

Biomass Power and Gasification Technologies Toward Net-Zero Society

CEFIA FLAGSHIP BIOMASS WEBINAR

2026/01/14



Sumitomo Heavy Industries, Ltd.

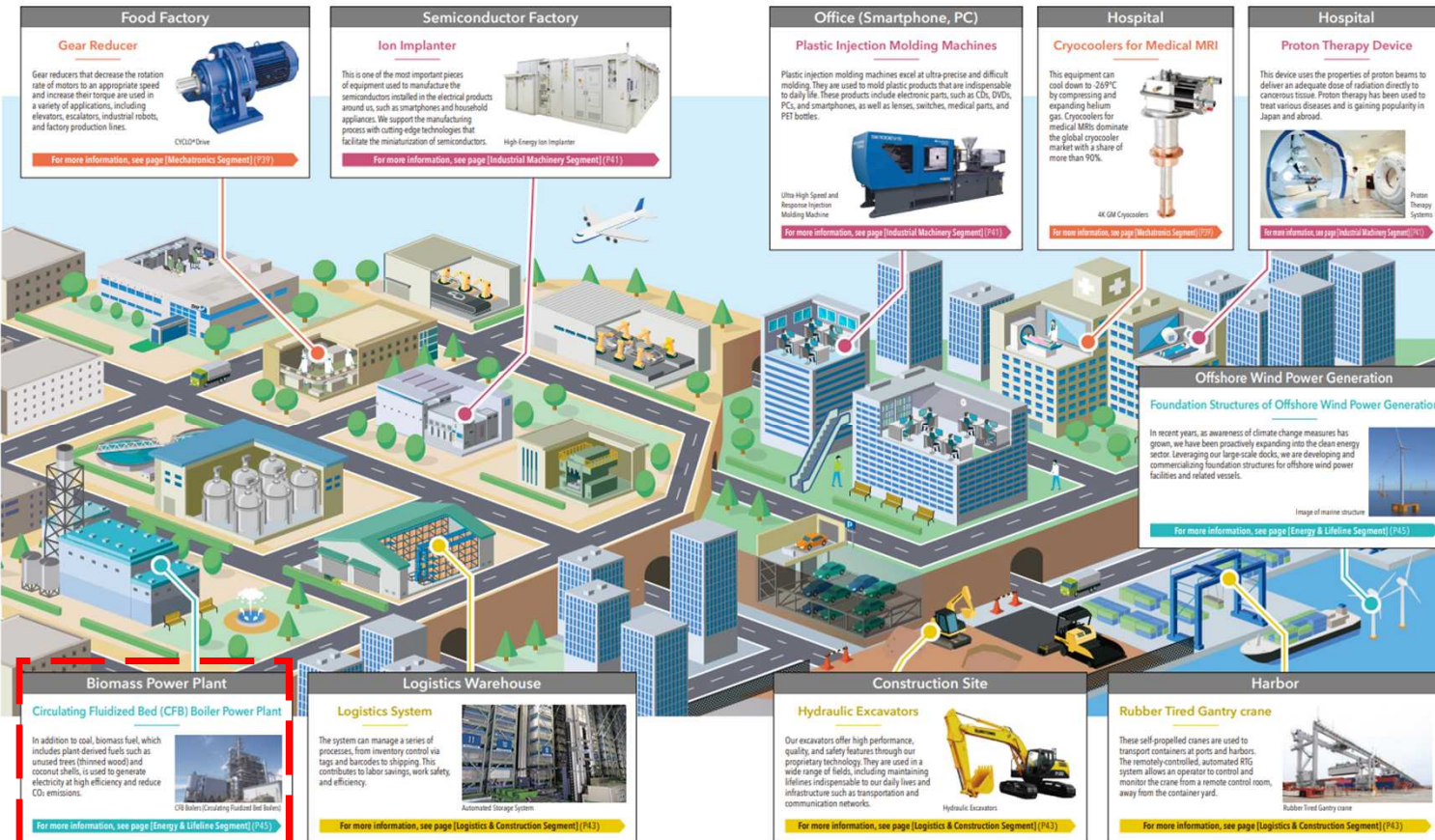
I N D E X

- 01** **Brief Overview of SHI**
- 02** **Circulating Fluidized Bed (CFB) & Bubbling Fluidized Bed Boilers (BFB)**
- 03** **Fluidized Bed Gasifiers**
- 04** **Technology Modernization & Upgrade (TMU)**

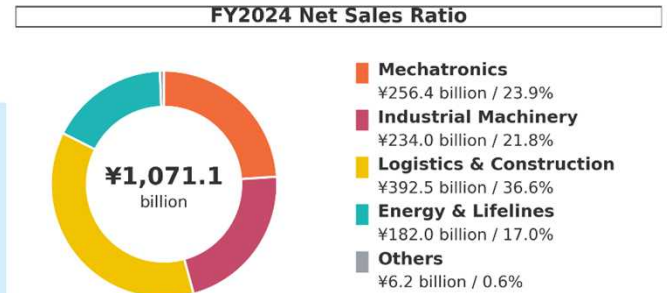
Please find our 2025
integrated report
(as per Dec 31, 2024)



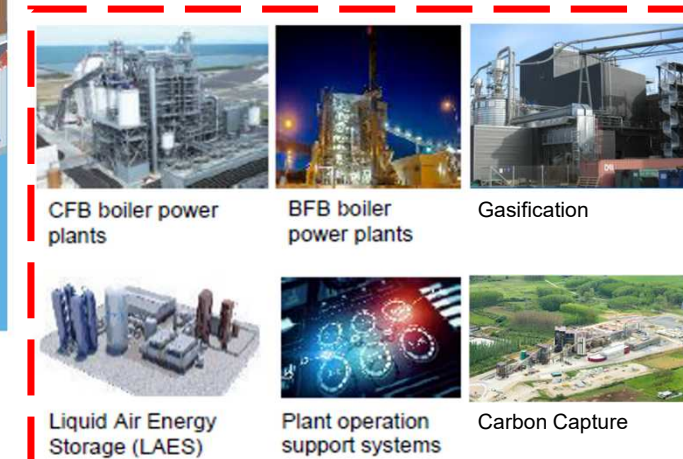
SHI's Business Segments



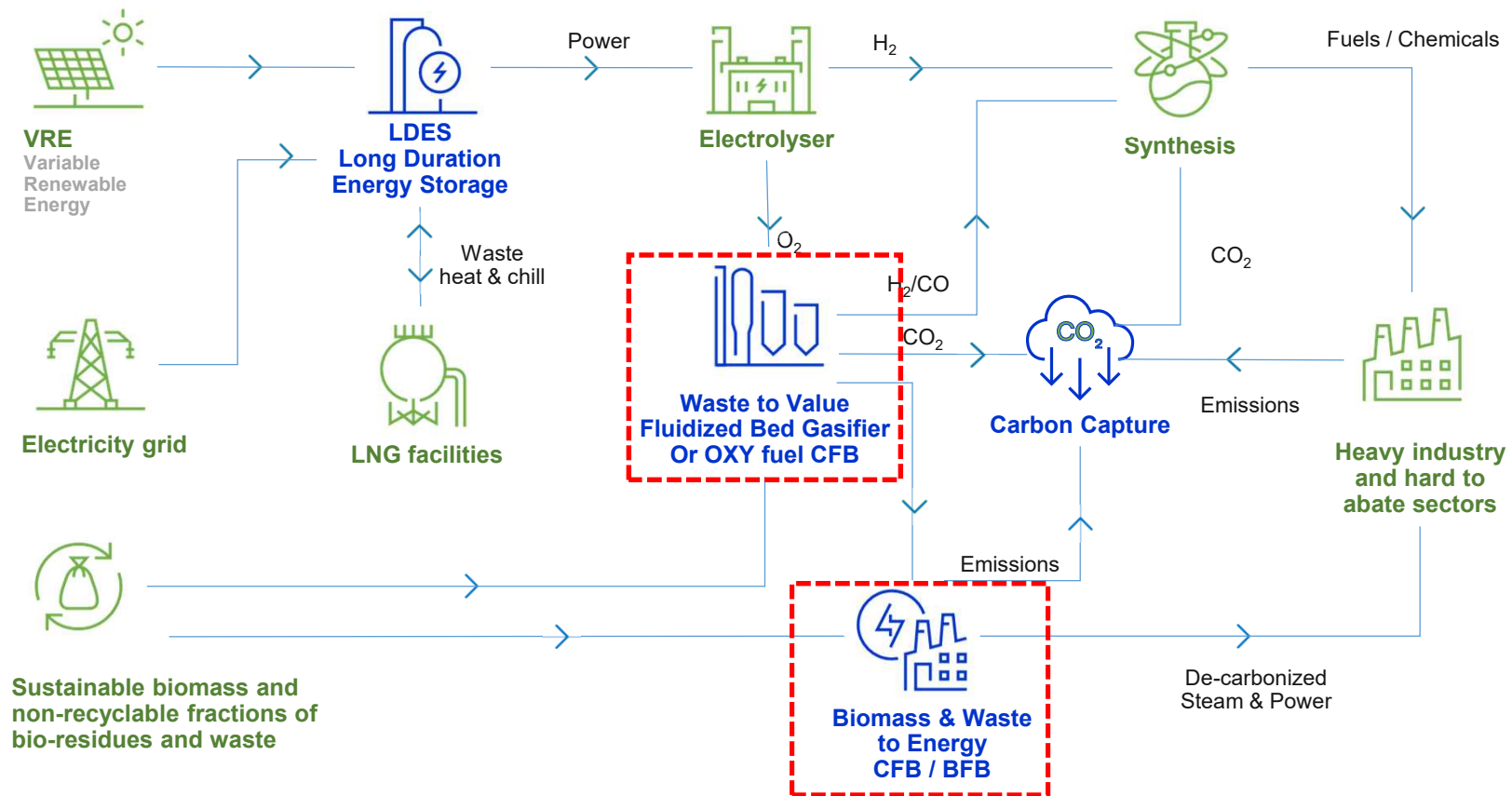
Sales by Segment



Energy & Lifelines



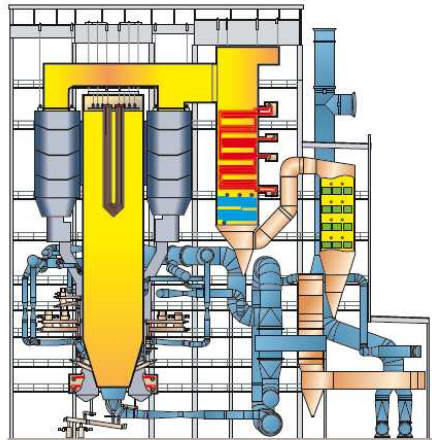
Our product supporting net zero ecosystem



CFB and BFB Boilers for Biomass Fuels

CFB & BFB Technology are suitable for firing wide variety of fuels including biomass and waste residues

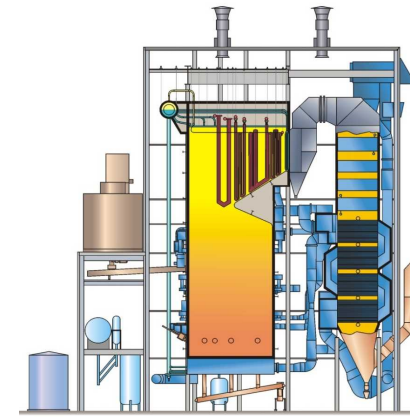
Circulating Fluidized Bed (CFB)



Unit delivered **+500**

Size **5~550MWe**

Bubbling Fluidized Bed (BFB)



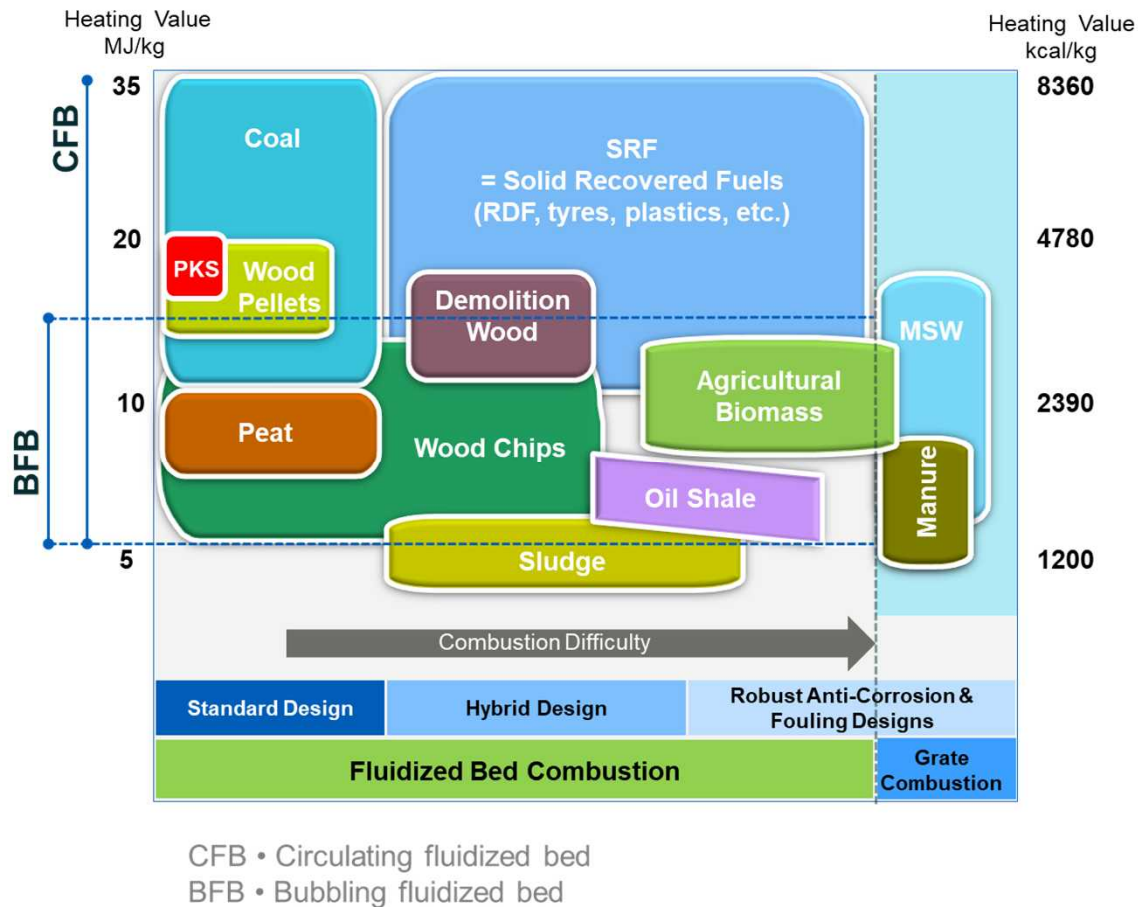
Unit Delivered **+140**

Size **~100MWe**

Key features of our CFB and BFB technology:

1. **Fuel Flexibility** - stable combustion over a wide range of fuels
2. **Simple Emission Control** - Very low NO_x, Low CO and Sulfur Captured in Furnace
3. **High reliability / Low maintenance** - No ash slagging, which minimizes furnace corrosion and fouling

Fluidized bed combustion technology has the widest fuel range including non-edible biomass



We are the global CFB market leader

Served market order over last 10 years (2014-2023)

SHI Group has supplied 540 Circulating Fluidized Bed (CFB) steam generators from 1975 - Today

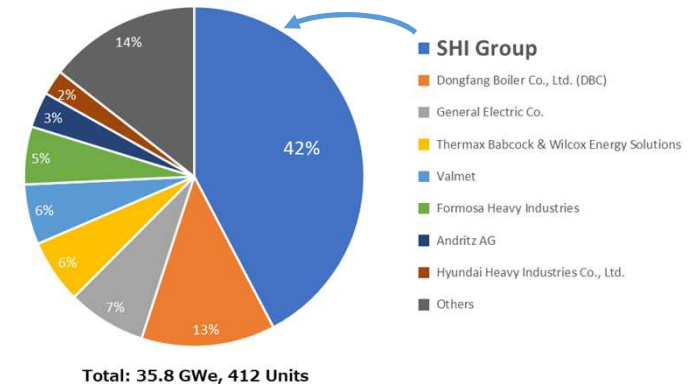
- Totaling 43 GWe in power capacity
- 3 GWe Supercritical Once-Thru units
- 37 GWe of Natural Circulation units
- Single unit capacities up to 550 MWe
- Proven by over 50M+ hours of operation
- Burning a wide range of premium and waste coals, biomass, petroleum cokes, oil shale, SRF (*)

(*) SRF (Solid Recovered Fuel) involve following wastes/materials;

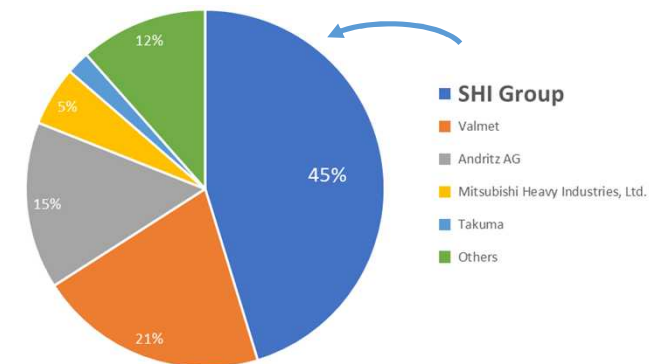
- **Biodegradable waste**; food and kitchen waste, green waste, paper.
- **Recyclable material**; paper; glass, bottles, cans, metals, certain plastics, fabrics, clothes, etc.
- **Inert waste**; construction and demolition waste; dirt, rocks, debris.
- **Composite wastes**; waste clothing, Tetra-Packs, waste plastics such as toys, garden furniture etc.

Source: GRDS, April 18. CFB boiler type. Excludes domestic orders provided by domestic suppliers in China and India.
Licensee orders included under licensor market share. Market Share based on MWe. Biomass Fuel Types Exclude municipal solid wastes and refuse derived fuels.

**Global CFB Orders
All Sizes
SHI Group Served Market Over 2014 - 2023 Period**



**Global Biomass CFB Orders
All Sizes
SHI Group Served Market Over 2014 - 2023 Period**



CFB Gasification Technology

❑ Air Gasification Technology

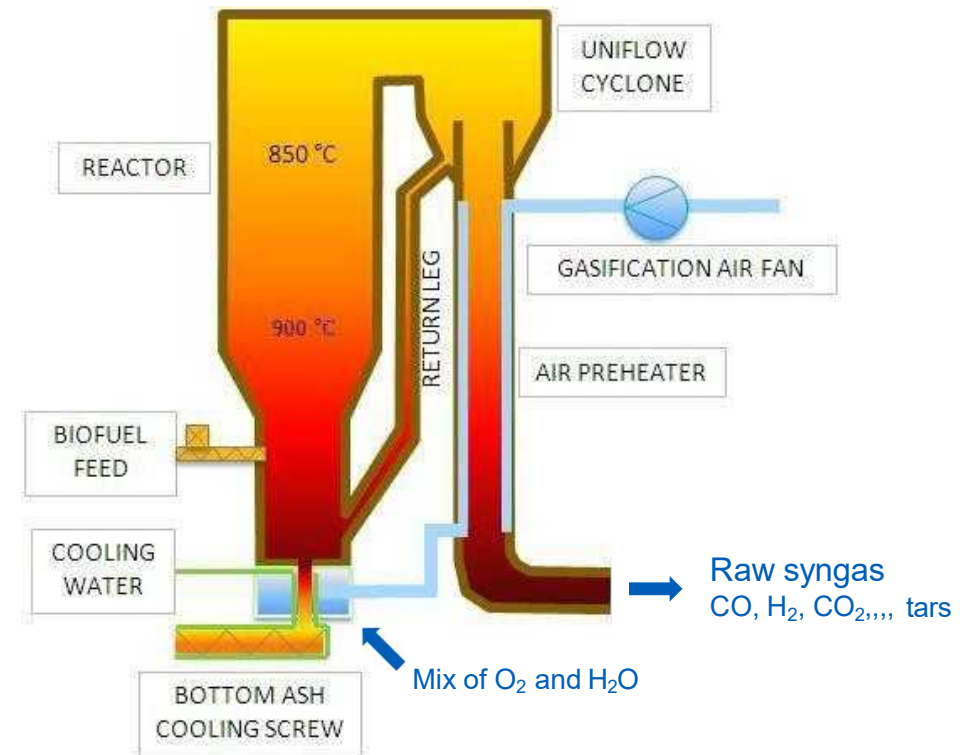
- Final Product → Syngas for **Heat and Power**

❑ Oxy-Steam Gasification Technology

- Final Product → Ultra-clean Syngas for **Chemical Process**

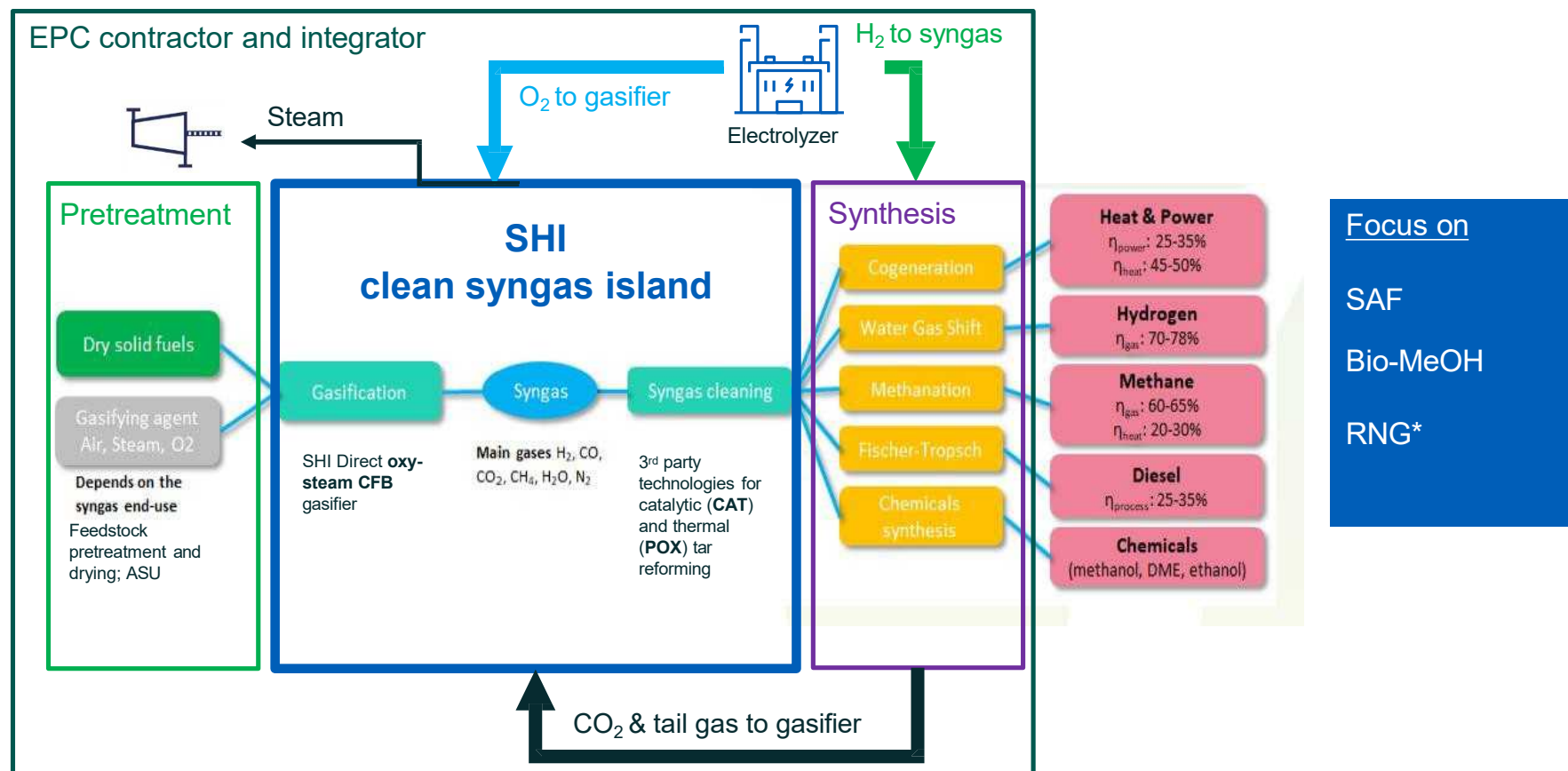
❑ Fluidized Bed Technology with for long particle residence times for **High Efficiency** even for low quality fuels

❑ Low-temperature fluid bed gasification, the residual ash never melts, allowing the use of feedstocks considered too corrosive for other gasifiers.



* CFB = Circulating Fluidized Bed

Syngas Island Supplier and Integrator



*RNG: Renewable Natural Gas

SHI's long history with Fluidized Bed Gasification

Over 40 years experience with biomass and waste gasifiers

11 gasifiers

(2 pilots, 2 demos, and 7 commercials)

~ 1 million operating hours

Our Fluidized Bed Gasifier References

Start-up	Customer	Country	MWth	Feedstock	Application
2009	NSE Biofuels	Finland	12	Biomass	Biodiesel demo
2002	Electrabel	Belgium	60	Biomass	Biomass co-firing
2000	Corenso United	Finland	60	Plastic Waste	Recycling & Energy Recovery
1997	Lahti Energia	Finland	60	Biomass & waste	Bio/waste co-firing
1993	Sydskraft	Sweden	18	Biomass	Biomass IGCC demo
1986	Kemira	Finland	4	Coal, peat	Pilot
1985	Portucel	Portugal	15	Biomass	Lime kiln
1984	ASSI Karlborg	Sweden	27	Biomass	Lime kiln
1984	Norrsundet Bruks	Sweden	25	Biomass	Lime kiln
1983	Oy W. Schauman	Finland	35	Biomass	Lime kiln
1981	Alhstrom Lab	Finland	3	Fossil, bio & waste	Pilot

Additional operating experience

- Lahti long term tests on gas cooling and filtration in 2003-2004
- Karhula atmospheric pilot gasification test runs with O₂-enriched air in 2005
- Corenso REF gasification tests / demonstration in commercial scale in 2011-2012
- Corenso O₂ enriched air gasification in commercial scale 2013

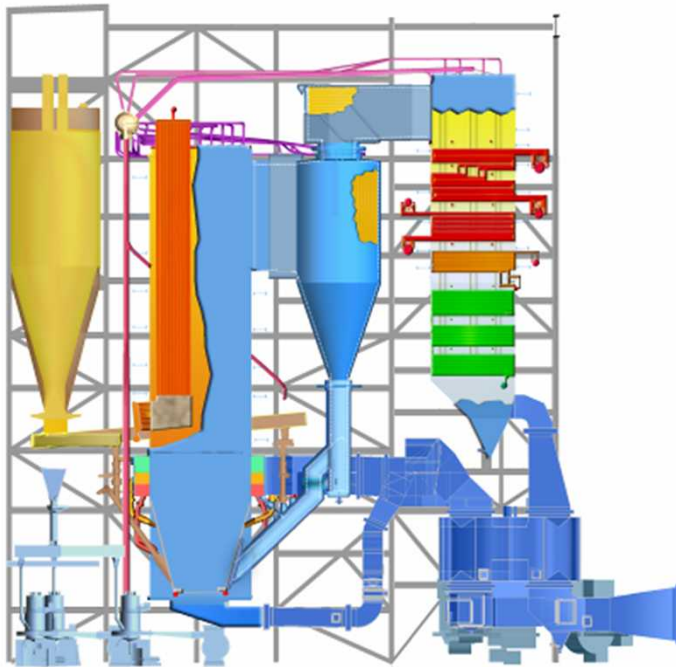
IGCC: Integrated Gasification Combined Cycle

4

Technology Modernization & Upgrade (TMU)

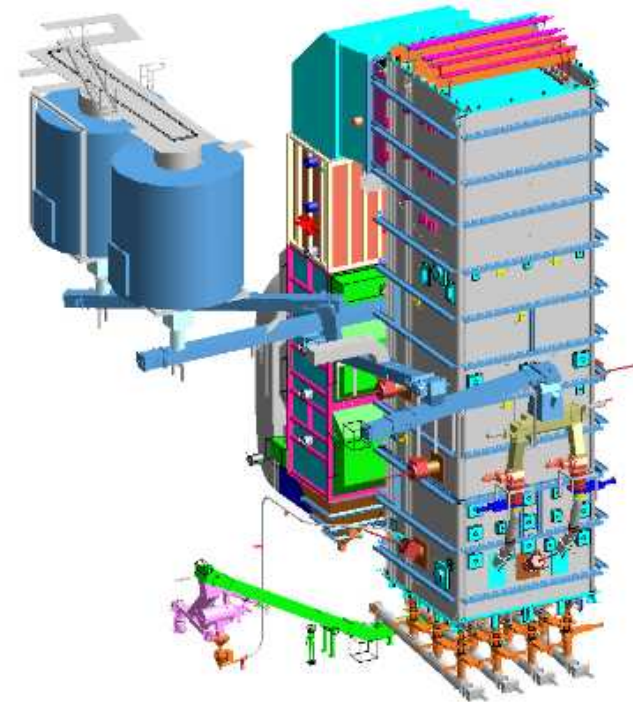
2 approaches to increase Biomass and SRF share

CFB Boiler upgrade



Increasing biomass and/or SRF share
in existing CFB boiler

BFB or CFB retrofit



Modifying existing boiler combustion
technology to BFB or CFB

4 Technology Modernization & Upgrade (TMU)

CFB & BFB Retrofit cases around the world

CFB Boiler Upgrade newest case

Case: Hanwha G2, Gunsan, South Korea

Conversion from coal to biomass

Hanwha G2	Original design	Upgrade
Fuels	<ul style="list-style-type: none"> Sub-bituminous Coal 0-100% Wood Pellets < 50% 	<ul style="list-style-type: none"> Wood Chips 60-80% Wood Pellets < 35% Sewage sludge pellets <10%
Steam output	435 tph 100 MWe	435 tph 100 MWe
Steam parameters	125 bar 540 °C	125 bar 520 °C
Start-up	2017	2025



Del. Year	Customer/Site	City	Country	# units	Boiler type	MWt	Flow [kg/s]	Press. [bar]	Temp. [°C]	Fuels	Retrofit from
2022	Nevel Oy Forssan voimalaitos	Forssa	Finland	1	BFB	57	20	61	510	100% Biomass, max. 50% SRF	BFB
2019	Vantaan Energia	Vantaa	Finland	1	BFB	110	40	115	510	Forest residues, demolition wood, peat, oil, natural gas	Oil Fired Boiler
2018	NeVe	Rovaniemi	Finland	1	BFB	40	-	16	-	Forest residues, peat	New BFB to existing building
2013	Etelä-Savon Energia	Mikkeli	Finland	1	BFB	101	35	66	515	Bark, Wood Residue, peat, Oil	BFB
2007	Segezha Pulp & Paper Mill	Segezha	Russia	1	BFB	45	15	40	440	Bark, peat, Oil	BFB
2006	Vapo	Lieksa	Finland	1	BFB	30	10.5	60	510	Peat, Bark, Sawdust, Oil	CFB
2006	Stora Enso Hylte AB	Hyltebruk	Sweden	1	BFB	69	25	63	450	De-Inking Sludge, Biosludge, Demolition Wood, Bark	Oil Fired Boiler
2003	Celulosa Arauco y Constitución	Constitución	Chile	1	BFB	51	19.7/11.1	62	450	Bark, Wood Residue, Sludge, Oil	Grate Fired Boiler
2002	Paneles Arauco	Cholguan	Chile	1	BFB	123	47.2	82	490	Bark, Wood Residue, Sludge, Oil	Chemical Recovery Boiler
2000	Södra Cell AB	Mönsterås	Sweden	1	BFB	73 /105	25 / 37	61	480	Bark, Sludge, Oil	Grate Fired Boiler
2000	Modo Paper AB	Husum	Sweden	1	BFB	87	31	60	450	Bark, Sludge, Oil	Grate Fired Boiler
1998	AssiDomän Sepap a.s.	Steti	Czech Republic	1	CFB	176	61.1	94	535	Coal, Bark, Sludge	Pulverized Coal Fired Boiler
1997	Celulosa Arauco Y Constitucion, S.A.	Arauco	Chile	1	BFB	67	25	43	400	Bark, Sawdust	Grate Fired Boiler
1997	Stora Cell AB	Norrundet	Sweden	1	BFB	50	15.3	60	450		Grate Fired Boiler
1997	Metsä-Serla Oy	Simpela	Finland	1	BFB	113	40	115	525	Peat, Bark, Sludge, Oil	Pulverized Peat Fired Boiler
1997	Willamette Industries	Hawesville, Kentucky	U.S.A.	1	BFB	170.1/136.1	63/50.4	41.3	339	Hog Fuel, Gas, Oil	New Boiler in Existing Steel Structure
1997	Elektrociepłowni Ostrołęka	Ostrołęka	Poland	1	BFB	35	13	40	450	Bark, Primary Sludge, Biosludge	Pulverized Coal Fired Boiler
1997	Oy Metsä-Botnia Ab	Kaskinen	Finland	1	BFB	78/96	26.5/35	85	500	Bark, Sludge, Oil	Grate Fired Boiler
1996	Klabin Fabricadora de Papel e Celulose SA Monte Alegre Mill	Telemaco, Borbary	Brazil	1	BFB	113.8	41.7	47	430	Bark, Wood, Chips, Sludge	Grate Fired Boiler
1996	UPM-Kymmene Oy Kaukas	Lappeenranta	Finland	1	BFB	109.3	40	115	500	Bark, Sludge, Peat,	Grate Fired Boiler
1995	AS Anne Soojus	Luunja	Estonia	2	BFB	18	-	-	-	Peat, Wood Chips	Oil Fired Boiler
1995	Sunila Oy	Sunila	Finland	1	BFB	77.3	28	65	470	Natural Gas, Wood Residues, Primary Sludge, Biosludge	Grate Fired Boiler
1995	Söderenergi AB Igelstaverket	Södertälje	Sweden	1	BFB	120	-	14-May	200	Wood Residues, Oil, Coal, Peat	Pulverized Coal Fired Boiler
1994	Oy Metsä-Botnia Ab	Kemi	Finland	1	BFB	115	40	85	480	Wood Residues, Chips, Peat, Sludge	Grate Fired Boiler
1993	Landstinget, Skaraborg Kärrsjukhuset	Skövde	Sweden	1	BFB	20	-	20	220	Wood Chips	Grate Fired Boiler
1993	Mantán Energia Oy	Mantta	Finland	1	BFB	94.3	33.3	75	510	Peat, Oil, Biofuel, Sludge	MgO-Boiler
1993	Imatran Voima Oy	Uimaharju	Finland	1	BFB	91.4	32	83	480	Bark, Sludge	Recovery Boiler
1991	Elektrim KWK Czechoz Coal Mine	Tychy	Poland	1	BFB	46		16	155	Coal, Diesel Oil	Grate Fired Boiler
1990	Paper Mill	Rauma	Finland	1	BFB	60	22	62	465	Waste Fiber, Bark, Coal, Sludge	Recovery Boiler
1990	Novosibirsk Electrode Works	Novosibirsk	Russia	2	BFB	116		10	150	Graphite, Coal, Anthracite	Pulverized Coal Fired Boiler
1990	VVO Technoexport Pulp & Paper Mill	Svetogorsk	Russia	1	BFB	34/56	12.5/20.8	40	440	Bark, Oil	Oil Fired Boiler
1990	TPO Karelssprom Pulp & Paper Mill	Kondupogabumpram	Russia	2	BFB	40/60	13.9/20.8	40	440	Bark, Sludge, Oil	Local-Made Steam Boiler
1985	Metsä-Sellu Oy	Aänekoski	Finland	1	CFB	76	27.8	83	480	Coal, Wood Residues, Peat, Oil,	Recovery Boiler
1985	Paper Mill	Rauma	Finland	1	BFB	50	18.3	62	465	Wood Residues, Peat, Oil,	Recovery Boiler
1983	Enso Oy	Varkaus	Finland	1	CFB	20	6.9	61	480	Wood Residues	La Mont Boiler
1979	Suomen Kuitulevy	Pihlaja	Finland	1	CFB	15	5.6	84	520	Peat, Wood Residues	Grate Fired Boiler
1977	IVO-yhtiöt	Kokkola	Finland	1	BFB	24	10	60	500	Coal, Peat, Wood Residues	Co Pyrite Roasting Plant
1977	IVO-yhtiöt	Kokkola	Finland	1	BFB	17.5	7	60	500	Coal, Peat, Wood Residues	Pyrite Roasting Plant



All forward-looking statements regarding the company's future performance are based on information currently available to Sumitomo Heavy Industries and determined subjectively. Future performance is not guaranteed and all information related to future performance contained herein is subject to changes in business environments.