

# SiC Road Map

~ Future Society based on Power Electronics ~

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16<sup>th</sup> Dec., 2020

SiC alliance Planning Committee



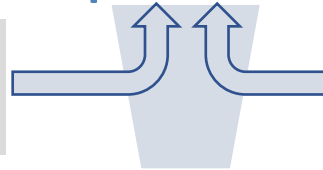
# 1. Vision

Revised : 20th Oct. 2016

## Realize the Ultimate Eco-Society

Create Competitive Companies and Brand-new Markets

Promote Electric Powertrains  
for Mobility of Ground, Sea, Sky



Establish Energy Networks  
Maximize Renewable Energy



Source: JR East

Commercialized in 2015

Revolution of System Design

SiC Characteristics make  
System Design new



Eco-Friendly  
with New Function  
or New System



Maximize Renewable Energy



Source: Toyota Motor corp.



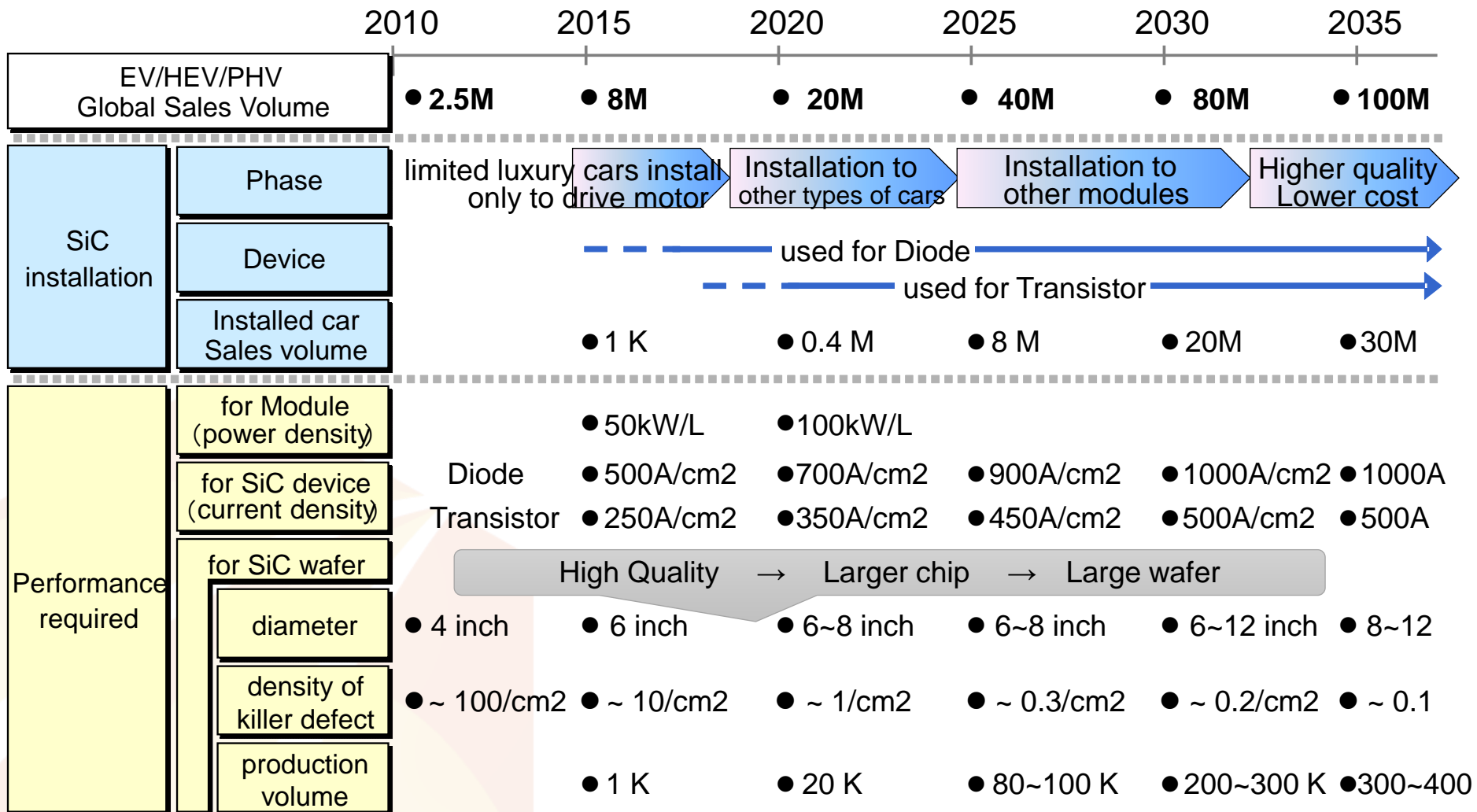
Source: Toyota Motor corp.

Commercialize around 2020



# 2. Auto Mobile

Revised : 7th Oct. 2020



Source: Yole Development "Power GaN"; Fuji Economist Research "Market Perspective of Next Generation Power Devices2011"; DI interviews and analysis (estimated in 2011)

# 3. Super Express Train

Revised : 20th Oct. 2016

		2010	2015	2020	2025
Social situation	Global	210B\$ Bullet trains: China, Spain, France, Russia, India, USA Conv.: Europe (Replacement), Developing Countries (City)	250B\$ Next Generation Bullet Train 400km/h (DLR, Germany)	● Beijing-Moscow 400km/h	● Future : Evacuated Tube Transport (6500km/h) Hyperloop (1200km/h) Packet Transport
	Japan	Conv.: Replacement (depopulation)	● Bullet train (Tokyo-Hokkaido) (1st section)	● Bullet train (Kanazawa-Osaka) (2nd section)	● Maglev (Tokyo-Nagoya) *Maglev: Magnetic levitation (500km/h)
System	High-speed railway	weight reduction energy saving		Bullet train (SiC Diode & MOSFET)	
	Vehicle	as above	Subway (SiC Diode)	Conventional Line (SiC MOSFET)	Solid State Transformer (for 16.7Hz, 50/60Hz, power grid)
	Power supply	space reduction energy saving	Station Auxiliary Power Supply Unit, Railway Substation		Maglev
Components	Motor	Induction Motor	Synchronous Motor	Reluctance Motor	
	Battery		Vehicle & Ground: reuse of EV battery (low cost, high reliability, compact)		
	Inverter Converter		Traction converter unit: high efficiency inverter, Matrix converter, high-frequency insulation transformer Auxiliary power supply: volume reduction by high frequency operation, contactless feeding, low EMI Ground power supply: Rectifier, regenerating inverter, DC circuit breaker, reactive power compensator, power storage		
	Module		higher voltage/frequency/temperature, cooling technology, lower cost, monitoring technology		
	SiC Power device		1.7kV	3.3kV	6.5kV

\*Based on commercial operation









Take off to the world with new generation power electronics

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# 4. Industrial Inverter

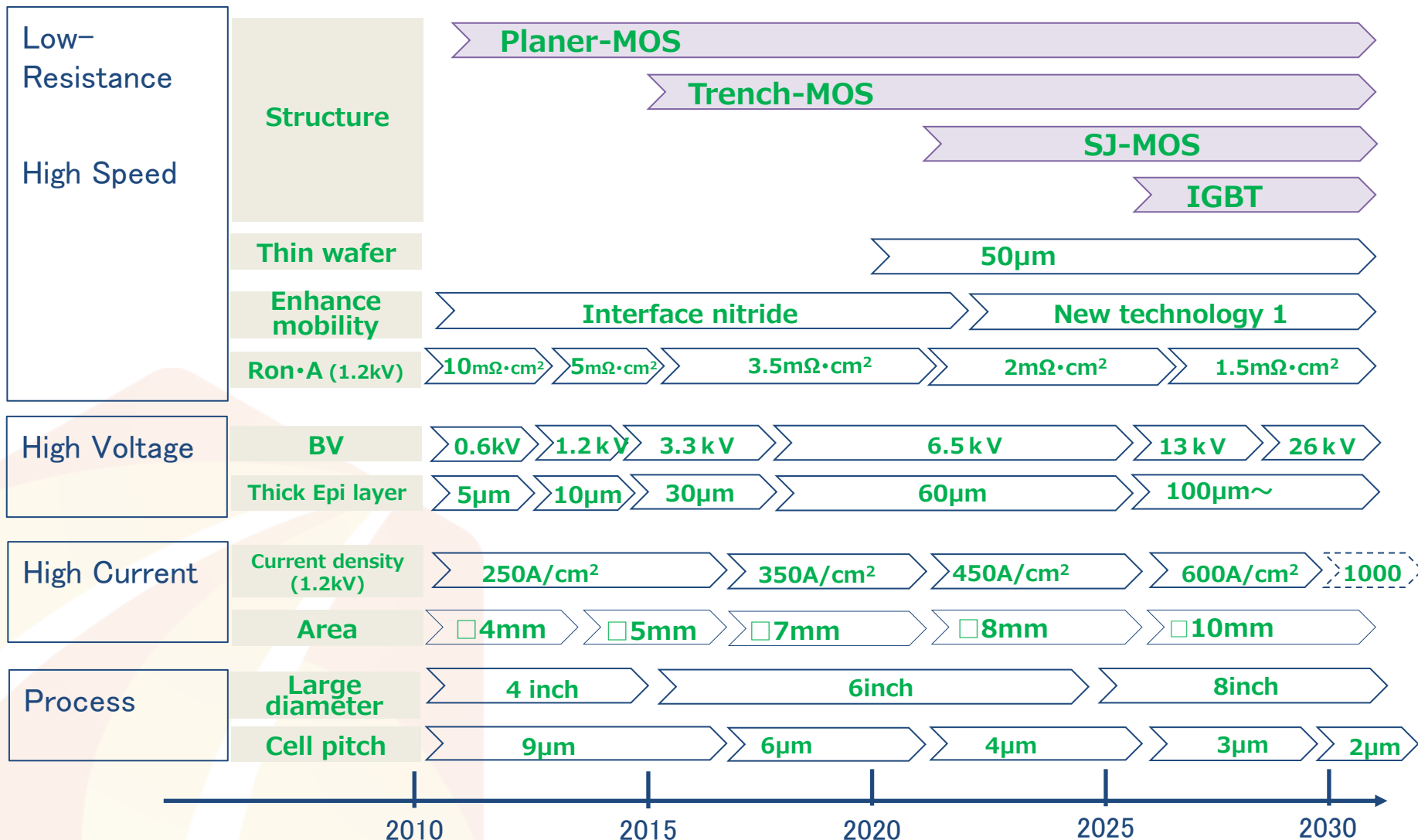
Revised :5th Feb. 2018

			2010	2015	2020	2025		
1.2kV Device (MOS)	Spec.	$R_{onA}$	5.0 $m\Omega cm^2$	3.5 $m\Omega cm^2$	2.0 $m\Omega cm^2$	1.5 $m\Omega cm^2$	1.0 $m\Omega cm^2$	0.75 $m\Omega cm^2$
		$E_{on} + E_{off}$	● 35 $\mu J/pulse \cdot A$ (@ $V_{bus}=800V$ )			● 25 $\mu J/pulse \cdot A$ (@ $V_{bus}=800V$ )		
System	System		 Inverter with Motor (Industrial)			 High Efficiency Inverter		
	System		 AC-AC Matrix Converter			 AC-AC High Voltage Direct Converter		
HV Device (MOS/ IGBT)	Spec.	BV	1.2kV	3.3kV	6.5kV	1.2kV 2.0 $m\Omega cm^2$	13kV	26kV
		System		 Modular Multilevel Converter			 AC-AC High Voltage Direct Converter	

Source: Fuji Electric, Nikkei, SIP

# 5. Switching Device

Revised: 9th Sep. 2020



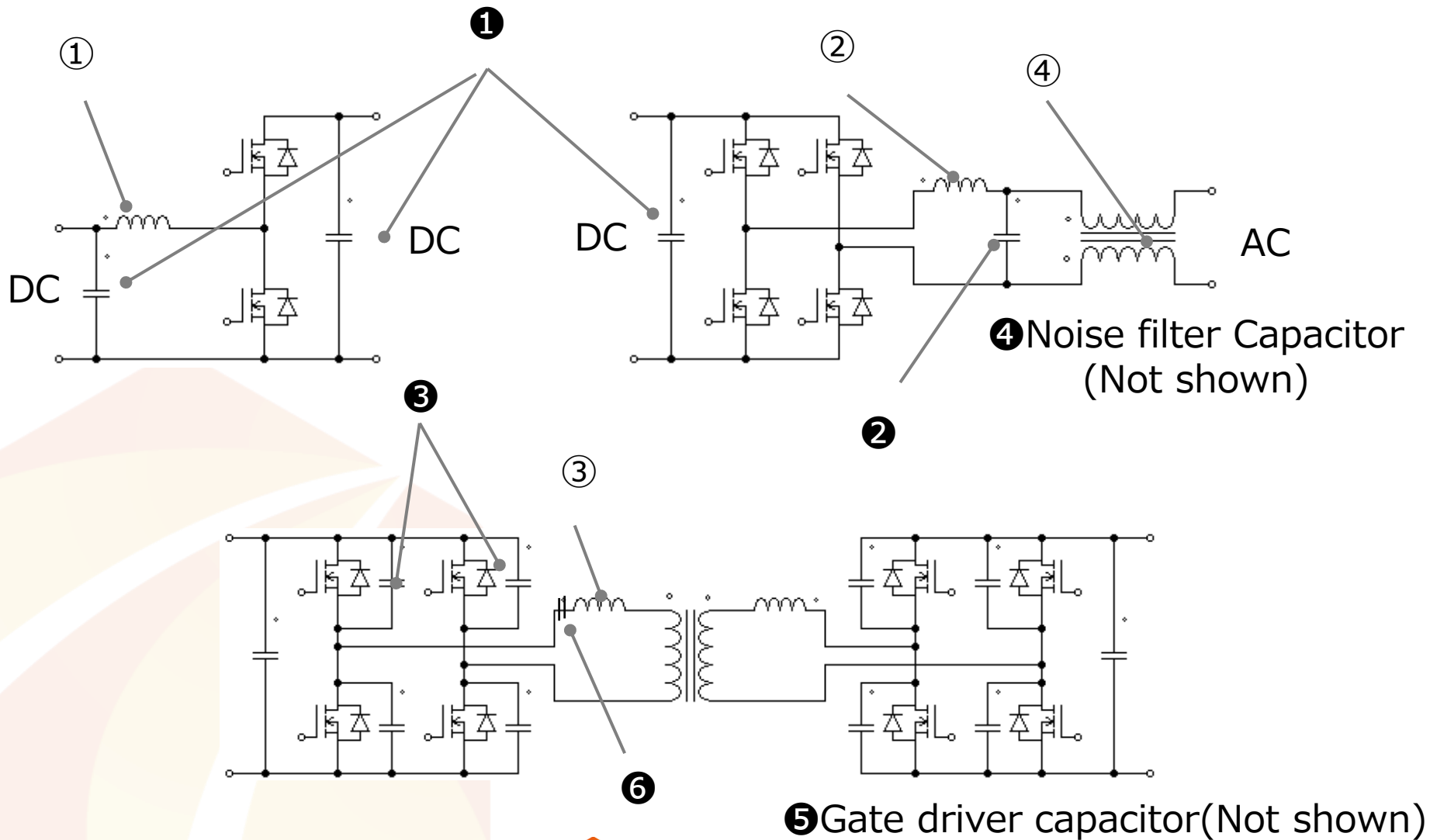
# Passive Component Road Map

## Updated on Dec. 16, 2020

(Notes) Target value with arbitrary unit have reference "1" in 2020. CY2020 CY2030年 CY2035

		CY2020	CY2030年	CY2035			
Inductor	① ② ③	Frequency adaptation	50kHz	100	200		
		Non-disclosure					
	④	Operating temperature	125°C	150			
		Non-disclosure					
		Permeability	1	1.2	1.3		
Capacitor	Ceramic ① ② ③ ④ ⑤ ⑥	Non-disclosure					
		Capacity density	1	1.5	2.0		
		Non-disclosure					
		Breakdown voltage	1	1.5	2.0	2.5	
			Operating temperature	150°C	175	200	250
	Film	① ② ⑤	Non-disclosure				
			Non-disclosure				
		① ②	Non-disclosure				
			Non-disclosure				
		③	Non-disclosure				
Non-disclosure							
Film	①	Capacity density	1	1.2	1.3		
		Non-disclosure					
	②	Breakdown voltage	1				
		Operating temperature	105°C	125	150		
		Non-disclosure					

# Inductor and Capacitor for Power





# 7. Wafer

Revised: 9th Sep. 2020

