

# EEMI450 and global 450mm Cooperation

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- Spokesman EEMI450
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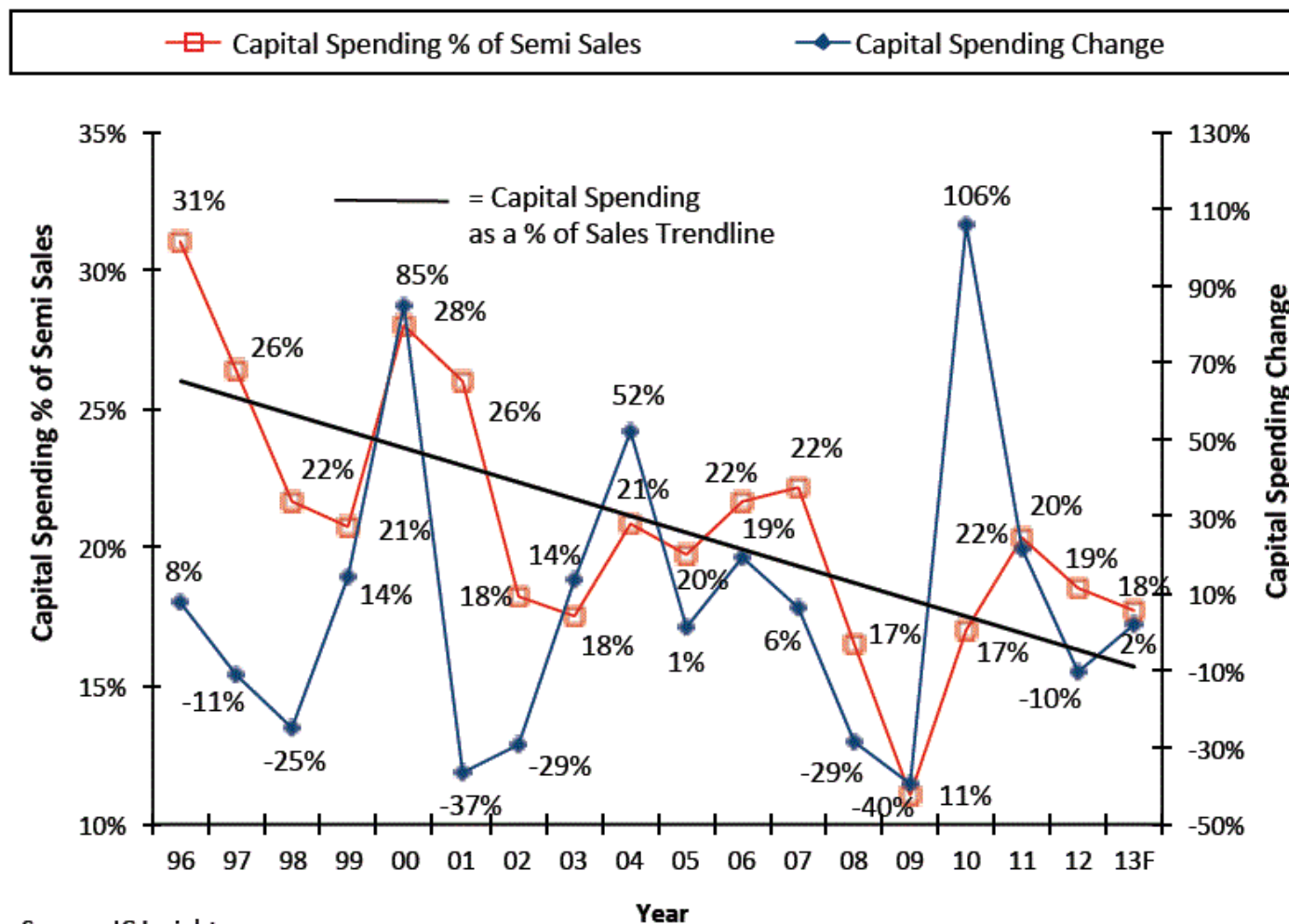


# Overview

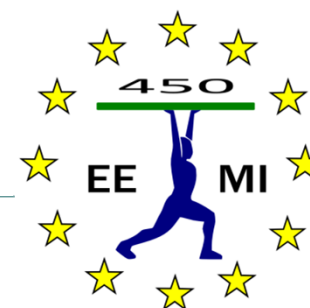
- Semi-equipment market
- 450mm R&D
- 450mm E&M activities in Europe
- International Collaboration



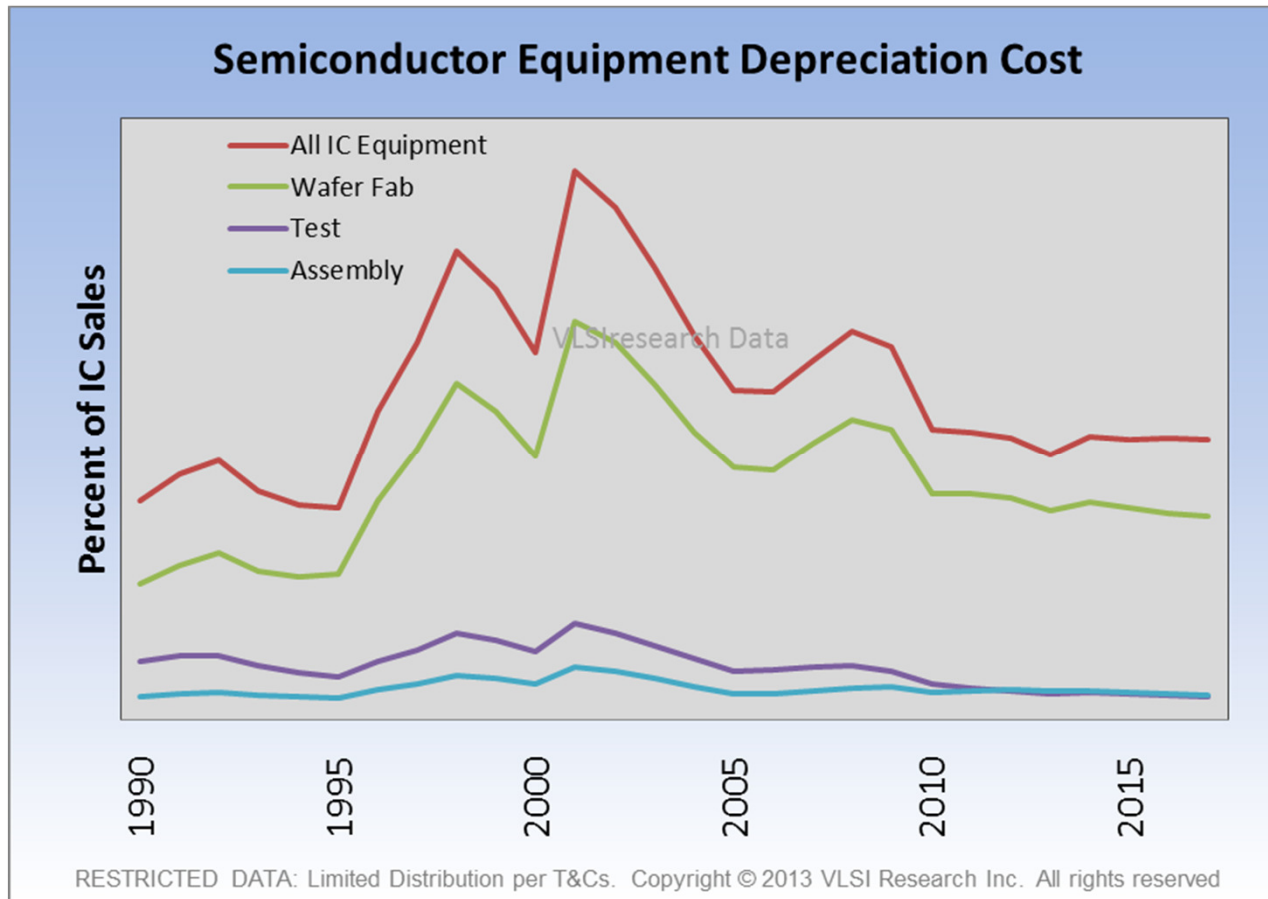
# Semi equipment costs per sq./cm



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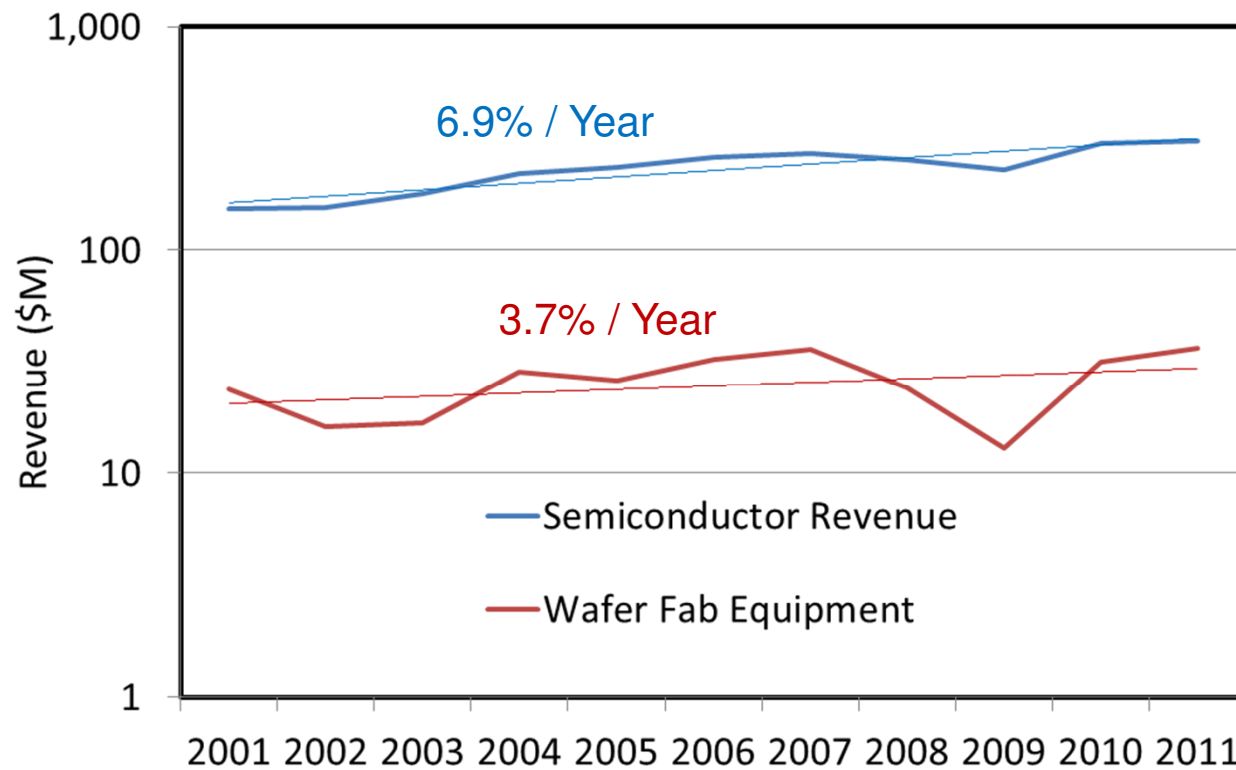
# Equipment depreciation costs



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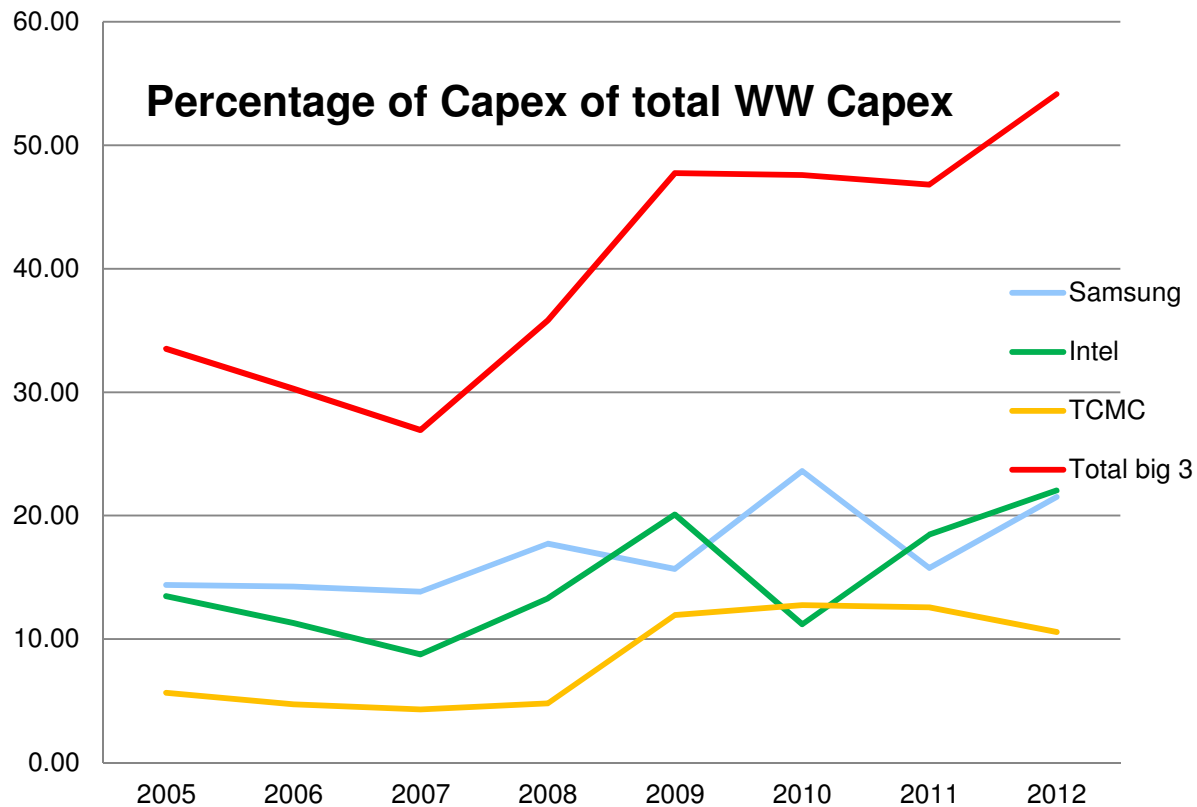
# Revenue diverging



Source: VLSI/SEMI



# Consolidation customers



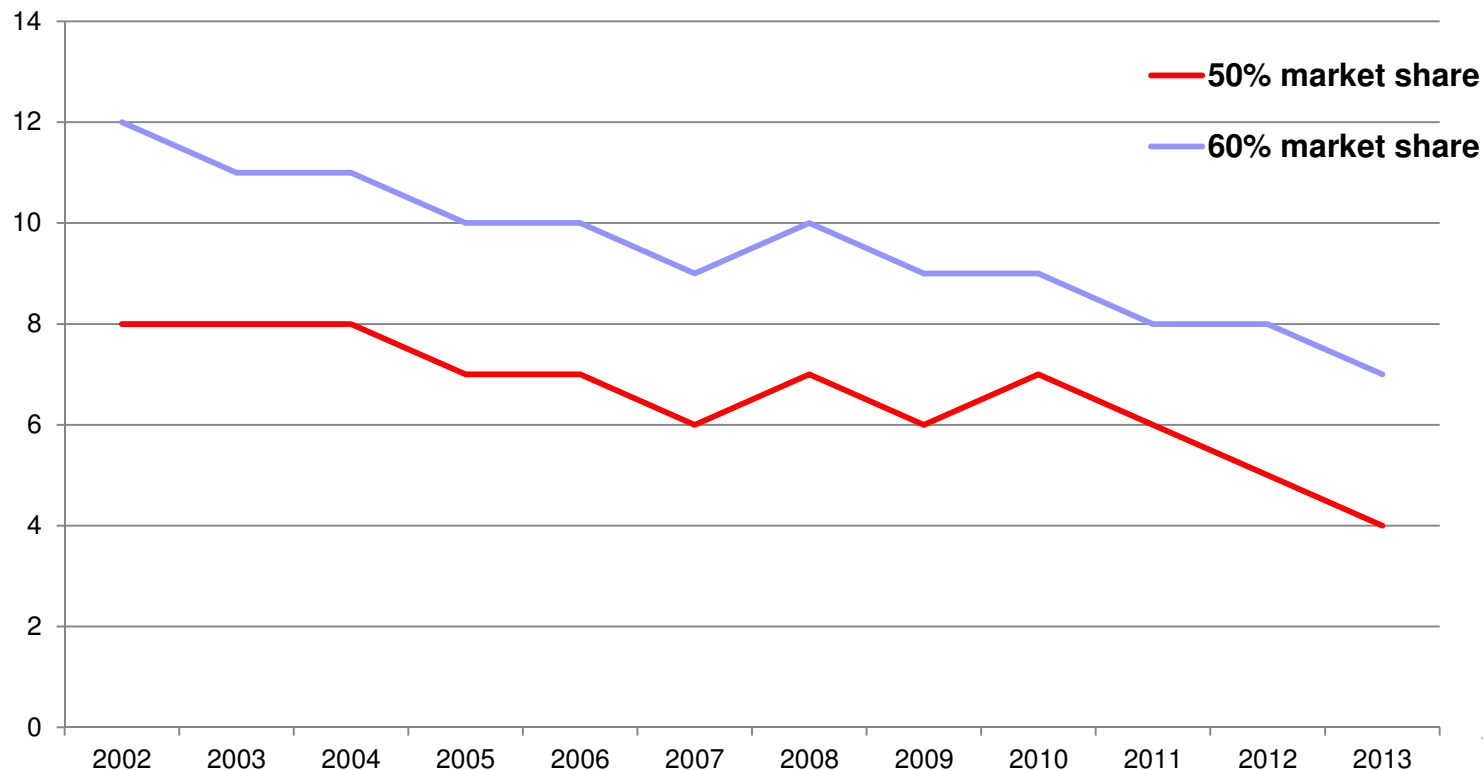
Source IC Insights

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# Consolidation Equipment suppliers

**Number of equipment suppliers providing cumulative market share of  $\geq 50/60\%$  of total market**



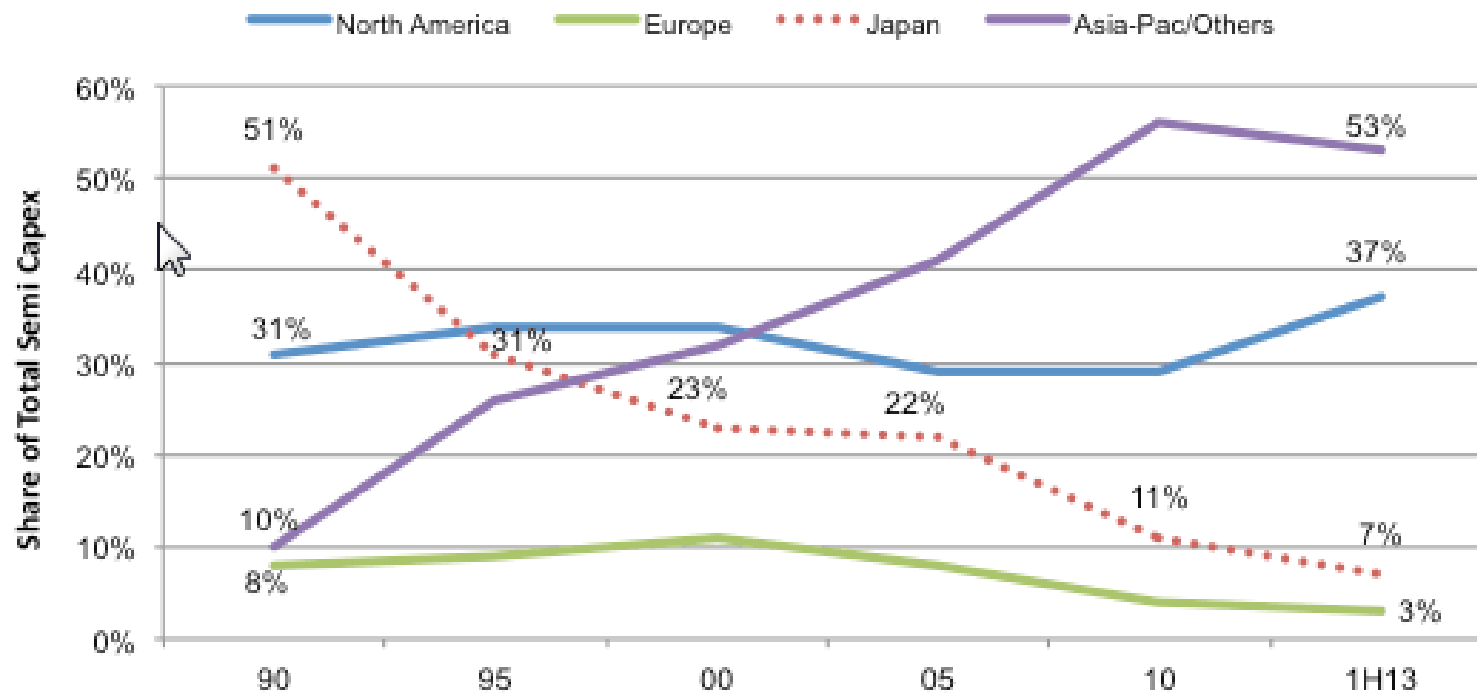
Source: Gartner

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# Equipment market per region

## Semiconductor Capital Expenditures by Region

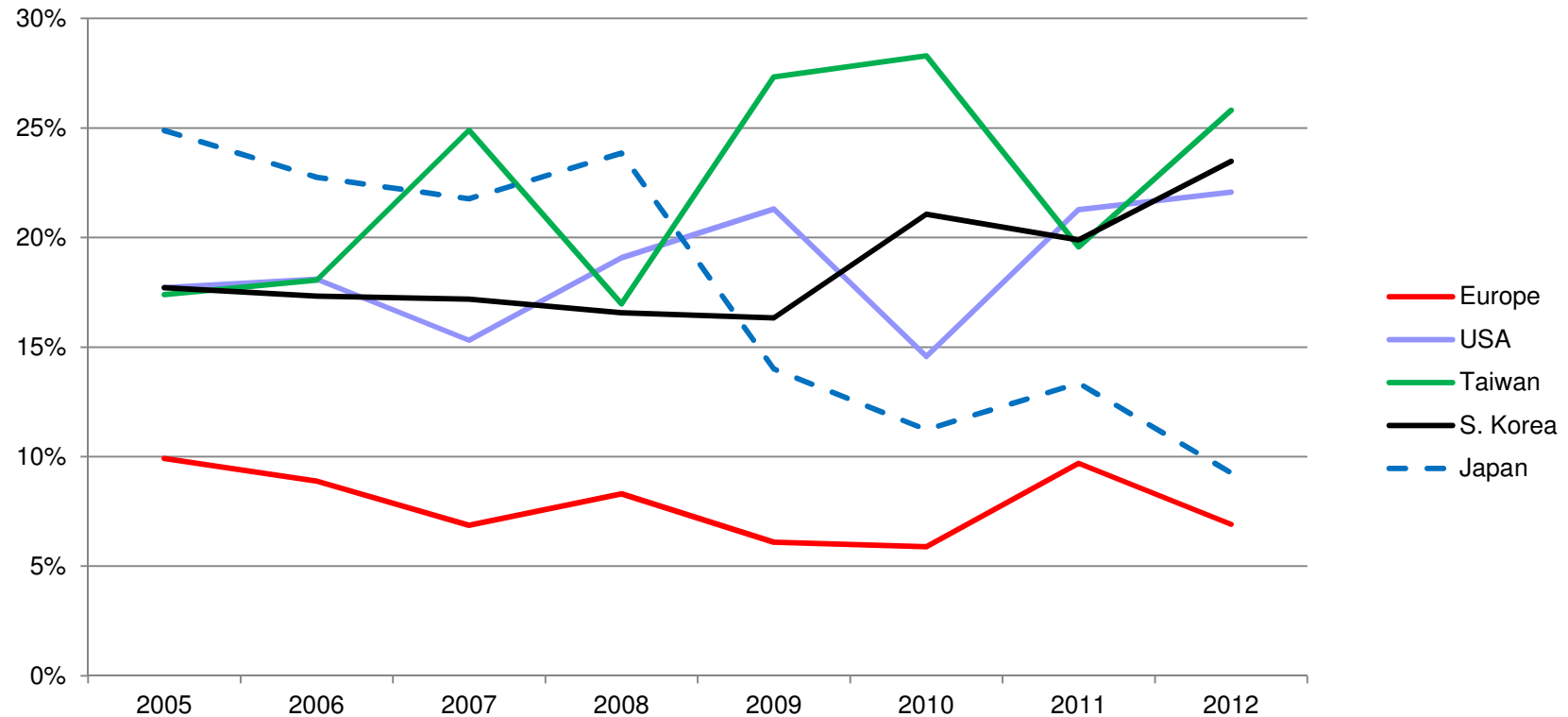


Source: IC Insights





# Equipment market % per region



Source SEMI

# Foundries capital spending

## Major Pure-Play Foundries' Capital Spending as a Percent of Sales Trends

Company	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013F
TSMC	94%	28%	25%	26%	18%	30%	45%	51%	49%	50%
UMC	76%	21%	27%	25%	11%	20%	47%	48%	47%	38%
GlobalFoundries*	N/A	N/A	N/A	N/A	N/A	42%	78%	155%	83%	88%
SMIC	N/A	77%	61%	55%	49%	18%	47%	58%	32%	30%
Chartered	85%	55%	36%	52%	33%	26%	N/A	N/A	N/A	N/A
<b>Total</b>	<b>86%</b>	<b>33%</b>	<b>30%</b>	<b>31%</b>	<b>21%</b>	<b>27%</b>	<b>50%</b>	<b>67%</b>	<b>54%</b>	<b>53%</b>
<b>Semiconductor Industry Average</b>	<b>28%</b>	<b>20%</b>	<b>22%</b>	<b>22%</b>	<b>16%</b>	<b>11%</b>	<b>17%</b>	<b>21%</b>	<b>19%</b>	<b>18%</b>
<b>Percentage of "Final Sales"***</b>	<b>39%</b>	<b>15%</b>	<b>14%</b>	<b>14%</b>	<b>9%</b>	<b>12%</b>	<b>23%</b>	<b>30%</b>	<b>24%</b>	<b>24%</b>

\*Includes Chartered beginning in 2010.

\*\*Assumes a 55% gross margin for the foundries' customers.

Source: IC Insights

# EU based equip. suppliers



Source: VLSI Technology



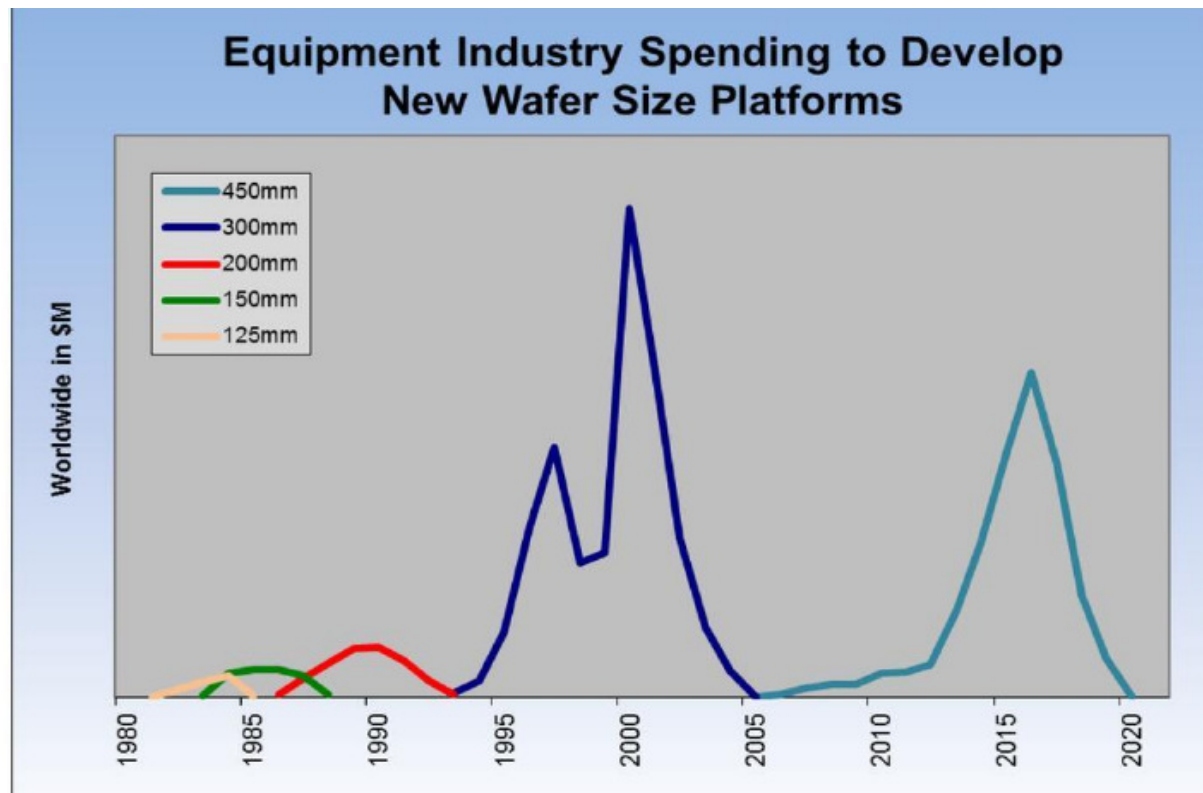
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# Forecasted 450mm investments

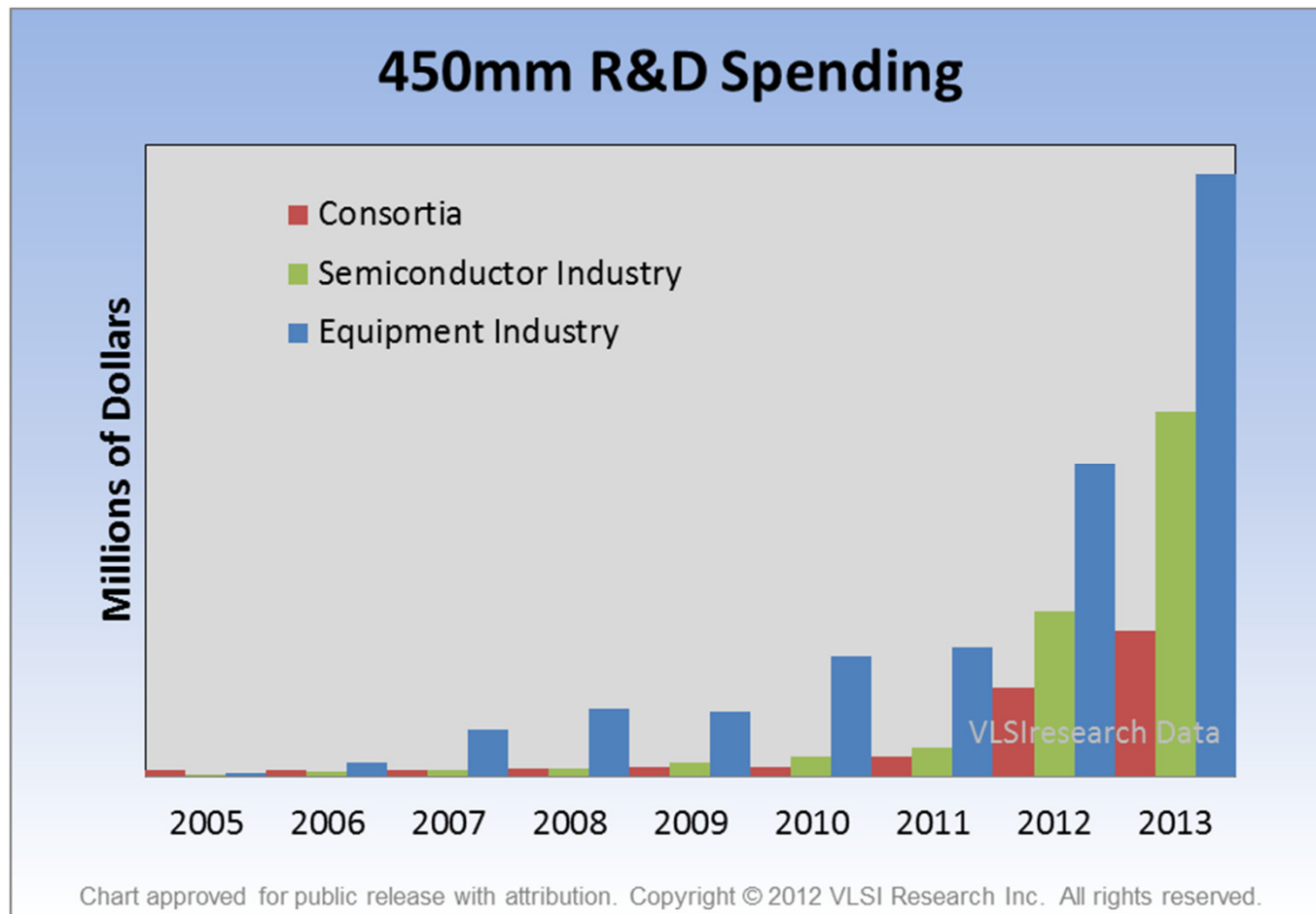
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# 450mm R&D Spending



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# Overview

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# European Cooperation

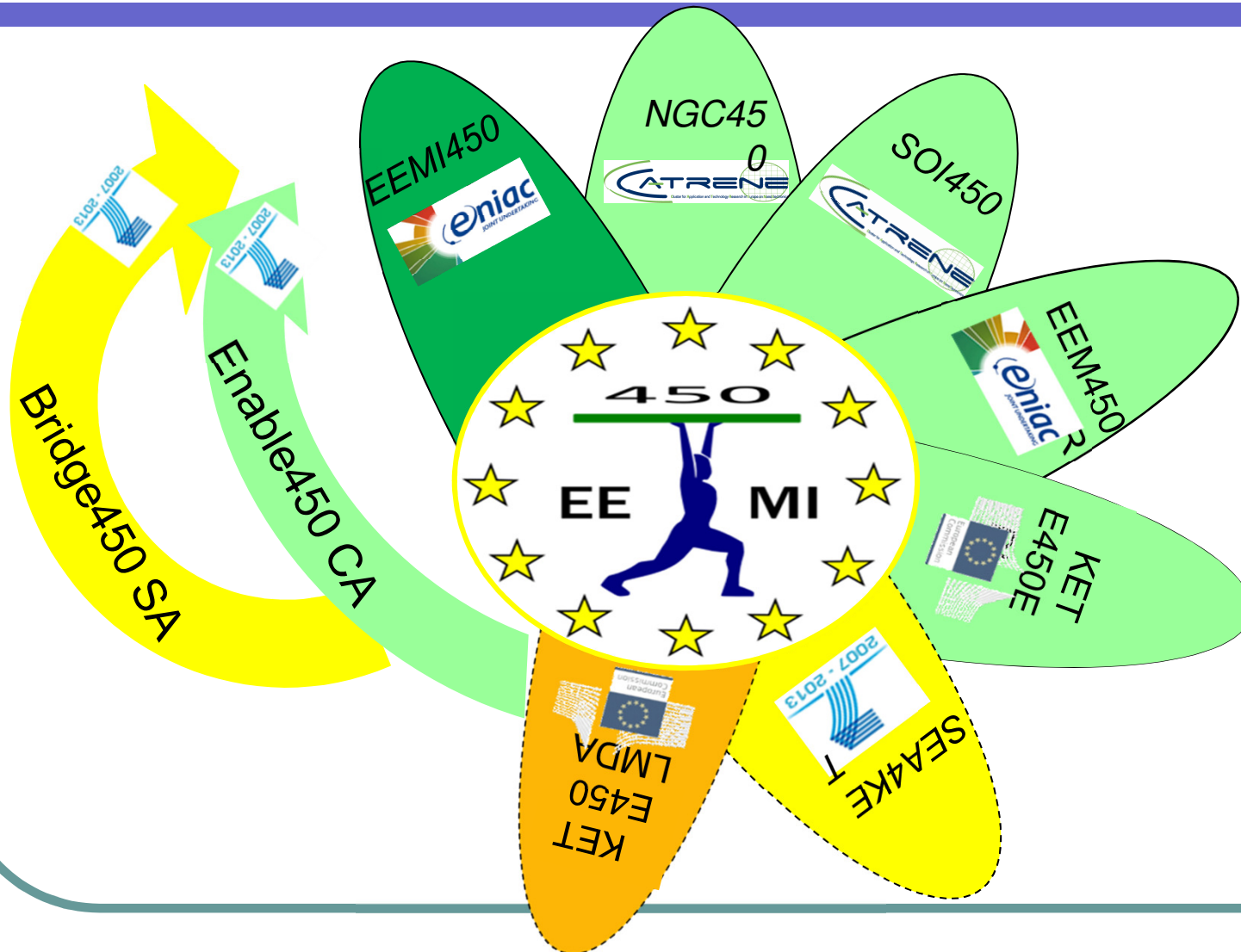
- Membership of EEMI450

- Started in 2009      20 members
- 2010 (start project)      32 members
- 2011      40
- 2012      46
- 2013      54 members





# EEMI450 related projects



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# EEMI450 related projects

- The EEMI450 community has initiated 8 European 450mm projects, which were granted up to now:
  - EEMI450 (ENIAC) 2010 - 2012
  - NGC450 (Catrene), started end of 2011 till end of 2014
  - SOI450 (Catrene), started end of 2011 till 2014
  - EEM450PR (ENIAC), started in April 2012 till April 2015
  - Enable450 (FP7 CA), started end of 2012 till end of 2015
  - E450EDL (ENIAC KET- Demo line), just started, duration 3 years
  - SEA4KET (FP7, partly 450mm), will start shortly, duration 3 years
  - Bridge450 (FP7 CSA), will start shortly, duration 2 years



# More projects

- Recently a large ENIAC KET- pilotline proposal was submitted: E450LMDAP (*European 450mm Lithography and Metrology Development for Advanced Patterning*)
- This is a very large litho centric proposal, coordinated by ASML.
- Further project proposals to be submitted in 2014 are expected.
- All current ENIAC projects are containing equipment evaluations at imec, especially E450EDL (Equipment-demo-line) and E450LMDAP are targeting a European 450mm demo/pilotline at imec.



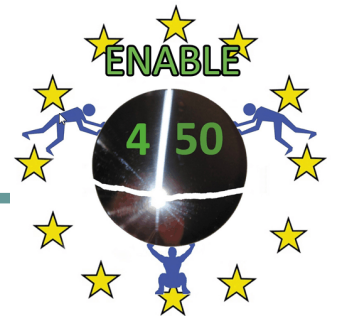
# Overview

- Semi-equipment market
- 450mm R&D
- 450mm E&M activities in Europe
- **International Collaboration**



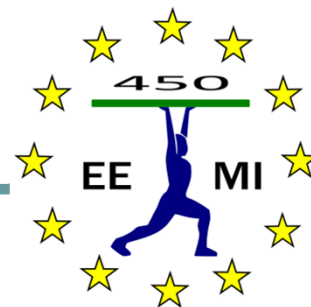
# Enable450/EEMI450

- Within the Enable450 project, a so-called Coordination Action funded by the EU, international collaboration was one of the tasks defined.
- During the first year of the project several discussions with G450C, both face-to-face (Brussels and Albany), as by conf. calls, took place to exchange information and establish common cooperation topics.
- In addition on the Taiwan-EU ICT Technical Cooperation Conference in March 2013, several 450mm presentations were given by EEMI450 members.



# EEMI450-G450C topics of cooperation

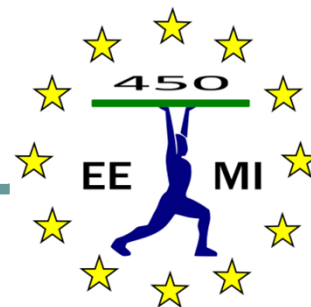
- Common protocol for tool assessment and alignment on DTS (Demonstration Test Method)
  - Advantage for equipment suppliers:  
Tools can be evaluated at either imec or G450C and results are transparent
  - Common approach discussions ongoing
  - Opens possible coordination between imec and G450C, where equipment could be assessed



# EEMI450-G450C topics of cooperation

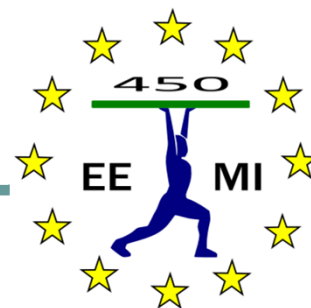
- Metrology

- Overview what is available on both sides of the ocean was shared.
- Especially in the early phase where not all equipment is available everywhere a “global” lab would be advantageous
- Cooperation between G450C and Metro450 under discussion
- Calibration wafer standard on the agenda



# EEMI450-G450C topics of cooperation

- **AMC (Airborne Molecular Contamination)**
  - Topics of Collaboration as proposed by FhG IISB:
    - Minienvironment evaluation by sampling and offline analysis
      - Passive sampling using sorbent tubes
      - Active sampling by impinger (requires qualified staff @ sampling site)
    - Investigation and evaluation of different decontamination strategies
      - Set-up of different contamination/decontamination scenarios for wafers, FOUPs/MACs and other minienvironments
      - Monitor and optimize decontamination efficiency
    - Definition of AMC limits (in close cooperation with manufacturing sites)
      - Identify critical parameters from processes/equipment/*in situ* sensors/... to predict the amount of contamination and the right time for decontamination (APC)
      - End-of-life prediction for FOUPs/MACs





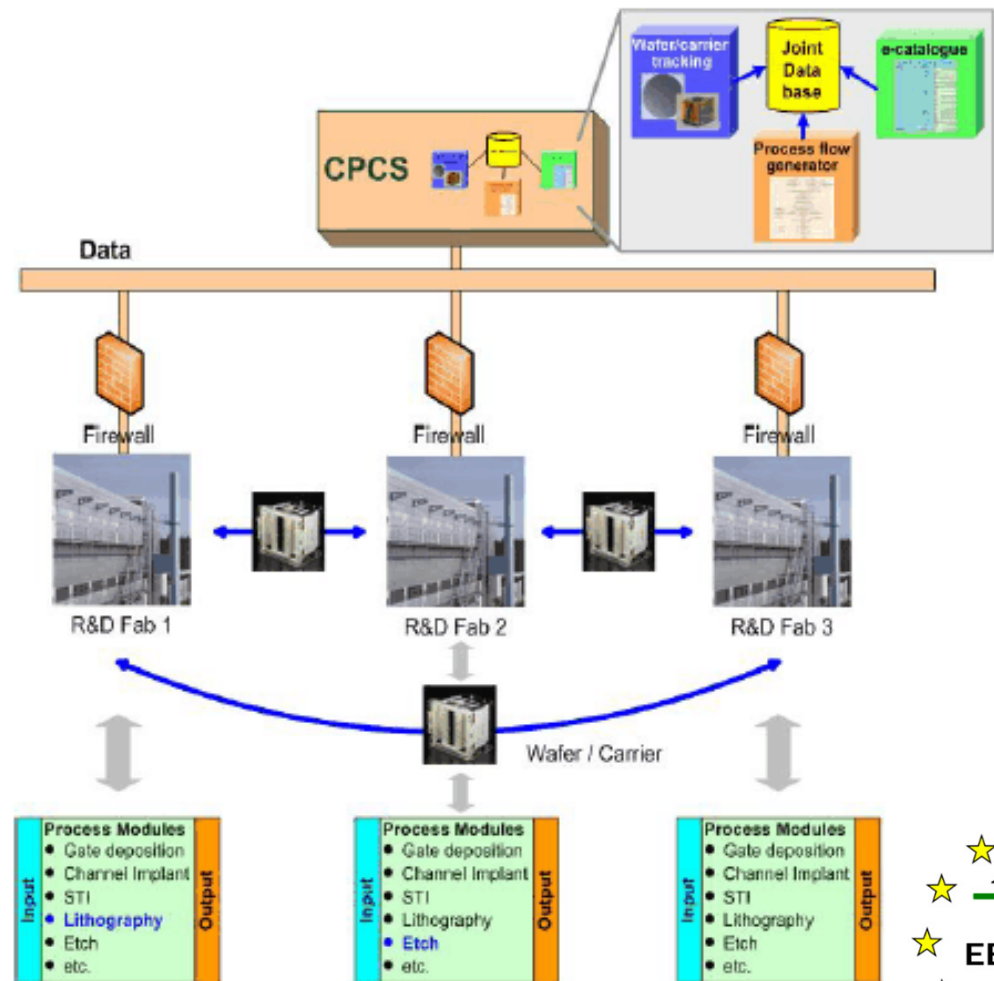
# EEMI450-G450C topics of cooperation

- 450mm (test)wafers
  - European partners, coordinated by imec, are sending their requirements concerning
    - Quality, numbers and timingto G450C, which will include those in their total 450mm wafer orders
- Advantages
  - Pricing
  - Consistent quality both sides of the ocean.

# EEMI450-G450C topics of cooperation

## ● Flying wafer (concept 300mm)

- Wafers are exchanged between R&D sites for processing and characterisation
- Wafers are transferred using predefined I/O procedures
- Wafer controlled using defined specifications for contamination level and control methods
- Process/metrology and logistic data is transferred to and made accessible by a Central Planning and Control System (CPCS)



Source FhG IISB

Semicon Europe - 450mm Session



# EEMI450-G450C topics of cooperation

- Flying wafer for 450mm

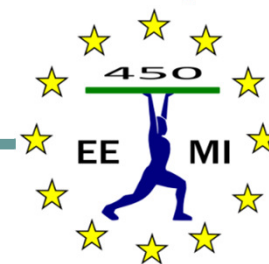
## **Objective**

To develop a gradual concept for the implementation of a flying wafer infrastructure for 450 mm, building on the process resources at 450 mm sites, R&D sites, equipment suppliers to accelerate collaboration and learning curve

## **Proposed activities**

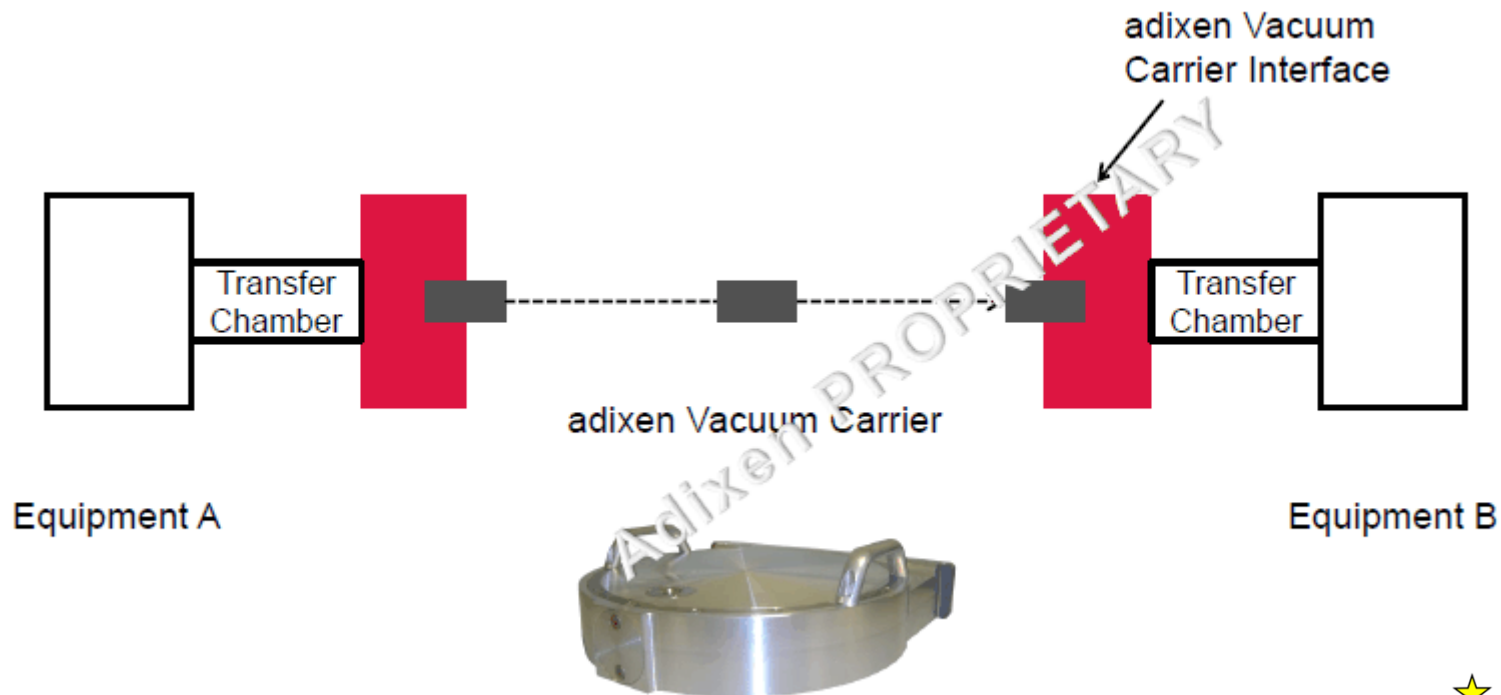
Exhaustive specifications of a flying wafer infrastructure with different grades of implementation levels, e.g. base level (e. g. for equipment supplier) with wafer specifications. High end level (manufacturing site) includes full set of specifications.

A kind of “Flying Wafer™” certificate might be elaborated; Fraunhofer IISB might act as certification entity providing the required expertise and control methods and services, respectively.



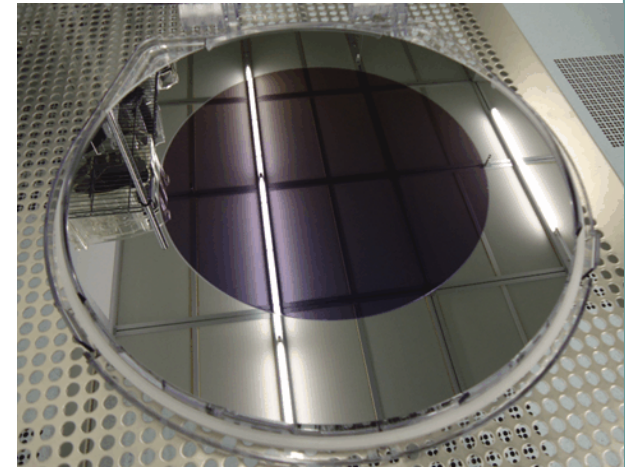
# EEMI450-G450C topics of cooperation

- Flying wafer wafertransport carrier



# EEMI450-G450C topics of cooperation

- 450mm Pocket wafer (Xycarb)
  - A common 450mm pocket wafer
    - To be able to measure smaller wafers in a 450mm environmentis under discussion as well
- Green idle mode
  - Green idle mode of vacuum equipment, under development in the EEM450PR project, is on the common agenda as well. Standards are being developed, but process implications have to be investigated.



# EEMI450-G450C topics of cooperation

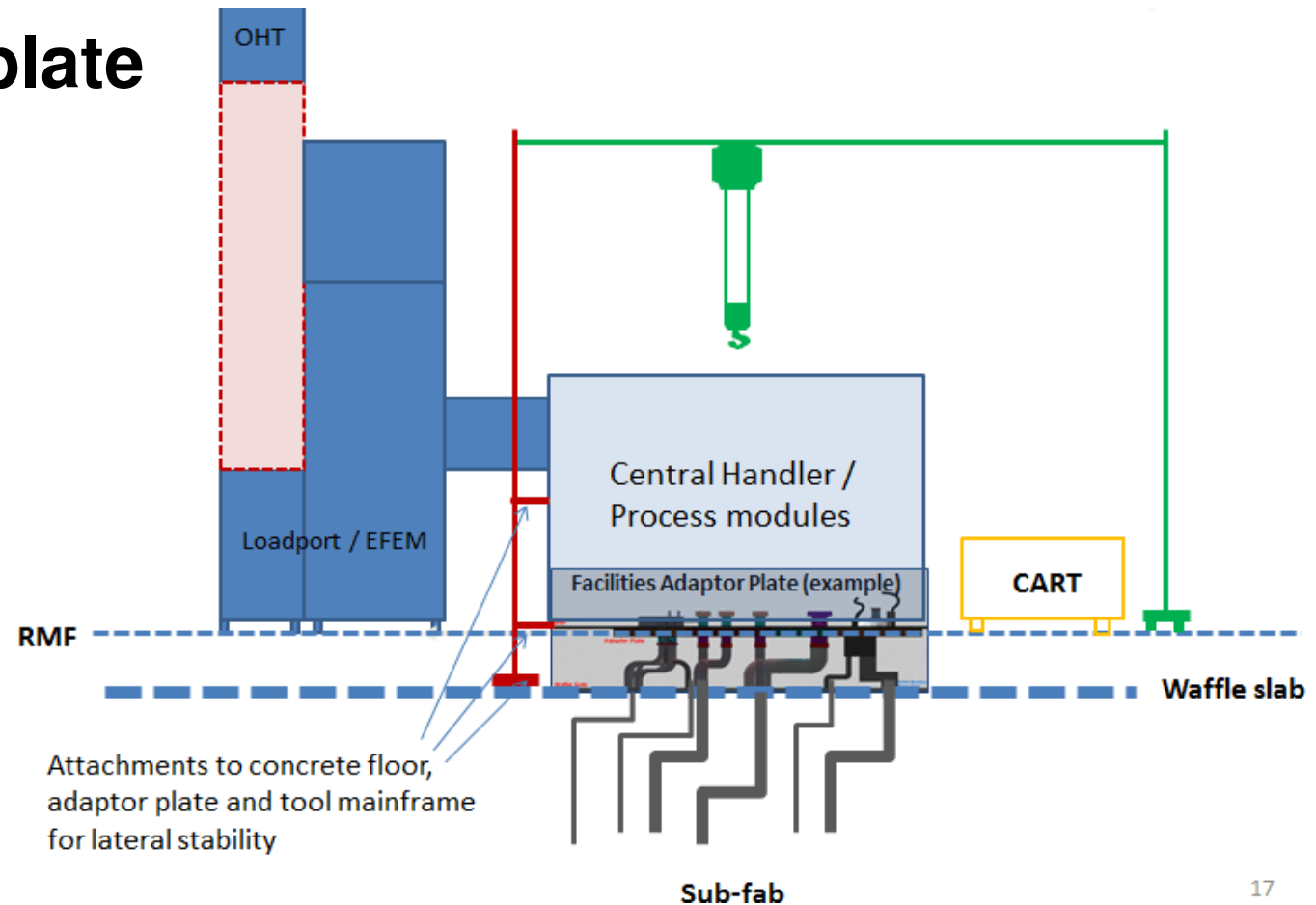
## ● F450C

- The Facilities 450mm Consortium (F450C) is a first-of-its-kind partnership at SUNY's College of Nanoscale Science and Engineering (CNSE) that is leading the global effort to design and build next-generation 450mm computer chip fabrication facilities. The collaboration includes 10 of the world's leading nano-electronics facility companies, including Air Liquide, CH2M HILL, CS Clean Systems, Ceres Technologies, Edwards, Haws Corporation, Mega Fluid Systems, M&W Group, Ovivo and Swagelock.
- One of the objectives is to come to standard facilities 3D template for installation to ease the effort and reduce installation time when the system is brought into the cleanroom.



# EEMI450-G450C topics of cooperation

## 3D template



# EEMI450-G450C topics of cooperation

- SEA4KET (FP7) project
  - In this European project a vertical furnace will be evaluated at G450C
  - Data obtained at G450C may be used in the project





# EU-Taiwan (Asia) cooperation

- In the Brige450 FP7 “ Support Action” project, which can be viewed as an extension of Enable450, the emphasis is put on intensifying contacts with Asia and visits are planned to the tier 1 semi companies.
- Example: the mentioned EU-Taiwan conference where 450mm related EU – Taiwan cooperation was discussed, especially since Taiwanese institutes and companies now may join EU projects.

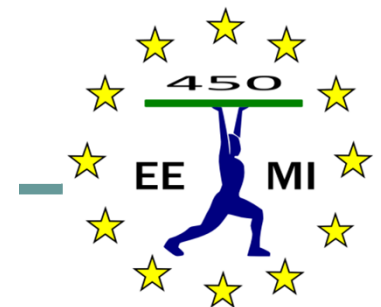
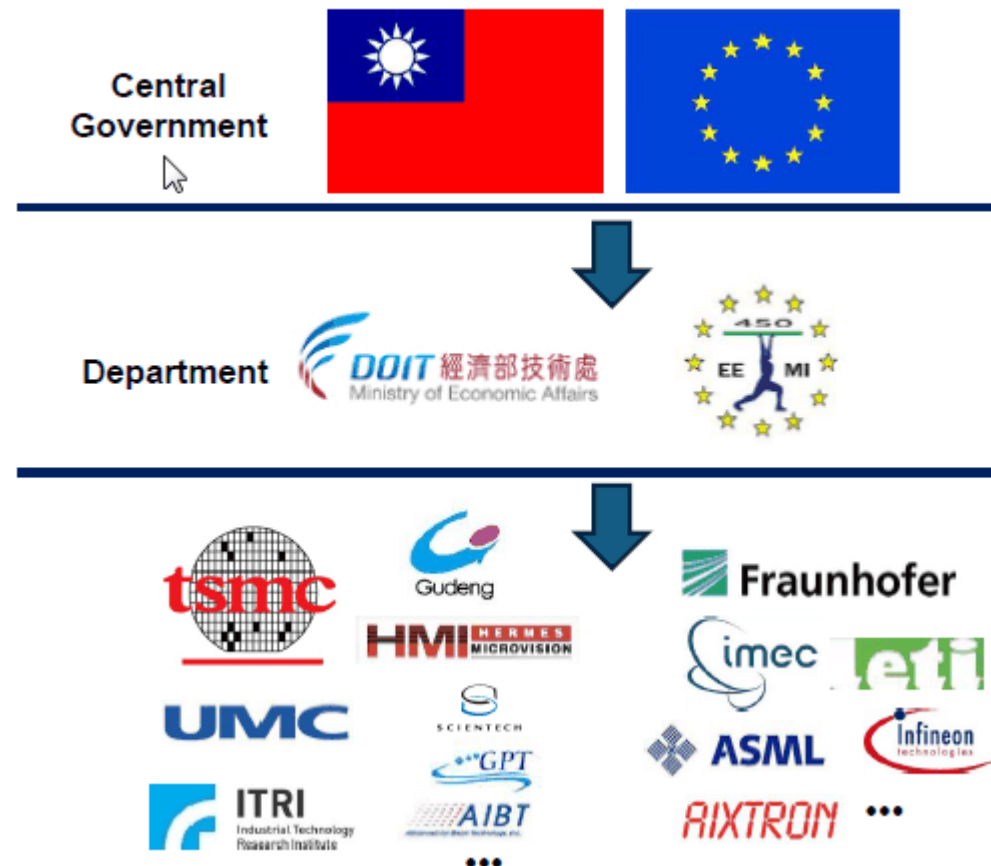


# Taiwanese ideas

## 2 heads are better than 1

- Co-exploring the emerging opportunity on 450nm-

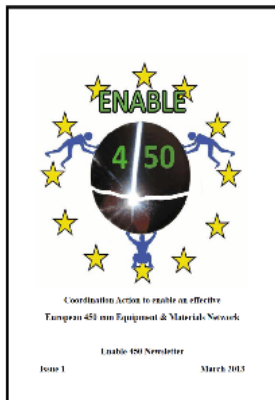
### Possible action Plan



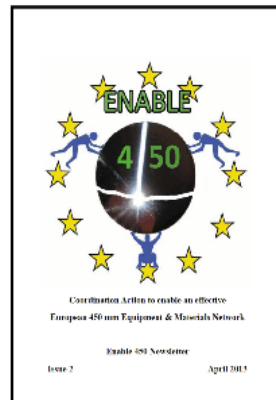
# Enable450 newsletter

- Within the Enable450 project a Newsletter is generated, distributed and published on the project website: [www.enable450.eu](http://www.enable450.eu)
- This newsletter provided by Future Horizons gathers global 450mm related information and is available to the global community

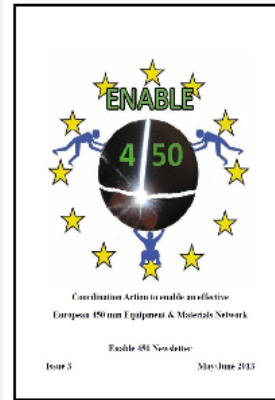
March 2013



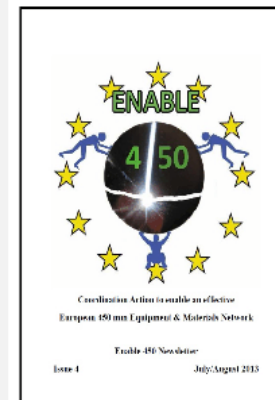
April 2013



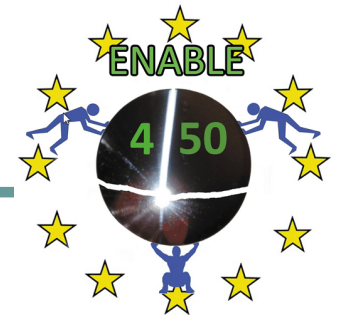
May & June 2013



July & Aug. 2013



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# Thank you

## Thank you for your attention!

