CMC Fabs
Critical Materials Council for Semiconductor Fabricators

2016 FEB MONTHLY MEETING

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TECHCET
Electronics Materials Information

Outline

- CMC Market Update
  - *Wet Chemicals by Dr. Yu Bibby*
  - *Rare Earth Materials in China*
  - *Supply Chain Impact of Tainan 6.4 Earthquake*
- CMC Fabs Update
  - *Techcet Reports*
  - *Mini-Survey and Chemical Pricing Survey update*
  - *Additional China Supply Chain for Gases*
- 2016 F-2-F Meeting & Conf Update
  - *Shared Focus and Invited Suppliers*
  - *May 2-6 meeting logistics*
- Hot Topics, Q&A (15 min)

CMC Feb Market Update

- Wet Chemicals
- Rare Earth Materials

Report by Yu Bibby, Ph.D./Chris S. Blatt

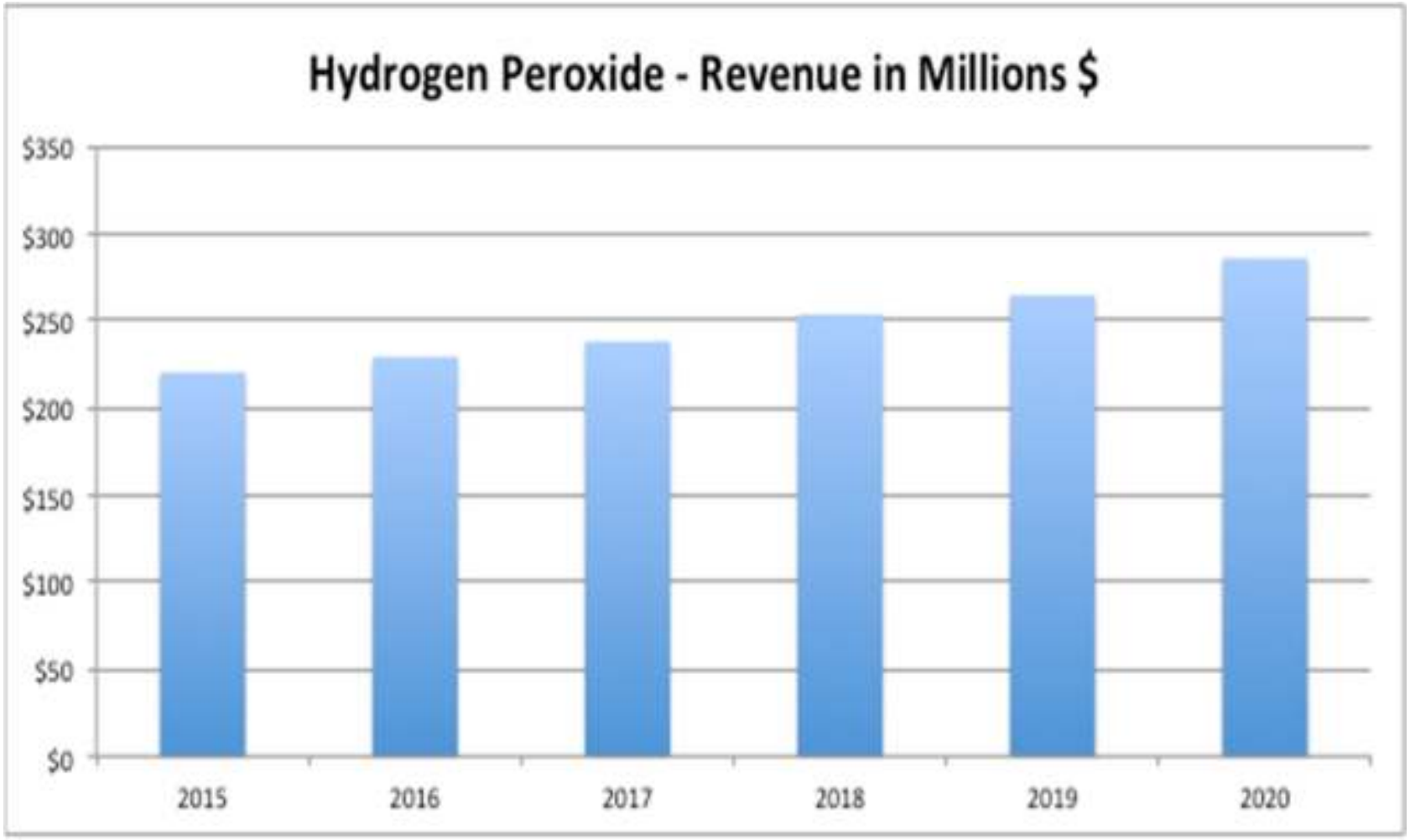
Wet Chemical Industry Outlook

- Global demand for silicon wafers will grow by about 3% in 2016. Companies that supply wet chemicals will also grow slowly.
- Manufacturers of semiconductors and displays, each for their own reasons, will push for lower materials prices. At one end of the market, suppliers of materials for mature products will face declining demand. At the other end of the market, suppliers of materials used for making more advanced chips fabricated on 300-mm wafers will enjoy growth as high as 7%.
- Profitability will be tempered by demands from chip makers for price reductions . Materials have become a cost-cutting target because the manufacture of chips with thinner circuit lines requires more steps and more chemicals such as photoresists, dielectrics, thin-film precursors and processing wet chemicals.

Industry Outlook Cont'd

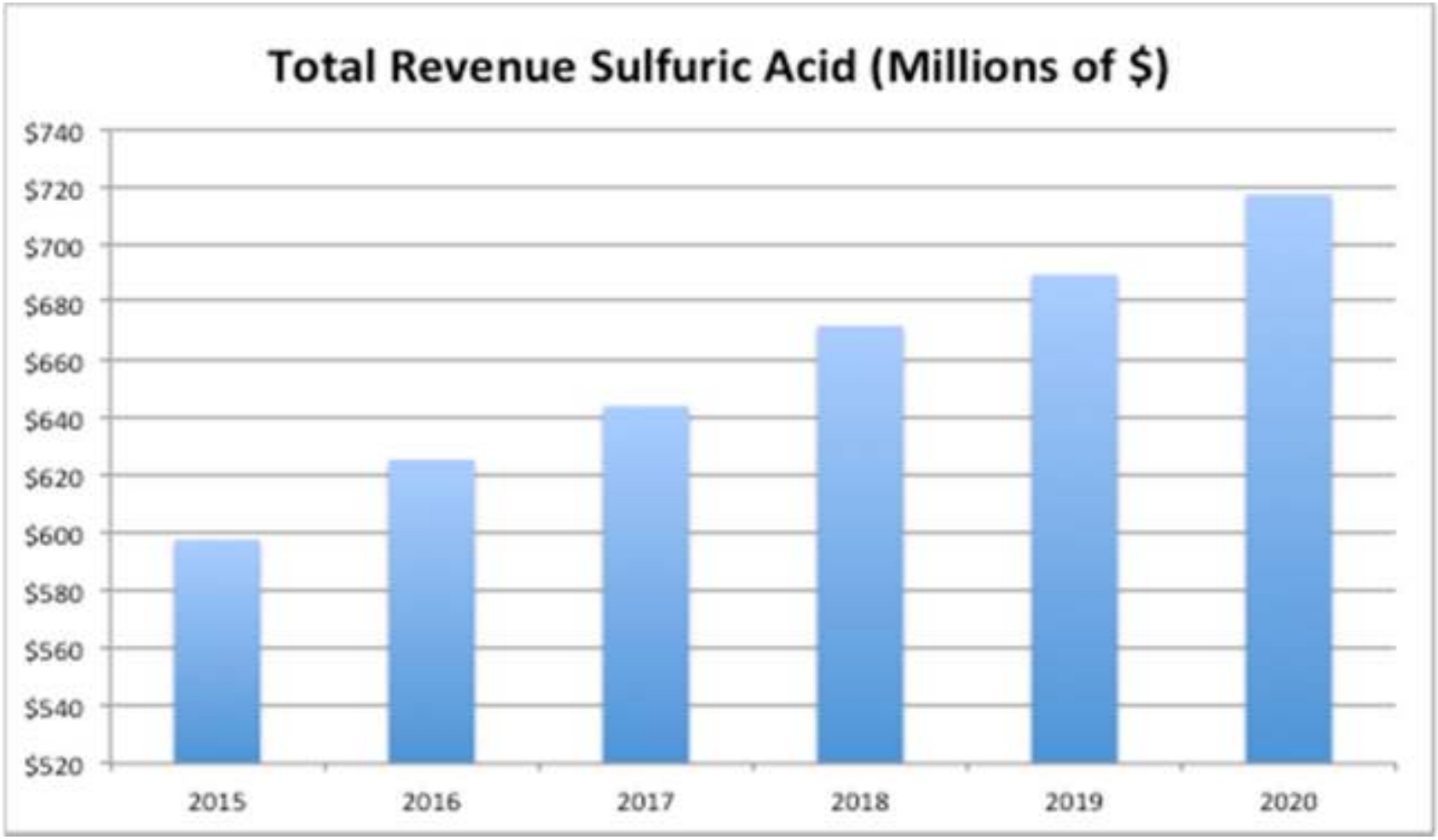
- We are seeing steady improvement over several sectors with OEM activity starting to pick up. One of the more ramp centric areas is the OLED section. This is poised to jump quickly in 2017 and then continue for 18-24 months. The first round will be driven by mobile devices followed by larger sized devices for home entertainment – TVs. This should help drive the demand for chemistry in a positive direction.

Hydrogen Peroxide



Small growth due to industry drivers – 1-3 %

Sulfuric Acid



Small growth due to industry drivers – 1-3 %

Mergers and Acquisitions

- **DowDuPont: The merger of DuPont with Dow Chemical created a massive chemical company—$130 billion in market capitalization and $83 billion in annual sales. The new DowDuPont will then break into three separate companies in about two years:**
  - ***1) Material Science -- $51 billion business will have Dow's massive petrochemical operations and downstream polyethylene, Polymers in packaging and elastomers businesses, and the acrylic acid and derivatives businesses that Dow acquired as part of its 2009 Rohm and Haas purchase. The materials science is also designated as the future home of Dow Corning's silicones business.***
  - ***2) Agriculture -- $19 billion business will have strengths in seeds, insecticides, and herbicides.***

M&A: DowDuPont-cont'd

- *3) Specialty Products -- $13 billion business, more than 30% of their revenues will come from electronic materials.*

The specialty products will combine electronics materials businesses from both parents into a $4 billion franchise – this is included in the $13B business. Dow's electronics business, which originated for the most part with Rohm and Haas, is strong in materials for CMP pads. DuPont's strength is in electronics areas other than chip fabrication with a strong business in materials for solar panels such as encapsulants and metallization pastes. Its Tedlar polyvinyl fluoride film has become the standard material for photovoltaic backsheets.

China Wet Chemical Supply Chain in the works

- Requested in Q4 2015~ Q1 2016 by Asia Fabs Samsung, Hynix, TSMC, and UMC on analysis and 3rd party evaluation for China IC Materials Supply Chain. This work currently is underway by Techcet and to be included in selected reports.
- The list of Wet Chemicals Suppliers in China market to be prioritized:

Shanghai Hua yi Chemical -上海华谊
BASF
Sinopec -中國石化
Anji安集微電子
Zfchem - 如东振丰奕洋化工
Rumma chemical -江阴润玛电子材料
JJM Materials江陰市江化微電子材料
Kanto – PPC(Kanto Group) 関東化学
Rudong Zhenfeng Yiyang Chemical, 如东振丰奕洋化工
Hangzhou Greenda Chemical 杭州格林达化学

China's new "Rare Earth" Policy

- **As the results of WTO ruling, China eliminated its decades' long export tariffs & quota on rare earths elements and other materials last May. This includes Phosphor rock, Fluorspar, Cerium, tungsten, molybdenum, iron and steel particles and other products. This leads to important policy changes in China rare earth law, as well as huge impact on the world rare earth industry and markets such as HF and Phosphoric Acid. There are 5 major impact areas:**
- **1) China's new law for their rare earth industry:**
  - ***China's Ministry of Industry and Information Technology (MIIT) requires by the new law that the china's rare earth industry integrates and restructures into six large State-Owned Enterprise (SOE) groups.***
  - ***China Treasury also established special funds to subsidize its Rare Earth restructure & exploitation. For example, on Aug. 2015, it issued subsidies of 458M yuan to the Ganzhou Rare Earth Group for their rare earth operation. This Group has received total subsidies of 950M yuan from Chinese government Since 2012.***

China's new "Rare Earth" Policy Cont'd

- **2) China's new consolidated rare earth industry infrastructures:**
  - ***China's Rare Earth industry enters the six SOE groups era: China Aluminum Group, China Minmetals Group, Northern Rare Earth Group (NREG), Xiamen Tungsten Group, Southern(Ganzhou) Rare Earth Group and Guangdong Rare Earth Industry Group***
  - ***Early 2015, the newly formed NREG completed the integration of Baotou Steel Rare Earth with 6 other companies within the Inner Mongolia Region. The new law requires NREG to integrate all the rare earth mining, smelting and separation, utilization enterprises in the Inner Mongolia area and in Gansu province. As of now, total of 28 such companies has been consolidated into one roof under NREG.***
  - ***Consolidation in other part of the China is also near completion. China's MIIT announced recently that it has completed the integration of the country's 77 rare earth mining permits (out of 78 total), and 77 smelting and separation enterprises (out of 99 total) into the 6 SOE groups. It is expected to complete all the consolidation tasks by 2016.***

China's new "Rare Earth" Policy Cont'd

- 3) China's new tax law for their rare earth export:
  - *When China eliminated its export tariffs on May 2015, they also implemented a new rare earth Resource tax law. The new Resource tax calculated by flat rates and rates varies by the regions and by the type of rare earths elements.*
  - *Previously China's rare earth export tariffs are 15% for light rare earth and 25% for heavy rare earth respectively. Under the new Resource tax, the tax is calculated using the following formula:*

    Resource tax = Sale Total X Resource tax rate%

    Where: Sale Total = sale amount X unit price

China's new "Rare Earth" Policy Cont'd

- ***Resource tax rate various by category and by region it came from:***

  For all heavy rare earth: Resource tax rate% = 27% for all regions.

  For all light rare earth: Resource tax rate% =11.5 % for the Inner Mongolia region,

  =9.5 % for Sichuan region,

  =7.5 % for Shandong region.

  Examples of Resource tax rates for selected critical materials :

  phosphor rock == ➔ 27%,

  F (fluorspar) == ➔ 7.5 % to 11.5 % depend which region it came from

  Ce (Cerium) == ➔ 7.5 % to 11.5 % depend which region it came from

  W (Tungsten ore) == ➔ 6.5%

  Molybdenum == ➔ 11%.

6.4 Earthquake on 2/6 hit Tainan Science Park

Official Statement by TSMC and UMC

- TSMC Statement: TSMC revel that the earthquake of 6.4 magnitude did not cause any serious personnel injuries nor any structural or facility damage to the Company's Fab 14 and Fab 6 manufacturing sites in the Tainan Science Park. Damage to wafers in progress remains under assessment, but TSMC's initial estimate is that more than 95 percent of the tools can be fully restored to normal in two to three days.
- UMC Statement: the recent 6.4 magnitude earthquake recorded in southern Taiwan had limited impact to UMC's operations. All personnel are safe at UMC facilities. The automatic safety measures at Fab 12A in Tainan, Taiwan did trigger and an automatic equipment shutdown that affected work-in-progress wafers; however, normal operations are resuming and wafer shipments will not be affected. UMC's Hsinchu fabs were not affected, and there will be no meaningful impact on UMC's business.
- It appears the impact on 300mm wafers and critical materials such as quartz parts and CMP parts are limited, as February and Chinese New Year time are normally low season for foundry fabs in Taiwan. The Feb Critical material shipment already arrive at fabs before end of Jan. But there will be a short term demand increase for ~ 20~25K Si wafers in Q1.

CMC Fabs Update

- Techcet Reports for 2016
- Mini-Survey and Chemical Pricing Survey
- China Supply Chain for Gases and Wet Chemicals

Techcet Critical Materials Report		Issue Date
1	2016 CVD / ALD Metal Precursors	March 10
1	2016 Electronic Gases	May 10
2	2016 Wet Process Chemicals	May 10
3	2016 Silicon Wafers	May 10
4	2016 Photoresists and Ancillaries	April 10
5	2016 CVD / ALD Dielectric Precursors	Aug 10
6	2016 CMP Slurries and Pads Consumables	June 10
7	2016 Sputtering Targets	July 10
8*	2015 -16 Quartz -Consumable Equipment Components (Dec ’15)	Available
9*	2015-16 Ceramics - Consumable Equipment Components (Dec ’15)	Available
10*	2014-16 Silicon Carbide - Consumable Equipment Components (Dec ’15)	Available

***** Critical Material Reports no Advisory Service

Mini-Surveys and Double Blind Survey

- Completed a Mini-Survey for ESH Safety Benchmarking in Feb 2016, consolidated summary provided back to participating members.
- Any additional requests of Mini-Survey please send it to JYang@techcet.com
- Double Blind Survey on 90-days-old on Pricing Survey NF3/WF6/ SiH4 will be send out in March with password protection from me, and blind returns to Mary Frances Corey at Techcet LLC (e-mail: mfcorey@techcet.com). ≥ 5 minimum must participate.

Additional China Supply Chain for Gases

For the 3rd part evaluation on China regional supplier, CMC Fabs has prepared a list to be prioritized. Some of these supplier information will be included in the Techcet reports.

Guangdong Huate Gas 广东华特气体	**Founded 1993: Specialty Gases:** Halogen gas, N2, Ar, He, SiH4, SiF4, BF3, AsH3, PH3, SF6, WF6, TMA..
Linggas 绿菱电子材料（天津）	**Founded 2008: Specialty Gases:** SF6, CF4, C4F8, CHF3,CH2F2, C3H8, CH4, H2S,. CO,COS, H2Se, SiF4..
Shanghai Pujiang Gases上海浦江特种气体	**Founded 1971: Specialty Gases:** O2, N2, He, CO2, BCl3, SiH4, CHF3,CH2F2, NF3, etc...
JinHong Gas金宏气体	**Founded 1999: Specialty Gases:** SiH4, CF4, SF6, H2, C2F6, C4F8,N2O, BCl3, Ne, N2, NO etc....
Air Liquide	Enter China since 1916. Electronics Specialty Gases/Materials Center China opened in July, 2008 in Zhangjiagang. Various Specialty Gases including BCl3, NH3, CO2, CO,Cl2, B2H6, SiH2Cl2, CHF3, He, HBr, NO, NF3, N2O, C2F6, C4F8, SiH4, SiF4, SF6, WF6, Xe.....
Praxair	Praxair (China) Investment Co. Ltd. operates as a subsidiary of Praxair Inc. enter China in 1998.
Air Products	Air Products and Chemicals (China) Investment Co. Ltd. operates as a subsidiary of Air Products and Chemicals, Inc. enter China in 1997.
Taiyo Nippon Sanso (Matheson) Co.	Establish 1st subsidiary in Dalian, China in 1993.
Messer-Group	In 1995, Messer Group set up corporate office in Shanghai, China.

CMC F-2-F (May 3-4)
and
CMC Conference (May 5-6)
in Hillsboro, Oregon

May 3-4 CMC F-2-F Meeting

- Location: Intel Hillsboro site meeting room (Busing from Hotel in a.m.)
- May 3-4 (Day 1&2) - 8-5pm
- 3~4 Supplier to be invited for presentation to include:
  - *Company Brief / Update*
  - *Current Capacity, Materials Forecast and Performance Management of Raw Material suppliers/sub-suppliers*
  - *Current Technology & Materials Challenges*
  - *Supply Chain Risks*
  - *Global / China Plans*
  - _____*(or other)*

- Gases
- Wet Chemicals
- Site visits ? (Kanto, TOK, Fujimi and ….. (tentative))

May 3-4 CMC F-2-F Meeting ‘ Con’t

- Shared Presentation Topics
  - **Materials Forecasting Methods**

    (Methodologies, Ownership, effectiveness metrics for forecast accuracy, and risk management)
  - **Managing Supplier Performance**

    (Criteria and performance metrics, tiering/spec process categories, recognition and communication)
  - **Optional Break-out session with (1) Hazardous Waste Management, or**

    (2) Sustainable Energy - requires ≥ 4 representatives
- Hot Topics Discussion
- Networking Dinner on Day 1 (Location tbd)
- CMC Conference Reception on Day 2 at 5-7 pm

- May 3-4 F-2-F Meeting Logistics – Due date: March 18th
  - *Air Travel and Hotel Reservation, please contact Mary Frances Corey at Techcet LLC (e-mail: mfcorey@techcet.com)*
- May 5-6 CMC Conference/Seminar
  - *2 CMC members per company for free registration, please also contact Mary Frances.*
  - *Add'l Persons early bird discount from same company, please register on-line (early bird discount by* April 15*)*
- Family member traveling together

- please also contact Mary Frances Corey at Techcet LLC (e-mail: mfcorey@techcet.com)

CMC Conference Update

Agenda to be emailed out in two weeks

Hot Topics to Discuss – 300mm Wafers

1. Offsetting Supply Shortage Considerations

- Utilization of 300mm wafer production capacity has certainly tightened, but likely remains in the range of 91-93%
- Underutilization remains in part due to incremental capacity gains largely via OEE (this targets lower costs to help mitigate declining unit pricing via effective capacity increases such as throughput, yield, etc.)
- As part of China's strategy to become a semiconductor superpower, an investment fund has been set aside to facilitate the objective and will likely extend into the supply chain
- Indeed it appears that an initiative by the former SMIC CEO Richard Chang will bring 300mm silicon wafer manufacturing to China by 2017

2. Key Takeaways

- Utilization of 300mm silicon wafer capacity has continued to increase but underutilization remains
- Planned output capacity of the 300mm silicon wafer facility in China should be sufficient to cover demands of the new fabs slated there

3. Other Concerns – 200mm shortage possible – more info coming

Hot Topics to Discuss

- _____III-V Wafer Supply and Demand _(your hot topics here)
- _____(your hot topics here)
- Supplier mergers and consolidation, impacts, fcst
  - Dow-DuPont
  - Others
- Neon

Questions / AR's / Wrap-Up

- AR's
  - *Survey for Pricing of NF3/WF6/ SiH4 will be sent out in March*
  - *Please feed back your free report selection*
  - *Please feel free to make suggestions about the second F-2-F meeting in 2H16*
    - Dates
    - Location
    - Meeting host volunteers
  - *Survey for May F-2-F meeting site visits.*
  - *Please let Jerry know if there are additional monthly meeting participants from your company(JYang@techcet.com)*

Thank You!

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