5 due to higher targeted power and voltage dynamic targeted	Fine topology selection, efficiency >98%, high power validation, voltage dynamic range of 3 validation validation of magnetic device	5
GaN switches	4	Aeronautics - Automotive- Industrie research lab	Lab proto up to 3kW	3 .5 due to higher targeted power and no yet proved integrated gate driver and GaN transistor system for safe operation of GaN devices at high switching frequency	High power (7,5kw) and safe Driver- GaN transitor implementation, GaN component with target perf Voltage > 400V, I >60A	5
Digital control and command integration	3	research lab	Sagem on going thesis somes principles already working on breadbord	3.5 Will benefits of Sagem on going thesis work (1 year work at the beginning of GaNOMICS)	development and implementation of digital regulation control algorithm, demonstration of perf, robustness and flexibility	5
3D embedded structure and packaging	4	research lab	already existing breadboard 600V 50kw running at TU Lab	4 but some additional technologies are TRL 3 (hermetic sealing, high frequency & skin effect, voltage above 600V)	Hermetic sealing, voltage 1,5kV, high frequency switching, high frequency, high current planar transformer	5
Full embeded 7,5 kw module with the herabove technolgies					V&V test on final BBM	5 & 6 for functional and electric

SCHEDULE & PROGRESS

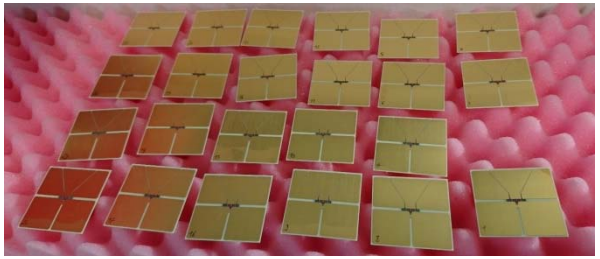


CURRENT RESULTS

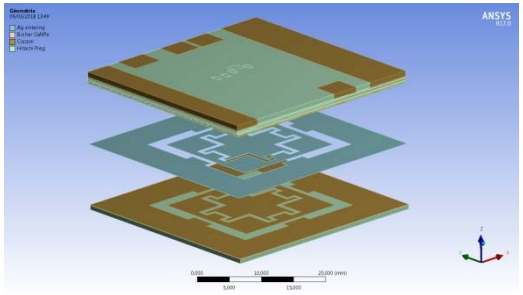
- **Electrical characterization of embedded power GaN transistors in PCB and mock-up converters parts.**
- **4kW anode module Converter design and electrical & thermal modelling completed.**
- **Embedded power boards with power circuit & drive in manufacturing.**
- **Processing ressources evaluation of robust control algorithm software implementation.**



Electrical test on B1505 test bench



Test Vehicles of embedding GS66516T



3D embedding power block layout

THANK YOU