



Evaluation of Emissions from Thermal Conversion Technologies Processing Municipal Solid Waste and Biomass

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- **Previous Studies**
- **Status of Thermal Conversion Technologies**
- **Updated Review of Emissions**



Previous Studies

- 2004 California Integrated Waste Management Board
 - Technical Evaluation of Conversion Processes (UCR and UCD)
 - Life Cycle Analysis (RTI)

- 2006 California Integrated Waste Management Board
 - Case Studies – Emissions from Three Thermal Conversion Processes Using Waste Feedstocks (UCR)

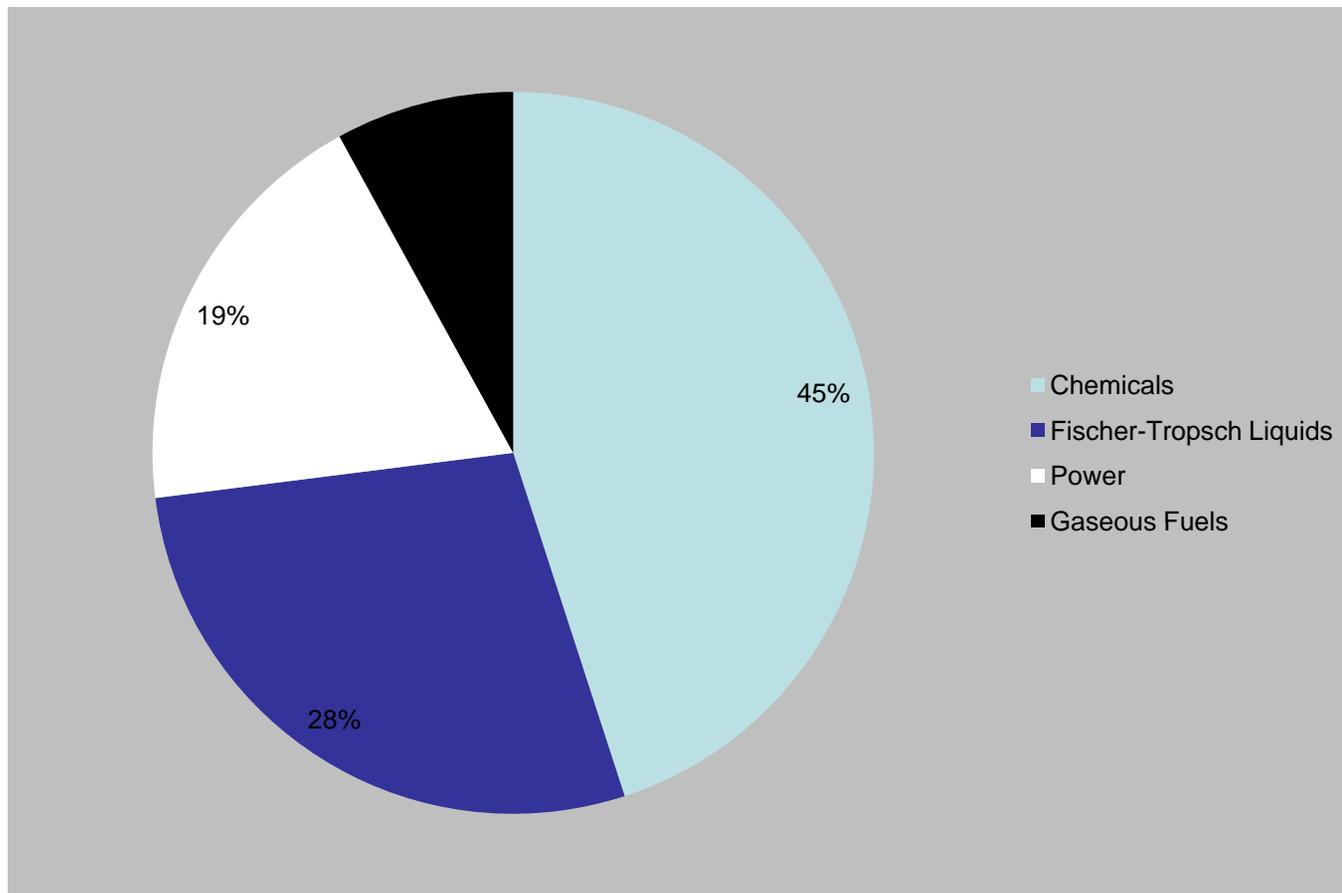


Status of Thermal Conversion Technologies

- US Department of Energy – World Gasification Database
 - 144 Major Operating Plants Employing 427 Gasifiers
 - Plants Operating in 27 Countries
 - More than 50% of Syngas Production Occurs in China/South Africa
 - Total Output of 56,000 MW Thermal Equivalent
 - By 2010, New Plants Will Provide Additional 17,000 MW Thermal



Current End-Use of Syngas Production





Emissions From Thermal Conversion Processes

- No regulatory limits currently in place in the US for thermal conversion processes
- Comparison to other emissions limits
- Results and/or regulatory limits converted to normalized concentration values for comparison
 - US EPA limits for starved air combustors
 - South Coast Air Quality Management District (SCAQMD) permit limits for municipal solid waste (MSW) incinerators
 - European Union limits for thermal conversion processes
 - Japanese Air Standards

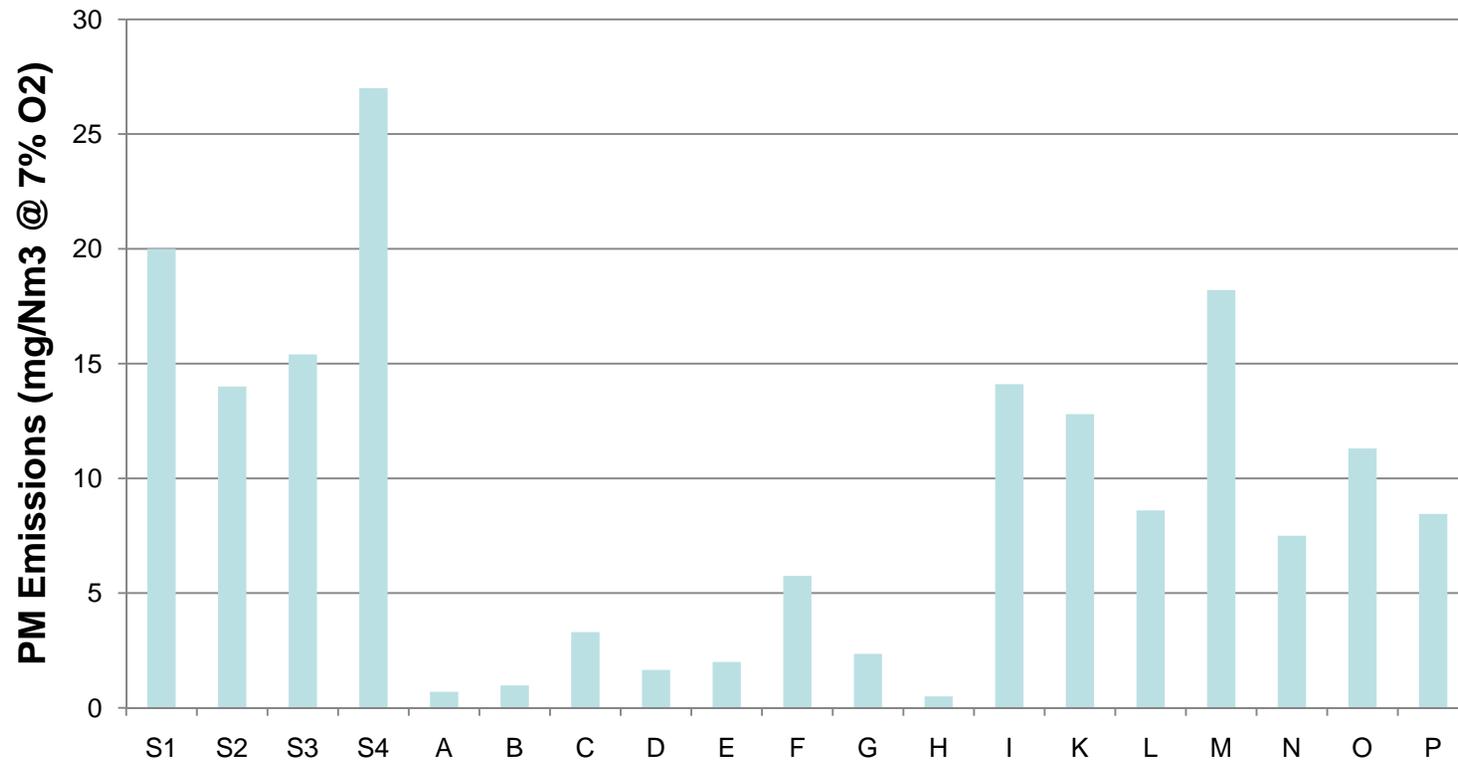


Emissions From Thermal Conversion Processes

	Company	Technology	Feedstock	Location
S1	US EPA Standard (new MSW incinerators)			
S2	European Commission 2000/76 Standard			
S3	Japanese Standard			
S4	SCAQMD MSW Incinerator Permit Limits			
A	Ebarra TwinRec	Fluidized bed gasification/ash melting	420 tpd Industrial/MSW	Kawaguchi, Japan
B	Entech Renewable Energy Technologies	gasification	3.5 tpd medical waste	Kuznica, Poland
C	InEnTec	Plasma Arc Gasification	10 tpd circuit boards	Richland, WA
D	InEnTec	Plasma Arc Gasification	10 tpd medical waste	Richland, WA
E	INEOS Bio	gasification/biosynthesis	1.5 tpd MSW	Fayetteville, AK
F	International Environmental Solutions	pyrolysis/syngas boiler	30 tpd MSW	Romoland, CA
G	JFE Environmental Services/Thermoselect	pyrolysis + gasification/syngas engines and boiler	300 tpd MSW	Nagasaki, Japan
H	Mitsui Recycling 21 (R21)	pyrolysis + gasification/steam turbine	400 tpd MSW	Toyohashi, Japan
I	Nippon Steel DMS	high temperature gasification	200 tpd MSW	Kazusa, Japan
J	Nippon Steel DMS	high temperature gasification	400 tpd MSW	Akita, Japan
K	Plasco Energy	plasma arc gasification	110 tpd MSW	Ottowa, Canada
L	OE Gasification	gasification	20 tpd MSW	Heanam, Korea
M	OE Gasification	gasification	25 tpd MSW	Gangjin, Korea
N	OE Gasification	gasification	45 tpd MSW	Bosung, Korea
O	OE Gasification	gasification	25 tpd MSW	Pyungshan, Korea
P	OE Gasification	gasification	20 tpd MSW	Hapchon, Korea

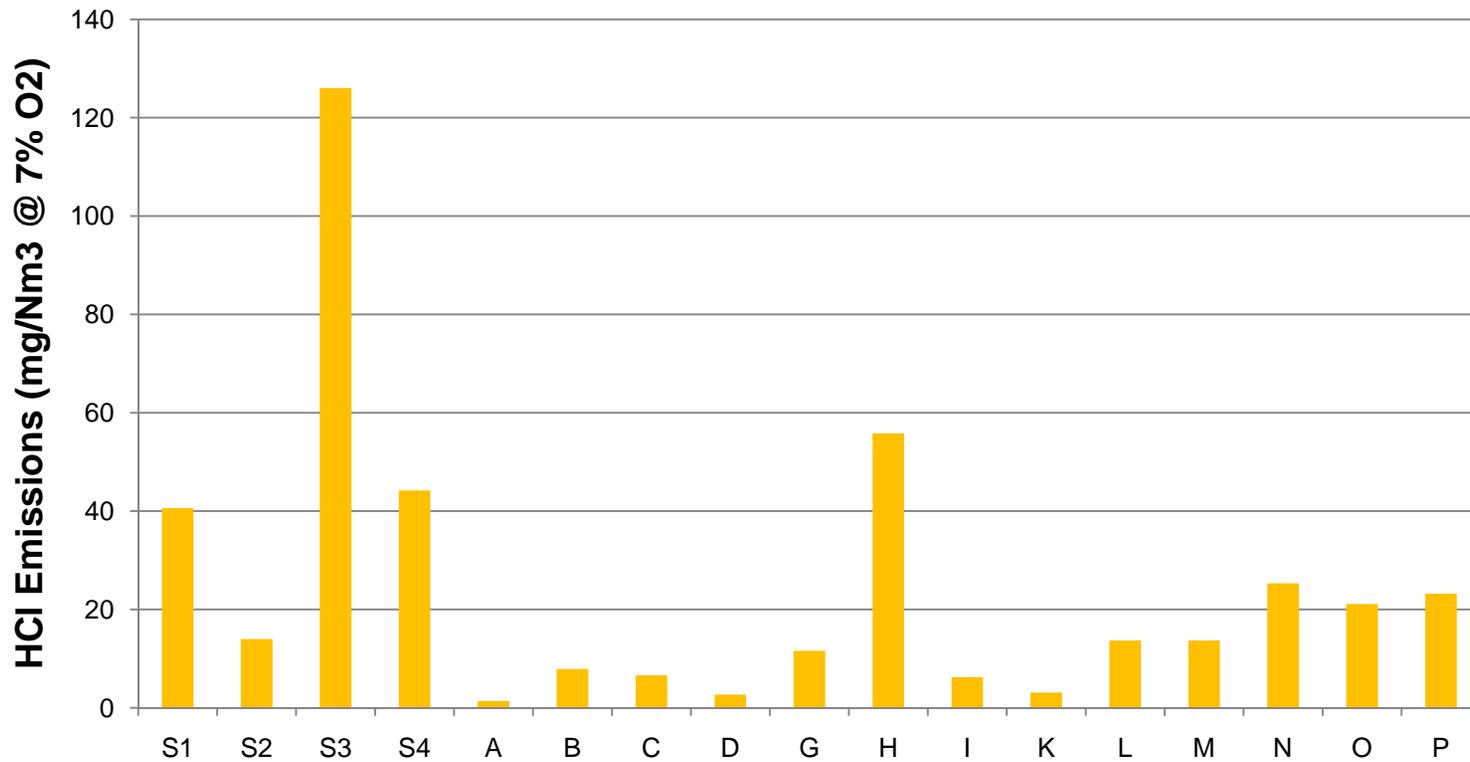


Comparison of Particulate Matter (PM) Emissions from Thermal Conversion Technologies



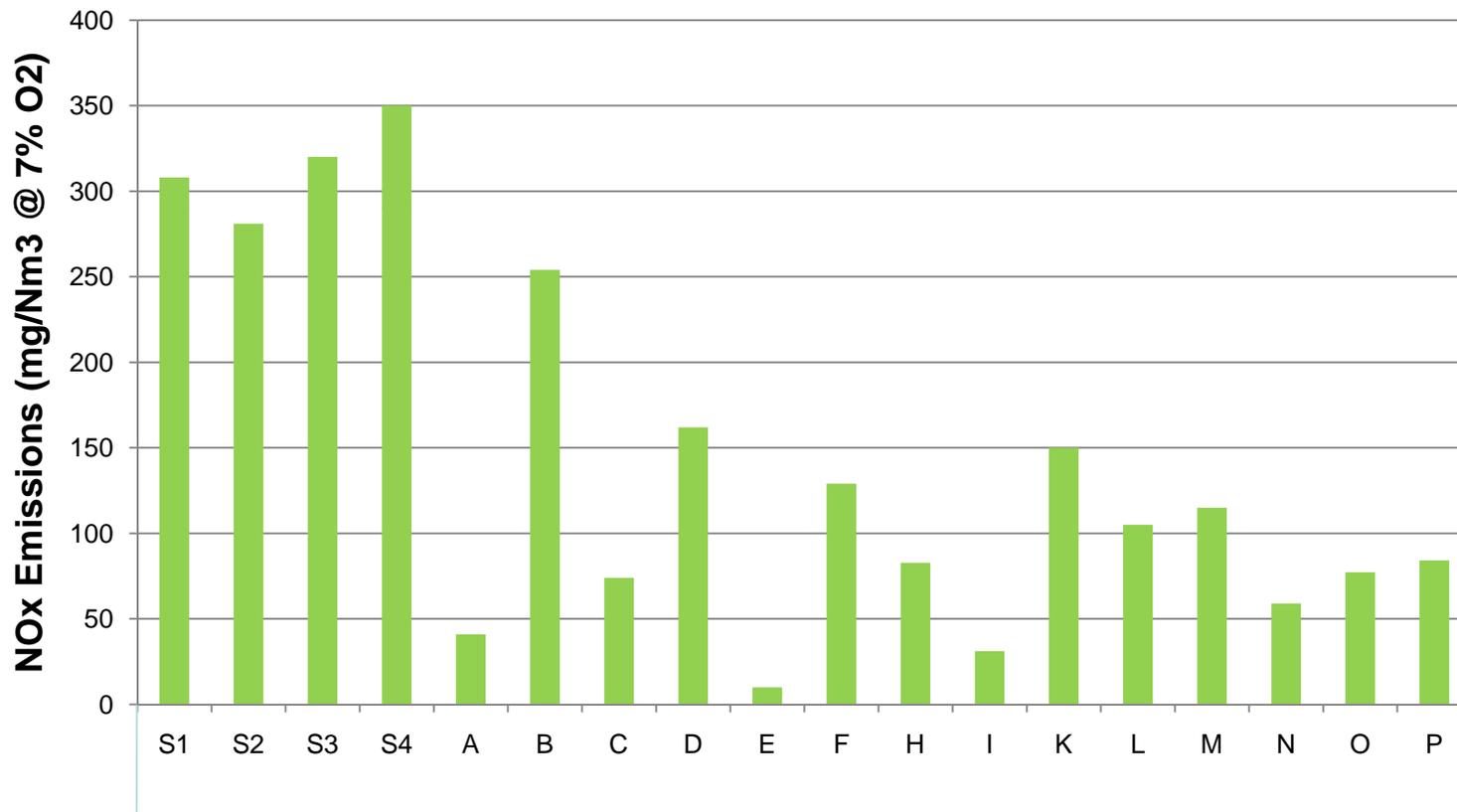


Comparison of Hydrogen Chloride (HCl) Emissions from Thermal Conversion Technologies



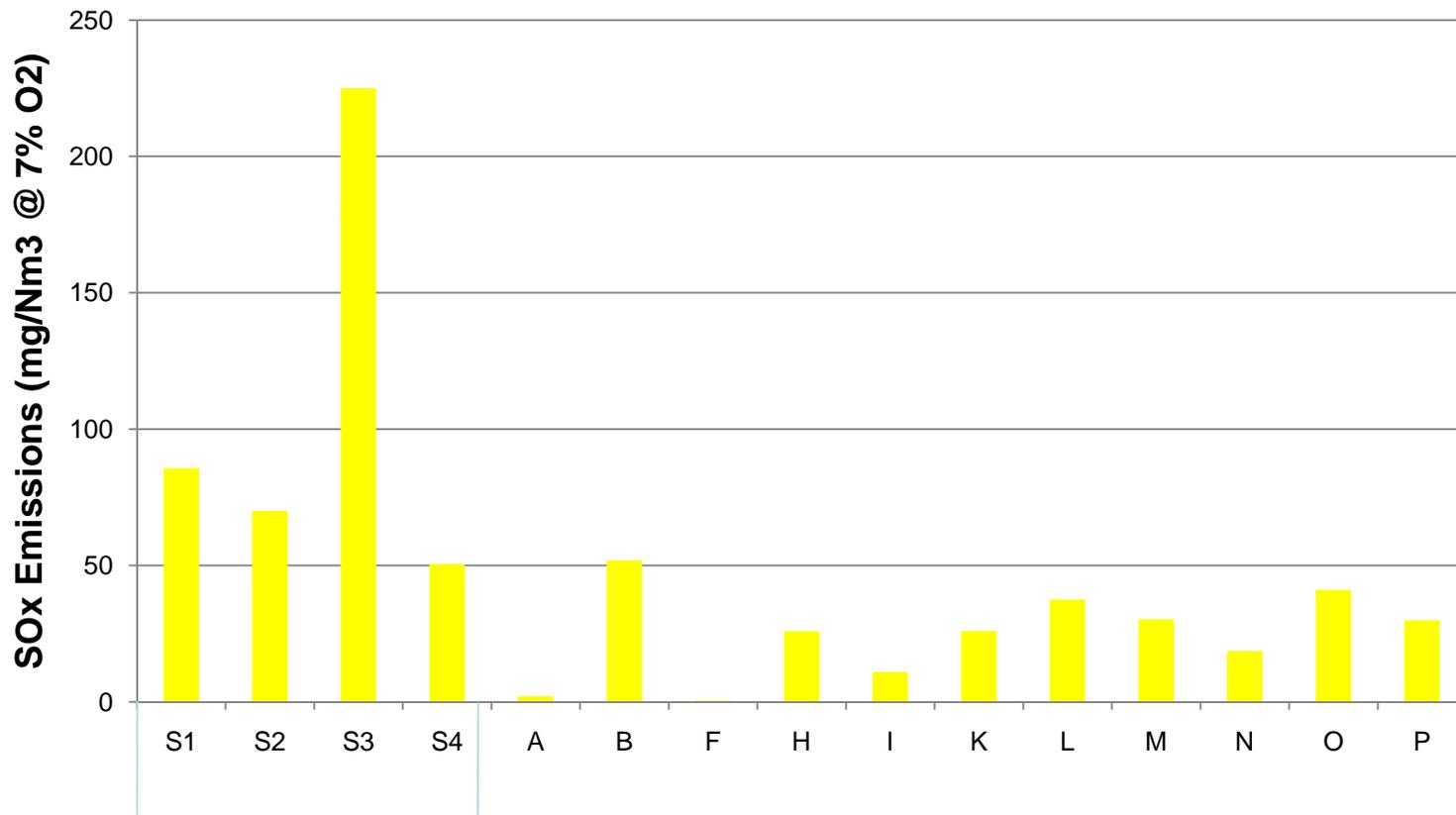


Comparison of Nitrogen Oxides (NOx) Emissions from Thermal Conversion Technologies



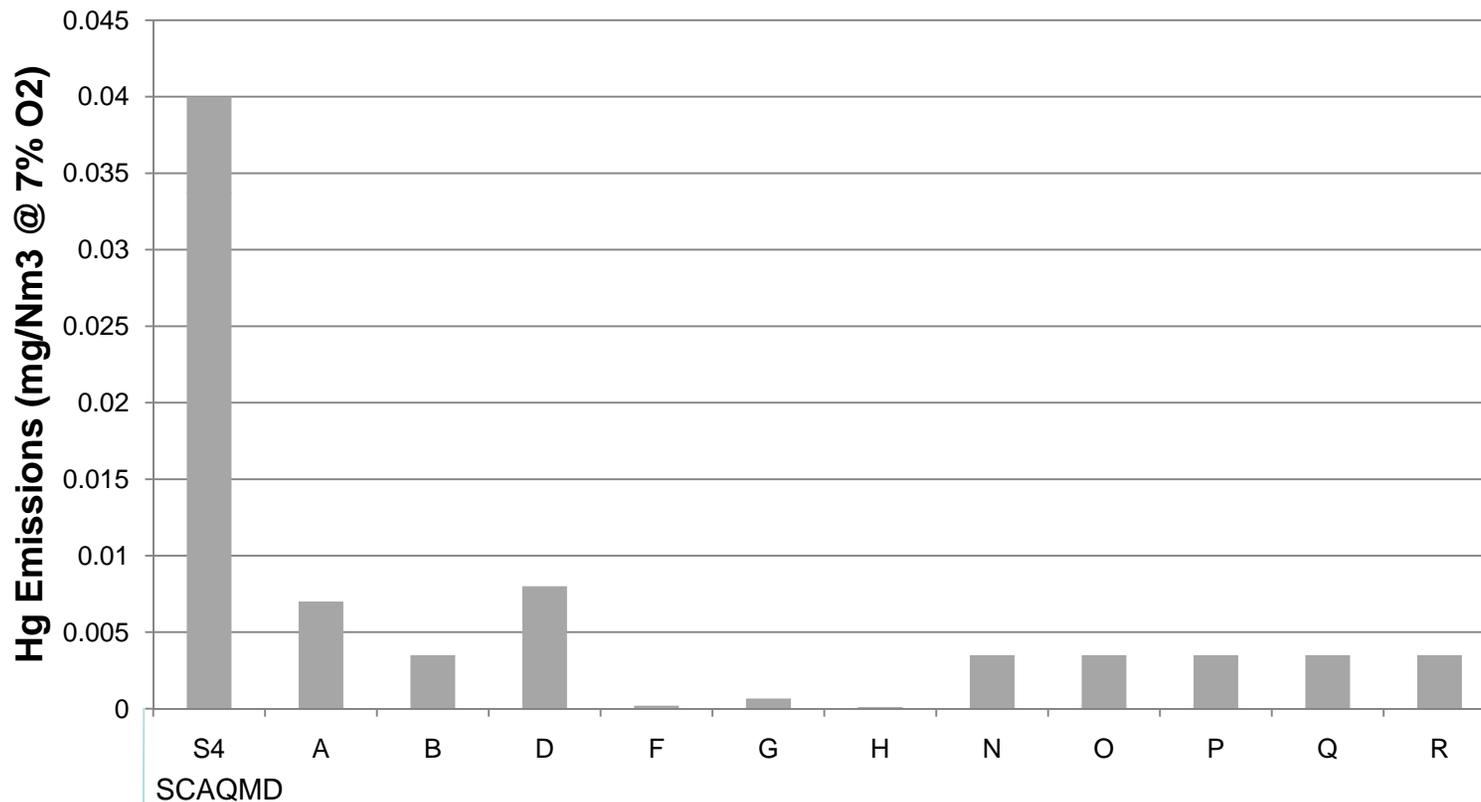


Comparison of Sulfur Dioxide Emissions (SO_x) from Thermal Conversion Technologies





Comparison of Mercury (Hg) Emissions from Thermal Conversion Processes*



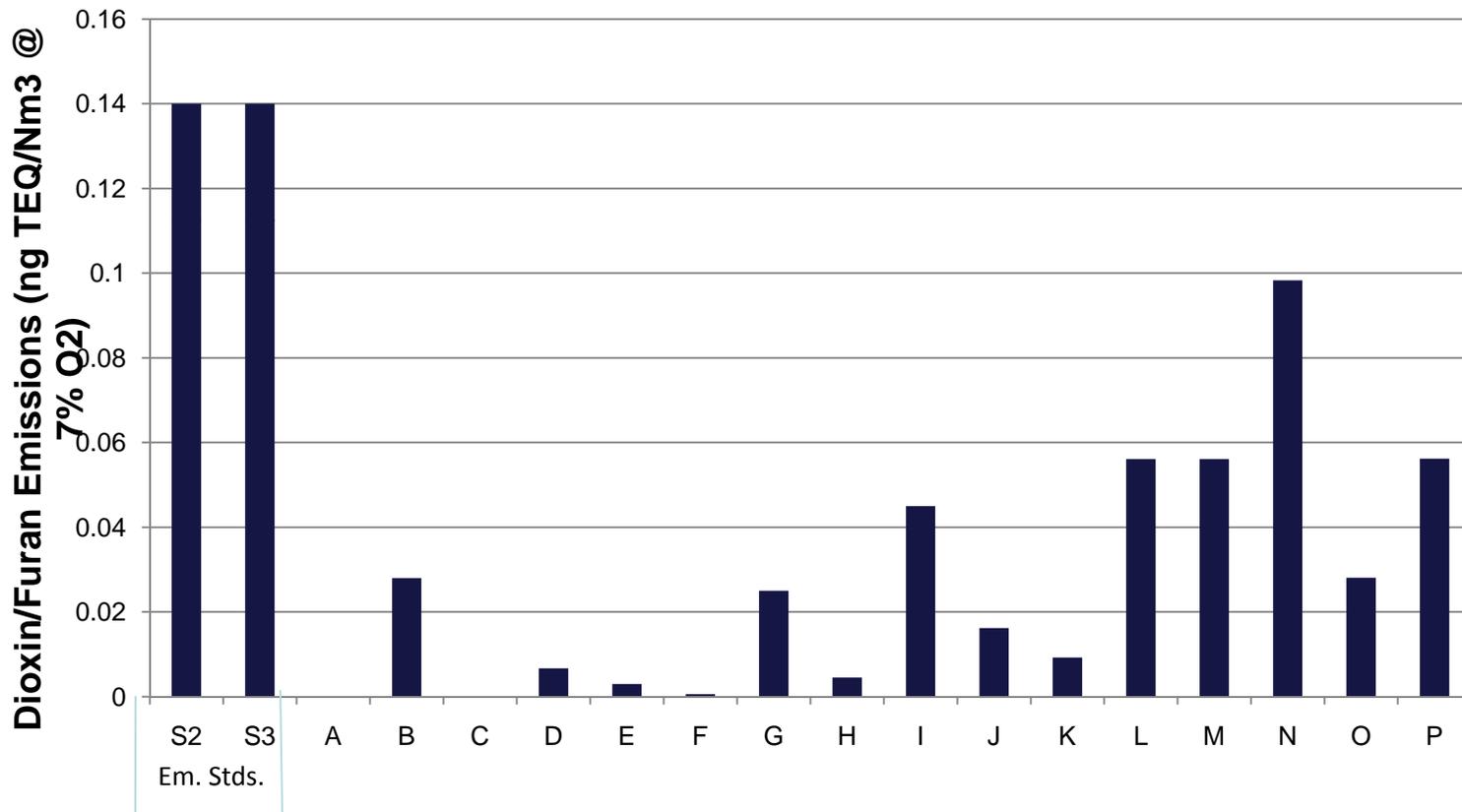
* US EPA limit (50 mg/Nm3) and EC 2000/76 limit (14 mg/Nm3) deleted for scale. There is no Japanese limit specific to Hg.

Comparison to SCAQMD MSW Incinerator Permit Limit Only





Comparison of Dioxin/Furan Emissions from Thermal Conversion Processes*



* US EPA limit (13 ng/Nm³) deleted for scale. There are no SCAQMD permit limits for dioxins/furans, as facilities are evaluated on an individual basis in a health risk assessment





Conclusions

- Commercial Gasification Plants Processing MSW Streams are Complying With Respective Air Standards
- The Majority of Plants Meet All Current Worldwide Standards
- In California, Facilities Will be Subject to New Source Review and Best Available Control Technology