

# TABLE OF CONTENTS

<b>1.0 EXECUTIVE SUMMARY 1 OF 8</b>	<b>7</b>	3.3 CHIP EXPANSION EXPECTED TO GROW	30
1.1 EXECUTIVE SUMMARY 1 OF 8	8	3.4 WET CHEMICAL DEMAND	32
1.2 EXECUTIVE SUMMARY 2 OF 8	9		
1.3 EXECUTIVE SUMMARY 3 OF 8	10	<b>4.0 SUPPLY, DEMAND &amp; CAPACITY</b>	<b>33</b>
1.4 EXECUTIVE SUMMARY 4 OF 8	11	4.1 DEFINITIONS OF THE TERMS USED THROUGHOUT THIS REPORT	34
1.5 EXECUTIVE SUMMARY 5 OF 8	12	4.2 EXPANSION DRIVES GROWTH IN MATERIALS DEMAND	35
1.6 EXECUTIVE SUMMARY 6 OF 8	13	4.3 CAPACITY SHORTFALLS EXPECTED	36
1.7 EXECUTIVE SUMMARY 7 OF 8	14	4.4 CHEMICAL DEMAND FORECAST, MANUFACTURING CAPABILITIES & GAP	37
1.7 EXECUTIVE SUMMARY - TECHCET MARKET ASSESSMENT	15	4.5 FAB EXPANSIONS PUSH UP DEMAND FOR ALL MATERIALS	38
		4.6 DEMAND GROWTH BY WET CHEMICAL TYPE	39
<b>2.0 THE CURRENT STATE OF AFFAIRS</b>	<b>16</b>	4.7 WET CHEMICALS SUPPLY-DEMAND FORECASTS	40
2.1 SHRINKING DOMESTIC MARKETS	17	4.7.1 SULFURIC ACID – US SUPPLY V. DEMAND	41
2.2 MATERIAL MARKETS REMAIN SIGNIFICANT	18	4.7.1.1 H2SO4 US MARKET LANDSCAPE OVERVIEW	42
2.3 WET CHEMICAL DEMAND WILL RISE >40% FROM LEADING CHIP FAB	19	4.7.2 IPA – US SUPPLY V. DEMAND	43
2.5 IMPACT OF US CHIP EXPANSION ON WET CHEMICAL DEMAND	20	4.7.2.1 IPA US MARKET LANDSCAPE OVERVIEW	44
2.5 CURRENT SUPPLIERS - GENERAL COMMENTS	21	4.7.3 HYDROGEN PEROXIDE – US SUPPLY V. DEMAND	45
2.6 AN OVERVIEW	24	4.7.3.1 H2O2 US MARKET LANDSCAPE OVERVIEW	46
		4.7.4 HCL – US SUPPLY V. DEMAND	47
<b>3.0 THE FORECAST CHANGES TO THE STATUS QUO</b>	<b>26</b>	4.7.4.1 HCL US MARKET LANDSCAPE OVERVIEW	48
3.1 ANNOUNCED AND PLANNED FAB EXPANSIONS	27	4.7.5 NH4OH – US SUPPLY V. DEMAND	49
3.2 MAJOR US ANNOUNCED FAB EXPANSIONS	29	4.7.5.1 NH4OH US MARKET LANDSCAPE OVERVIEW	50

# TABLE OF CONTENTS

4.7.6 HF US MARKET LANDSCAPE OVERVIEW	51	<b>7.0 PACKAGING &amp; PURITY</b>	<b>74</b>
4.7.6.1 HF US MARKET LANDSCAPE OVERVIEW	52	7.1 EVOLVING PACKAGING REQUIREMENTS	75
4.7.7 H3PO4 – US SUPPLY V. DEMAND	53	7.2 ULTRA HIGH PURITY DEMANDS – A LIABILITY OR OPPORTUNITY	76
4.7.7.1 H3PO4 US MARKET LANDSCAPE OVERVIEW	54	7.3 CHEMICAL PURITY TRENDS	77
4.7.8 HNO3 – US SUPPLY V. DEMAND	55	7.3.1 EVER INCREASING PURITY REQUIREMENTS	78
4.7.8.1 HNO3 US MARKET LANDSCAPE OVERVIEW	56	7.4 SHIP TO CONTROL & EVOLVING REQUIREMENTS	79
4.8 KEY TIER II SUPPLIERS SUMMARY	57		
<b>5.0 ANTICIPATED MARKET ADJUSTMENTS</b>	<b>58</b>	<b>8.0 TECHCET'S ASSESSMENT OF RISKS AND OPPORTUNITIES</b>	<b>80</b>
5.1 ANTICIPATED MARKET ADJUSTMENTS	59	8.1 RISKS AND OPPORTUNITIES	81
5.2 ANTICIPATED ACTINS	60		
5.3 ANTICIPATED ACTIONS BY CURRENT DOMESTIC SUPPLIERS	61	<b>9.0 APPENDIX: MANUFACTURING UHP CHEMICALS</b>	<b>84</b>
5.4 THE IMPACT OF TSMC	63	APPENDIX 9.1	85
5.6 COMMENTS FROM THE PARTICIPANTS	64	APPENDIX 9.2	86
		APPENDIX 9.3	87
<b>6.0 DEPENDENCIES &amp; CHALLENGES OF IMPORTS</b>	<b>67</b>		
6.1 US DEPENDENCY ON IMPORTS FOR UHP	68		
6.2. A GROWING DEPENDENCY IN IMPORTED PRODUCTS	69		
6.3 "TO IMPORT OR NOT TO IMPORT, THAT IS THE QUESTION"	71		
6.4 AN ADDITIONAL BUT IMPORTANT CONSIDERATION	73		

# FIGURES & TABLES

## FIGURES

FIGURE 1: 2025 CHIP FAB CAPACITY- 36M/YR	9	FIGURE 15: IPA US VOLUME DEMAND 35% GROWTH 6% CAGR	44
FIGURE 2: US WAFER CAPACITY FORECAST 2020-2025 BY NODE	11	FIGURE 16: H2O2 SUPPLY VS. DEMAND (METRIC TONS)	45
FIGURE 3: SUPPLY-CHAIN CHALLENGES WILL ESCALATE AS CHEMICAL DEMAND INCREASES (LOS ANGELES, CA, 4/16/2021, BELOW)	15	FIGURE 17: H2O2 US VOLUME DEMAND 42% GROWTH 7% CAGR	46
FIGURE 4: SHARE OF GLOBAL SEMICONDUCTOR MANUFACTURING	17	FIGURE 18: HCL SUPPLY VS. DEMAND (METRIC TONS)	47
FIGURE 5: 2020 SEMICONDUCTOR MATERIALS MARKET BY SEGMENT	18	FIGURE 19: HCl US VOLUME DEMAND 47% GROWTH 8% CAGR	48
FIGURE 6: US WAFER STARTS ESTIMATE BY DEVICES TYPE AND NODE, 2020-2025 (200MM EQUIV. WAFERS)	19	FIGURE 20: H2SO4 SUPPLY VS. DEMAND (METRIC TONS)	49
FIGURE 7: US WET CHEMICAL DEMAND BY CHIP FABRICATOR 2020-2025 (200MM EQUIV. WAFERS)	20	FIGURE 21: NH4OH US VOLUME DEMAND 43% GROWTH 7% CAGR	50
FIGURE 8: SULFURIC ACID	24	FIGURE 22: HF SUPPLY VS. DEMAND (METRIC TONS)	49
FIGURE 9: CHIP EXPANSION EXPECTED TO GROW >40% TO 37M 200MM EQUIVALENT WAFER CAPACITY (17M 300MM)	30	FIGURE 23: HF US VOLUME DEMAND 23% GROWTH, 4% CAGR	52
FIGURE 10: WET CHEMICAL DEMAND WILL RISE >40% FROM LEADING CHIP FABs, 2020-2025	32	FIGURE 24: H3PO4 SUPPLY VS. DEMAND (METRIC TONS)	53
FIGURE 11: CHIP EXPANSION GROWTH	38	FIGURE 25: H3PO4 US VOLUME DEMAND 23% GROWTH, 4% CAGR	54
FIGURE 12: H2SO4 SUPPLY VS. DEMAND VOLUME (METRIC TONS)	41	FIGURE 26: HNO3 SUPPLY VS. DEMAND (METRIC TONS)	55
FIGURE 13: HSO4 US VOLUME DEMAND 37% '25/'21 ; 6% CAGR	42	FIGURE 27: HNO3 US VOLUME DEMAND 13% GROWTH, 3% CAGR	56
FIGURE 14: IPA SUPPLY VS. DEMAND VOLUME (METRIC TONS)	43	FIGURE 28: IMPORTING BULK PROCESS CHEMICALS INTO THE US IS FEASIBLE BUT IT'S NOT EASY AND INCLUDES MULTIPLE STEPS	68
		FIGURE 29: SUPPLY-CHAIN LOGISTICS CHALLENGES PERSIST TODAY (LOS ANGELES, CA, 4/16/2021, BELOW)	74
		FIGURE 30: SHIP TO CONTROL FOR PROCESS CHEMICALS EXAMPLE	78

# FIGURES & TABLES

## TABLES

TABLE 1: CHEMICAL VOLUME GROWTH 2020-2025	10
TABLE 2: CAPACITY SHORTFALLS EXPECTED	12
TABLE 3: US DOMESTIC TIER 1 SUPPLIERS	22
TABLE 4: KEY PROVISIONS OF THE AMERICAN FOUNDRIES ACT	28
TABLE 5: MAJOR US ANNOUNCED FAB EXPANSIONS	29
TABLE 6: WET CHEMICALS WITH THE HIGHEST DEMAND GROWTH IN THE US 2025/2020	35
TABLE 7: CAPACITY SHORTFALLS EXPECTED	36
TABLE 8: UHP AND IC GRADE SPLIT USED FOR GRAPHS	37
TABLE 9: 2020 – 2025 CHANGE IN VOLUMES REQUIRED FOR US CHIP PRODUCTION	39
TABLE 10: SUMMARY OF KEY US TIER 2 AND TIER 1 SUPPLIERS*	57
TABLE 11: ANTICIPATED ACTIONS BY CURRENT DOMESTIC SUPPLIERS	61
TABLE 12: COMMENTS FROM THE SELECTED PARTICIPANTS	65
TABLE 13: IMPORTING BULK PROCESS CHEMICALS ASSUMPTION	69
TABLE 14: EVOLVING PACKAGING REQUIREMENTS	70
TABLE 15: ALL BULK PROCESS CHEMICALS AND REQUIREMENTS IMPORTED	75
TABLE 16: PURITY REQUIREMENTS	76