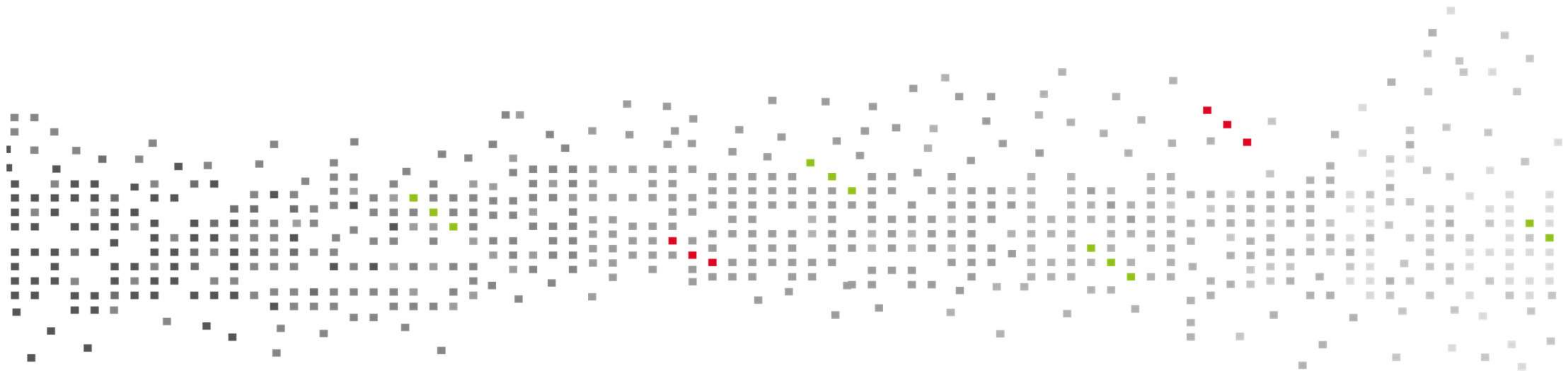
leti
cea tech



# TECHNOLOGY PLATFORM : OUTLOOK & CAPABILITY

SEMICONWEST 2019 - FRAUNHOFER LETI WORKSHOP

July 2019 | L CLAVELIER - L PAIN

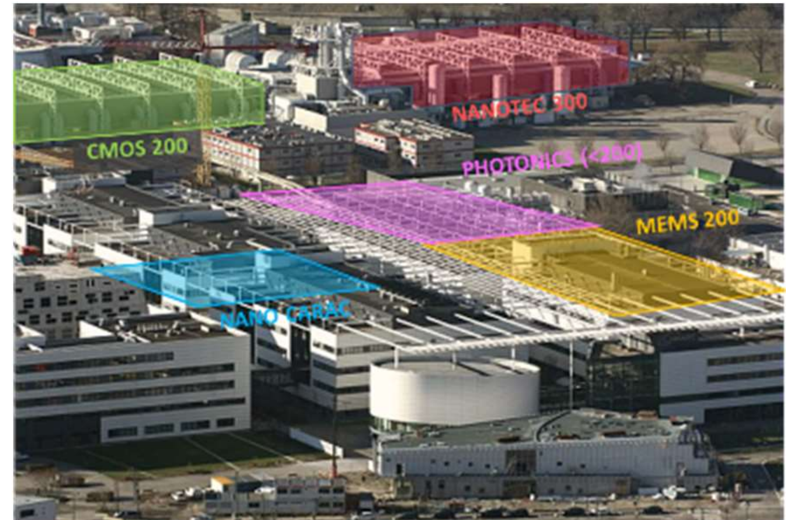
# ABOUT THE MICRO, NANO-ELECTRONICS & PHOTONICS PLATFORMS

- **300mm & 200mm Si components Platforms**
  - **~270**@200mm equipments
  - **~105**@300mm equipments
  - 5600 square meters Cleanroom - ISO3-5
  - 24/7 operations

- **200mm MEMS Platform**
  - **~130**@200 mm equipments
  - 2200 square meters - ISO 4-5
  - 24/7 operations

- **Substrates <200 mm, III-V and II-VI Platform**
  - **~230** @ various diameter equipments
  - 1000+1000 square meters - ISO 4-5
  - 1shift/day

- **Nano-CHARACTERIZATION Platform**
  - **~ 40** huge equipments
  - 2200 square meters
  - 8 centers of competences




**PLATFORM ID CARD :**

- >700 equipments on 10000m2 of clean room >500 talented people including international experts
- >150 scientific papers published in 2018
- ~40 patents filed in 2018
- 7/24 operations

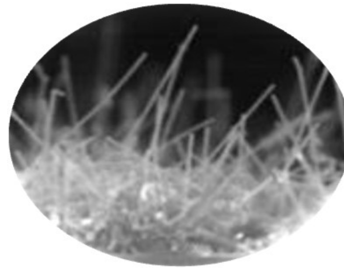
# OUR COLLABORATION OFFER

**New products & applications**

- Collaboration thru LETI's Silicon Product Divisions (DCOS, DOPT, DTBS)

**Mature Processes & Technologies**

- Wafer service thru LETI 3S (Silicon Specialties Solutions)
- IP licensing
- Technology Transfer



**New Materials & Process Development**

- Collaborative bilateral research on specific project
- Common laboratories
- Affiliation program

**New Equipment Engineering**

- Specific Joint Development Program

## A full range of business models to meet our partner's needs

leti
cea tech

# <200mm, 200mm & 300mm PLATFORMS

300mm
1. Imager
2. µController/eNVM
3. Photonic on Si
4. 3D Integration
5. FDSOI & Quantuum
6. SOI substrates

200mm
1. Power GaN and RF
2. Sensor
3. Display
4. Lighting
5. Photonic on Si
6. 3D Integration
7. SOI substrates

< 200mm
1. II-VI material
2. II-VI componants
3. III-V material
4. III-V components
5. X-OI substrates

# EVOLUTION OF THE 300mm TOOL SET

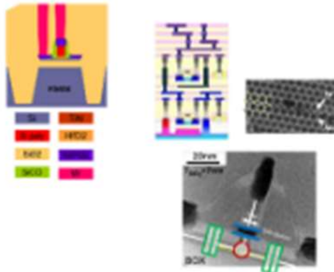
| Scatterometry ASML Yieldstar | Scanner ASML NXT | Track SCREEN DUO | Scatterometry eKLA Archer 600 | Scrubber for thick Epi Si | Cluster DIEL3 filters / BEnd- AMAT Producer | Cluster DIEL2 FEnd AMAT Producer | Stripping FEnd MATTSON SUPREMA XP | TXRF + VPD RIGAKU V310 | Etching Imagers TEL TACTRAS VIGUS | Surfscan (SP3) KLA | Reactor PVD Ta/TaN AMAT pour Endura 300B |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 04- 2018 | 05- 2018 | 05- 2018 | 06- 2018 | 09- 2018 | 11- 2018 | 12 - 2018 | 02- 2019 | 02 - 2019 | 03 - 2019 | 04 - 2019 | 04 -2019 |
| Low Temperature epitaxy | Stripping Imagers DNS SU3100B | Contact etch/ Bevel deposition LAM Versys4 | multi-cathode PCRAM Chamber | CMP bevel | Colour filters track RGB TEL ACT12 | Inspection & Defectivity platform AMAT | Rsquare Measurement Napson | Molecular bonding | FIB / SEM | PLD piezo | CMP Cu BEOL / bonding |
| 08- 2019 | 09- 2019 | 09- 2019 | 09- 2019 | 09- 2019 | 10- 2019 | 11- 2019 | 12- 2019 | 03-2020 | 03-2020 | 03-2020 | 03-2020 |
| wet SiN etch | Cluster Diel1 FEND | Wet etch Si | Ellipsometer | | | | | | | | |
| 03-2020 | 10-2020 | 2021 | 2021 | | | | | | | | |

**→ State of the art 300mm line for FDSOI, Memories, imagers, photonic, substrats and 3D**

# 6 technological roads available in 300mm and more

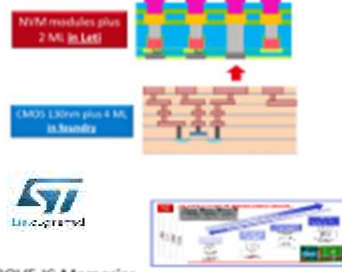
## Advanced Nano-Elec 300mm ROADS

### FDSOI – BEYOND CMOS



- Computing, low power, coolcube, ...
- 120 process step flow (short version)
- 8 levels of litho (and more)
- C28 compatible and lower

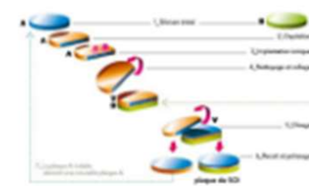
### MEMORIES




- ABOVE IC Memories
  - OXRAM
  - PCRAM
- 120 process step flow
- 9 levels of litho
- C28 compatible and lower

## Enablers

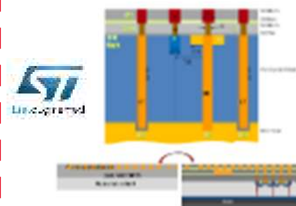
### SOI SUBSTRATES



- RFSOI, Imager SOI, Photonic/Power SOI, FDSOI
- 30 process step flow
- Prototping capability

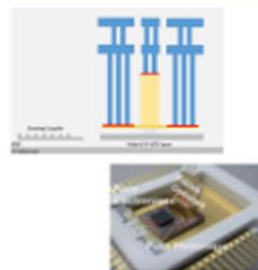
## OPTO 300mm ROADS

### VERTICAL IMAGERS



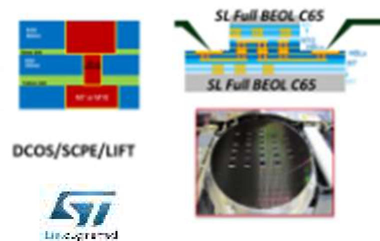
- Full CMOS compatible process
- Long range 3D imagers
- 120 process step flow
- 9 levels of litho

### PHOTONIC



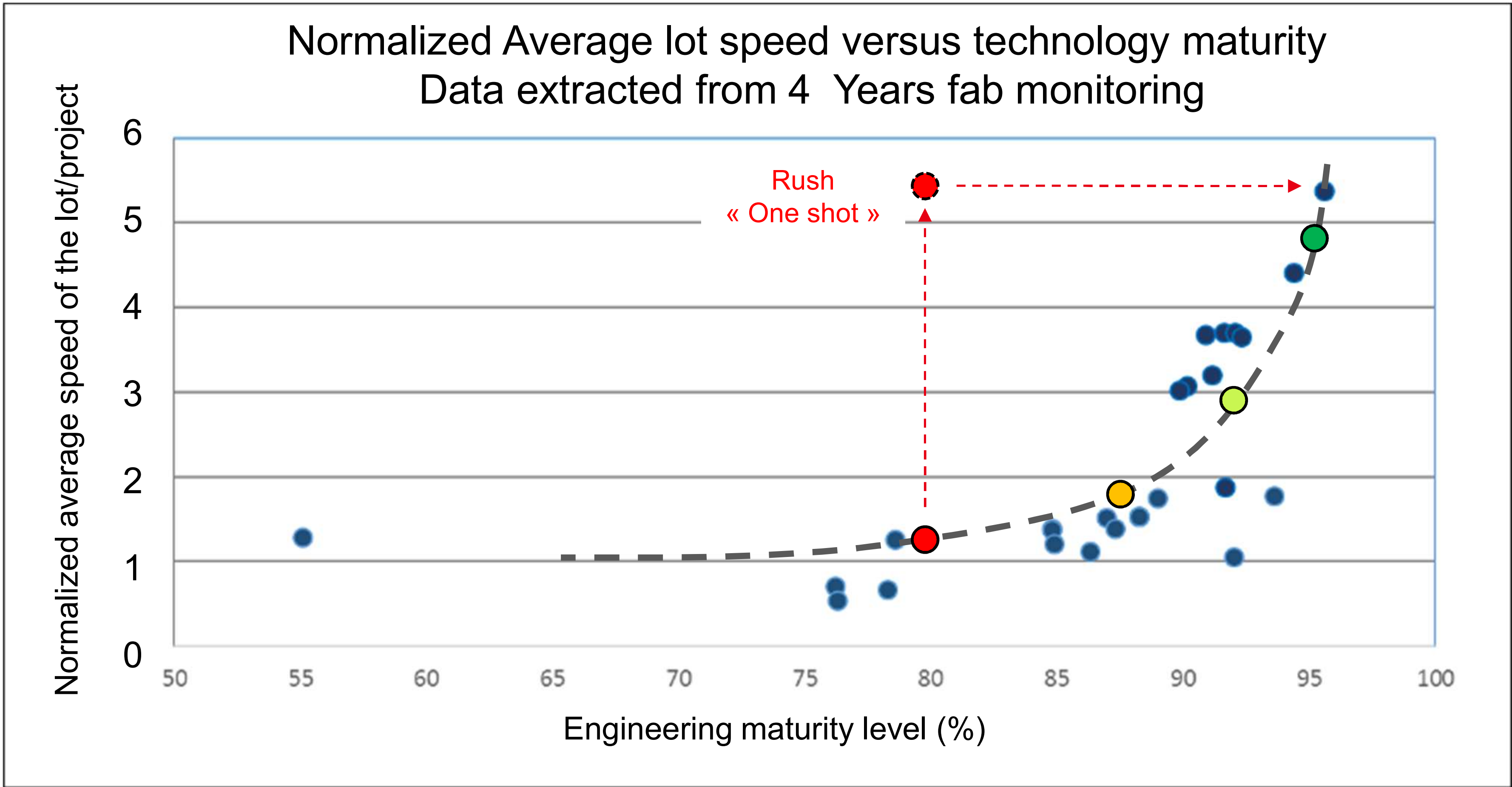
- Passive (WG, switchs, ...) and active (III-V)
- full CMOS compatible process
- Communication and HPC
- 150 process step flow
- 15 levels of litho

### 3D



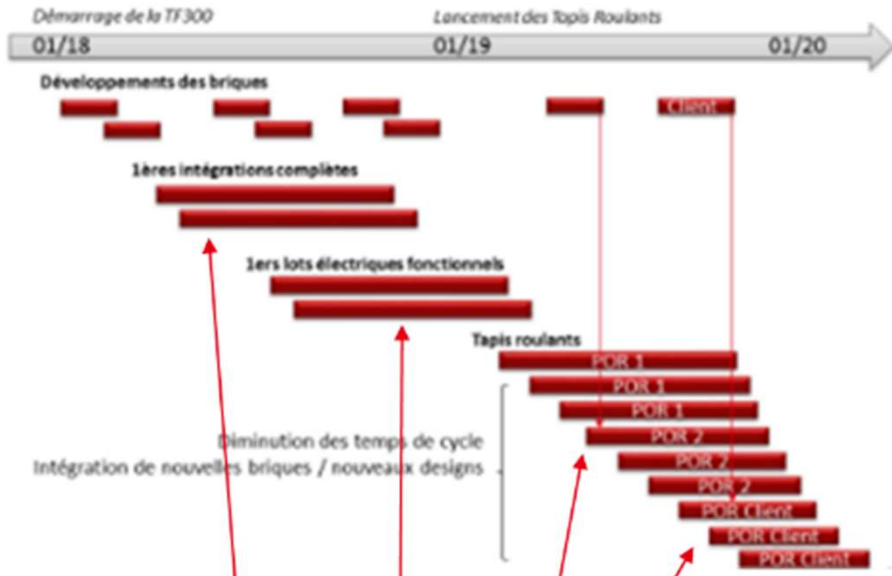

- Interposer, 3D SoC (→ computing, displays,...)
  - Hybrid bonding Cu-Ox
  - TSV 1:12 – 1:15
- 60 process step flow
- 4 levels of litho
- W2W (and C2W)

## FAB PERFORMANCE PLAN 2018-2020

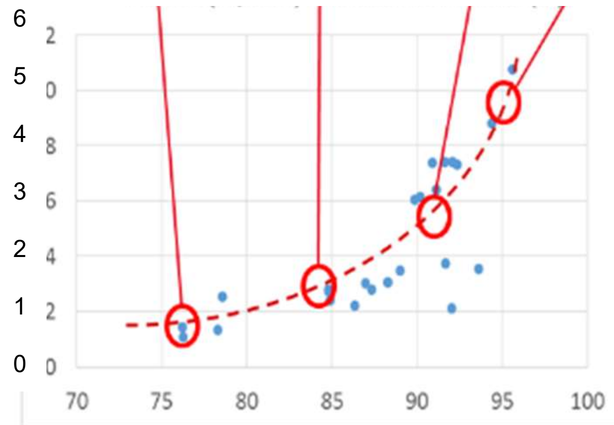



*Data measured on more than 400 lots -Year 2018*

# PERFORMANCE PLAN RAMP UP 2018-2020
# RECURRENT BATCH LAUNCH ON STABILIZED FLOWS




Lot speed (step/week) vs normalized maturity (%)




Engineering maturity level (%)

**Strengths of**
**Recurrent batches**
- Reduced engineering / lot (Eng mat > 93%)
- More lots with POR in WIP
- Reduced process steps (In line control)
- Improved cycle time

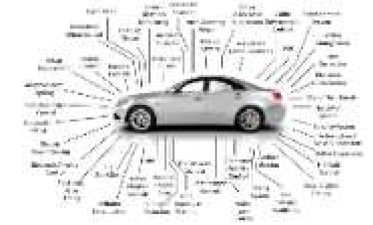
**Experienced on FDSOI : it works !**

**Approach compatible**
**for fast R&D cycle time**

**Already validated**
→ FDSOI baseline

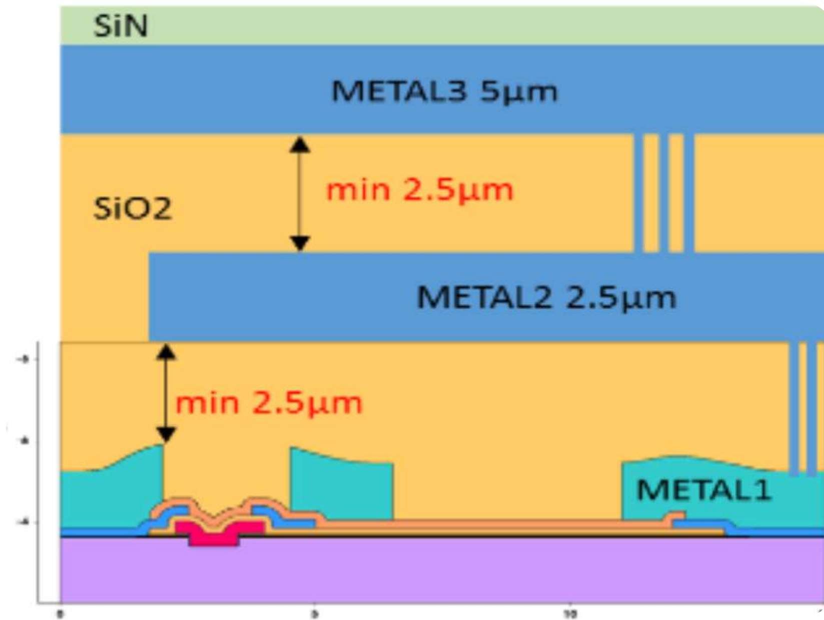
**Strategy deployed in 2019 on**
→ Photonic
→ Power device
→ Substrate
**Other to come in 2020**

# 200mm GaN : POWER DEVICES



**September 24th 2018**

## Base Line for GaN/Si MOS and Diodes



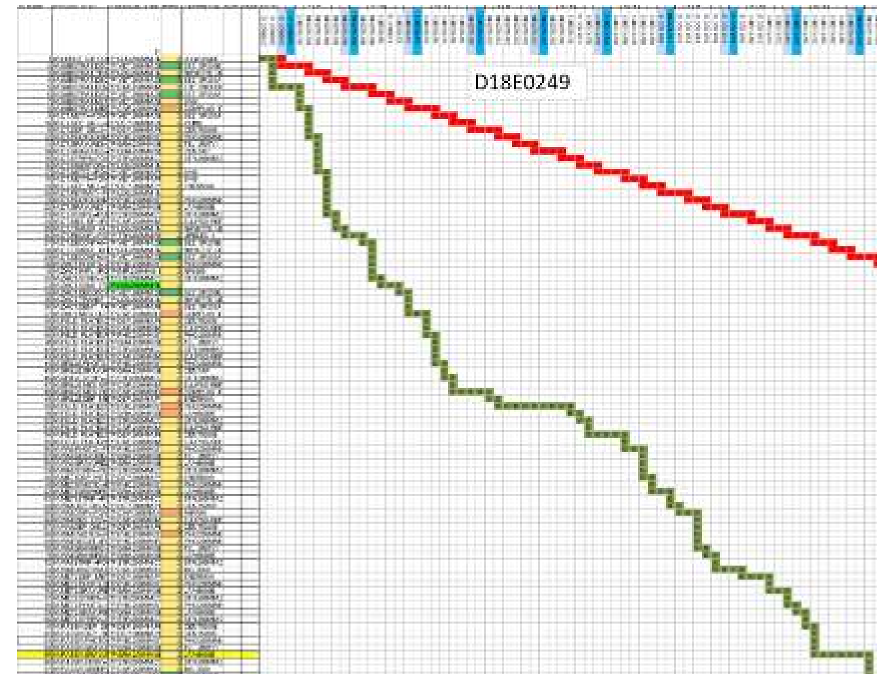

### ST and Leti to make GaN-on-Si power transistors

STMicroelectronics to manufacture GaN-on-Si power transistors, based on a process developed by French research lab Leti, ST and IRT Nanoelec.

The process will be transferred from Leti's 200mm R&D line to an ST-operated 200mm-wafer pilot-line, operational by 2020, which will allow ST to address high-efficiency, high-

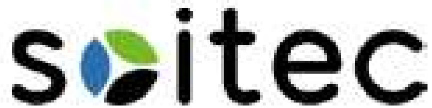
# PERFORMANCE PLAN 2018-2020

POWER-GaN base line example with ST




**10 step/w in average → 9-10 week cycle time**
**with recurrent batches approach implemented**
**Full compatible with MPW approach**

# 100-300mm SUBSTRATES PROTOTYPING LINE WITH SOITEC



**R&D comon lab**

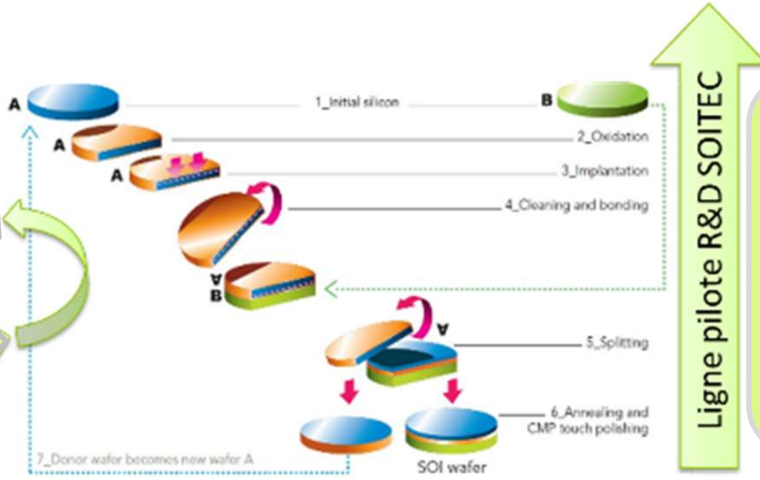
Derivatives techno blocks

Epitaxy trap rich : Functionalization

Thick top Si

Thick BOX bonding

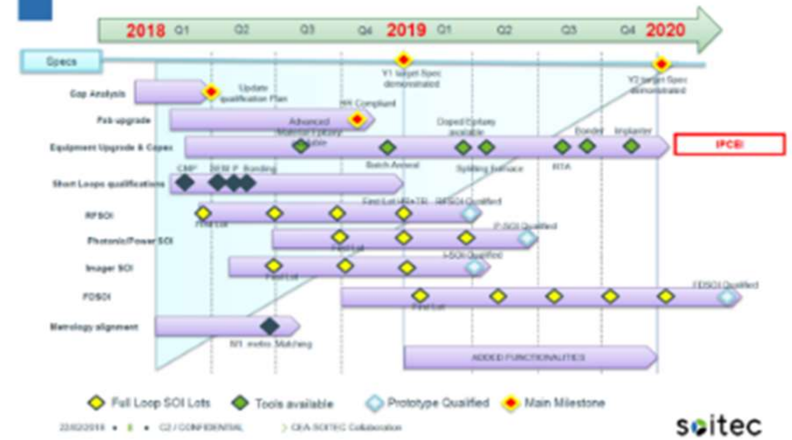
Disruptive finishing & uniformities




**1 – R&D technology modules validation**

**2 – Prototyping possibility**

**3 – Acceleration & transfer to SOITEC for large scale ramp up**



# A WORLDWIDE ECOSYSTEM FOR COMPONENTS MANUFACTURING

Equipment

Electronics

Energy

Communication
5G, RF

# A COMPLETE SYNERGIE AT EUROPEAN LEVEL

R&D EU platforms

- Large structure projects
- European projects
- Back-up solutions
- New applications

leti
cea tech

# CONCLUSIONS

- State of the art 100-200-300mm tool set & technologies in « one stop shop »
- From R&D to Instsutrial Transfer thanks to Highly skilled teams comming from both words
- Full compatible with all Fab requirements (flying wafers)
- Access to the SOITEC-CEA « substrate innovation center »
- Access to
  - Specific device developments for your needs

  or
  - Access to our recurent batches (MPW, tool and material assessment)
    - FDSOI CMOS and cool cube
    - R-RAM memories
    - GaN power devices
    - Substrates (Substrate Innovation Center)
    - III-V photonic on Si
    - 3D
    - …
- Confidentiality managment & IP protection