

World MEMS Equipment & Material Market 2009



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Methodology & Introduction

- **Methodology**
 - The market & technical information has been gathered directly at:
 - System manufacturer: car equipment manufacturers, IT equipment and medical device manufacturers ...
 - Device manufacturers: key MEMS inertial sensor manufacturers worldwide
 - Equipment & material suppliers for the MEMS industry
- **MEMS (Micro Electro-Mechanical Systems) definition used in the report:**
 - We consider MEMS devices that include moving parts (or fluids) in the μm to mm range and that use a photolithography process for manufacturing.
 - Limitations
 - Only die-level components (first level packaging) are considered, not the full system including MEMS devices.
 - Volumes and prices are for a packaged MEMS (inclusion of electronics according to the component technology)
- We have calculated projected equipment and material market **demand based on the number of wafers needed to meet forecast market demand** for the tracked MEMS devices, and the number of tools required to run that volume of wafers.
- We have **revamped our model this year** to better figure the effect of the crisis.
- The forecast now includes **only production tools**, omitting the \$100M or so spent annually on R&D equipment.
- For wafer size analysis, **we did not include old 4" and 5" fabs.** because of the current shift from 6" to 8", Yole has focused its analysis on 6" & 8" eq. wafer size forecasts.
- Our forecasts include all **new production equipment**, including mainstream CMOS CVD, CMP, etc. tools as well as specialty MEMS equipment but all of them are for **MEMS manufacturing**.

The MEMS Supply Chain Size 2008-2012

2008 → 2012

MEMS-based systems

\$46 B → \$83 B

MEMS devices

\$6.94 B → \$12.4 B

Equipment

\$142 M → \$510M

**Materials &
chemicals**

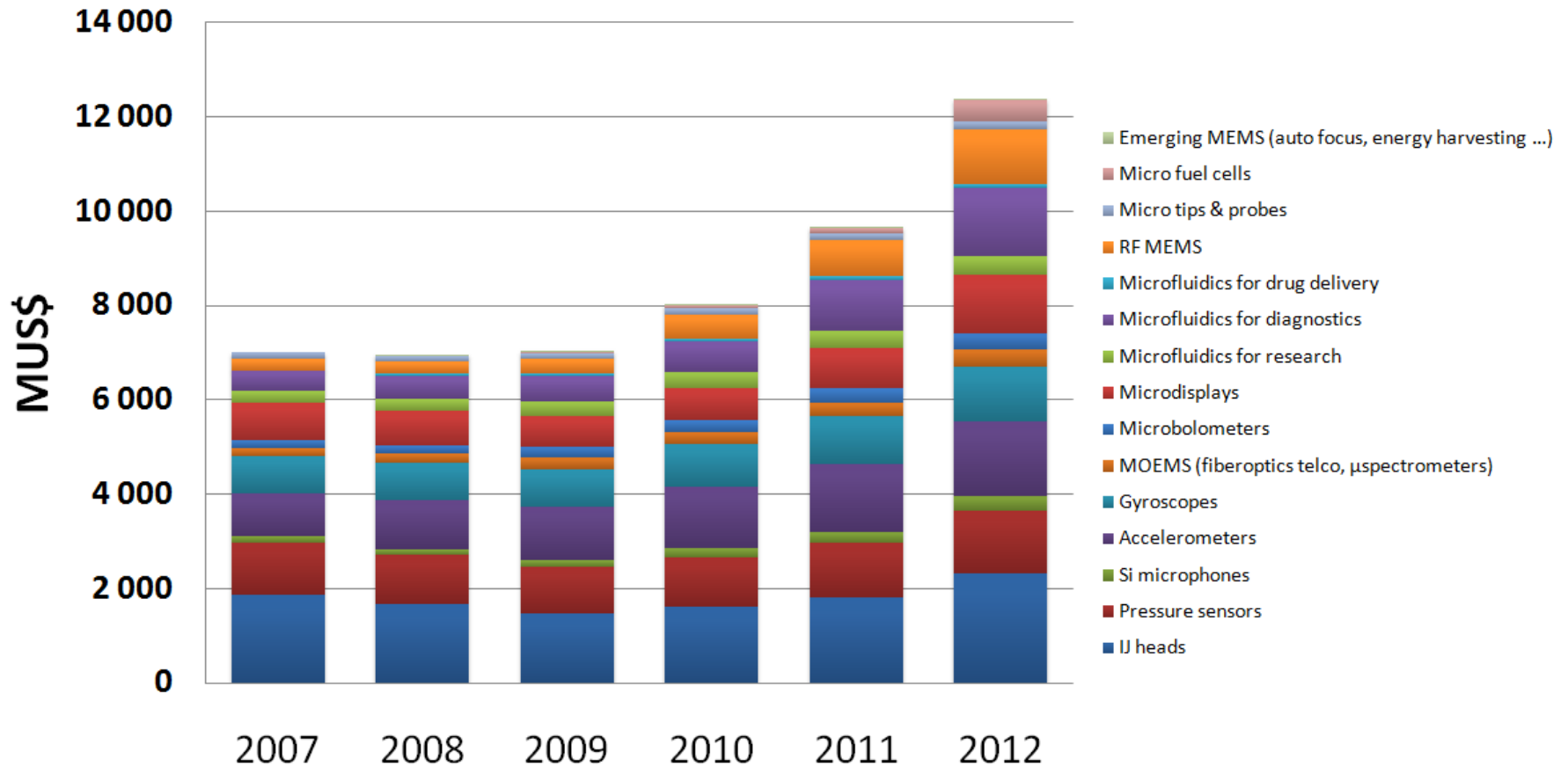
\$220M → \$321 M for substrates & photomasks

\$89 M → \$149 M for chemicals (wet, gas ...)

MEMS Market Forecast by Device in \$M

The turmoil effect (June 09)

MEMS Markets Value (M\$)
June 09

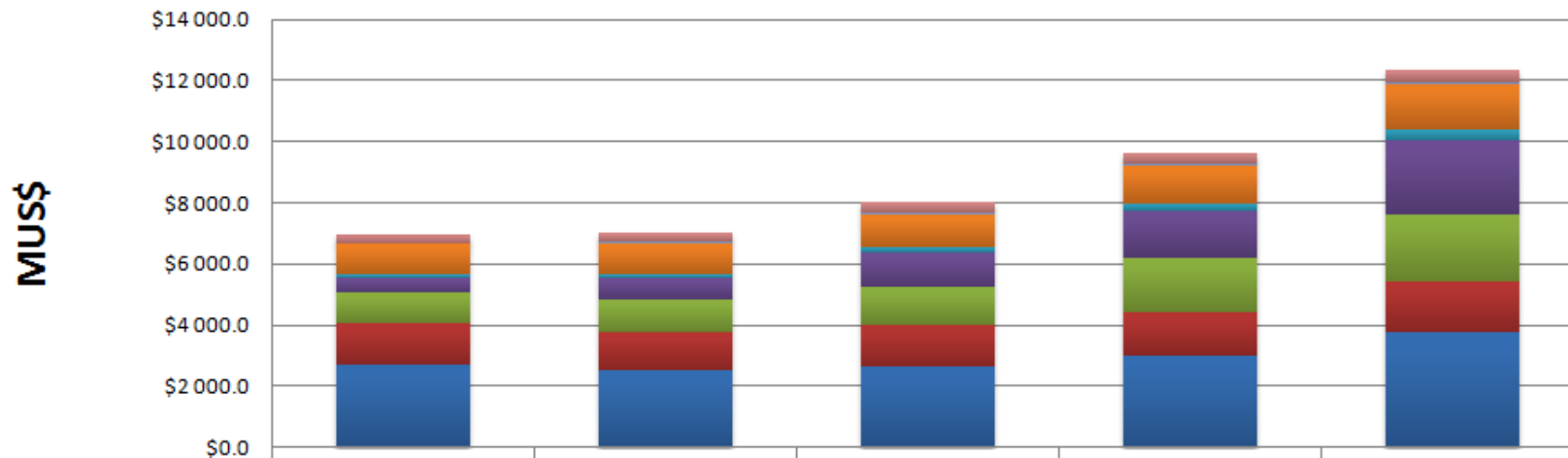


MEMS Market Forecast by Application in \$M

The turmoil effect (June 09)

MEMS market forecasts in MUS\$

June 2009 data



	2008	2009	2010	2011	2012
Defense	\$242.9	\$273.3	\$314.5	\$368.7	\$429.6
Aeronautics	\$48.5	\$49.6	\$50.8	\$51.7	\$52.9
Industrial	\$978.6	\$1 004.6	\$1 086.1	\$1 253.4	\$1 484.4
Telecom Infrastructure	\$132.8	\$173.6	\$201.8	\$214.0	\$378.4
Telecom	\$476.0	\$664.1	\$1 077.3	\$1 564.5	\$2 370.9
Medical & Life Science	\$986.2	\$1 110.9	\$1 271.0	\$1 775.7	\$2 191.8
Automotive	\$1 338.2	\$1 234.6	\$1 333.4	\$1 436.0	\$1 676.8
Consumer	\$2 735.9	\$2 507.9	\$2 675.4	\$2 983.1	\$3 778.4

Automotive is strongly affected

Inertial MEMS for consumer is not much affected but the IJH business badly impacts the total "MEMS for consumer" segment.

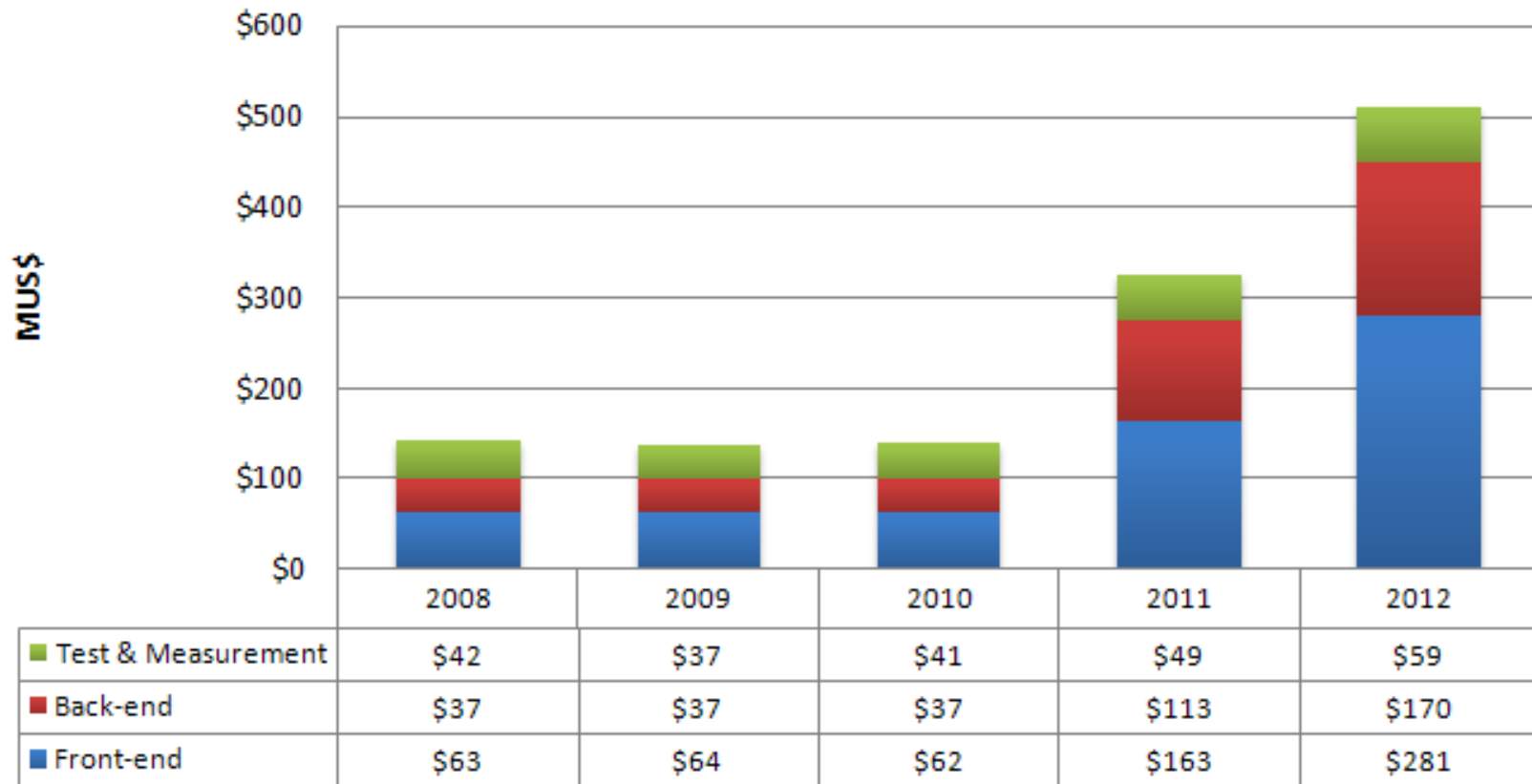
What's New Compared to 2008 for the MEMS Markets?

- The 2009 economic crisis has definitely had an impact on the MEMS market and companies' financial results. This started **Q4 2008**. But this impact is very different according to the various MEMS markets.
 - The automotive business is probably the most dramatically impacted by the downturn.
 - In terms of units, there is a decrease compared to the previous years. However, some companies suffer less than others (as is the case for Robert Bosch for example) but all of them are impacted.
 - The impact is also different according to the maturity of the MEMS products. Established devices such as airbag accelerometers are suffering more than emerging devices (e.g. TPMS or ESC).
- The consequences in consumer markets are also different, depending on the MEMS products.
 - Manufacturers of ink-jet heads are suffering a lot, with about a 12% decrease of IJH market compared to 2008.
 - On the other hand, inertial MEMS products for the consumer market are still growing (in the range of a few %) with some players (e.g. STMicroelectronics and ADI) showing pretty good results.
- How will the future be for MEMS markets?
 - Such a crisis will come to an end only when device stock levels fall.
 - First sign from Taiwanese players seems to indicate a restart of IC production. Although it could also be the case for MEMS, we believe that 2009/2010 will be a flat year for the MEMS market.

MEMS Equipment Market

(June 09)

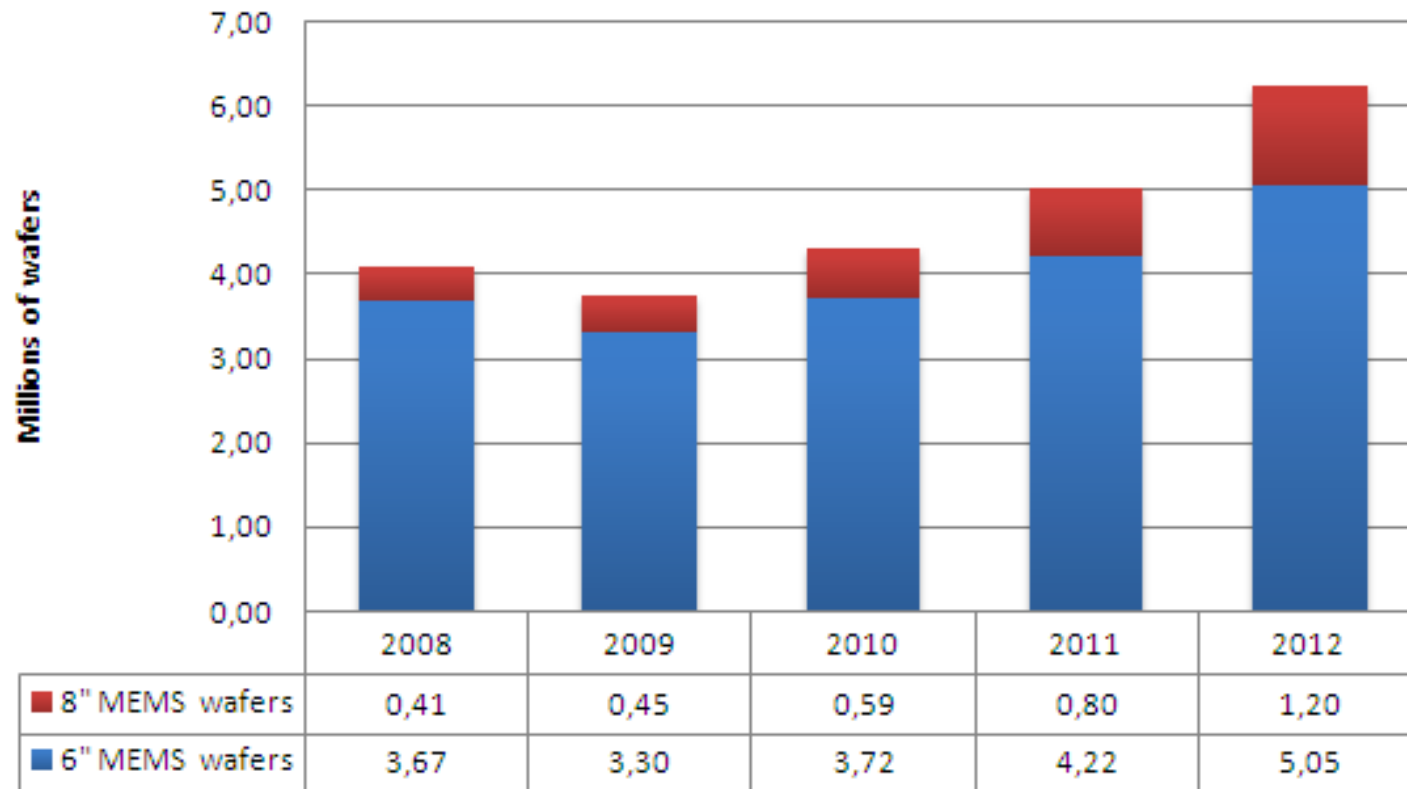
MEMS Equipment Forecast
June 2009 data



MEMS Wafer Size Breakdown

(June 09)

MEMS wafer size breakdown



MEMS Equipment & Material Market

The downturn

- Existing overcapacity in the face of the recession continues to limit capital expenditures.
- Tool demand in 2008 dropped to **\$142 million**, but should jump back up to a **\$510 Million market by 2012**.
- The downturn, and an overhang of excess capacity from the build out of 8" fabs and the conversion of some CMOS fab lines to the MEMS foundry business will mean flat growth for MEMS equipment will continue this year and next year.
 - But producers are continuing to buy R&D equipment, and are continuing to add capacity for select devices, especially for cell phone applications, and for some new projects for things like RF switches, energy harvesting and micromirrors.
- The new caution tends to mean, however, that even in growing niches, MEMS makers are aiming for just-in-time delivery of equipment, waiting to add capacity until they actually have the device orders in hand, and then wanting the tools immediately. There is also continued demand for production processes to shrink the die.
- However, because of the **shift to 8" wafer size**, there are still opportunities for investments (for example, Robert Bosch has invested into a DRIE for its MEMS business in early 2009).
 - However, some process modules will be very complex to replicate on 200 mm. Uniformity across the wafer will affect yield and throughput → **close collaboration with equipment vendors is necessary**.

MEMS Equipment & Material Market

And after 2010?

- Although the MEMS business is undergoing a crisis, the need for smaller, more performing devices still drives innovative process developments.
 - **\$500M forecast in 2012** includes value for new equipment that will be bought in 2012 to cope for the future production of MEMS.
 - Assumptions consider there will no real recovery of the MEMS business before 2009-2010, so current production equipment in the fabs have capacity enough to cope with MEMS production.
 - In 2011, if the MEMS production grows again, then new investments will be needed.
- This time favors new developments:
 - It has taken more than 10 years for **DRIE** to be largely adopted by the MEMS industry
 - Today, there are many technologies under development with large expectation of use: **sacrificial release (XeF₂), packaging, testing ...**
 - Packaging is particularly a “hot” topic with strong evolution: wafer level capping, wafer level packaging, 3D, interposers
- New MEMS business catchers are coming (*see following slide*)