

# Sustainability Strategy



## VISION & CORE VALUES

# WE CONNECT SCIENCE TO LIFE FOR A BETTER FUTURE



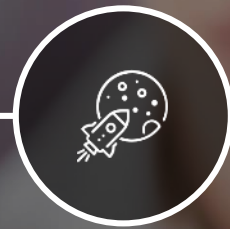
Customer Focus



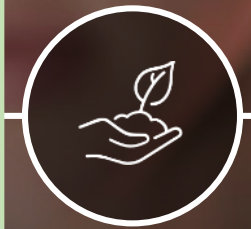
Agility



Collaboration



Passion



Sustainability

Sustainability is incorporated into the vision as a core value.



# ENVIRONMENT

MANAGING THE IMPACTS  
OF CLIMATE CHANGE

Climate Action

Renewable Energy

Water Management



# CUSTOMER

LEADING SUSTAINABLE  
INNOVATION FOR CUSTOMER

Responsible Products

Circular Economy

Environment Protection



# SOCIETY

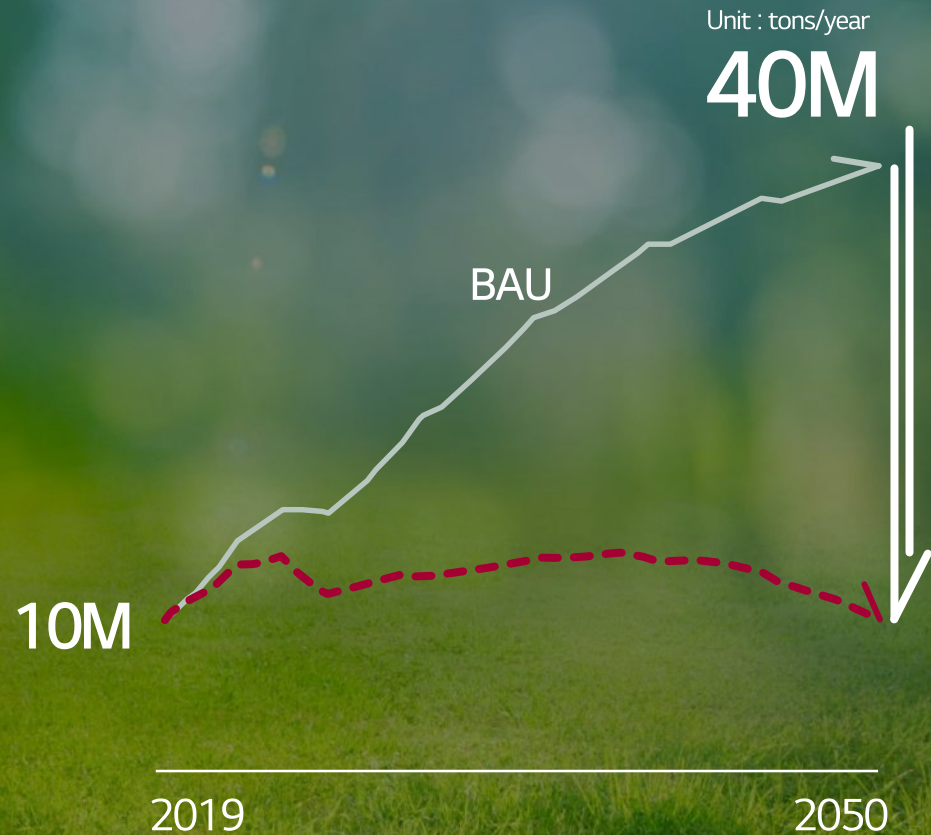
MAKING A POSITIVE  
CONTRIBUTION TO SOCIETY

Responsible Supply Chain

Human Rights / Diversity

Safety / Wellness

# CARBON NEUTRAL GROWTH 2050



We are proud to be the first Korean chemical company to declare 'Carbon Neutral Growth by 2050'. It is our firm determination to keep carbon emissions flat to 2019 level while pursuing a sustainable growth.

# CARBON NEUTRAL GROWTH 2050

# 30,000,000t



12.5M

Fossil Fuel Vehicle\*

\*Carbon Emissions a year



220M

Pine Trees

To achieve this ambitious target, 30 million tons of carbon, equivalent to emissions from 12.5 million of fossil fuel vehicles a year should be reduced in our global operations. It is the same amount that can be offset by planting 220 million of pine trees.

# RENEWABLE ENERGY

# 100%



## WATER



## WIND



## SOLAR

We are also the first mover in Korea to commit to RE100, which means our products will be made with renewable energy by 2050. To take action in this regard, battery plants in Europe and the US are now running on clean energy.

# CIRCULAR ECONOMY



There is no planet B. Moving away from linear economy towards recycling economy is not our final destination. Instead, we are on our way to circular economy making our products more adaptable to recycling and increasing use of bio sources.

Our Goal :

To achieve the transition to circular economy, we must develop more sustainable plastic through collaboration with global customers, while maintaining virgin-like quality and with far better environmental benefit.



# Sustainability DNA



SUSTAINABLE  
PLASTIC



e-MOBILITY  
(EV, ESS BATTERY)



PHARMACEUTICALS

Strategic foresight in sustainability is put into our perspective and products we supply.

# Product Portfolio

Mechanical Recycle

PC

PC/ABS

PBT/PET

Chemical Recycle

PC

PC/ABS

PBT

TPEE

Bio-Based

PBT

TPEE

PA56 (Replace PA66)

Bio-Mass Balanced

PC

PC/ABS

# Mechanical Recycle

## Technical Description

Grinding Compounding (In-House)

Consumer Product -> Post Consumer Recycled (PCR) Resin -> PCR Compound

Source : Sheet, Wafer tray, Headlamp

## Business Summary

PCR Sales Record : 11,000MT ('19)

PCR Supply Capacity : 32,000MT  
PCR30%

### PCR Product Portfolio

PC	Non-Reinforced: 10 grades Reinforced: 5 grades	PCR PC Content Max 85%
PC/ABS	Non-Reinforced: 9 grades Reinforced: 4 grades	PCR PC Content Max 60%
PBT/PET	Reinforced: 2 grades	PCR PET Content Max 30%

## Target Application

### E&E Industry

- AI Speaker
- Laptop
- Tablet PC
- Mobile Phone
- Charger
- Printer

### Automotive Industry

- Overhead console
- Airvent
- Audio
- Door Garnish
- Cockpit
- Trim

## Quality Control (3<sup>rd</sup> party Certification)

**UL ECV**  
(Environmental Claim Validation)

**TUV**  
Technical Inspection Association  
(Technischer Überwachungsverein)

Goal One :  
Maintaining Virgin-Like Quality

Goal One Problem :  
Maintaining Virgin-Like Quality is Not Easy

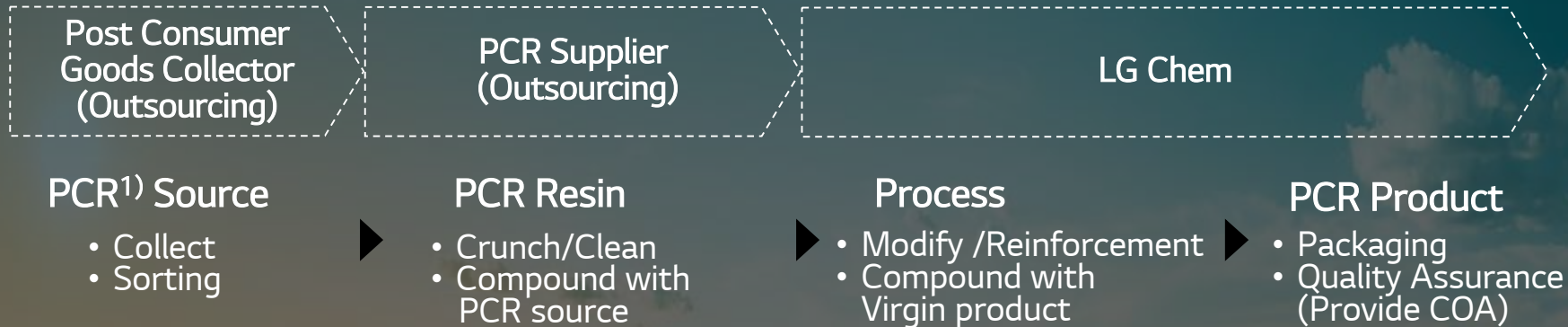


Virgin



PCR

# Quality Control of Full Value Chain (Sourcing to Processing)



## Quality Control Points

- Use highly qualified PCR source (Proper molecular weight source for compound processing)

- Strict warehouse inspection (7 categories)
- Provide direct guidance to improve PCR resin quality
- 3<sup>rd</sup> party certification (UL ECV, TUV)

- Use customized screw configuration
- Strict appearance inspection (Bright color products)

- 3<sup>rd</sup> party certification (UL ECV, TUV)

# Warehouse Inspection for PCR Resin

Strict inspection for screening contaminated PCR resin. Year after year, we are providing guidance to our PCR supplier in order to improve the quality.

## Inspections for Virgin source

2

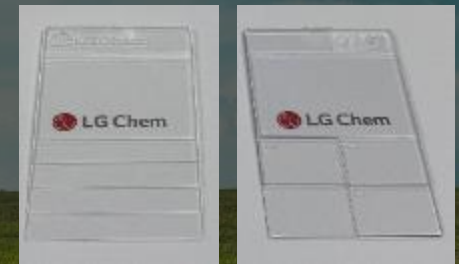
- Melt Flow Rate
- Color(Yellow Index)

## Inspections for PCR source

7

- Melt Flow Rate
- Color(Yellow Index, Darkness)
- Izod Impact Strength
- HDT<sup>1)</sup>
- Foreign Material
- Halogen/Heavy metal
- PDI(Poly dispersity Index)

[Color chip of Virgin/PCR resin]



<Virgin>

<PCR>

[Pancake test for inspection foreign material]



1) Heat Deflection Temperature

# Control of PCR Source and Processing

## PAST VERSION

## TODAY VERSION

### Source Control



Water Bottle



CD/DVD

Very High and Low (MFR 3~70) Molecular Weight Source  
-> Broad Dispersion + Unstable Quality between Lots



Wafer Tray



Sheet



Auto Headlamp

Proper (MFR 15~25) Molecular Weight Source  
-> Narrow Dispersion + Stable Quality between Lots

### Process Control



Conventional Screw Configuration

More Residential Time inside Extruder  
-> Possible Degradation + Less Self Wiping of Screw



Customized Screw Configuration

Less Residential Time inside Extruder  
-> Prevent Degradation + Enhance Self Wiping of Screw

# Virgin-Like Quality

Test class		Test Method	Test Condition	Unit	LUPOY HI5002A	LUPOY ER5002N
Physical	Specific gravity	ISO 1183	-	g/cm <sup>3</sup>	1.11	1.11
	Melt Flow rate	ISO 1133	260°C, 5kg	g/10m	25	25
Mechanical	Tensile Elongation	ISO 527	50mm/min	%	> 100	> 90
	Tensile Strength	ISO 527		MPa	54	49
	Flexural Modulus	ISO 178	2mm/min	MPa	2,300	2,280
	Flexural Strength	ISO 178		MPa	84	80
	Notched Izod Impact	ISO 180/A	23°C	KJ/m <sup>2</sup>	55	45
					-30°C	16
	Notched Charpy Impact	ISO 179-1	23°C		53	45
-30°C						
Thermal	Heat Distortion Temp	ISO 75	1.8MPa	°C	89	95
	Vicat Softening Temp	ISO 306	50N, 50°C/hr		111	111
Heat Aging (90°C/1000hr)	Tensile Strength	ISO 527	50mm/min	Retention %	57	51
	Notched Charpy Impact	ISO 179-1	KJ/m <sup>2</sup>	Retention %	40	38
Others	TVOC	LGC Methcod	250°C, 10min	µg/g	1768	802
		VDA278	90°C		< 0.1	< 0.1
	Odor	VDA270 (B,3)	80°C, 2hr	Level	2.5	2

Note) Typical values are only for material selection purpose, and variation within normal tolerances are for various colors. Values given should not be interpreted as specification and not be used for part or tool design.



# Virgin-Like Quality

Test class		Test Method	Test Condition	Unit	LUPOY HR5006A	LUPOY ER5006N
Physical	Specific gravity	ISO 1183	-	g/cm <sup>3</sup>	1.13	1.13
	Melt Flow rate	ISO 1133	260°C, 5kg	g/10m	21	23
Mechanical	Tensile Elongation	ISO 527	50mm/min	%	> 100	> 90
	Tensile Strength	ISO 527		MPa	51	51
	Flexural Modulus	ISO 178	2mm/min	MPa	2,200	2260
	Flexural Strength	ISO 178		MPa	79	83
	Notched Izod Impact	ISO 180/A	23°C	KJ/m <sup>2</sup>	48	48
			-30°C		36	35
	Notched Charpy Impact	ISO 179-1	23°C		52	50
-30°C						
Thermal	Heat Distortion Temp	ISO 75	1.8MPa	°C	100	99
	Vicat Softening Temp	ISO 306	50N, 50°C/hr		120	121
Heat Aging (90°C/1000hr)	Tensile Strength	ISO 527	50mm/min	Retention %	54	53
	Notched Charpy Impact	ISO 179-1	KJ/m <sup>2</sup>	Retention %	45	45
Others	TVOC	LGC Methcod	250°C, 10min	µg/g	1832	573
		VDA278	90°C		< 0.1	< 0.1
	Odor	VDA270 (B,3)	80°C, 2hr	Level	2.5	2

Note) Typical values are only for material selection purpose, and variation within normal tolerances are for various colors. Values given should not be interpreted as specification and not be used for part or tool design.

# Virgin-Like Quality

Test Class		Test Method	Test Condition	Unit	LUPOY HR5007AC	LUPOY ER5007N
Physical	Specific gravity	ISO 1183	-	g/cm <sup>3</sup>	1.14	1.15
	Melt Flow rate	ISO 1133	260°C, 5kg	g/10m	19	21
Mechanical	Tensile Elongation	ISO 527	50mm/min	%	> 100	> 90
	Tensile Strength	ISO 527		MPa	52	53
	Flexural Modulus	ISO 178	2mm/min	MPa	2,200	2270
	Flexural Strength	ISO 178		MPa	84	84
	Notched Izod Impact	ISO 180/A	23°C	KJ/m <sup>2</sup>	51	52
			-30°C		37	37
	Notched Charpy Impact	ISO 179-1	23°C		53	55
-30°C						
Thermal	Heat Distortion Temp	ISO 75	1.8MPa	°C	109	106
	Vicat Softening Temp	ISO 306	50N, 50°C/hr		130	131
Heat Aging (90°C/1000hr)	Tensile Strength	ISO 527	50mm/min	Retention %	56	56
	Notched Charpy Impact	ISO 179-1	KJ/m <sup>2</sup>	Retention %	47	49
Others	TVOC	LGC Methcod	250°C, 10min	µg/g	1129	351
		VDA278	90°C		< 0.1	< 0.1
	Odor	VDA270 (B,3)	80°C, 2hr	Level	3	2

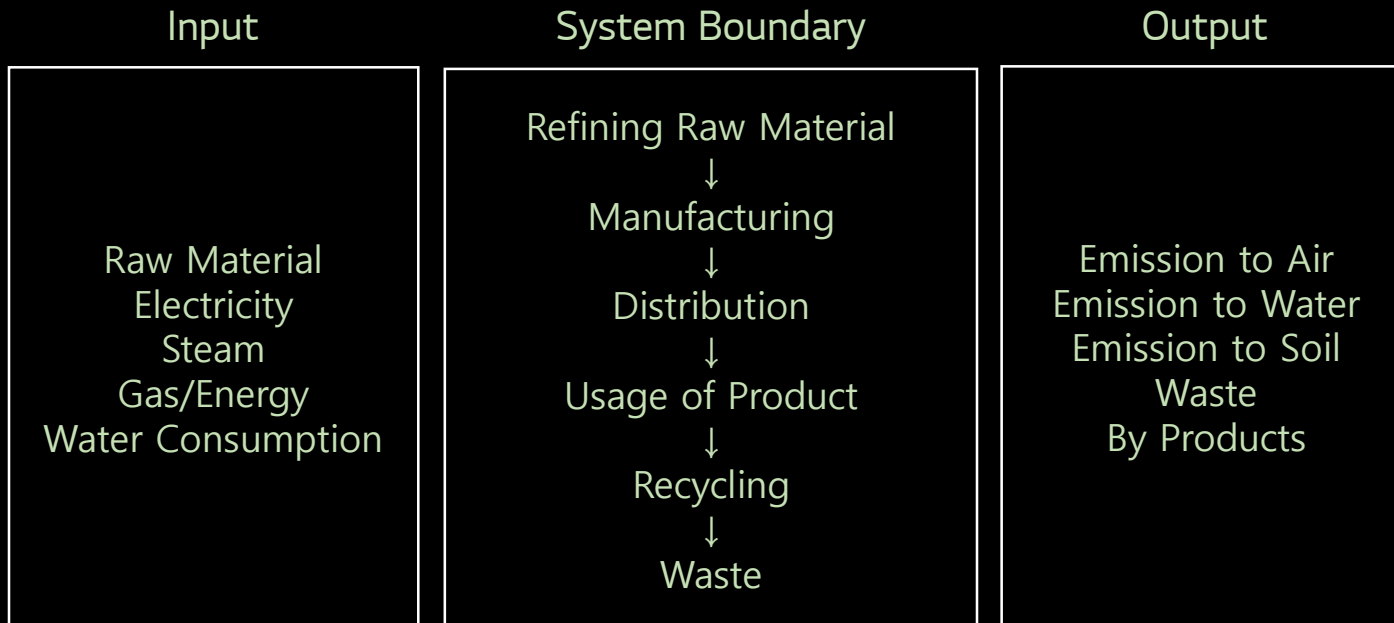
Note) Typical values are only for material selection purpose, and variation within normal tolerances are for various colors. Values given should not be interpreted as specification and not be used for part or tool design.

Goal Two :  
Providing Better Environmental Benefit

Goal Two Problem :  
Providing Better Environmental Benefit is Not Simple

## Life Cycle Assessment (LCA)

Full Examination and Calculation of Entire Value Chain



PCR PC 50%  
PC/ABS

-40%



CO<sub>2</sub> Emission

-30%



Water Consumption

-30%



Cumulative  
Energy Demand

Compared to virgin product (through LCA<sup>1)</sup> Tool), it has been proven that using PCR products result in reduction of environmental factors such as CO<sub>2</sub> emission, water consumption and cumulative energy demand. As PCR content (%) increases, reduction level increases accordingly.

1) Life Cycle Assessment

# Chemical Recycle

## Chem. Recycled PBT/TPEE

## Chem. Recycled PC

Technical Description



Waste PET



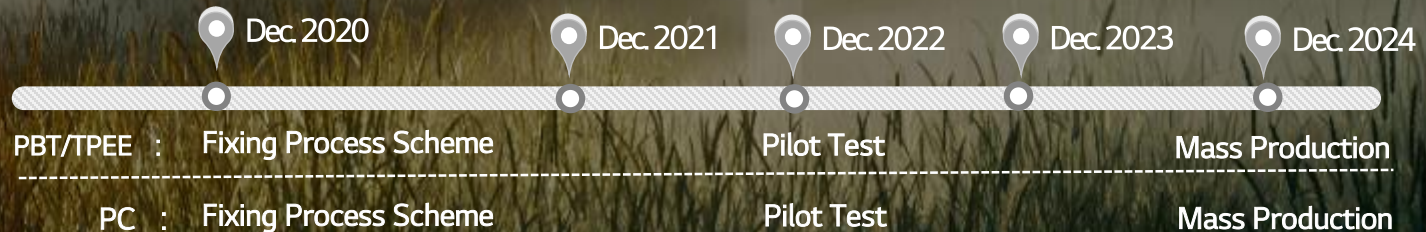
Extract Monomer from Waste Plastic



Waste PC

Milestone

\*Timeline may change during development



# Bio-Based

## Bio PBT/TPEE and Bio PA56 (Replace PA66)

Technical  
Description



Corn



Fermentation of  
Bio-Mass Source  
(Cultivated from Industrial Source Purpose)



Sugarcane

Milestone



Sep. 2020



Dec. 2020



Dec. 2021



Dec. 2024

Bio PBT/TPEE : Pilot Test

Bio-BDO Production (In-house)

Bio PA56  
Compound :

Pilot Test

Mass Production

\*Timeline may change  
during development

# Bio-Mass Balanced

## Bio-Polycarbonate (PC)

Technical Description



Mass-Balance Approach  
(Follow Allocation Rule from Input to Output)



Used Cooking Oil

Supply Chain

Certification for Bio-Mass Source



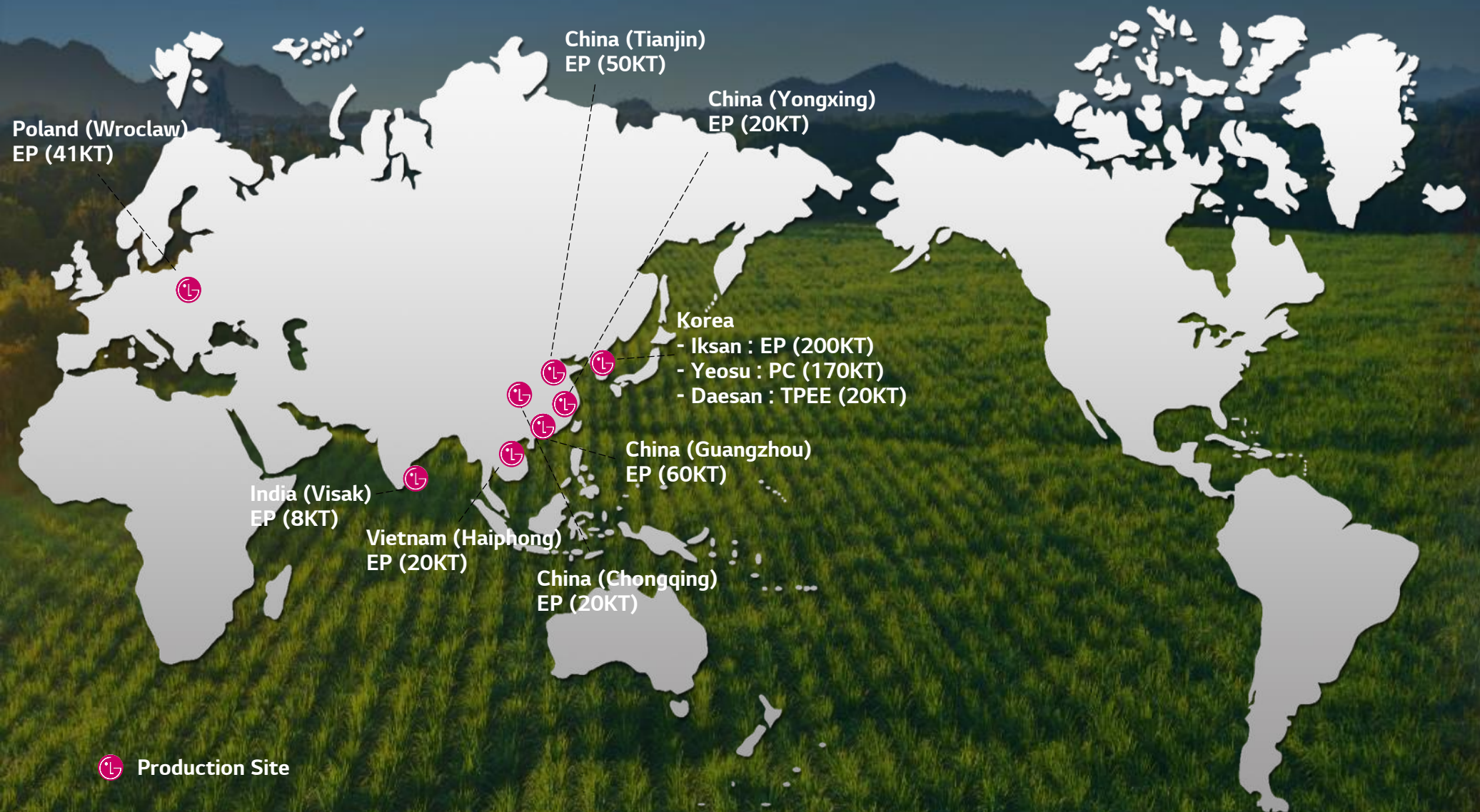
Milestone

\*Timeline may change during development



1) International Sustainability and Carbon Certification

# Global Plant Location



 Production Site



# Next Step

Based on customer's carbon neutral target, LG Chem would like to propose potential paths for new development and eventually lead to strong partnership.

## Material Innovation

### Target

Develop customized product as of virgin-like quality with far better environmental benefit

### Material

PC, PC/ABS, PA56 (replace PA66), PBT, TPEE

### Technology

- Mechanical Recycle
- Chemical Recycle
- Bio-Based
- Bio-Mass Balanced

## Renewable Electricity

### Target

Supply material by using renewable energy

-> Based on RE100 target, LG Chem will expand globally to all business units.

# Appendix. Mechanical Recycle

## PC Product Portfolio

		Recycled Type	Virgin Type	Description	Certification	
Non-Reinforced PC Comp.	Non-FR	ER1000D	GP1000M	PCR 50%	-	
		ER1004A	SC1004A	PCR 30%, IM <sup>1)</sup>	ECV	
		ER1004N		PCR 50%, IM	TUV	
		ER1004Z/X		PCR 70%/80%, IM	TUV	
	FR	ER1006FH	EF1006F	PCR 20%, V0 @ 1.0 mm	TUV, ECV	
		ER1006FD		PCR 30%, V0 @ 1.0 mm	UL 746D, TUV	
		ER1006FN		PCR 50%, V0 @ 1.0 mm	UL 746D, TUV	
		ER1006FZ/X		PCR 75%/85%, V0 @ 1.0 mm	-	
		ER1007F	SF1007F	PCR 30%, High Flow, IM, V0 @ 0.8 mm	UL 746D	
		ER1008RF	GN1008RF	PCR 35%, IM, V0 @ 0.6 mm	TUV	
	Reinforced PC Comp.	Non-FR	ER2102	GP2102	GF 9% + PCR 30%	TUV
			ER2102N		GF 9% + PCR 50%	TUV
FR		ER2201F	GN2201FM	GF 20% + PCR 50%, V0 @ 1.5 mm	UL 746D	
		ER2253F	GN2253F	GF 25% + PCR 30%, V0 @ 0.8 mm	TUV	
		ER2403FT	GN2403FT	GF 40% + PCR 30%, V0 @ 0.8 mm	TUV	

1) Impact Modifier

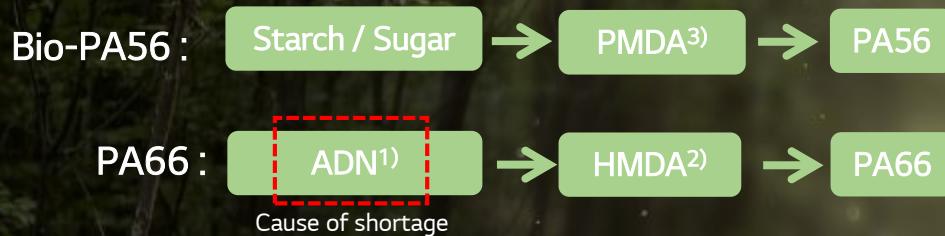
# Appendix.Mechanical Recycle

## PC/ABS and PBT/PET Product Portfolio

		<u>Recycled Type</u>	<u>Virgin Type</u>	<u>Description</u>	<u>Certification</u>
Non- Reinforced <u>PC/ABS Comp.</u>	Non-FR	ER5002N	HI5002A	PCR 50%, Low PC %	-
		ER5006N	HR5006A	PCR 50%, Medium PC %	-
		ER5007N	HR5007AC	PCR 50%, High PC %	-
	FR	ER5001RF	GN5001RF	PCR 30%, V1 @ 1.2 mm, RTI 80°C	UL 746D, RTI
		ER5001RFK		PCR 30%, V0 @ 1.2 mm	TUV
		ER5001RFZ		PCR 60%, V0 @ 1.2 mm	TUV
		ER5001RFA	GN5001RFA	PCR 30%, V0 @ 1.2 mm	TUV
		ER5001RFC	-	PCR 30%, V0 @ 1.2 mm	TUV
		ER5001RFG	GN5001RFG	PCR 35%, V0 @ 1.2 mm	TUV
	Reinforced <u>PC/ABS Comp.</u>	Non-FR	ER5104IM	HP5104IM	GF 10% + PCR 30%
FR		ER5151RFL	GN5151RFL	MF 15% + PCR 30%, V0 @ 1.2 mm	TUV
		ER5151RFA	GN5151RFA	MF 15% + PCR 50%, V0 @ 1.0 mm	TUV
		ER5254F	GN5254FD	MF 25% + PCR 30%, V0 @ 1.0 mm	UL746D
Reinforced <u>PBT/PET Comp.</u>	FR	ER5206F	-	GF 20% + PCR PET 30%, V0 @ 0.8 mm	-
		ER5306F	-	GF 30% + PCR PET 25%, V0 @ 0.8 mm	-

# Appendix. Bio-PA56 Advantage

## Supply Stability



## Capacity

- Bio-PA56 Supplier (Partner) Capacity  
→ 100kMT  
\* Supplier can control capacity of Bio-PA56 and Bio-PA510 flexibly within Capa. 100kMT
- LG Chem EPC Compound Capacity  
→ 391kMT  
\* EU : 41kMT(Poland-Wroclaw)  
China : 151kMT(Guangzou, Yongxing, Tianjin, Chongqing)  
Korea : 180kMT(Iksan)  
Others : 11kMT(Vietnam-Haipong), 8kMT(India-Visak)

## Carbon Footprint (Based on Neat Resin)

- Bio-PA56 : 3.4kgCO<sub>2</sub>/kg  
\*Source: PA56 supplier LCA analysis data
- PA66 : 6~8kgCO<sub>2</sub>/kg  
\*Source :  
Korea - LCI DB Government of Environment : 7.08kgCO<sub>2</sub>/kg  
Europe - Plastic Europe LCA eco profile : 6.4kgCO<sub>2</sub>/kg

## No Food Competition

- Industrial Corn, Wheat  
: Sources which cannot be used as food or feed
- Cultivated for industrial purpose from contracted individual famers (transparently traceable)



Thank you