

Evaluation of green house gas emission from
chemical products based on life cycle assessment
~ Practical use of LCA ~

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ASAHI KASEI CORPORATION

Junichi Nakahashi

Part I

Evaluation of CO₂ emission from chemical products
based on life cycle thinking by ICCA

International Council of Chemical Associations

Energy & Climate
Change
Leadership Group

LCA Task Force

Bench Mark
Task Force

Chemical Policy & Health
Leadership Group

Policy Task Force

Responsible Care
Leadership Group

Advocacy
Task Force

cLCAs* cover 8 broad end-use areas and were all externally validated

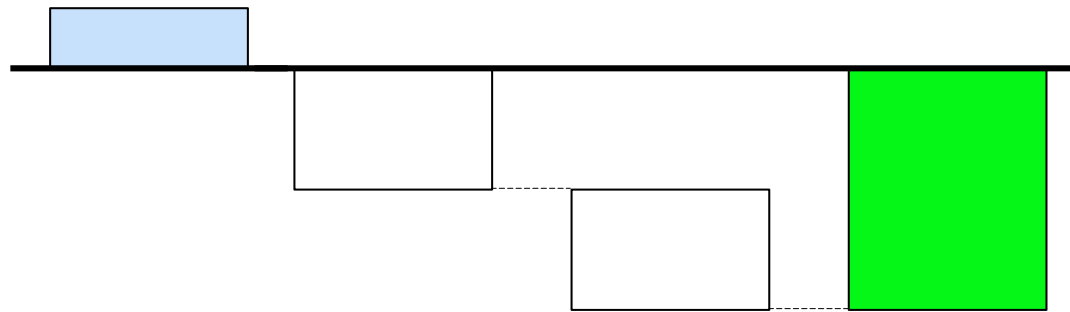
	<u>Category</u>	<u>Subcategory</u>	<u>Number of cLCAs</u>
Overall abatement potential	Transportation	<ul style="list-style-type: none"> • Automotive weight reduction • Lubricants • Lower friction • Engine efficiency • Aviation weight reduction • Marine fuel reduction 	19
	Insulation	<ul style="list-style-type: none"> • Building insulation • Fridge insulation 	19
	Building	<ul style="list-style-type: none"> • Construction material • Piping • Windows 	10
	Agriculture	<ul style="list-style-type: none"> • Feed supplements • Fertilizer & crop protection • Preservation • Food production efficiency 	17
	Packaging	<ul style="list-style-type: none"> • Food packaging • Shopping bags 	13
	Consumer goods	<ul style="list-style-type: none"> • Electronic components • House ware • Service wear • Textile • Low temp detergents 	18
	Power	<ul style="list-style-type: none"> • District heating • Solar power • Wind power 	4
	Lighting	<ul style="list-style-type: none"> • CFL lighting • LED lighting 	2

All cLCAs externally reviewed by the Öko Institut

* cLCA = CO₂e life cycle analyses

More than 100 cases evaluated to assess savings from using products of the chemical industry

Calculation scheme to compare the CO₂e emissions from using a chemical industry product with the total avoided CO₂e emissions from not using a non-chemical industry product

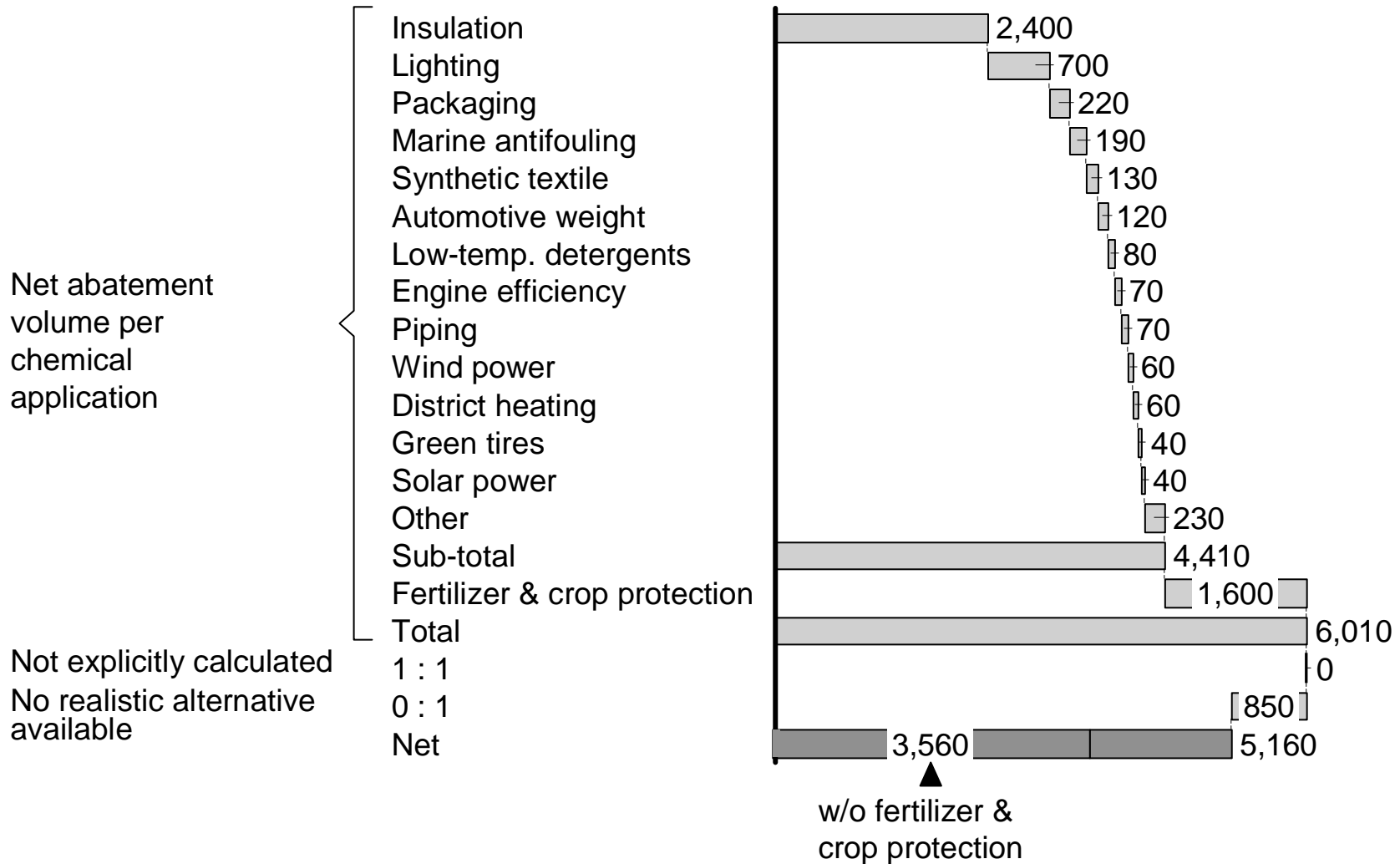


Chemical products emissions over life cycle of chemical product	Non-chemical product emissions over life cycle of non-chemical alternative	Difference in in-use emissions due to performance difference between chemical and non-chemical product	Gross emissions savings
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The main contributors are insulation, fertilizer & crop protection, and lighting

Net abatement 2005

MtCO₂e



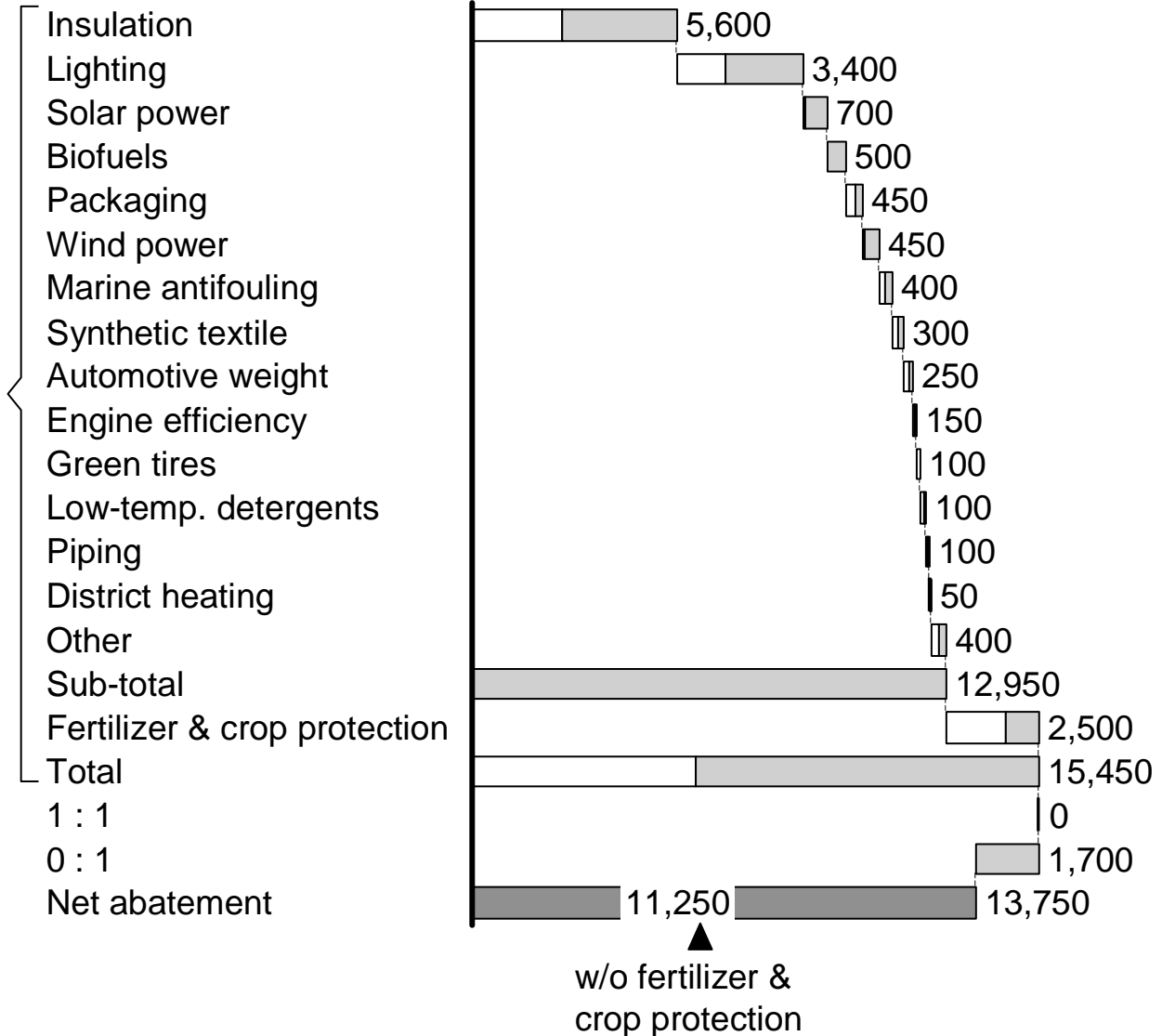
Net abatement grows to 13.8 Gt in 2030 under BAU assumptions (with the fertilizer case)

■ 2030 BAU
□ 2005

Net abatement
MtCO₂e

Net abatement
volume per
chemical application

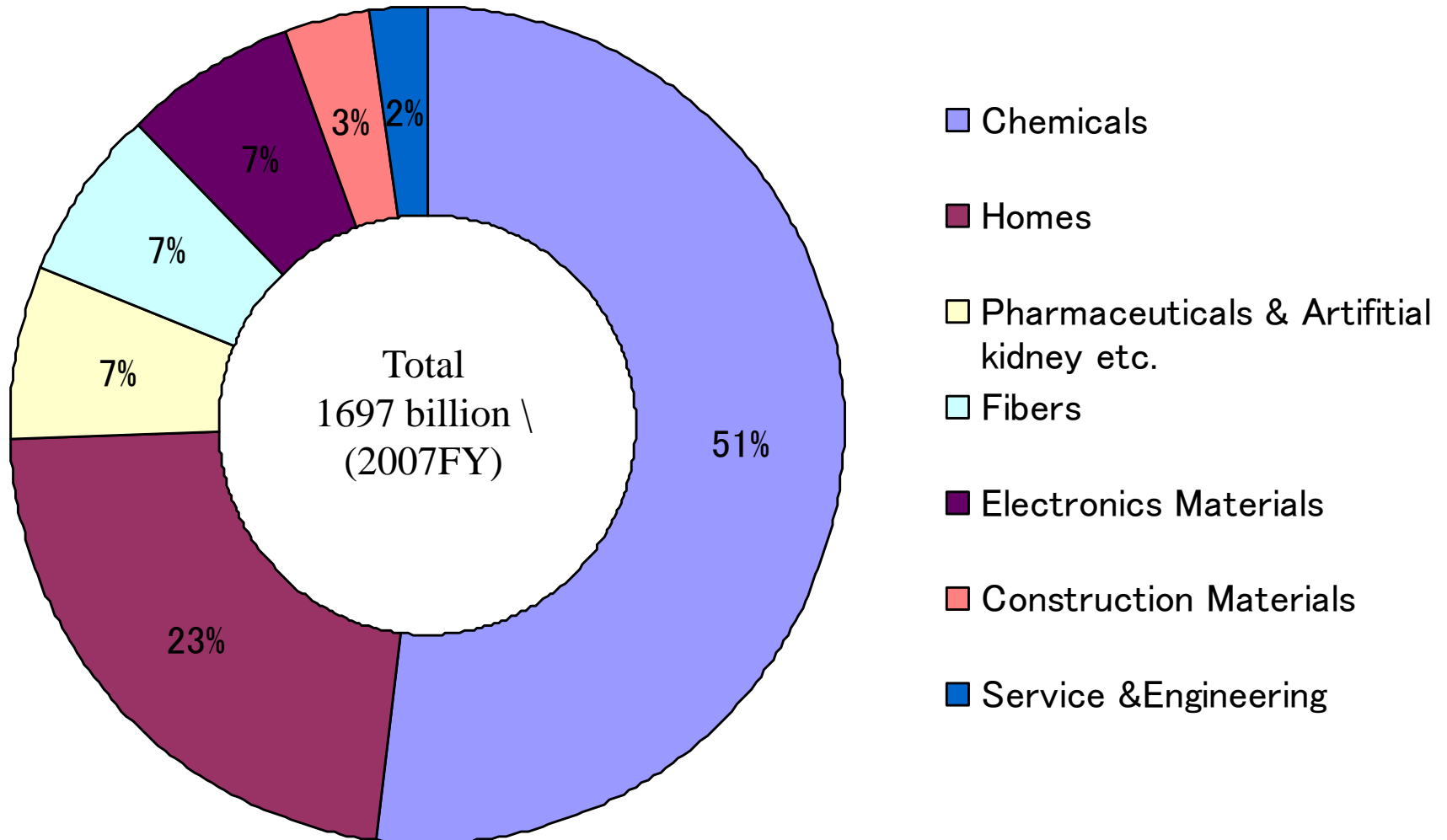
Not explicitly calculated
No realistic alternative
available



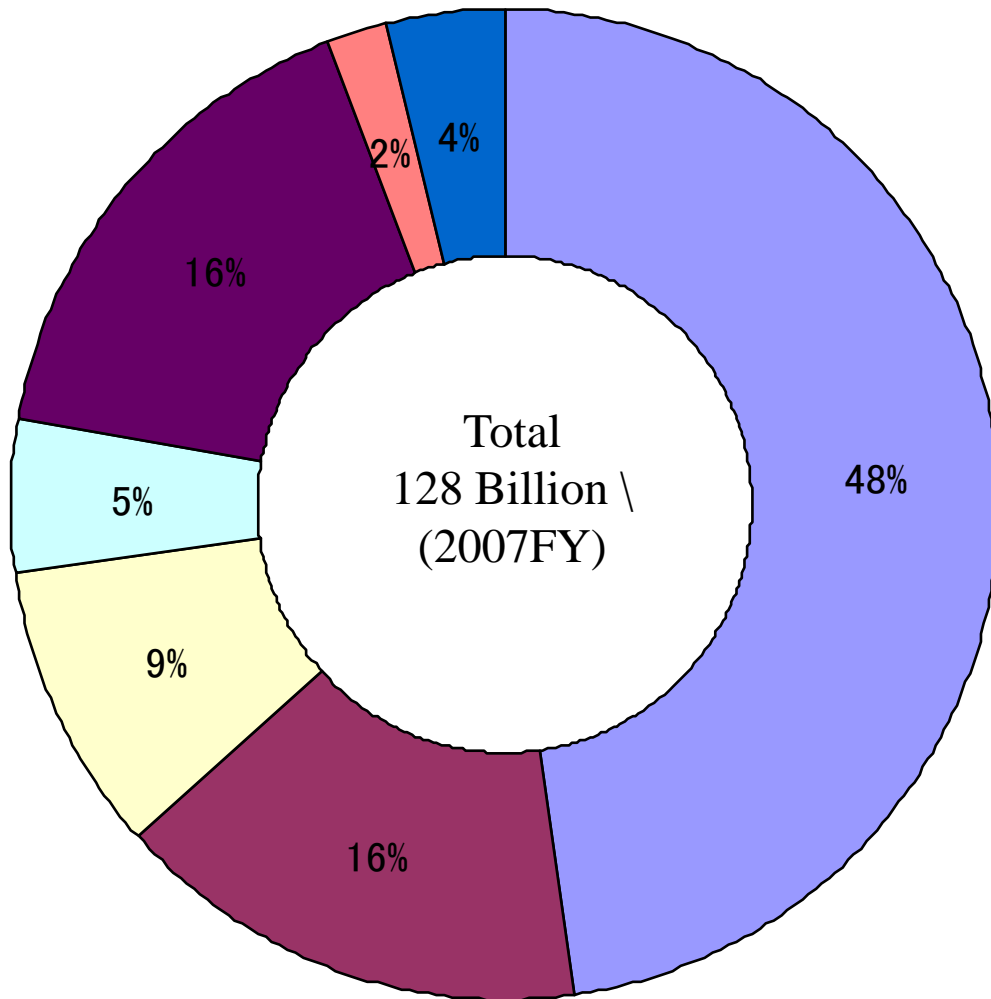
Part II

Evaluation of CO₂ emission from chemical products
of ASAHI KASEI Corporation based on
life cycle thinking

ASAHI KASEI CORPORATION - Net Sales -

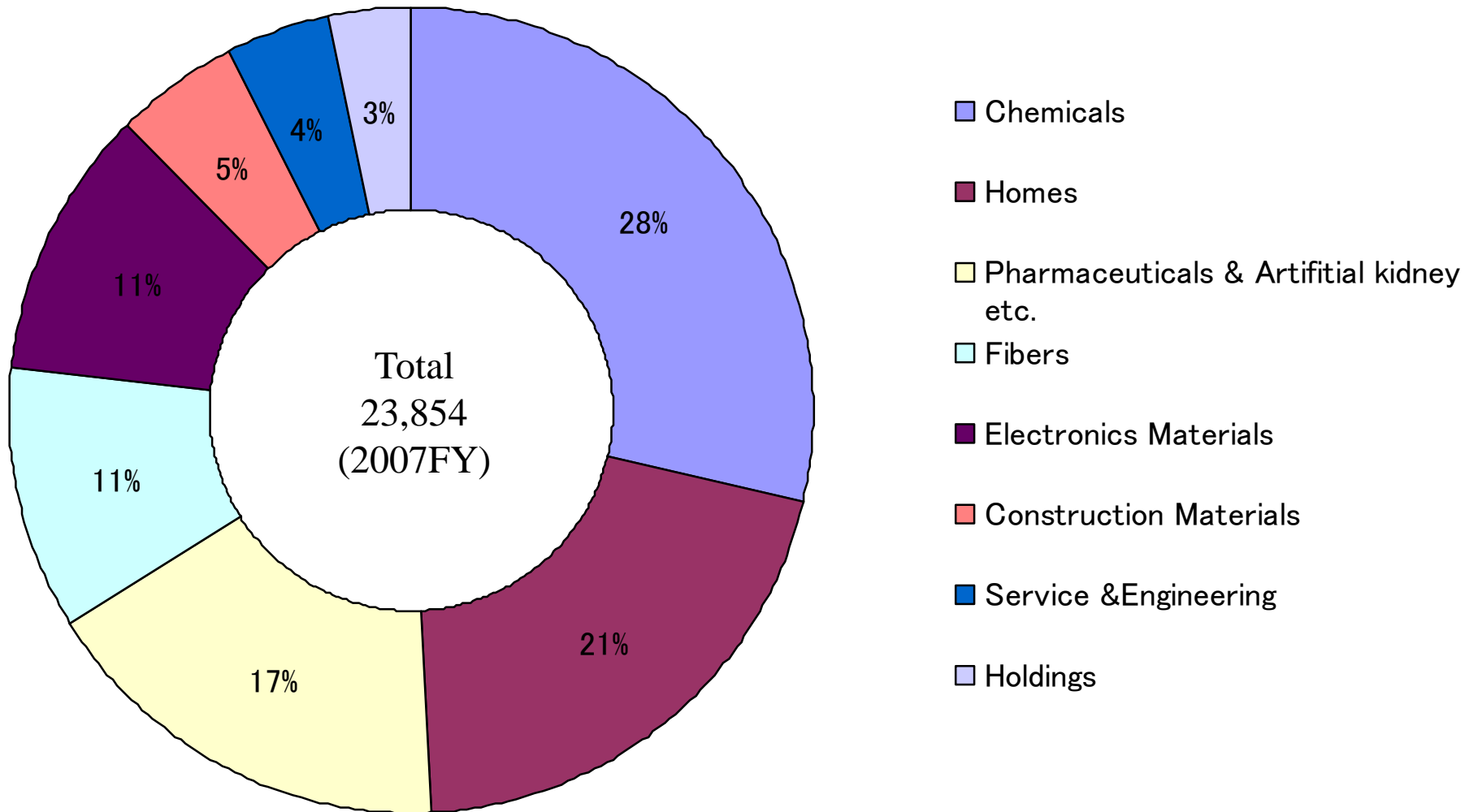


ASAHI KASEI CORPORATION - Operating Profit -



- Chemicals
- Homes
- Pharmaceuticals & Artificial kidney etc.
- Fibers
- Electronics Materials
- Construction Materials
- Service & Engineering

ASAHI KASEI CORPORATION - Employee -



ASAHI KASEI CORPORATION Group

Zhangjiagang
Asahi DuPont POM (Zhangjiagang) Co., Ltd.

Nantong
Asahi Kasei Performance Chemicals Corp.

Shanghai
Asahi Kasei Business Management (Shanghai) Co., Ltd.
Asahikasei Plastics (Shanghai) Co., Ltd.

Suzhou
Asahikasei (Suzhou) Plastics Compound Co., Ltd.
Asahi Kasei Electronics Materials (Suzhou) Co., Ltd.

Hangzhou
Asahi Kasei Marzosa (Hangzhou) Co., Ltd.
Asahi Kasei Medical (Hangzhou) Co., Ltd.
Hangzhou Asahikasei Spandex Co., Ltd.
Hangzhou Asahikasei Textiles Co., Ltd.

Korea
Tong Sun Petrochemical Corp., Ltd.
Asahi Kasei Adipic Acid (Korea) Co., Ltd.
Delegis Korea Corp.
Asahi Kasei EMD Korea Corp.

- Holding Company
- Chemicals segment
- Pharma segment
- Fibers segment
- Electronics Materials & Devices segment

Hong Kong
Asahi Kasei Plastics (Hong Kong) Co., Ltd.
Asahi Chemical (HK) Ltd.

Thailand
Asahikasei Plastics (Thailand) Co., Ltd.
Thai Asahi Kasei Spandex Co., Ltd.

Taiwan
Formosa Asahi Spandex Co., Ltd.
Asahi Kasei EMD Taiwan Corp.
Asahi Schwabel (Taiwan) Co., Ltd.
Asahi Kasei Wah Leif Hi-Tech Cor.

Europe
Asahi Kasei Plastics Europe SA/W
Asahi Photoproducts (Europe) SA/W
Asahi Photoproducts (UK) Ltd.
Asahi Kasei Medical Europe GmbH
Asahi Pharma Spain, SL
Asahi Kasei Spandex Europe GmbH
Asahi Kasei Fibers Italy SRL
Asahi Kasei Fibers Deutschland GmbH

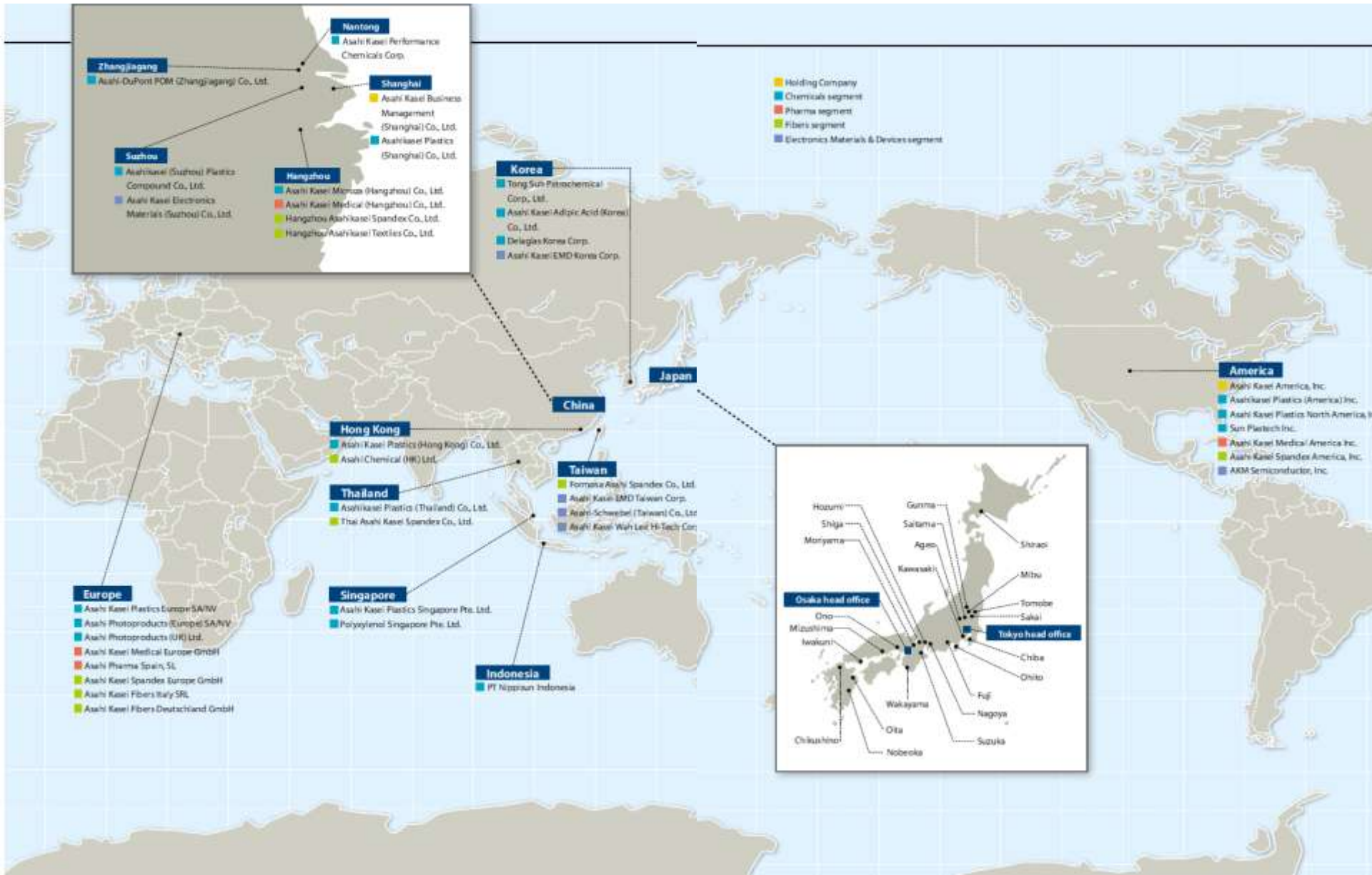
Singapore
Asahi Kasei Plastics Singapore Pte. Ltd.
Polyethylene Singapore Pte. Ltd.

Indonesia
PT Nipponan Indonesia

Osaka head office
Hozumi
Shiga
Moriyama
Gono
Mizushima
Iwakuni
Chikushino

Tokyo head office
Gunma
Saitama
Ageo
Kawasaki
Shizuoka
Mizu
Tomobe
Saka
Chiba
Ohta
Fujii
Nagoya
Suzuka
Wakayama
Oita
Nobeoka

America
Asahi Kasei America, Inc.
Asahikasei Plastics (America) Inc.
Asahi Kasei Plastics North America, Inc.
Sun Plastics Inc.
Asahi Kasei Medical America Inc.
Asahi Kasei Spandex America, Inc.
AKM Semiconductor, Inc.





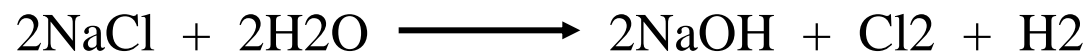
ION EXCHANGE MEMBRANE for ELECTROLYSIS



Electrolysis Plant



Ion Exchange Membrane



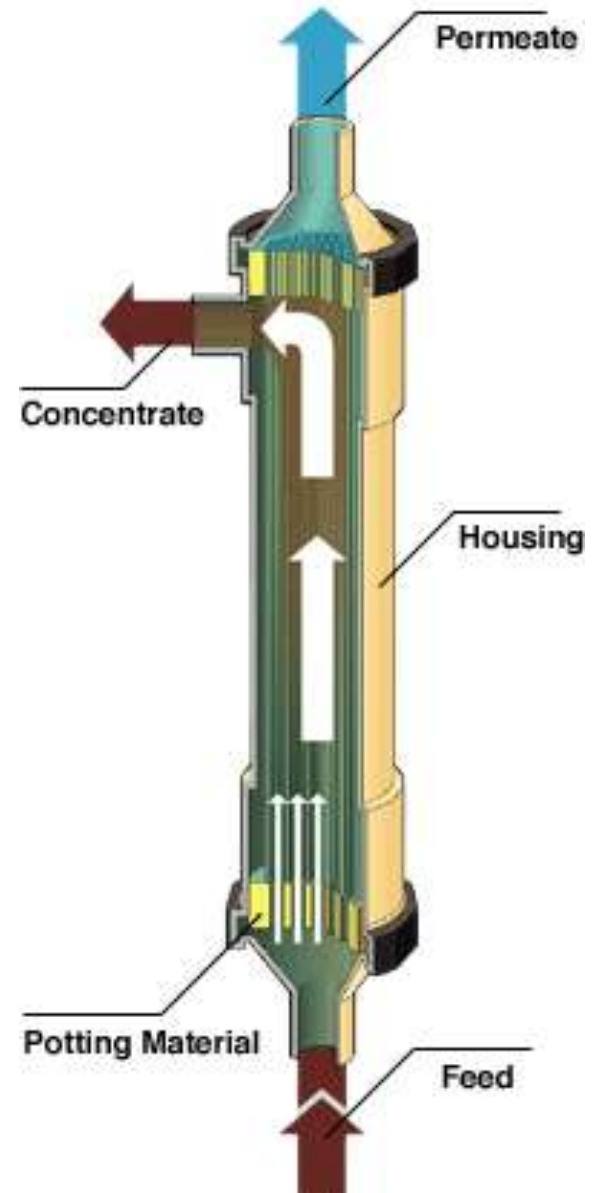
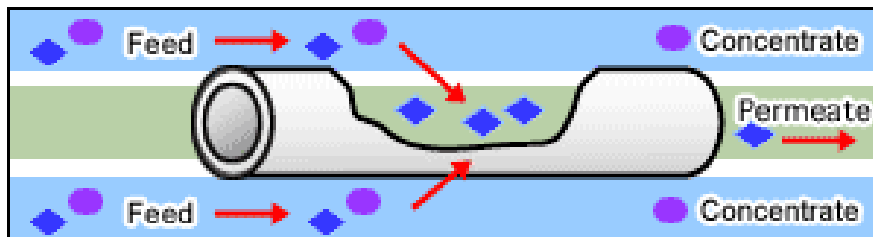
Life cycle CO₂ reduction of Ion exchange compared to Diaphragm and Mercury
 ~ comparison of electrolysis processes for NaOH manufacturing ~

Process	Ion exchange	Diaphragm	Mercury
Raw Material	NaCl aq.	NaCl aq.	NaCl aq.
Product	NaOH, Cl ₂ , H ₂	NaOH, Cl ₂ , H ₂	NaOH, Cl ₂ , H ₂
Electrolysis Energy	+	++	++
CO ₂ emission	+	++	++

Filtration module containing hollow fiber membrane (Microza)

Applications

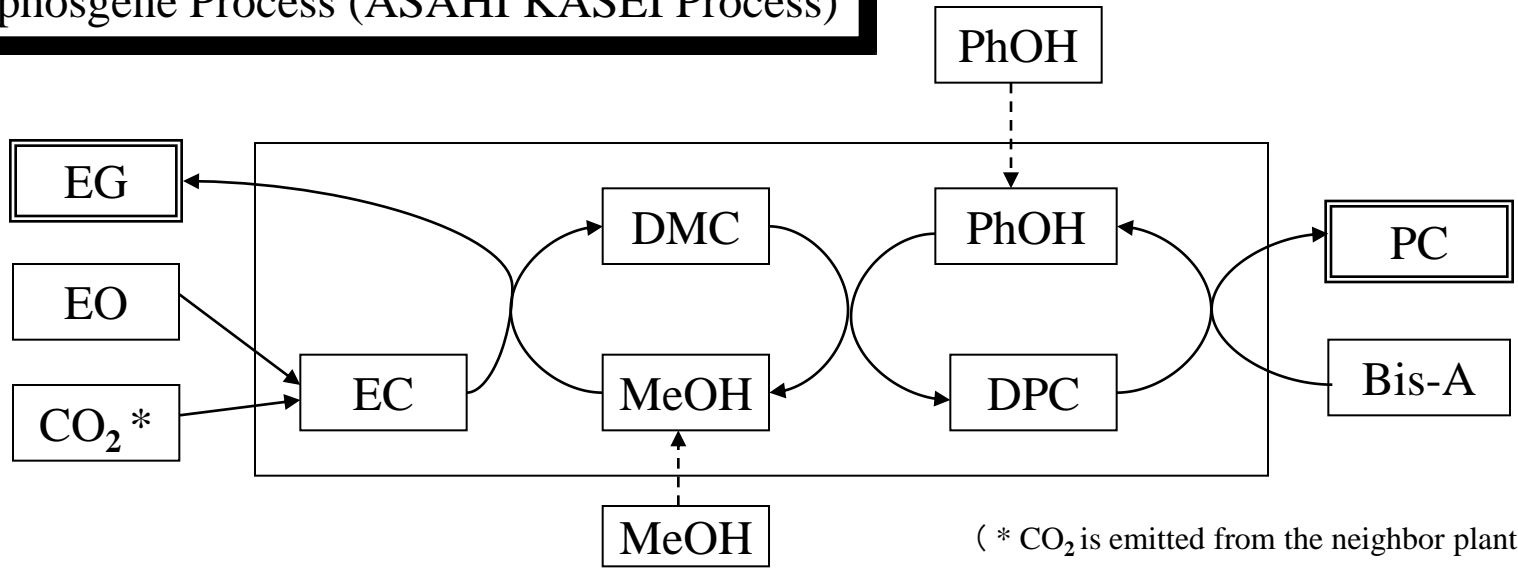
- filtration of water for drinking
conventional technology is sand filtration
- filtration of water for injection
conventional technology is distillation
- filtration of drain water from the plant of silica colloid
conventional technology is distillation



Life cycle CO2 reduction of Microza[®] compared to conventional technology

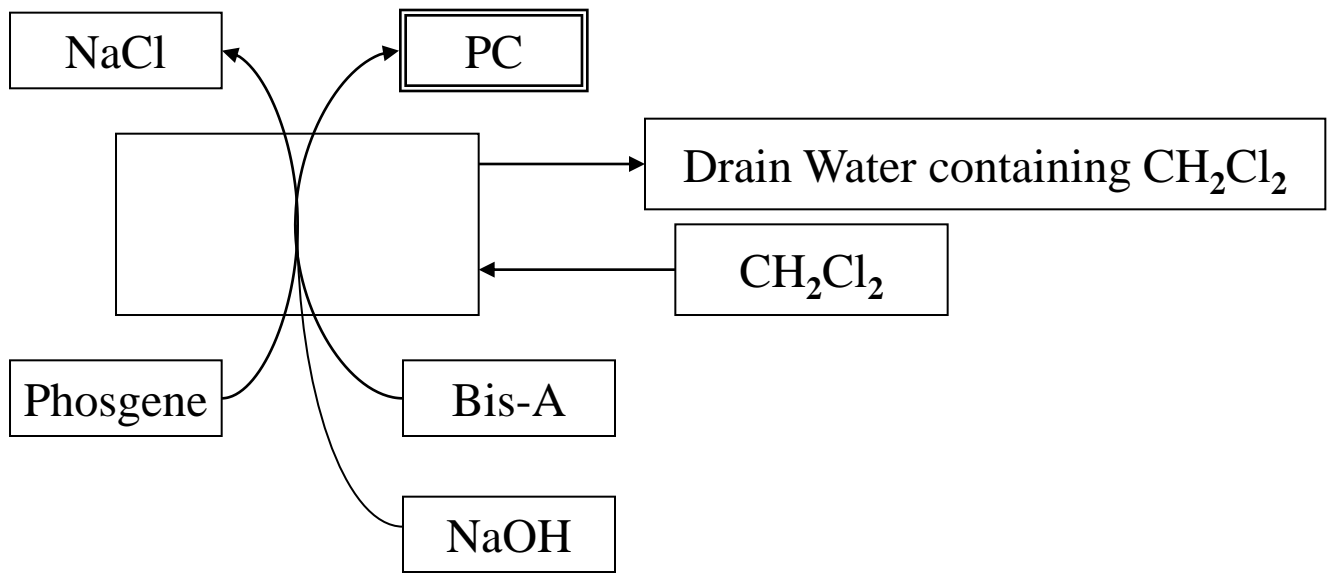
Application	Microza [®]		conventional	
	process energy	CO2 emission	process energy	CO2 emission
Filtration of water for injection	+	+	+++++	+++++
Filtration of drain water from silica colloid plant	+	+	+++++	+++++

Non-phosgene Process (ASAHI KASEI Process)



(* CO₂ is emitted from the neighbor plant)

Phosgene Process (Conventional Process)



Life cycle CO2 reduction of non-phosgene process compared to phosgene process

Non-phosgene Process

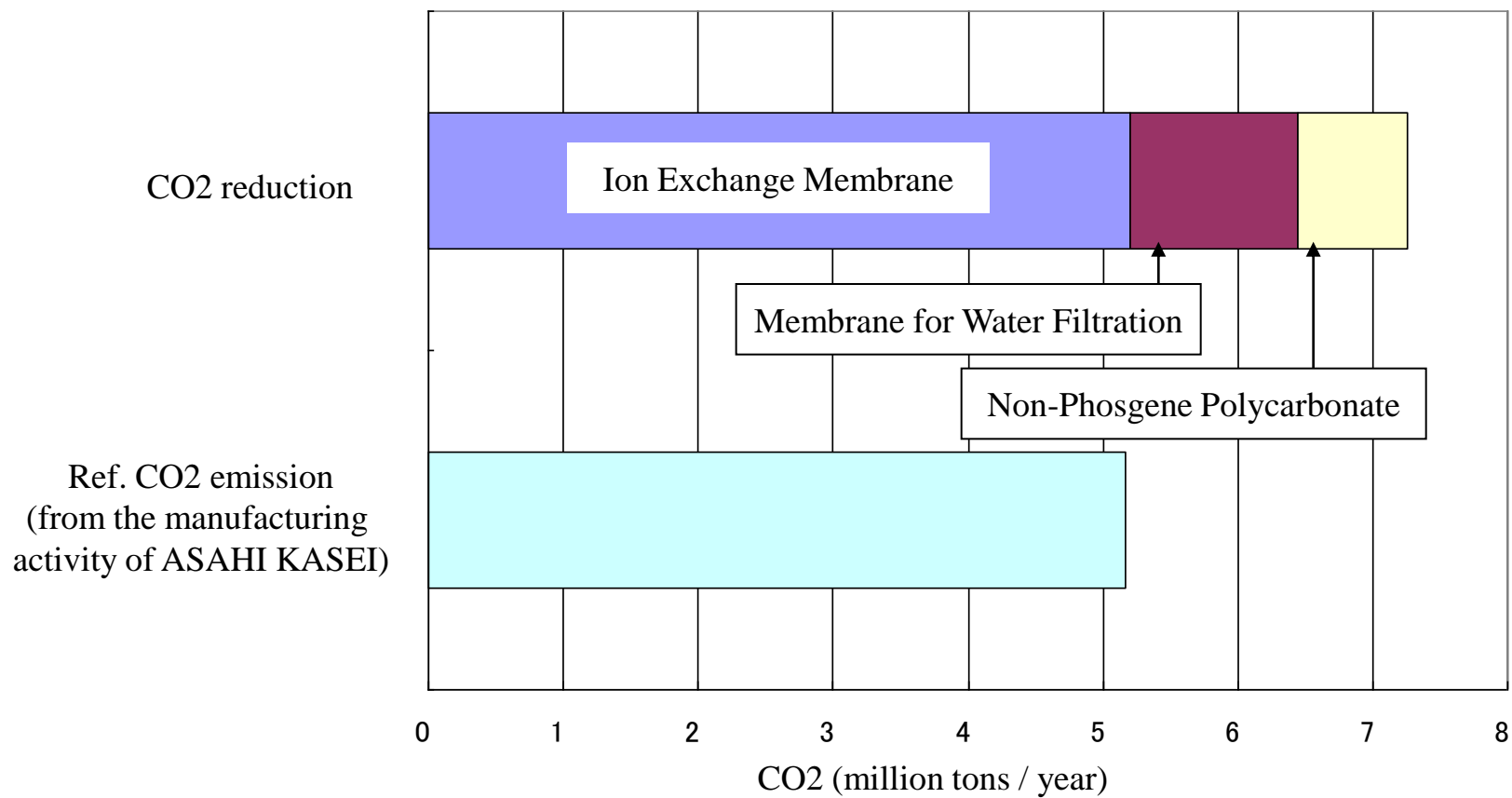
Raw Material	CO2 emission
CO2	—
Ethylene oxide	0 *
Bisphenol A	+
Total	T1
Product	Polycarbonate Ethylene glycol

* cancelled because ethylene glycol is sold as product

Phosgene Process

Raw Material	CO2 emission
Phosgene	+
NaOH	+
Bisphenol A	+
Total	T2
Product	Polycarbonate

CO2 emission $T1 < T2$



Life cycle CO2 reduction of ASAHI KASEI products

Conclusion

~ Part I ~

1. The worldwide LCA study on chemical products by ICCA showed the GHG emission in mining, producing, processing and disposal was one third the size of the GHG reduction in use.

~ Part II ~

2. In ASAHI KASEI Corp., an ion exchange membrane, a membrane for water filtration and polycarbonate made from chemical materials other than phosgene are the products which reduce CO2 emission in use phase.
3. The GHG reduction during the use phase of these three products alone was larger than the GHG emission of all products of the corporation combined.

~ Part I, II ~

4. Expanding sales of chemical products which reduce GHG emission during use can contribute to the overall reduction of GHG emission through their life cycle.

(nakahashi.jb@om.asahi-kasei.co.jp)