Taiwan Power Semi Foundry Outlook

Phoenix Silicon International (8028.TT) Aug. 2019

Safe Harbor Notice

- Psi's statements of its current expectations are forward-looking statements subject to significant risks and uncertainties and actual results may differ materially from those contained in the forward-looking statements.

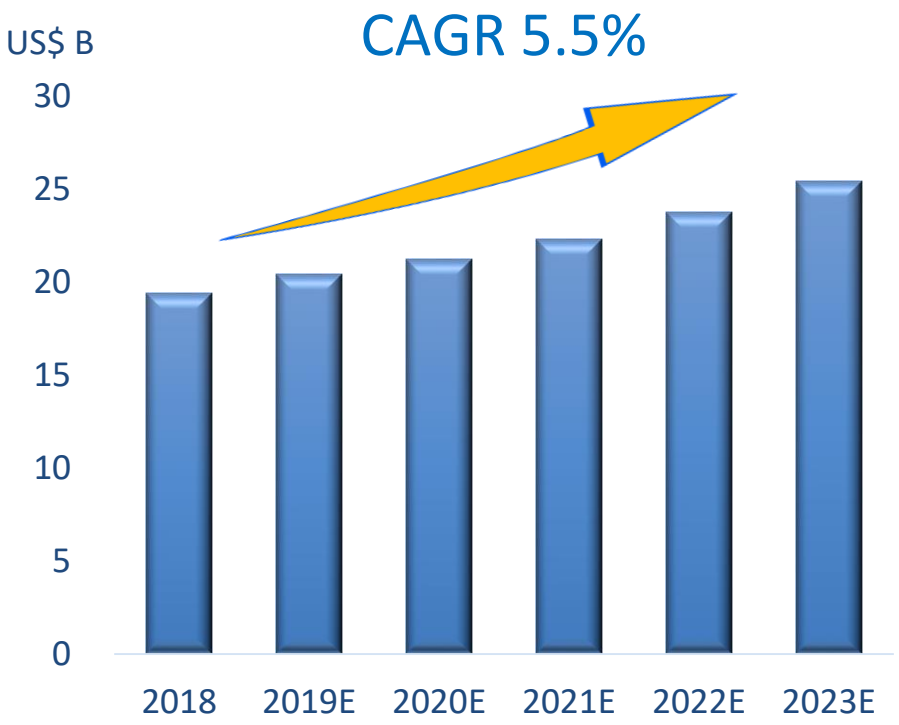
- Information as to those factors that could cause actual results to vary can be found in PSI's Annual or Quarterly Report filed with Taiwan Stock Exchange Corporation (TWSE) and such other documents as PSI may file with, or submit to the TWSE from time to time.

- Except as required by law, we undertake no obligation to update any forward-looking statement, whether as a result of new information, future events, or otherwise.

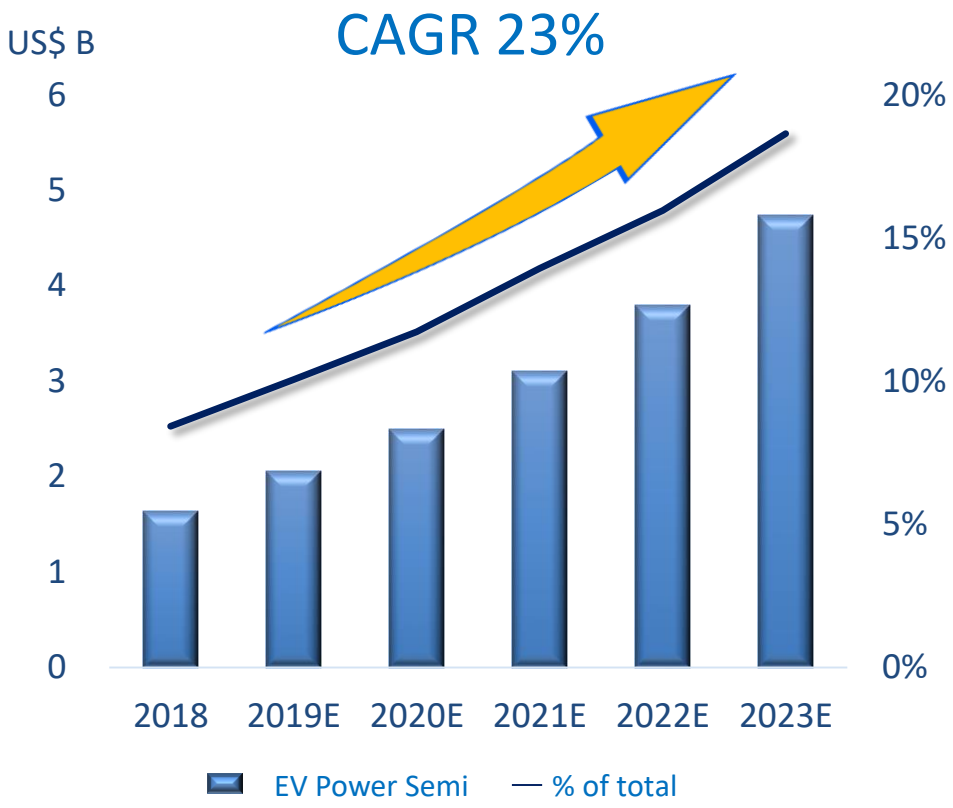
Power Semi Drivers

EVs, The Major Driver

Power Semi Market Size

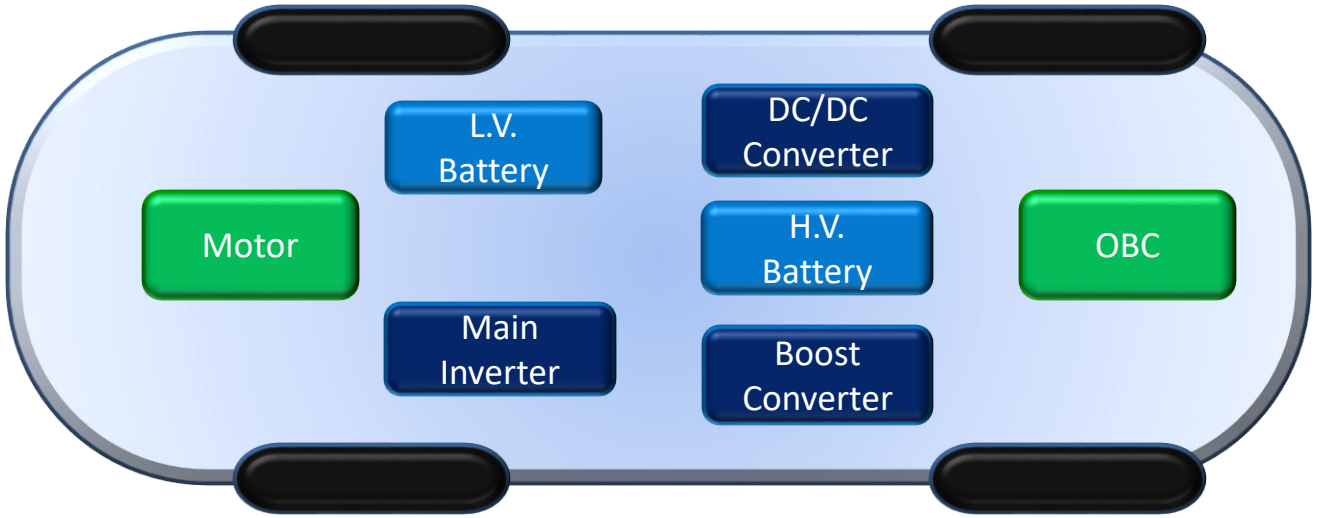


Source: IHS, YOLE and Bernstein



Source: YOLE and Bernstein

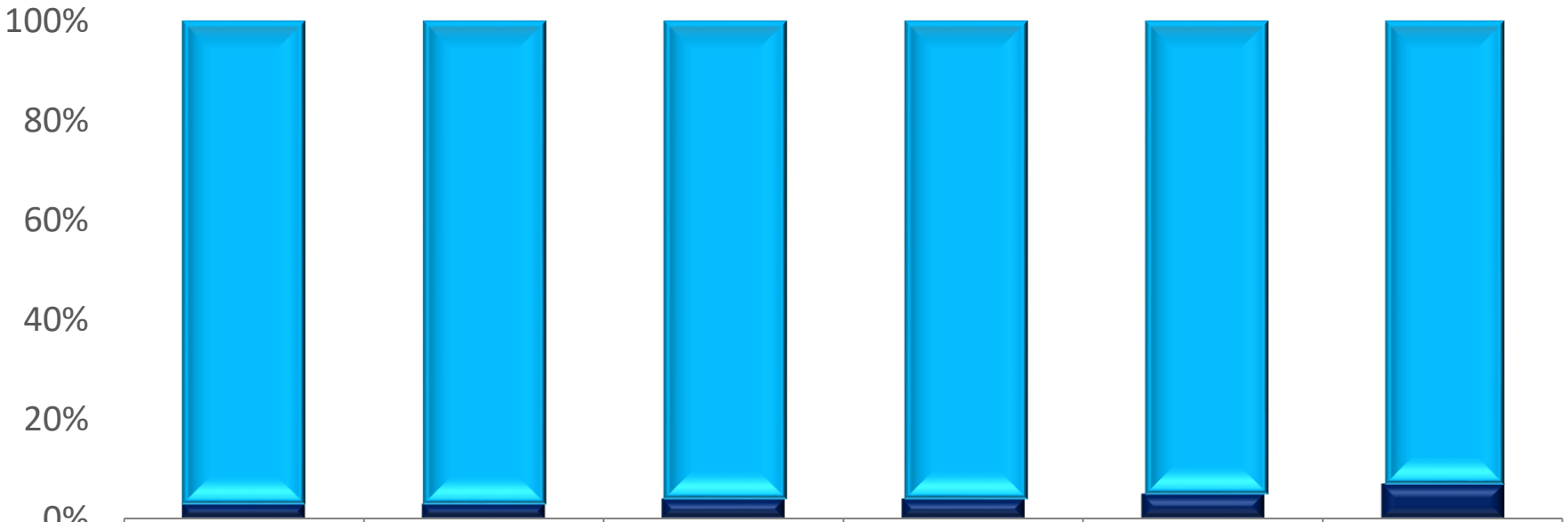
Power Semi, The Heart of EV



Converters	MHEV	FHEV	PHEV	BEV	High-end BEV
DC/DC converter LV-HV	6 MOSFETs: 1.5 – 4 KW				6 MOSFETs: 1.5- 4 KW
Main Inverter (+Boost Converter Option)	6 LV MOSFETs: 5 – 20 KW	6 IGBTs(+2IGBTs): 40 – 120 KW		6 IGBTs: 60 – 150KW	6 or 12 IGBTs: 250 – 600 KW
Generator		6 IGBTs: 20/50 KW			
OBC			6 MOSFETs: 1.8 – 7.2 KW 6 IGBTs: 10 – 20 KW		

Source: YOLE

Si Still Dominates Power Semi Market



	2018	2019	2020	2021	2022	2023
Si	97%	97%	96%	96%	95%	93%
SiC	3%	3%	4%	4%	5%	7%

Source: YOLE

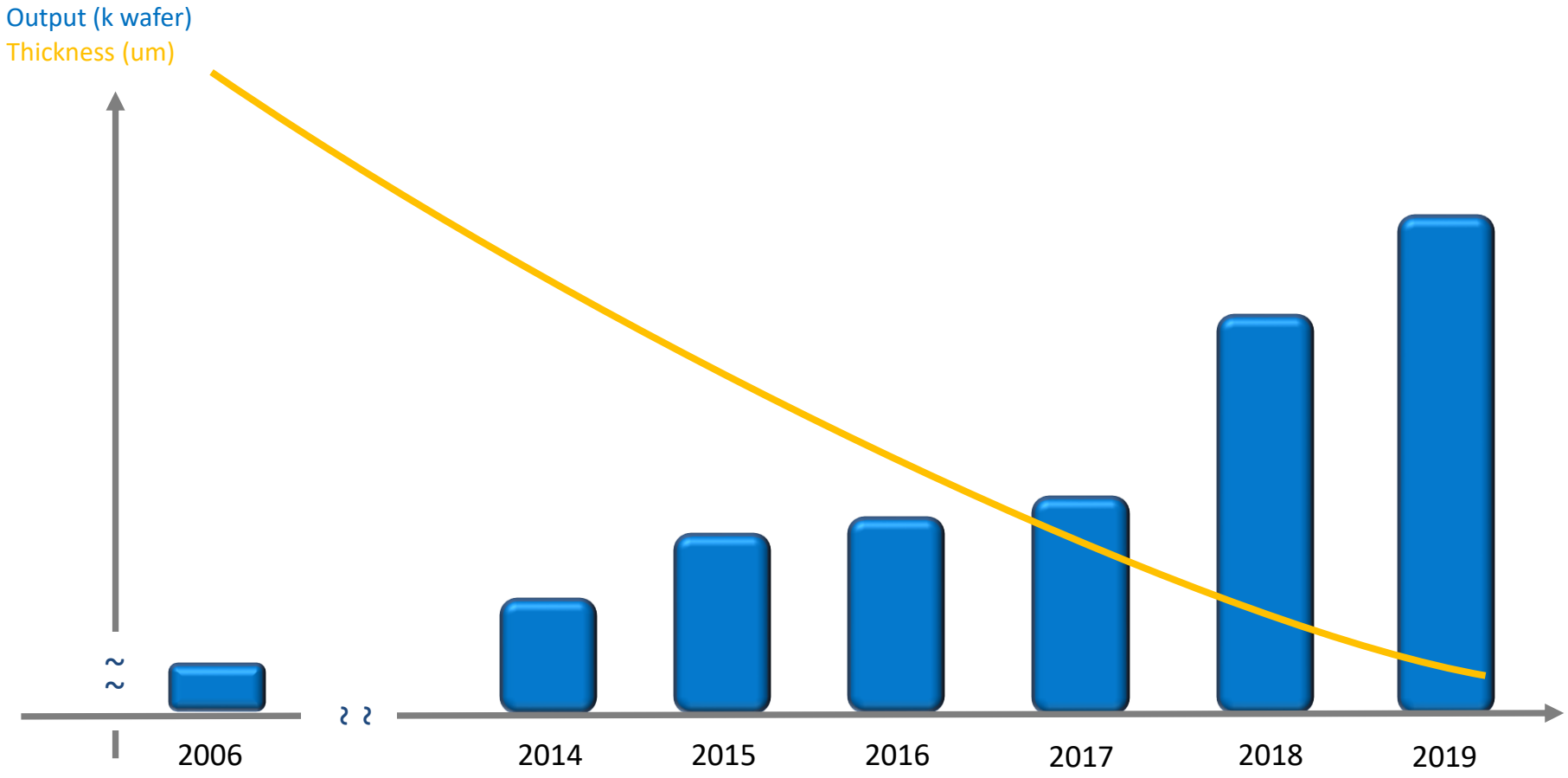
*Power IC not included

Supply Chain Maturity

TW MOSFET Supply Chain – Mature

Fabless	SUBSTRATE + EPI	FEOL	MEOL	BEOL
APEC	WAFER WORKS	TMSC	PSI	GTBF
Niko-Sem	GlobalWafers	UMC	UMC	GEM
Sinopower	Episil-Precision	VIS	Maxchip	
Inergy Tech.		Maxchip	MMEC	
Chip integration		Episil(6”)	Chipbond	
Excelliance Mos		Mosel(6”)	MSEC	
PFC Device			IST	
Force MOS				

PSI Participating MOSFET Growth Path



Source: Psi

- Output: increasing 3X, CAGR: 20%
- Expending Thin Wafer Process category: FSM, BGBM, CP
- Wafer Thickness: 250um ➔ 50um Taiko
- Tier 1 customer, Auto graded validated

Successful Factors of MOSFET MEOL Foundry

Yield
is the most basic thing

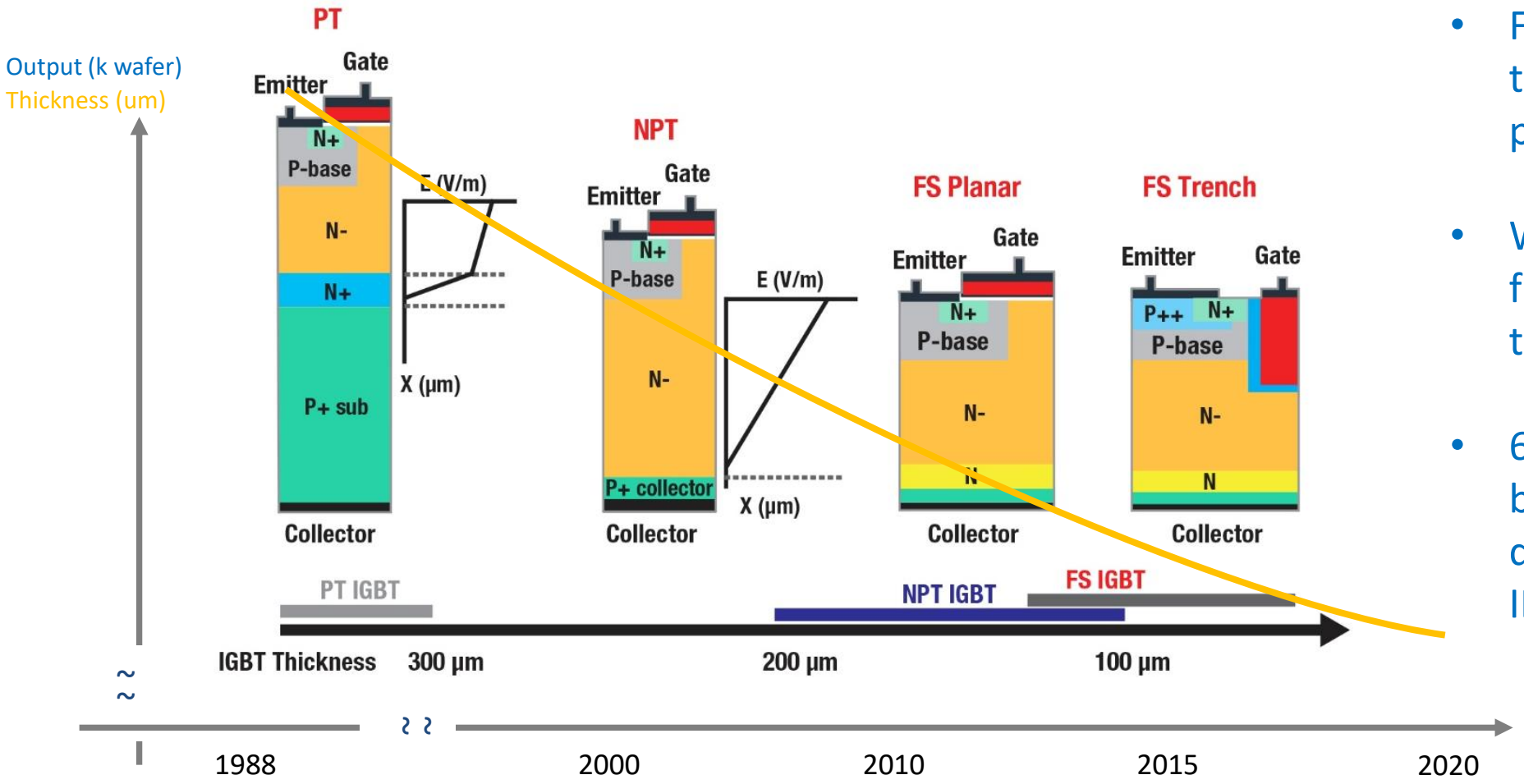
Market share
means competiveness

Roadmaps & IP
lead to the future

TW IGBT Supply Chain - Toddler

Fabless	SUBSTRATE + EPI	FEOL	MEOL	BEOL
A	WAFER WORKS	D	PSI	I
B	GlobalWafers	E	H	
C	Episil-Precision	F		
		G(6”)		

PSI Enabling FS-IGBT Supply Chain

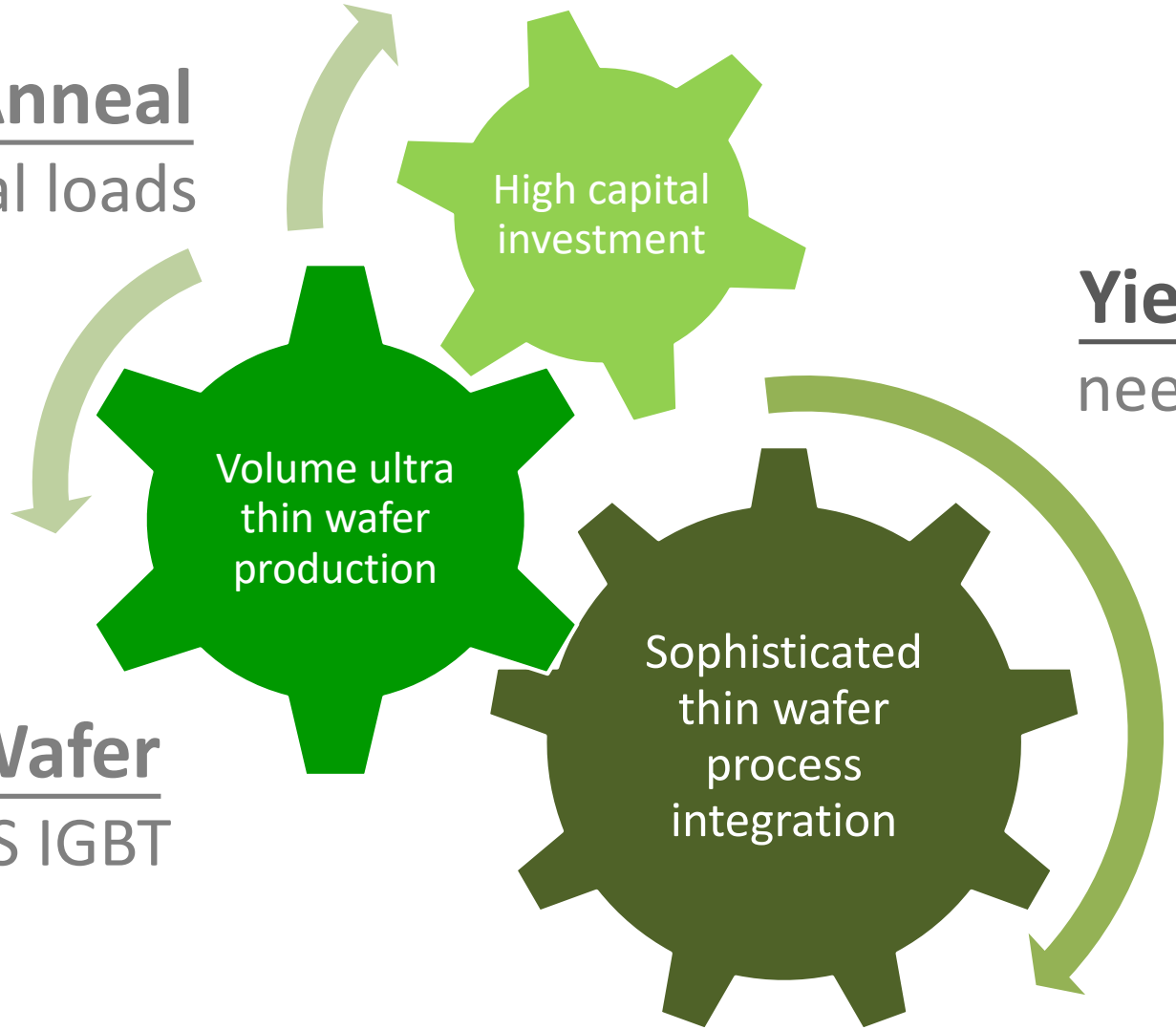


- Field Stop Trench is the main stream IGBT process
- Wafer Thickness down from 250um (PT/NPT) to 50um Taiko (FS)
- 6”/8” wafer stay now but 12” wafer developing by leading IDM

Source: Yole

More Barriers For IGBT Beyond MOSFET

Implanter/Anneal
are high capital loads



Yield & Quality
need one level up

Taiko Thin Wafer
is a must for FS IGBT

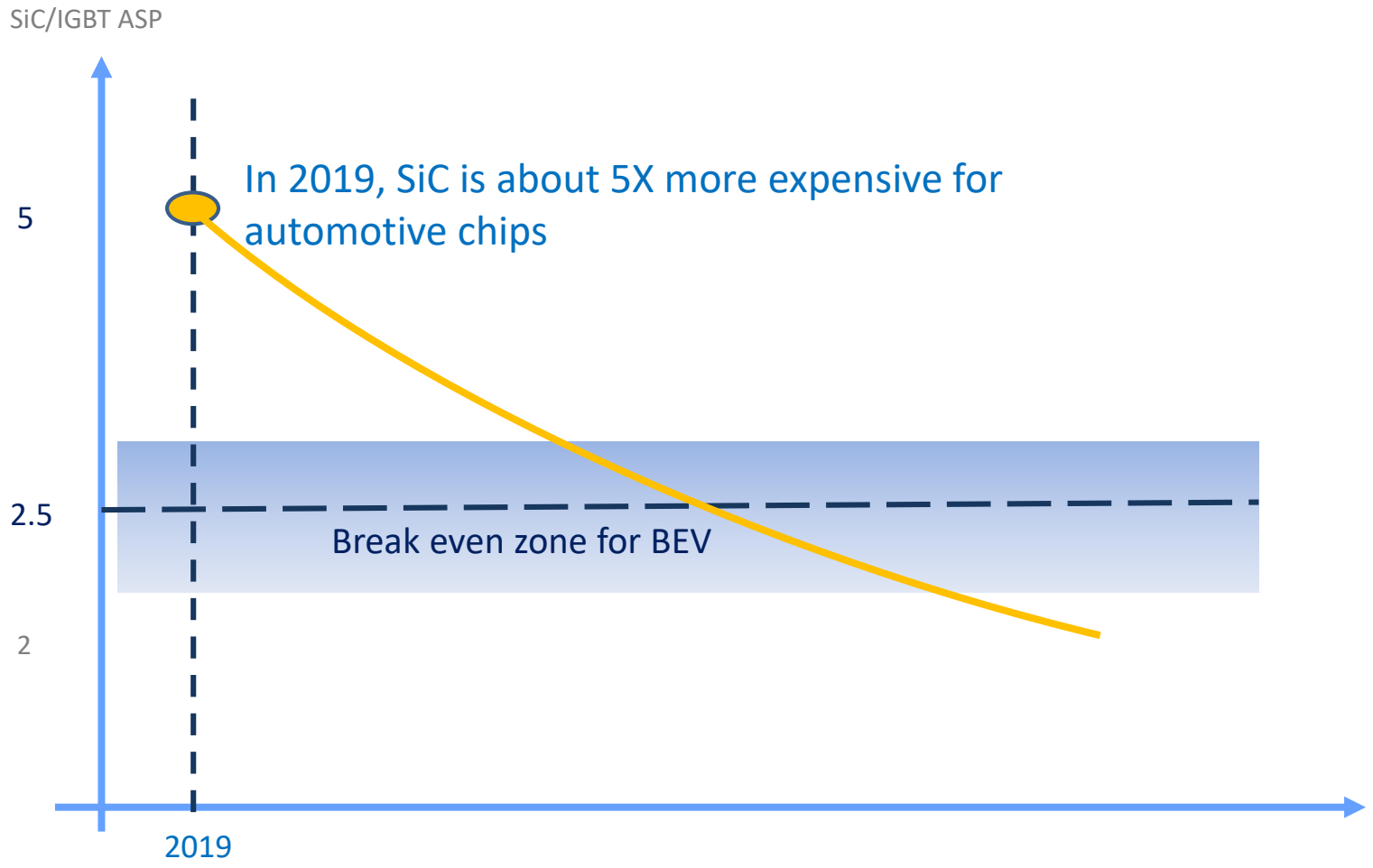
TW Power SiC Supply Chain - Infant

Fabless	SUBSTRATE + EPI	FEOL	MEOL	BEOL
A	GlobalWafers	B	PSI	
	Episil-Precision			

?

Source: YOLE

PSI Researching SiC Materials Cost Down

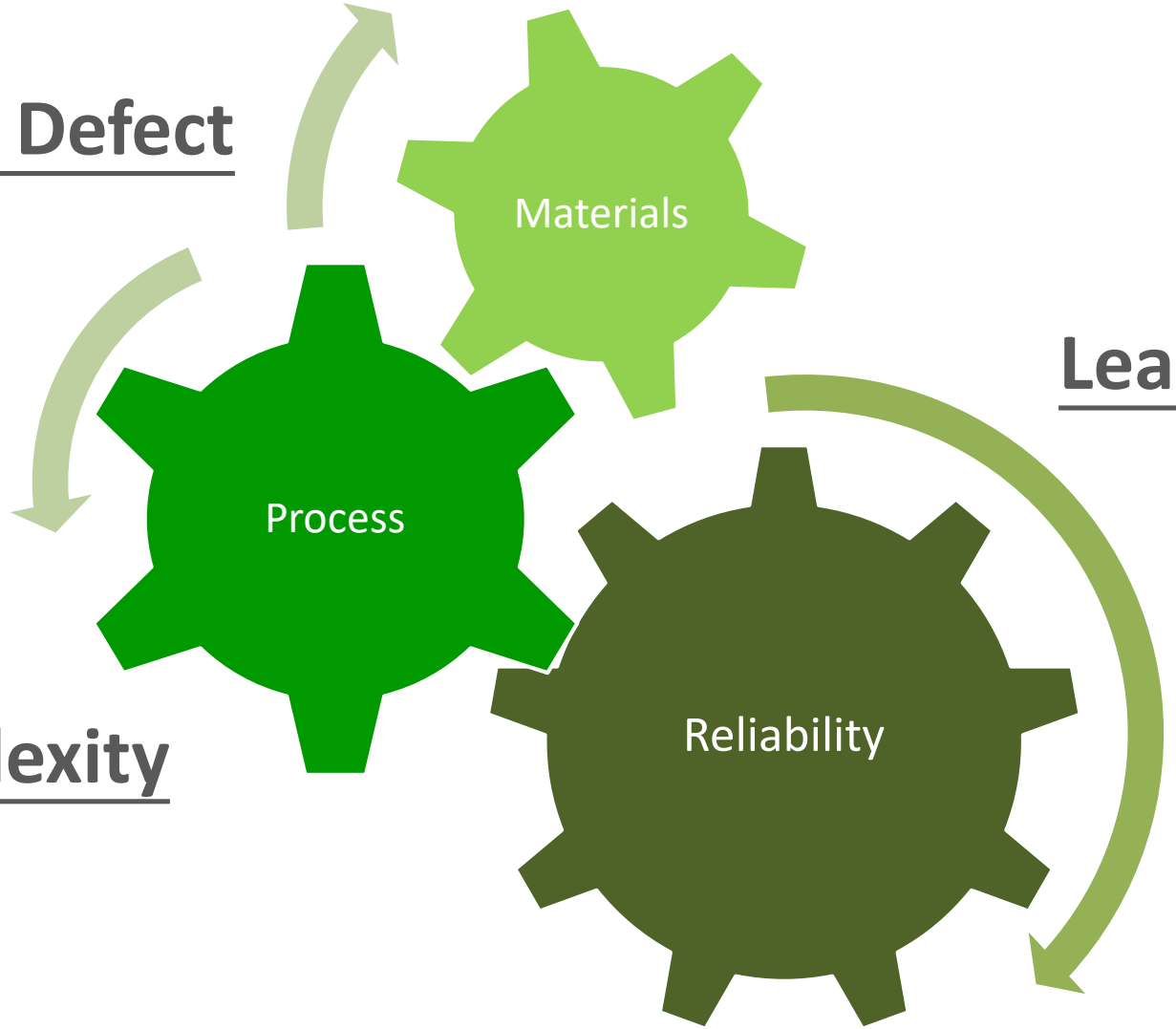


Source: YOLE

- Low SiC EPI yield rate due to SiC crystal wafer
- Major demand comes from EV for lower pack size and high power efficiency
- 4”/6” wafer stay now but 8” wafer developing by leading IDM

What Can/Will We Do in SiC?

SiC Crystal/EPI Defect

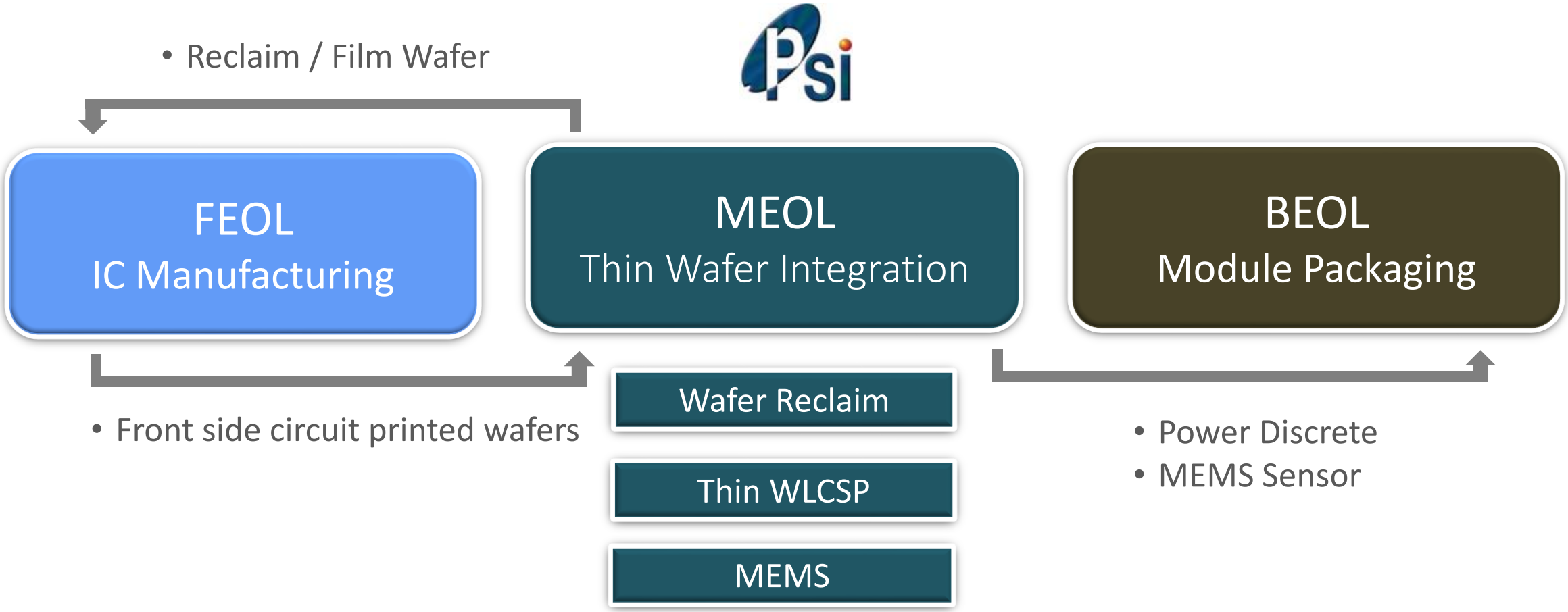


Learning Cycle

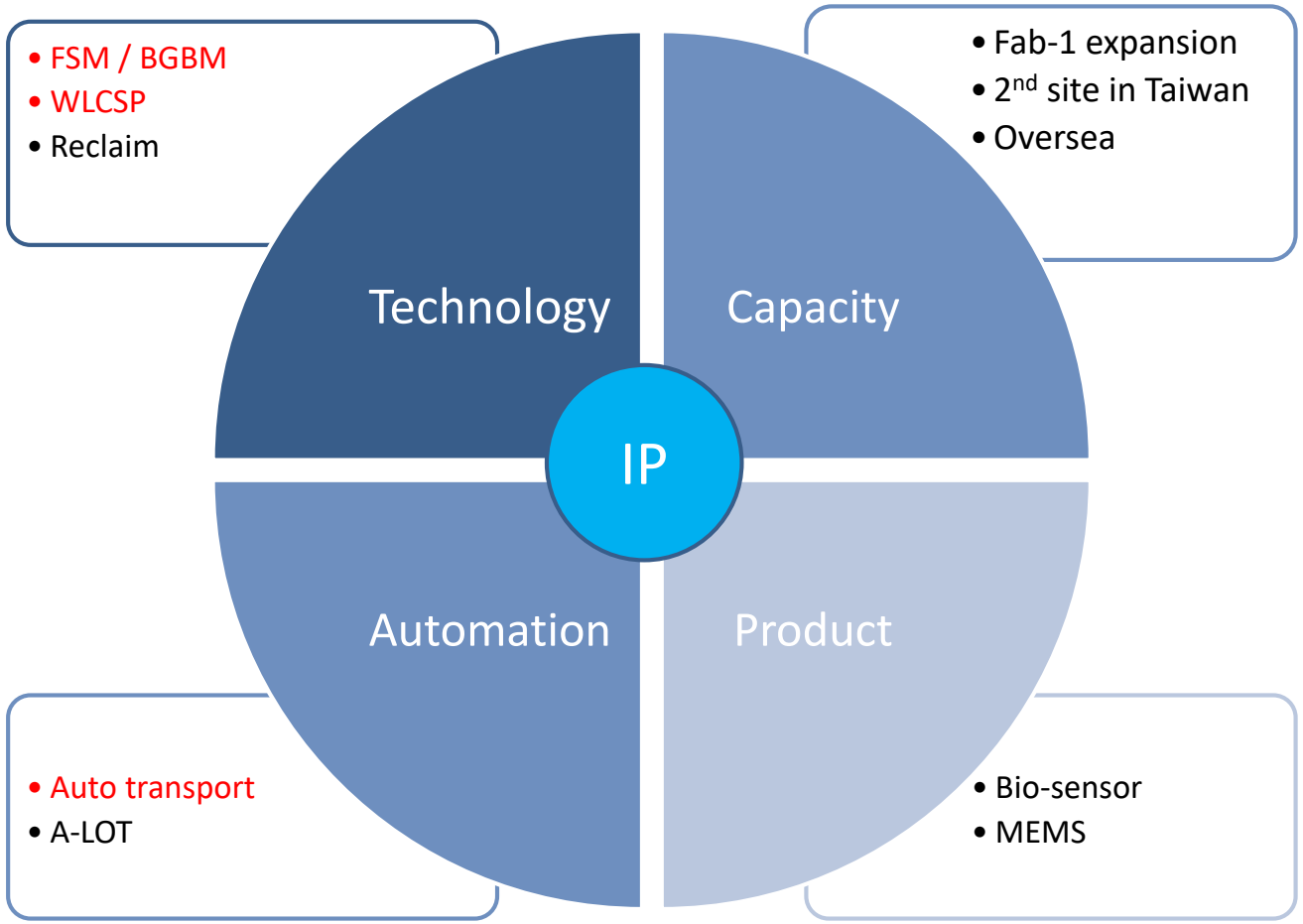
Process Complexity

PSI Position & Roadmap

PSI Position - Thin Wafer Integrator

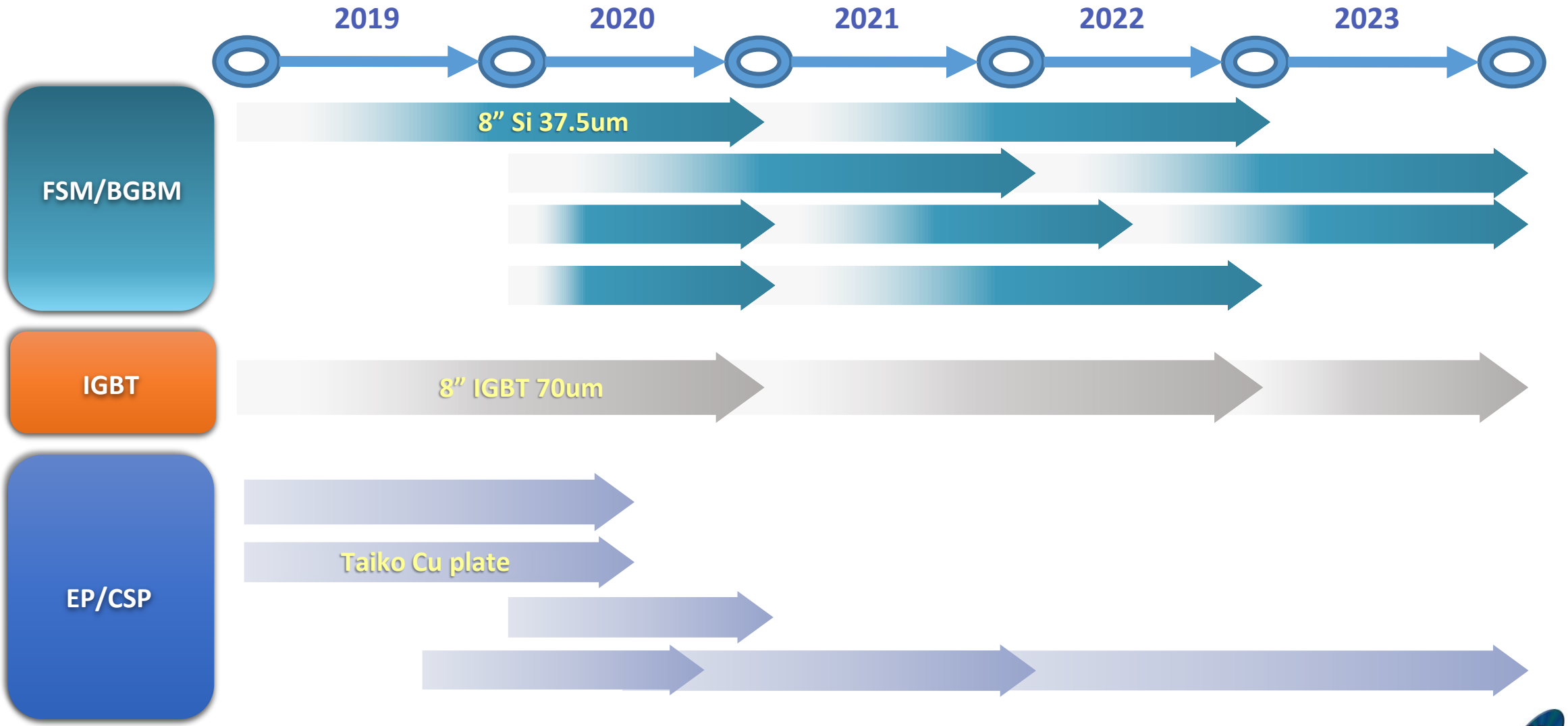


PSI Roadmaps – IP Centric



"We Design Roadmap to Meet Customer's Need"

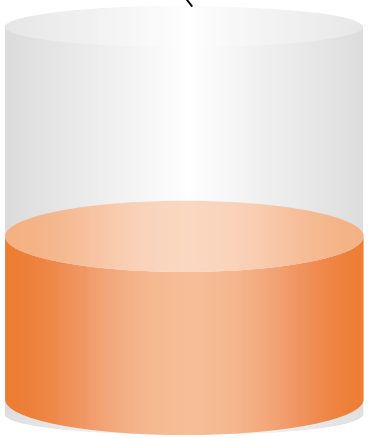
Technology Roadmap



Automation Roadmap

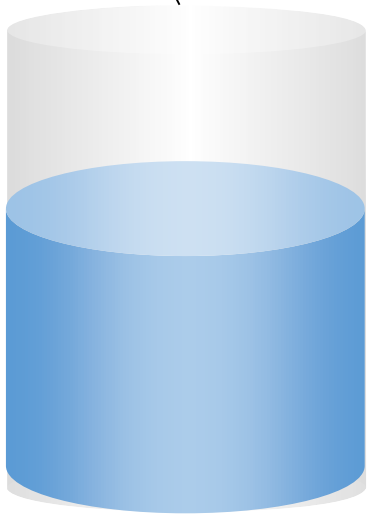
Film technology

Etching technology



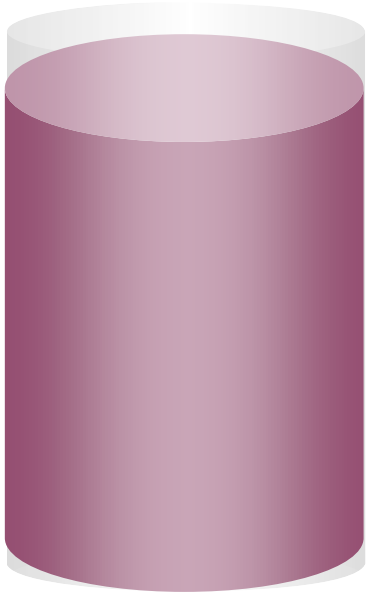
2019-1H

Metrology technology

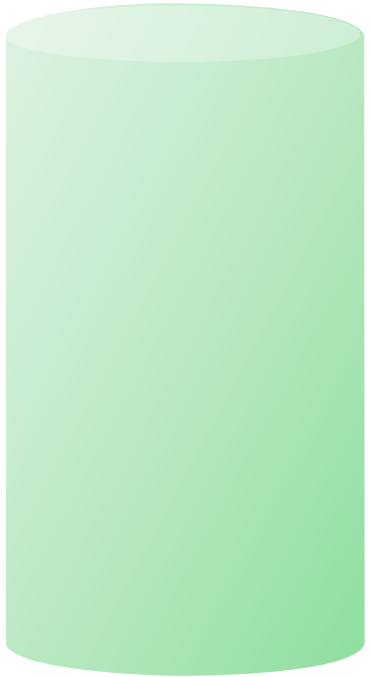


2019-2H

Packing technology



2020-2H



2021-2H

Takeaways

- Power semiconductor will keep growing mainly due to coming EV era
- MOSEFT foundry supply chain is getting mature with more IDM outsourcing
- IGBT foundry will follow MOSEFT model once BGBM MEOL is ready
- SiC is a must but complementary technology to silicon, however cost is a barrier
- PSI as the power semi innovator for thin technology will participate with our roadmap

Thinner is Better

Q & A