AGENDA

- CURRENT & FUTURE ISSUES
- POINT-OF-USE (POU) DEVICE INFORMATION
- EXPECTATIONS FOR POU DEVICE SUPPLIERS
IN APRIL, 1999, THE WORLD SEMICONDUCTOR COUNCIL (WSC) REACHED AGREEMENT TO REDUCE AGGREGATE ABSOLUTE EMISSIONS OF PFCs FROM SEMICONDUCTOR FABRICATION FACILITIES BY 10% OR GREATER BY 2010. THE BASELINE YEAR IS 1995 FOR EUROPEAN UNION, JAPAN, AND UNITED STATES; 1997 FOR SOUTH KOREA; AND 1998 FOR TAIWAN (JOINED IN YEAR 2000). THIS AGREEMENT ALSO PROVIDES UNIFORM GUIDANCE TO RESEARCHERS AND EQUIPMENT SUPPLIERS.
PERFLUOROCOMPOUNDS (PFC)

- SULFUR HEXAFLUORIDE (SF6)
- NITROGEN TRIFLUORIDE (NF3)
- TETRAFLUOROMETHANE (CF4)
- TRIFLUOROMETHANE (CHF3)
- HEXAFLUOROETHANE (C2F6)
- OCTAFLUOROPROPROPANE (C3F8)

Materials Lifecycle Solutions
PROCESS OPTIMIZATION:

- CLEANING OF CVD CHAMBERS WITH C2F6 WAS OPTIMIZED TO REDUCE THE AMOUNT OF C2F6 USED
  (EXAMPLE: END-POINT DETECTORS).

- CHANGES IN PROCESS VARIABLES
  (ie: PFC FLOWS, PRESSURE AND PLASMA POWER)
DEVELOPMENTS FOR CVD

◆ ALTERNATIVE CHEMISTRIES:

◆ NF3 HAS BEEN USED AS A REPLACEMENT IN A FEW INSTANCES. UTILIZATION EFFICIENCY IS HIGHER FOR NF3 THAN C2F6

◆ C3F8 IS USED AS A REPLACEMENT FOR C2F6, WITH THE MMTCE EMISSIONS BEING REDUCED. UTILIZATION EFFICIENCY IS HIGHER FOR C3F8 THAN C2F6

◆ SOME FACILITIES SWITCHED TO CIF3
DEVELOPMENTS FOR CVD

◆ PROCESS HARDWARE CHANGE:

◆ NF3 MICROWAVE CLEANS. NF3 IS BROKEN DOWN IN A PRE-CHAMBER PLASMA DEVICE TO GENERATE FLUORINE TO CLEAN CHAMBER.
SINCE THE PFCs ACTUALLY CONTACT WAFERS, PROCESS OPTIMIZATION AND ALTERNATIVE CHEMISTRIES ARE MORE SENSITIVE. CHANGES IN PROCESS VARIABLES (I. E. PFC FLOWS, PRESSURE AND PLASMA POWER) CAN BE DONE TO REDUCE EMISSIONS.
CENTRALIZED CAPTURE/RECOVERY SYSTEMS HAVE BEEN SHOWN TO RECOVER C2F6, CHF3 AND SF6 VERY EFFICIENTLY (>95%); HOWEVER, CF4 CAPTURE IS ABOUT 75%. THE COST EFFECTIVENESS OF THIS TECHNOLOGY IS STILL UNKNOWN. MANY OF THE RECOVERY/RECYCLE EFFORTS HAVE BEEN STOPPED.
ABATEMENT TECHNOLOGIES (BEFORE OR AFTER PUMP) EXIST AND ARE BEING DEVELOPED THAT CAN REDUCE PFC EMISSIONS. EACH TECHNOLOGY MUST BE REVIEWED FOR INDIVIDUAL PFC EFFECTIVENESS.

IT IS IMPORTANT TO NOTE THAT OTHER GASES EMITTED (E.G. SILANE) FROM THE PROCESS MAY REQUIRE POU ABATEMENT DEVICE. THIS WILL ENTER INTO POU ABATEMENT DEVICE SELECTION.
THE FOLLOWING TECHNOLOGIES CAN BE USED FOR REDUCING PFC EMISSIONS (EACH VENDOR'S TECHNOLOGY NEEDS TO BE REVIEWED):

- THERMAL OXIDATION
- PRE-PUMP PLASMA OR MICROWAVE (IN BETA TESTING AND ACTUAL PRODUCTION TESTING FOR DRY ETCH ONLY)
- CATALYTIC OXIDATION
PFC’S - FUTURE

1. **HOW WILL COUNTRIES NOT IN WSC AGREEMENT HANDLE PFC REDUCTIONS?**
2. **HOW WILL COMPANIES IN WSC AGREEMENT COUNTRIES HANDLE FABS LOCATED IN NON-AGREEMENT COUNTRIES?**
3. **RECOVERY/RECYCLE WILL BE A MINOR PFC STRATEGY.**
4. **COST TARGET FOR PURCHASING POU ABATEMENT DEVICE FOR DRY ETCH IS US$20,000 PER CHAMBER. COST TARGET FOR PURCHASING PFC REDUCTION TECHNOLOGY FOR CVD IS US$40,000 PER CHAMBER.**

*Materials Lifecycle Solutions*
ALTERNATIVE CHEMISTRY DEVELOPMENT FOR DRY ETCH WILL BE LIMITED FOR EXISTING PROCESSES. THESE EFFORTS WILL BE CONCENTRATED ON FUTURE PROCESSES.

PROCESS EQUIPMENT SUPPLIERS APPEAR TO ONLY SUPPORT 200 MM (AND LARGER) FABS.

SOME SEMICONDUCTOR MANUFACTURING COMPANY'S PFC REDUCTION GOALS ARE HIGHER THAN 10%.

Materials Lifecycle Solutions
DUE TO GLOBAL WARMING CONCERNS AND CONSTANT NEED TO REDUCE COST, ENERGY REDUCTION EFFORTS WILL INCREASE.

SEMICONDUCTOR COMPANY GOALS ARE BEING DEVELOPED AND COMMUNICATED.

PROJECTS ARE BEING CONDUCTED TO GET ENERGY USE BASELINES, REDUCE FACILITIES ENERGY USAGE, AND REDUCE AIR FLOW.

WILL THERE BE INTERNATIONAL REDUCTIONS?
PLUME OPACITY

- Ammonium halide plumes are a regulatory and/or visible issue in parts of the world.

- The solutions have been successfully implemented to eliminate plumes.

- New fabs require ammonia and acid gas segregation and/or POU device installation. Lower costs if this is done initially.

Materials Lifecycle Solutions
AIR EMISSIONS REDUCTIONS

- BETTER DESIGNED CENTRALIZED CONTROL DEVICES
- CHEMICAL USE REDUCTION
- CHEMICAL REPLACEMENTS
- PROCESS CHANGES
- WORK PRACTICES IMPLEMENTATION
- BY-PRODUCTS FROM PROCESSES AND CONTROL DEVICES (BOTH POU AND CENTRALIZED) KNOWN AND MINIMIZED

Materials Lifecycle Solutions
WATER REDUCTION/RECYCLE

- WATER REDUCTION IS A RESOURCE CONSERVATION AND COST REDUCTION ISSUE.

- WATER RECYCLE PROJECTS ARE PREVALENT THROUGHOUT THE INDUSTRY.

- RECYCLE OF RECLAIMED DI WATER BACK TO RO/DI PLANT HAS PRODUCED BETTER QUALITY DI WATER.
FLUORIDE WASTEWATER LIMITS

- IN MANY LOCATIONS FLUORIDE WASTEWATER DISCHARGE LIMITS ARE ESTABLISHED BY REGULATORY AGENCIES.

- SEGREGATION OF CONCENTRATED FLUORIDE PROCESS DISCHARGES AND SOMETIMES DILUTE PROCESS DISCHARGES.

- FLUORIDE WASTEWATER TREATMENT ON SEGREGATED STREAMS IS A KNOWN TECHNOLOGY.
WATER REDUCTION AND/OR RECYCLE IS REQUIRED TO MINIMIZE COSTS.

CONTINUED WORK ON DEVELOPING CMP WASTEWATER TREATMENT OPTIONS.
CHEMICAL USE REDUCTION

- CHEMICAL REDUCTION PROJECTS HAVE BEEN AND CONTINUE TO BE CONDUCTED (REPLACE SULFURIC ACID WITH OZONE, REPLACE NEGATIVE PHOTORESIST WITH POSITIVE PHOTORESIST, EXTENDING BATH LIFE, ETC.)

- CHEMICAL RECYCLE: SULFURIC ACID, ISOPROPANOL, ETC.

- CHANGING PROCESS EQUIPMENT

Materials Lifecycle Solutions
NEW CHEMICALS

- NEW CHEMICALS ARE BEING REQUIRED FOR DEVICE MANUFACTURING. HEALTH DATA IS VERY LIMITED.

- HOW DO WE DETERMINE THE CHEMICAL PROPERTIES (PHYSICAL, HEALTH, ETC.) WHEN TECHNOLOGY DRIVES NEW CHEMICAL USAGE?

- IS ENGINEERING OUT HAZARDS ENOUGH?
FAB FIRE SAFETY

- FAB FIRES HAVE CAUSED INCREASED ACTIVITY.

- PROPER INSTALLATION OF POU DEVICES AND FIRE SUPPRESSION SYSTEMS ARE NECESSARY. USE APPROPRIATE MATERIALS OF CONSTRUCTION FOR THE PROCESS APPLICATION AND DUCTWORK.
SAFETY

- LOCK-OUT/TAG-OUT
- MACHINE GUARDING (DESIGNING OUT HAZARDS)
- PROPER USE OF SEMI STANDARDS
- ERGONOMICS
- TOXIC GAS MONITORING
- ETC.

Materials Lifecycle Solutions