Sustainable Semiconductor Initiatives Learning from Abroad

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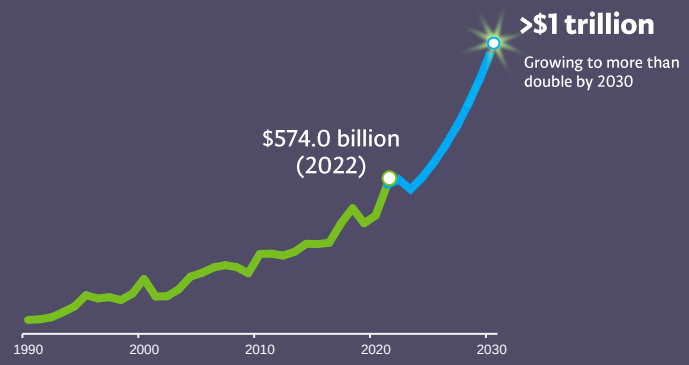
Our Obligation to the Earth

Climate Change

- Multiple unprecedented natural disasters
- Climate change is serious

Forecasted Growth



Source: 1990-2022 (WSTS)/ 2023-2030 (IBS, June 2023)

- Semiconductors are back!
- Reduction of power consumption is essential

Digital × Green

"Green by Digital" & "Green of Digital"

- To solve global environmental problems by "Digital × Green"

TEL's large product portfolio drives the industry toward a sustainable society

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Approaches to Sustainability

E-COMPASS

Environmental Co-Creation by Material, Process and Subcomponent Solutions

Semiconductors

Pursuing higher device performance and lower power consumption

Production Equipment

Achieving both high process & environmental performance

Business Activity

Reduction of CO_2 and equivalent emissions in all business activities

Promoting technological innovation of semiconductors and reducing environmental impact throughout supply chain

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E-COMPASS Progress Toward Scopes 1, 2 and 3

Logistics

CO_2 Emission reduction During Logistics

- Modal shift
- Packaging materials
- Electric/H_2 trucks

Hazardous Substances

Eliminate Prohibited Substances

- Harmful substances Survey
- Eliminate Prohibited Substances
- Management system

Green Products

Improving Product Green Performance

- Efforts with partners
- 10-year roadmap
- Environmental Targets sharing
- KPI on product

Collaboration is key to semiconductor industry sustainability

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Fab Equipment CO_2 Scope Contributors

Scope 3

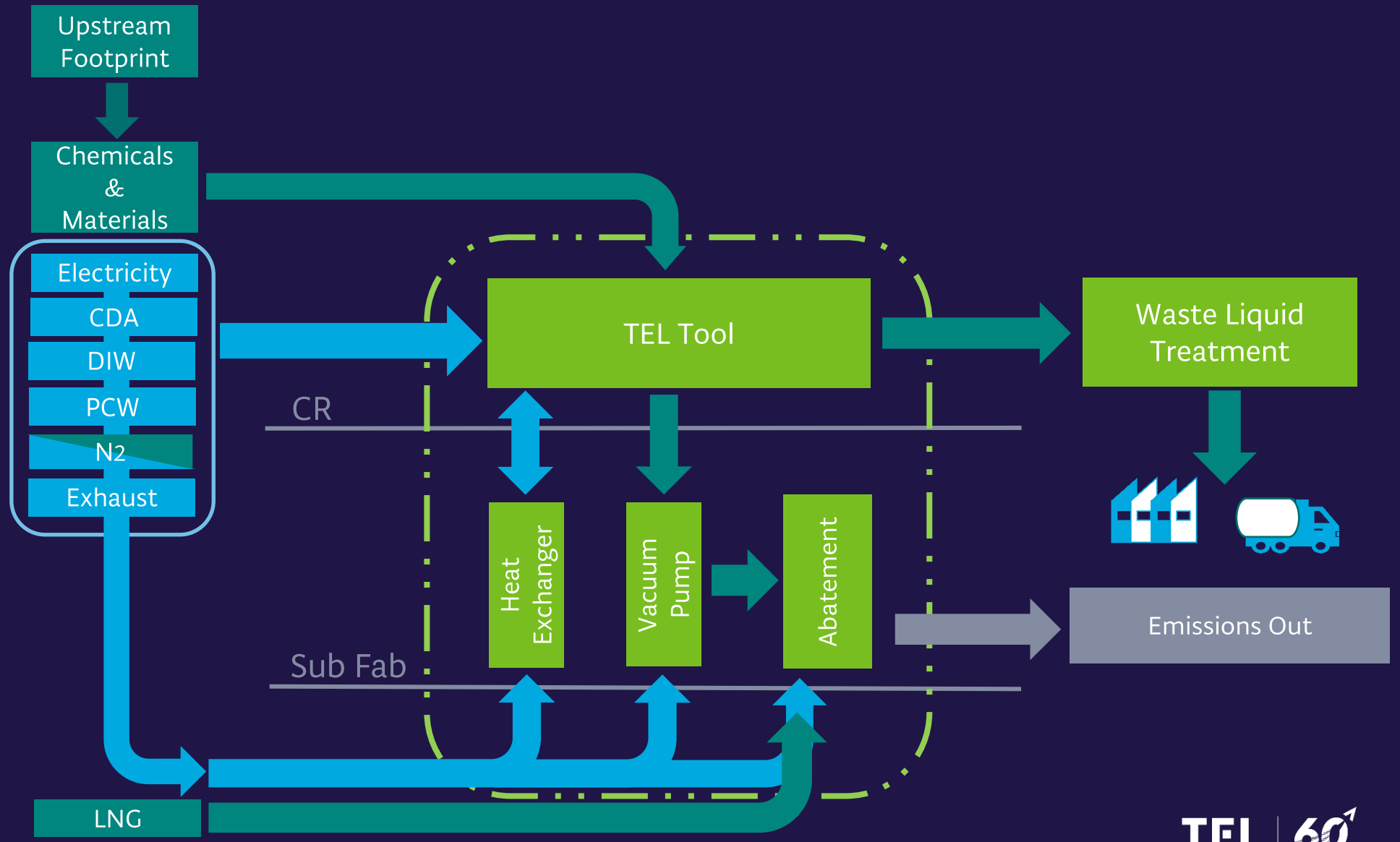
Direct/Indirect emissions from value chain (chemicals)

Scope 2

Indirect emissions from energy usage (electricity & utilities)

Scope 1

Direct emissions from process



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Environmental Performance and Components

Focus Area		Environmental Performance by TEL	Components (Including Functional Chemical)
	Energy	Lower power consumption・Higher power utilization	Motor, pump, Abatement, Chiller, Heater, Power supply, Waste heat, utilization system,
		Circulation reuse	
		Consumption and optimization of idle/sleep mode	
	Water Resources	Higher utilization efficiency	Abatement, Temperature controller, Cleaning, Heat exchanger, Circulation
		Circular reuse	
	Global Warming Chemicals	Low GWP materials	Heat transfer medium, Refrigerant, Refrigerator, Heat pump, Abatement, Cleaning gas, Process gas
		Reduction of usage, improvement of utilization	
		Abatement technology	
	Process Chemical	Improvement of chemical utilization	Greener chemicals (solutions, solvents), PFAS free, Abatement systems
		Circular reuse	
	Scarce Resources	Sustainable materials	All scarce resources, Rare earths, Rare metals, Scarce gas
		Circular reuse, long life cycle	
	Substance of High Concern	Environmental laws and regulations	Any not use REACH / RoHS / POPs target substances
		Low environmental burden materials	
		Reduction of PFAS, sustainable PFAS utilization	
	Plastic	Low environmental burden materials	Wire coating agent, RF cable, Piping, Valve, Fitting, Chemical tank, O-ring, Heat insulating material, Piezoelectric sheet, PCB board, Packing materials
		Reduction of PFAS, sustainable PFAS utilization	
		Circular reuse and waste reduction	

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TEL VENTURE CAPITAL

Investing Globally in Deep-tech Startups

Semiconductor Focus:

- Manufacturing
- Industrial Intelligence
- Design
- ESG
- Other Si Processes

42
Portfolio Companies

>300
New Dealflows per year

10
Countries

17
People

~10
Investments per year

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Driving Adoption of Sustainability Innovation

Sustainability impact alone is not sufficient to drive adoption

Startups with ESG + Semiconductor Focus

Japan is a *leading* startup generator in hardware-oriented ESG space

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ESG Start-up Examples

PFAS

- Abatement
- Replacement

Power Savings

- Switching loss reduction at high-power
- Thermoelectric generation

Chemical Waste Treatment

- Water / solvent separation process
- IPA / water separation

PFAS Abatement through Chiller Coolant Replacement

	Company							
	A	B	C	D	E	F	G	H
Refrigerant	a	a	a	a	b	b	c	d
GWP *1	1	1	1	1	0	0	~6	1~
Temp (°C)	-20	-20	-50	-20	-70	<-80	<-80	<-70
Size	Large	Small	N/A	Small	N/A	Large	Large	Small
COP *2	1~1.5	1~1.5	N/A	1~1.5	N/A	<0.5	0.5~1.0	1~1.5

Pros:

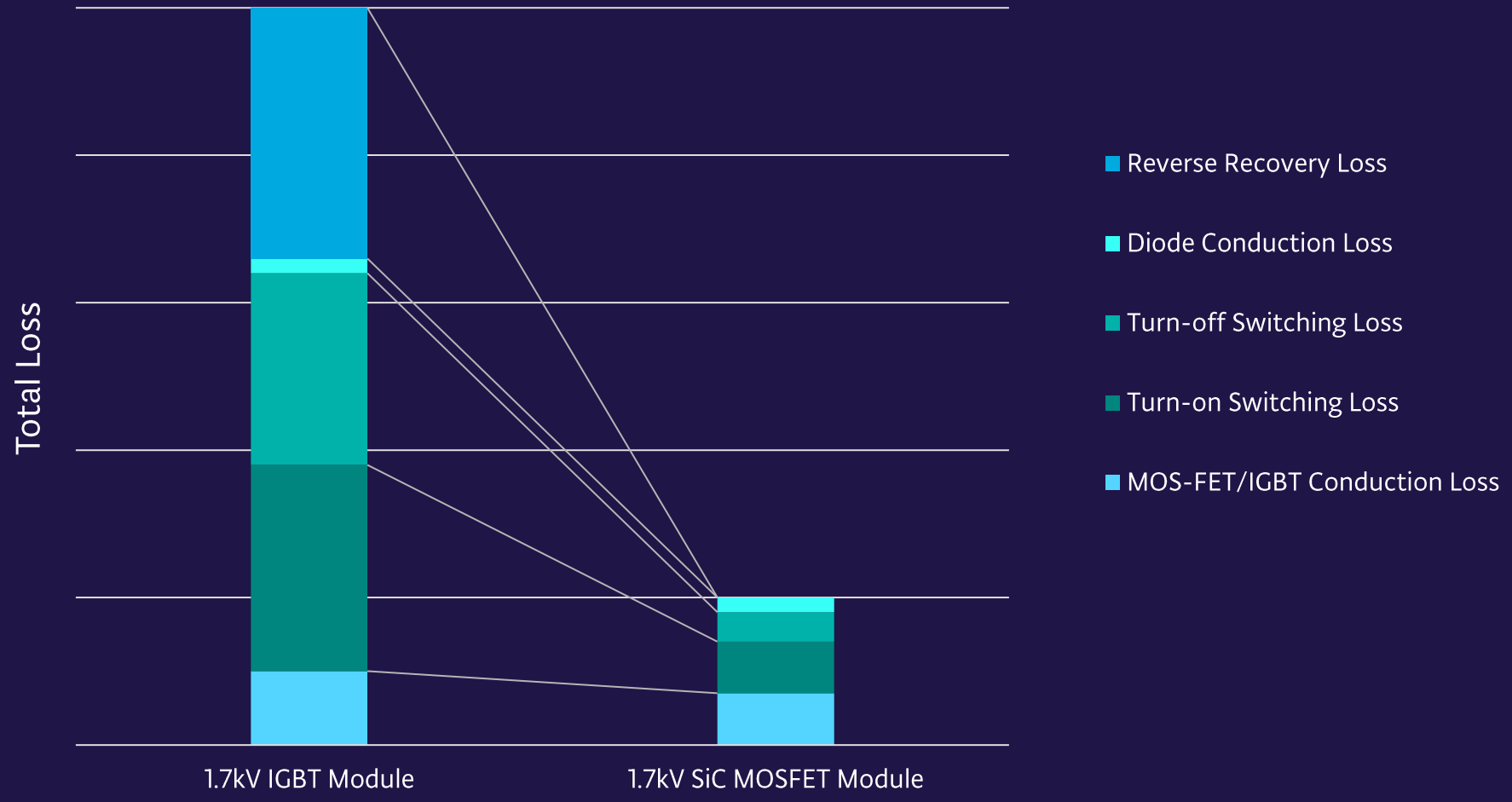
Cons:

*1 Global Warming Potential

*2 Coefficient Of Performance = $\frac{\textit{Cooling capacity}}{\textit{Power consumption}}$

Reducing Power Loss with SiC

Significant energy & space savings for high-voltage applications



https://toshiba.semicon-storage.com/jp/semiconductor/product/mosfets/sic-mosfet-modules.html

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Water/IPA Separation Technologies

	Distillation	Filtration	Mist
Energy Use	High	Medium	Low
Lifetime	N/A	Limited	N/A
Recycle rate	70~80%	~93%	~95%
Cost	High	Medium	Low

Path to Sustainability

Green Chips are Great Business

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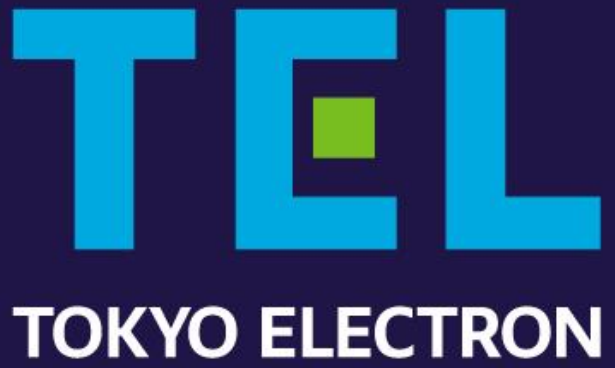
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