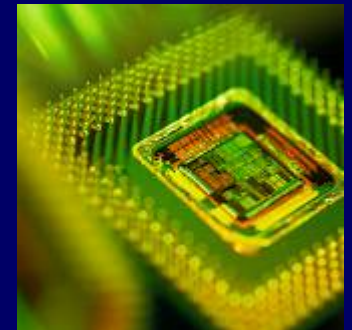




ISMI Symposium October 2009

**Accelerating Manufacturing Productivity**

# 450 mm Transition Update



Tom Jefferson  
450 mm Program Manager

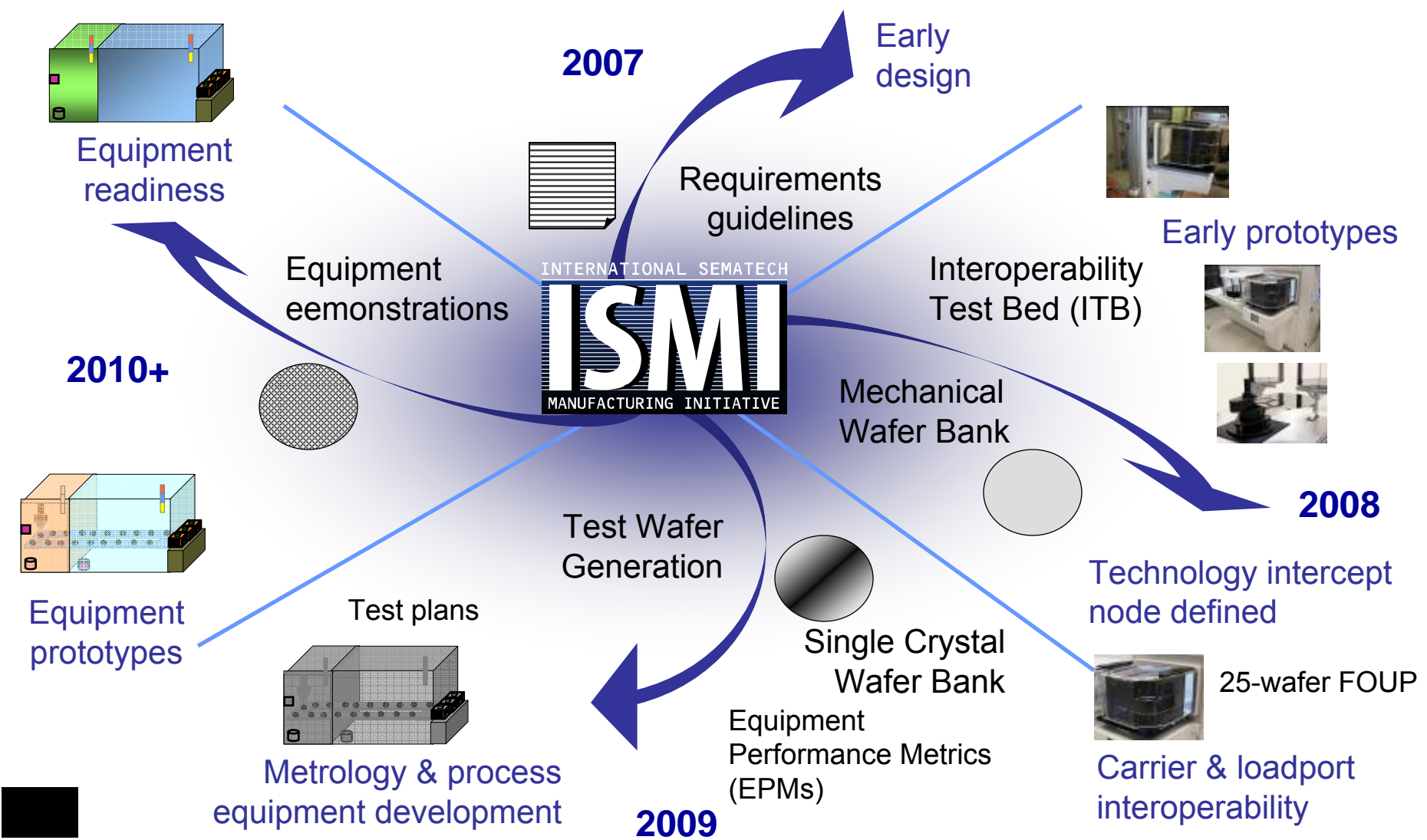


# October 2009 Briefing Agenda



- 2009 450 mm Program Overview
- 450 mm Process and Metrology Readiness
- 450 mm Silicon Readiness
- 450 mm Factory Integration Readiness
- 450 mm ESH Guidelines Update
- Key Messages and Next Steps
- Questions and Discussion

# Coordinating Industry Convergence Towards 450 mm



# Mission and Organization

## ISMI's 450 mm Mission Statement

Enable a cost-effective 450 mm transition through coordination and development of infrastructure, guidance, and industry readiness

### 450 mm Organization

## 450 mm Transition Program

Supplier Engagement

ESH Readiness

Test Wafer Operations

Factory Integration  
Readiness

Manufacturing Excellence

Starting Materials

Equipment Metrics and Test Methods

# ISMI Supplier Acknowledgement



ISMI 450 mm Program would like to acknowledge the following companies for their support and participation in the 450 mm Program:

**Angstrom Sun**

**CDE**

**Entegris, Inc.**

**Gudeng Precision Industrial**

**Hirata Corp**

**NanoPhotonics**

**SSEC**

**Sinfonia**

**Brooks Automation**

**CyberOptics Corp.**

**Genmark Automation**

**H-Square**

**IDC**

**Nikko**

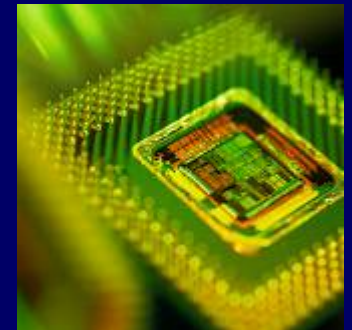
**SUMCO**

**TDK**

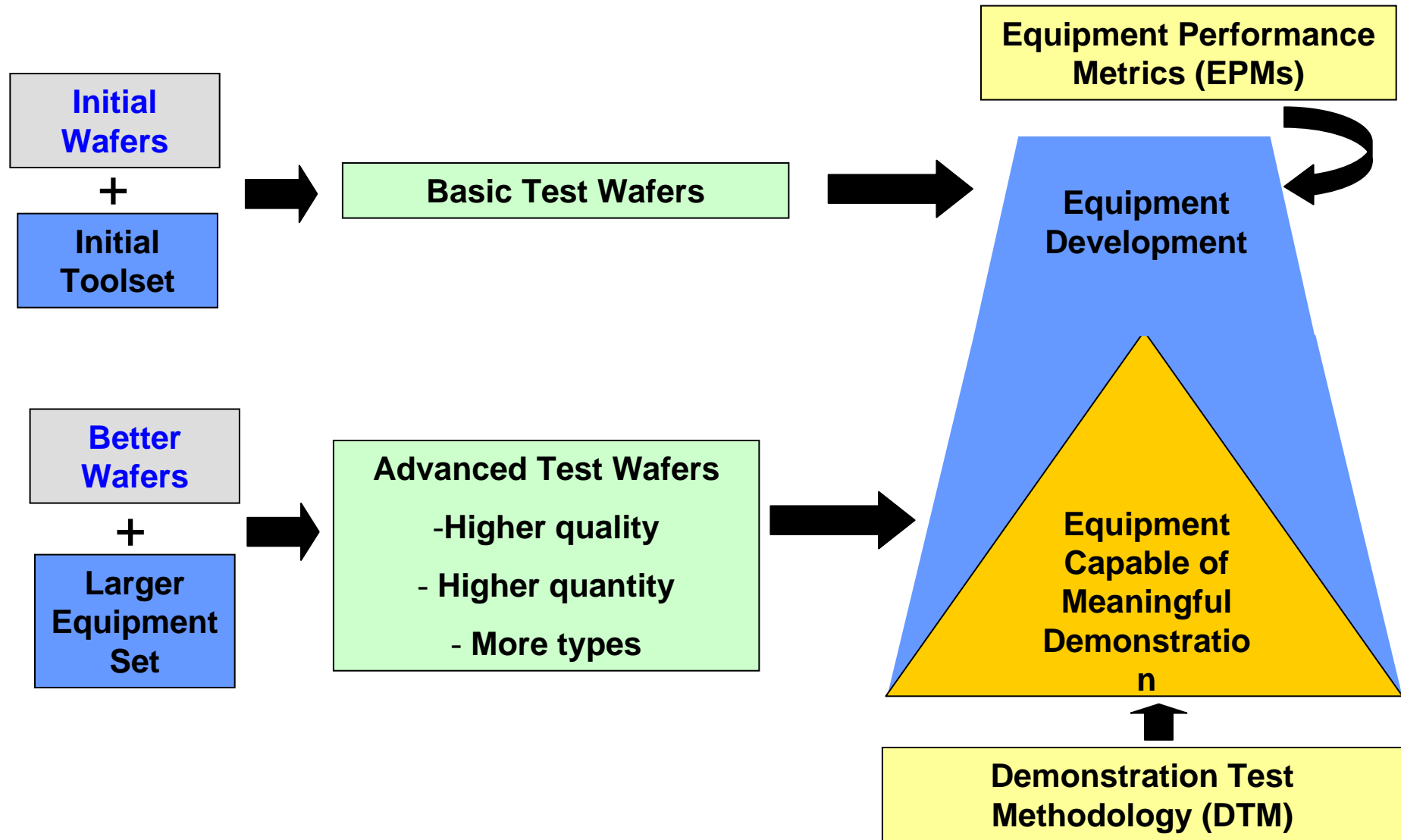


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# 450 mm Process and Metrology Readiness



# ISMI Equipment Development and Demonstration Strategy



# 450 mm Global Equipment Requirements



## 300 mm

### Carryforward

#### Safety/EHS:

- S2, S8, CE Mark
- FMRC 4910/UL 2360

#### Facilities / Utilities:

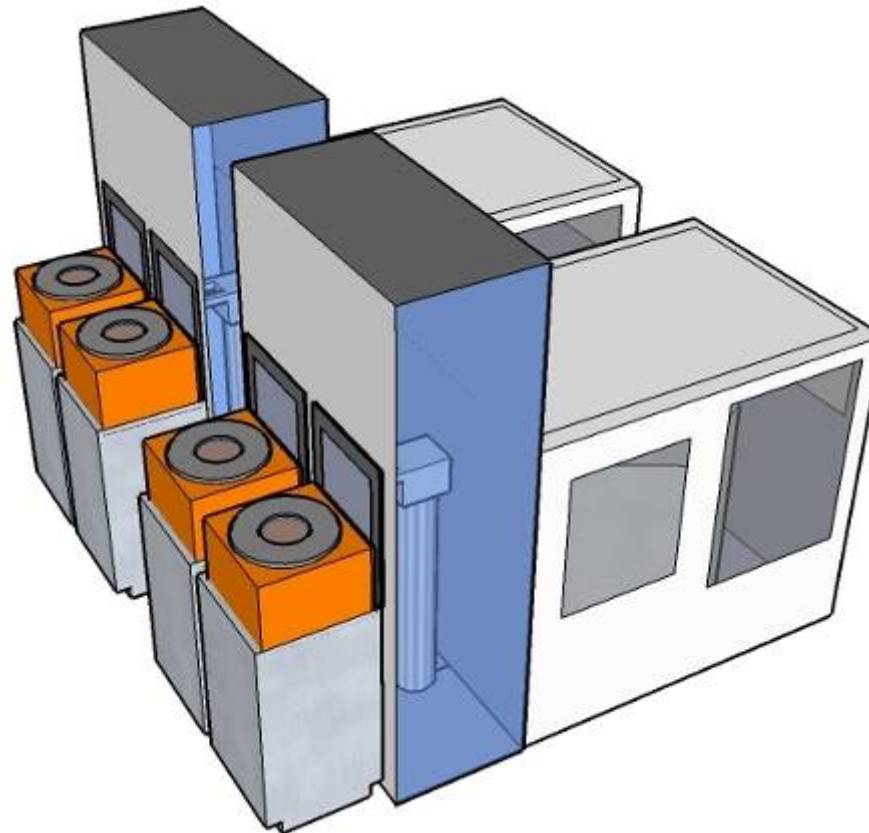
- Height <12 ft
- Sub-fab:Fab footprint <0.75
- SEMI F47

#### Automation:

- E84, GEM300

#### Productivity:

- No TPT loss due to # of loadports on tool



## 450 mm

### Safety/ESH:

- ISMI guidelines (manual handling risk characterization, fall protection, mass balance characterization)

- $\leq 1.0X$  utilities consumption, waste emissions / effluent per wafer processed

### Facilities / Utilities:

- $\leq 1.0X$  Footprint scalar (relative to throughput)
- $\leq 1.0X$  Install duration
- $\leq 1.0X$  Qual duration

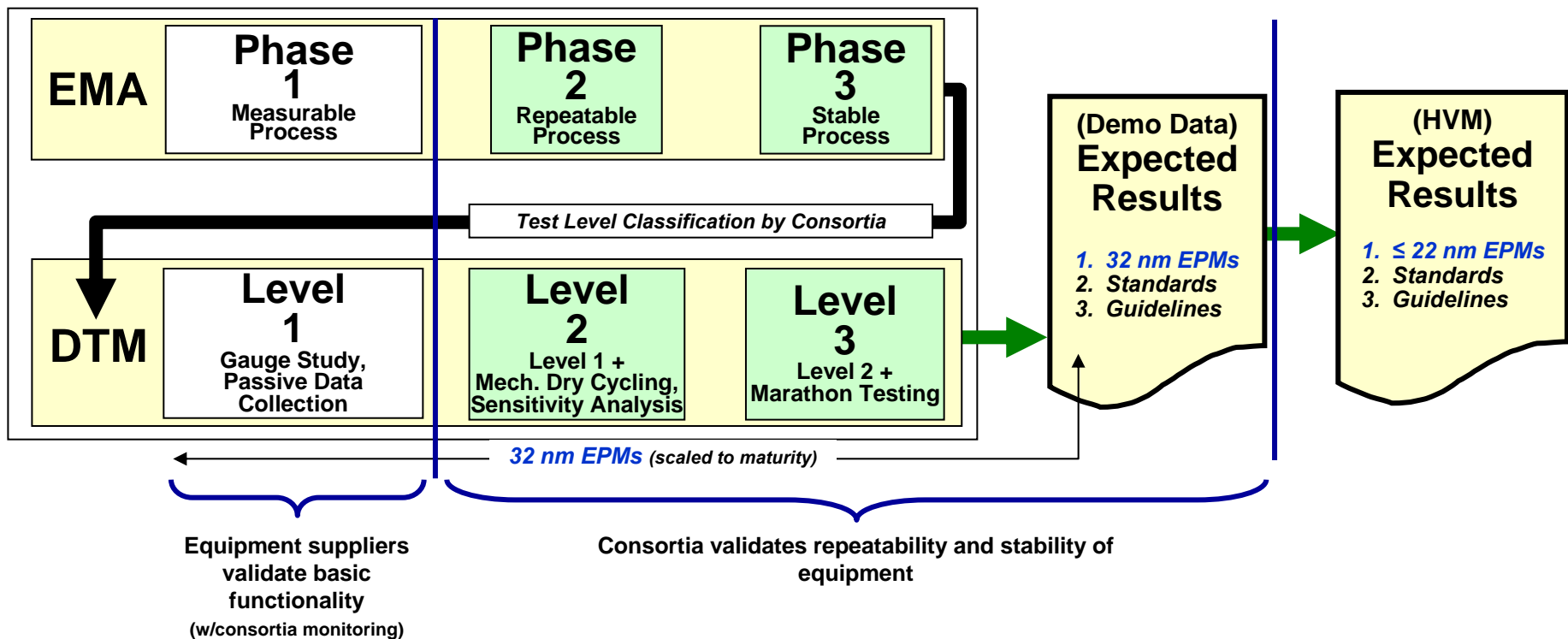
450 mm will re-use 300 mm guidelines and standards where possible to leverage learning where existing concepts are proven

# 450 mm Equipment Performance Metrics (EPMs)



- Equipment Performance Metrics (EPMs) provide customer targets for critical process and manufacturing performance metrics to suppliers as they begin development of 450 mm equipment
  - Tool demonstration will focus on 32 nm capability from early testing to first production-worthy process and metrology equipment.
  - Equipment maturation thereafter must achieve high volume manufacturing (HVM) cost/performance to support production ramps while technology scales to 22 nm and beyond.
- ITRS technology requirements were the starting point for EPM development and were refined with direct inputs from ISMI member company technical review
- Supplier input was incorporated before EPM publications through a series of three workshops attended by >80 participants from ~30 OEMs
- EPMs have been defined for 60 tool types in equipment parameters, process targets, process characteristics, and manufacturing / performance targets and are publically available on the ISMI website.

# 450 mm Demonstration Test Methodology (DTM) Strategy



**EMA:** Equipment Maturity Assessment    **DTM** = Demonstration Test Methodology

**Results of an EMA will define the appropriate level of testing**

# ISMI 450 mm Test Wafer Generation Strategy



## Motivation

- Few suppliers can generate all of their own test wafer needs
- Supplier feedback from 300 mm conversion was that I300I's coordination of test wafers was very useful
  - Significantly reduced cost and accelerated development

## ISMI Approach

- Coordinate 450 mm wafer processing to facilitate supplier equipment development
- Loan 450 mm test wafers for process and metrology equipment development to suppliers

# Early 450 mm Test Wafer Generation

## - Top Priority Capabilities and Expectations



**Particle Detection Metrology**

**Film Thickness Metrology**

**Thermal Oxide Deposition**

**Wet Cleans**

**PECVD Oxide**

**PVD Metal**

**Silicon Nitride**

**Early Patterning Capability**

**Dielectric Dry Etch**

**Dry Strip Asher**


**CD Measurement**


**Dielectric CMP for Reclaim**

### Targets for Early Test Wafer Tools

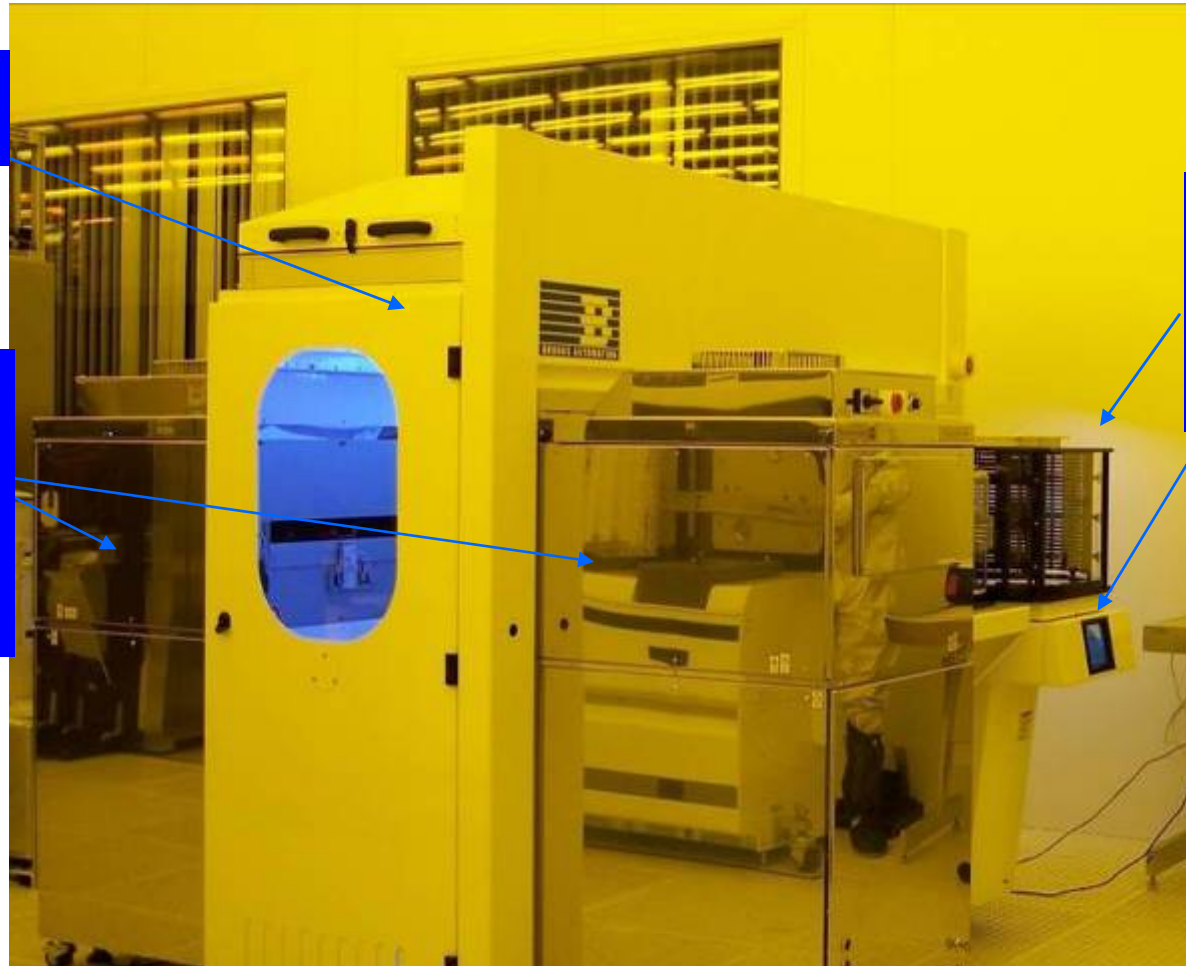
- Desired process performance is the current 300 mm capability or better
  - Lower performance may be acceptable to satisfy timing and capability needs
- Defect densities are a lesser concern for early TW tools
- Throughput and reliability are important, but only to support the level of TW processing volume
- Automated wafer handling
- Safe to operate and maintain

 = capabilities selected by ISMI to date

 = Capabilities being pursued for 2009

 = Capabilities being pursued for 2010

# 450 mm Test Wafer Generation ISMI Particle / Edge Inspection Module



450 mm  
EFEM

450 mm  
metrology  
modules  
(particle and  
edge  
inspection)

450 mm  
standard 12  
mm pitch  
FOUP and  
loadport

**Particle/edge inspection module installation in the cleanroom is completed – first ISMI 450 mm tools operational in clean environment**

# 450 mm Test Wafer Generation Prototype Wafer Cleans Tool



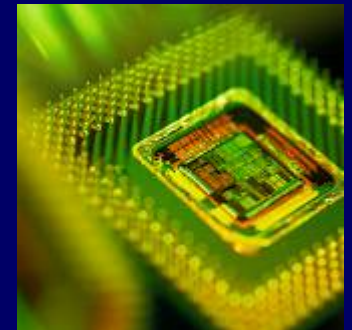
Photo Courtesy of Solid State Equipment Corp. (SSEC)

- **First process equipment at ISMI; installation has begun**
- **Single wafer cleaning**
- **SC1/SC2 cleans**



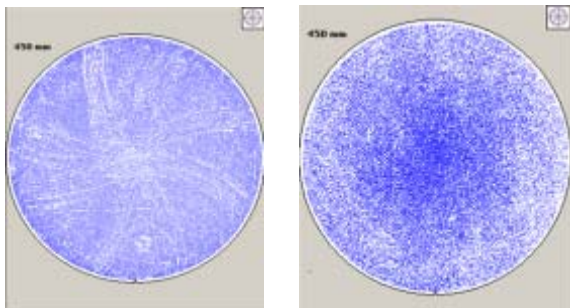
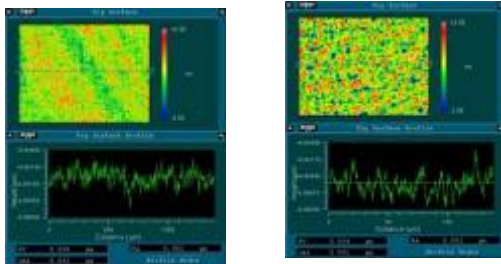
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# 450 mm Starting Materials Readiness

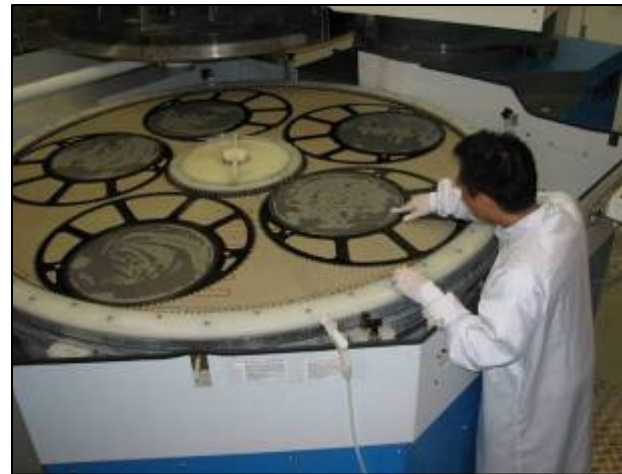


# Wafer Quality Improvement

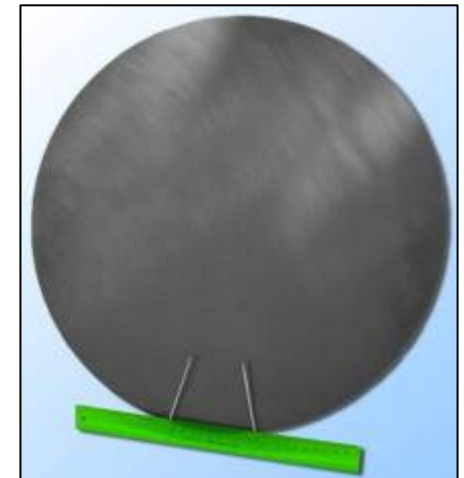
- The wafer quality is improving as suppliers and equipment manufacturers advance on the learning curve and new equipment becomes available.



Nano Photonics haze maps and Zygo / Nanometrics micro-roughness measurements reveal improvement between first and second polished wafer batch

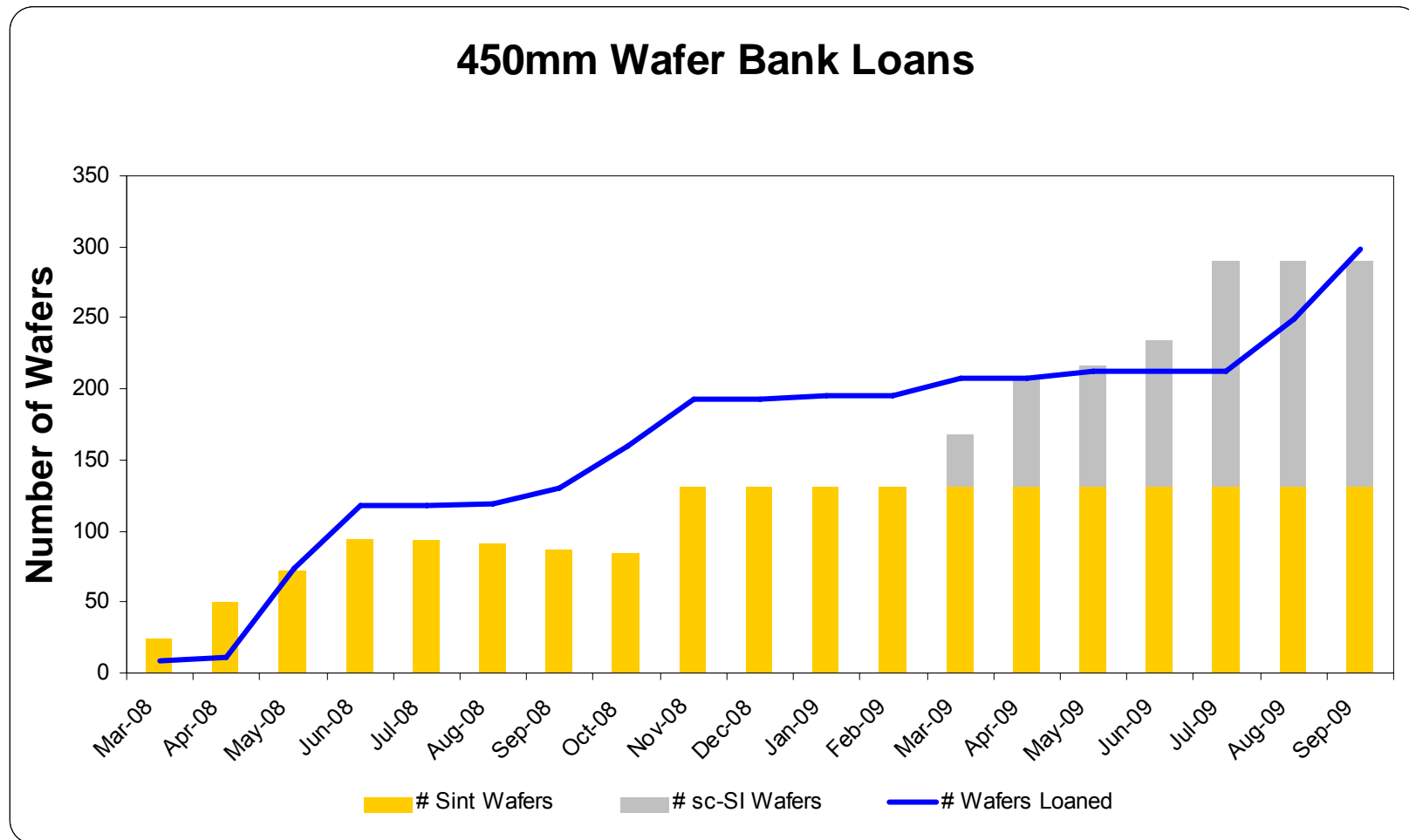


Peter Wolters AC 2000-P<sup>3</sup> processing 450 mm single crystal wafers



Planetary pad ground single crystal wafer

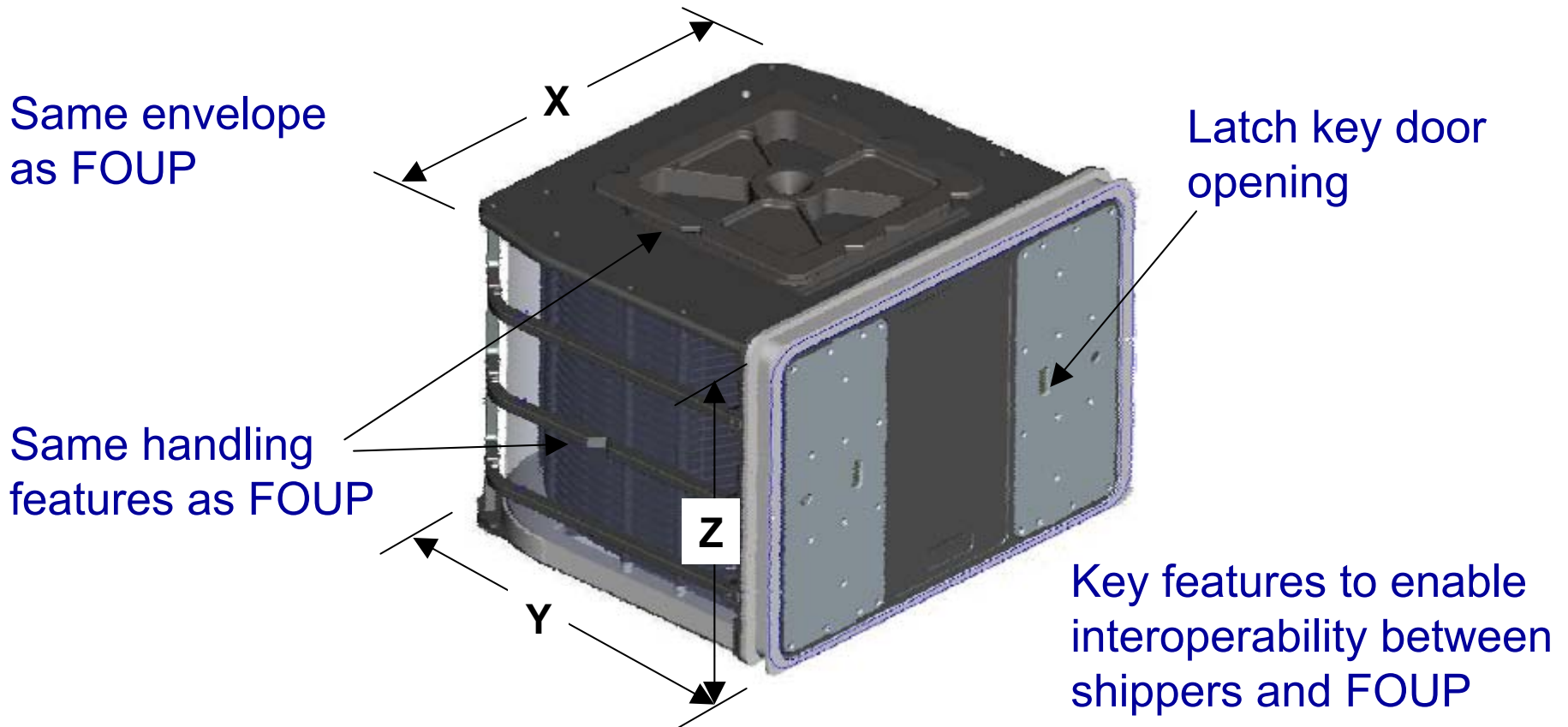
# Wafer Bank Status



**~300 wafers, more than half single crystal, are currently available for loans**

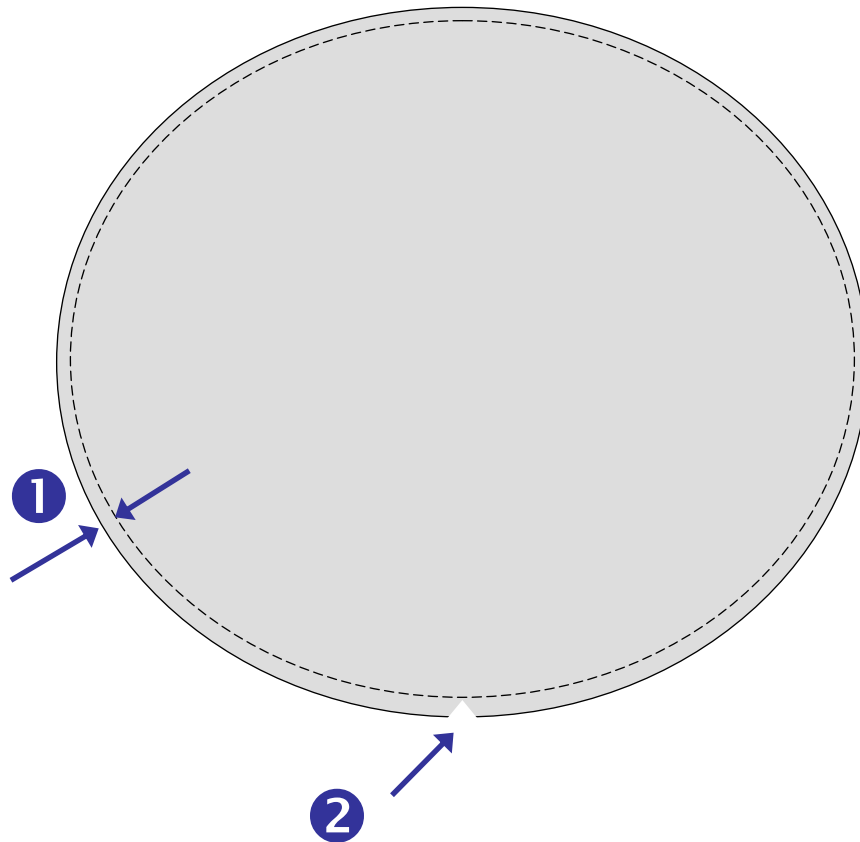
# 450 mm Clean Shipping Methods

## 450 mm Horizontal Multi-Application Carrier (HMAC )



**450 mm HMACs delivered and testing begun at ISMI**

# Additional ISMI Wafer Guidance



## ISMI Members' Consensus

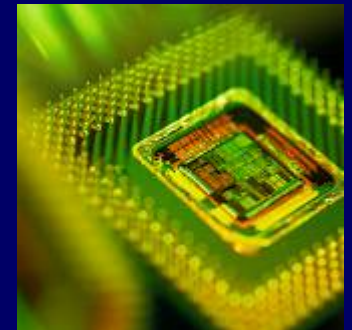
① Wafer Edge  
Exclusion  
Target = 1.5 mm

② Wafer  
Orientation  
Feature = Notch



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# Factory Integration Readiness



# Progress and Future Focus – *ITB Goes Clean*



## Standards Development Phase

### Tested:

- 3 versions of carriers from two suppliers
- 2 types of early loadports
- >5M wafer handling cycles
- Sintered and single crystal mechanical wafers

Provided key inputs to finalize standards

2009  
SEMICON  
West  
Stds  
Meetings

New revisions of carriers and loadports developed for testing in a cleanroom

## Standards Demonstrations Phase

- Yellow Ballot compliance testing of components
- Interoperability testing
- Cleanliness testing



# 450 mm 12 mm Pitch FOUPs



Multiple suppliers are providing standard compliant FOUPs for use and testing in H2 2009



**- Key Features are defined –  
12 mm wafer pitch, latchkey door design**

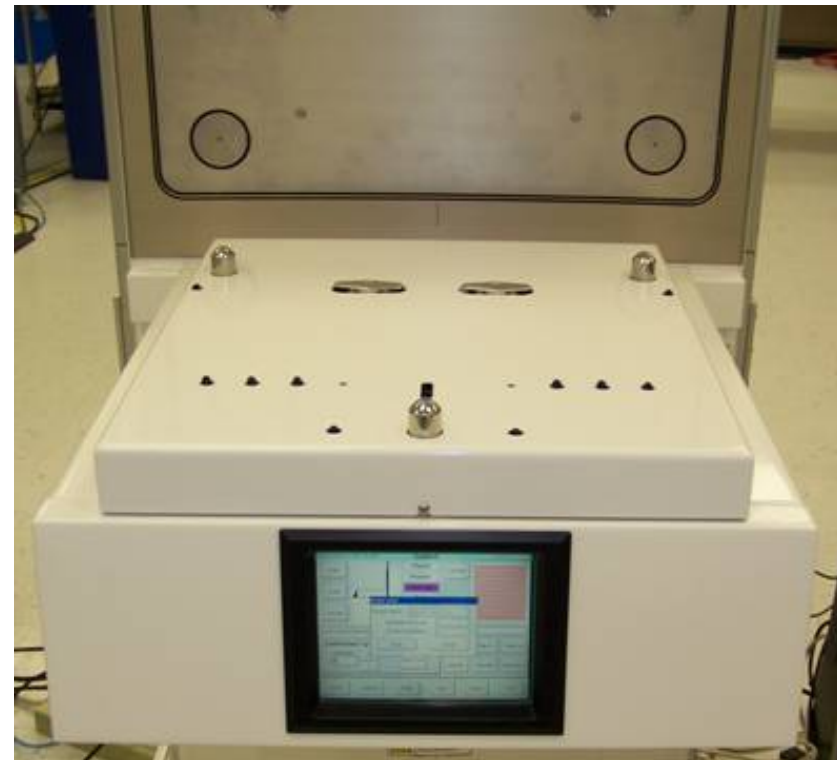
# 450 mm Prototype 12 mm Pitch Latchkey Loadport

12 mm pitch rotary latchkey loadport

Latchkey 12 mm FOUN



Standard loadport interface to 12 mm pitch FOUN



# 450 mm Platform Guidelines

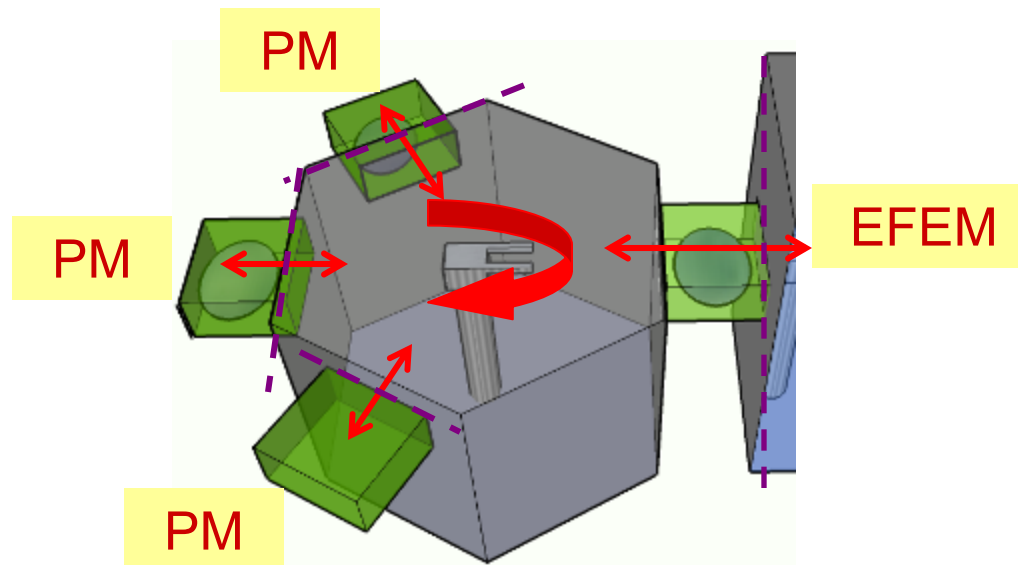


**Vision: Create guidelines to enable cost-effective 450 mm EQP platforms and prototype EQP development**

# Definition of “Platform”

“Platform” is the module system that includes

- The connection interface with EFEM
- The connection interface with process modules (PMs)
- Wafer transfer chamber and transfer robot
- Transfer, operational model, and interoperability with process modules



# 450 mm Platform Guidelines Scope



**Commonality and  
Integration**

**Process and Wafer  
Quality**

**Dimension and  
Size**

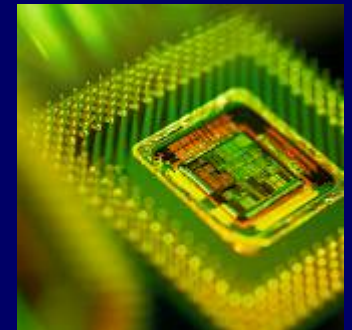
**Throughput**

- 450 mm Platform Guidelines are statements that aim to provide direction for 450 mm EQP platform development
  - Guidelines will require collaborative discussion between users and suppliers to support cost-effective development of 450 mm equipment
- A preliminary set of platform guidelines is currently under review with interested suppliers
  - Publication is expected by the end of 2009



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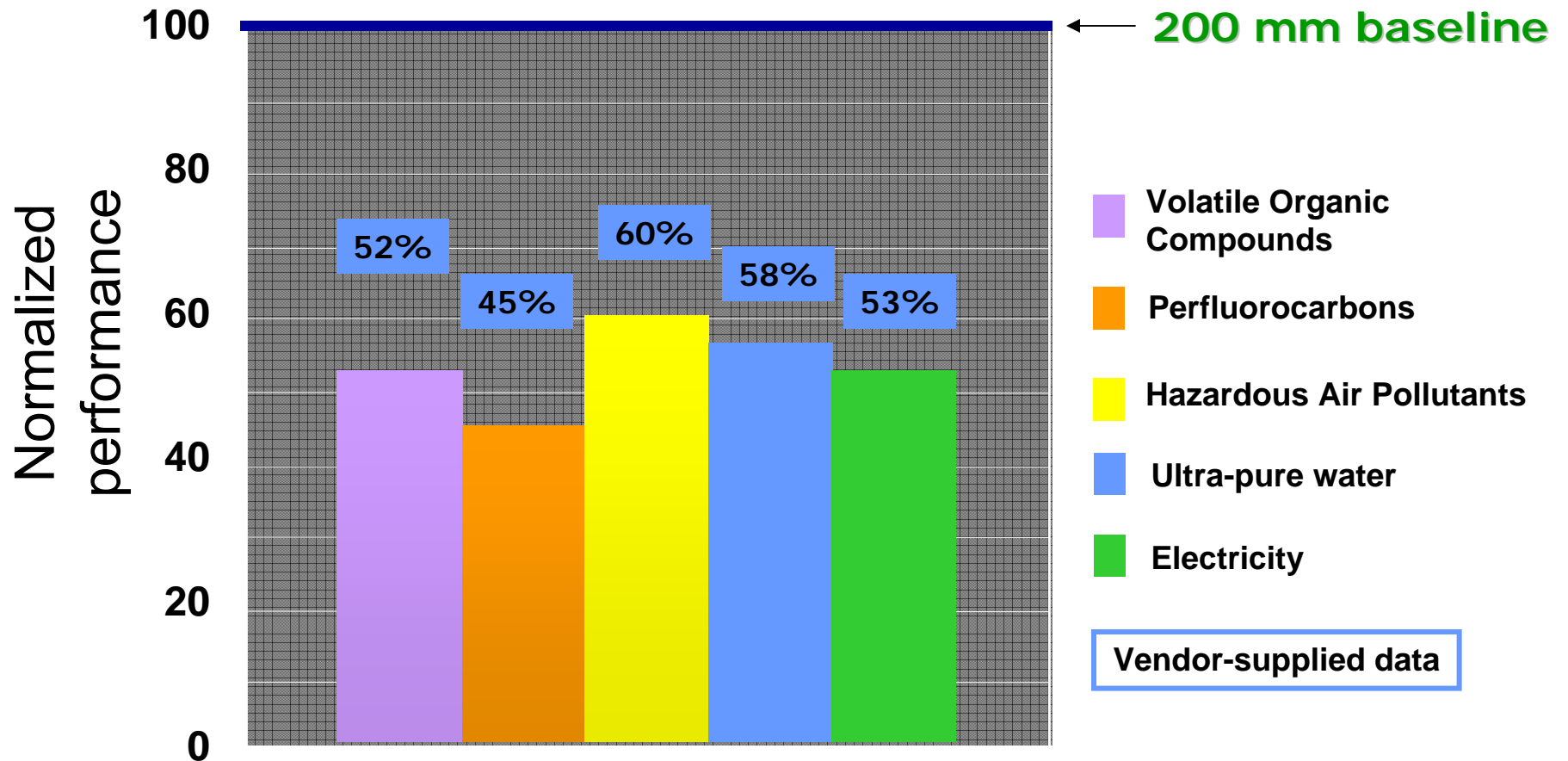
# 450 mm ESH Readiness



# 200-300 mm Improvement: Tool Data

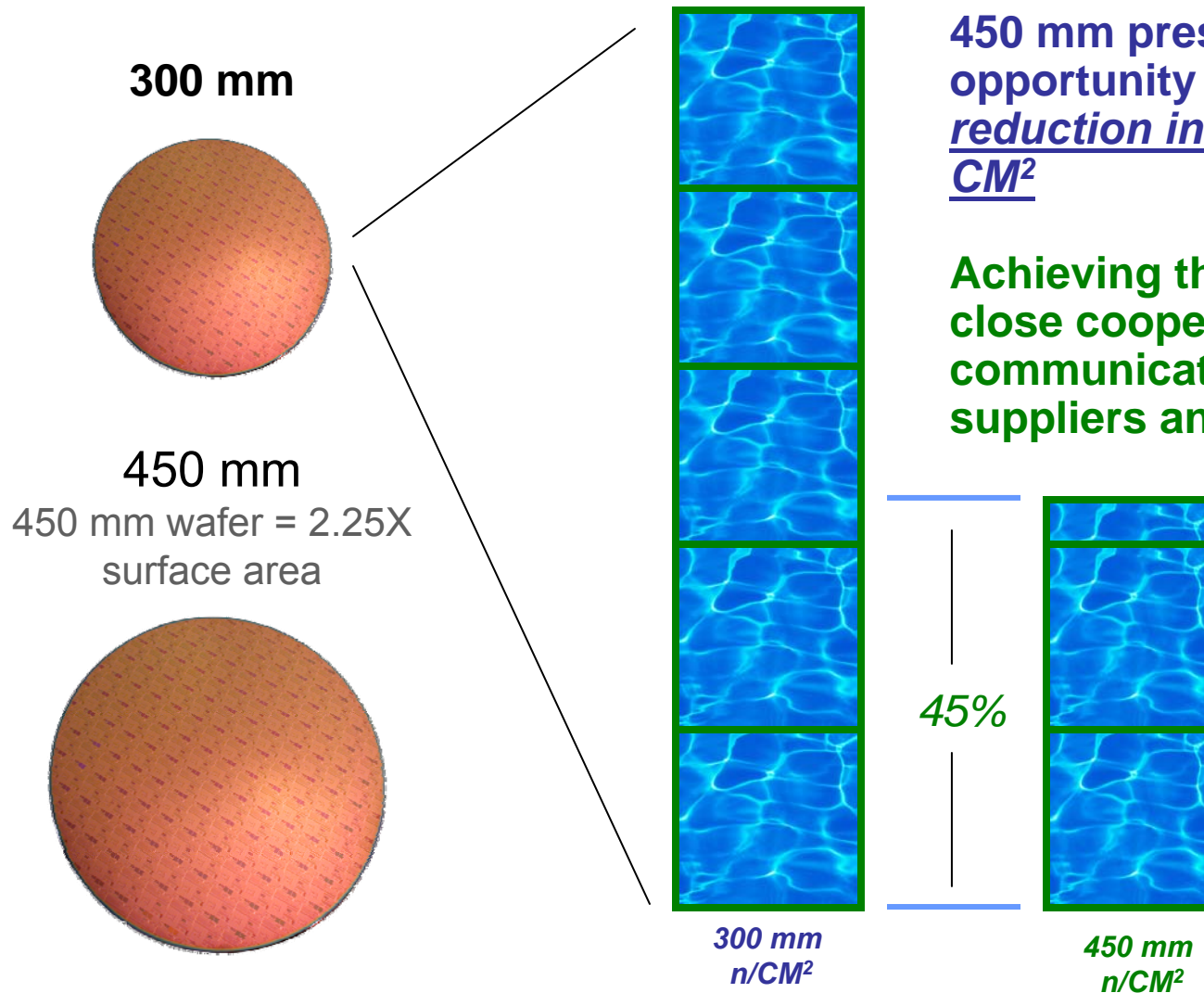


300 mm consumption relative to 200 mm  
(per cm<sup>2</sup> silicon processed)



# 450 mm Resource Conservation Vision:

*No per wafer increase in energy and water use, air emissions, or waste*



450 mm presents a unique opportunity to achieve a 55% reduction in resource use per CM<sup>2</sup>

Achieving this vision requires close cooperation and communication between suppliers and end users

# ISMI 450 mm ESH Resources



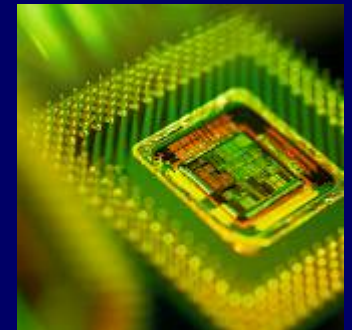
Resource	Purpose
450 mm Equipment ESH Checklist	Safety guidance for early prototype 450 mm process and metrology equipment.
ISMI Guideline for Environmental Characterization of Semiconductor Process Equipment	Characterizes equipment environmental performance using a common method
ISMI S23 Application Guide and Total Equivalent Energy (TEE) Conversion Tool	Characterizes equipment energy consumption using a common method
Combustible Materials Checklist	Characterizes the volume of combustible materials (i.e., plastics) involved in equipment construction
Manual Material Handling Application Guide for SEMI S8	Provides detailed instructions for manual material handling techniques required as part of an SEMI S8 Ergonomic assessment

Available on ISMI public website: <http://ismi.sematech.org/wafersize/index.htm>



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# Key Messages and Next Steps



# Key Messages - ISMI 450 mm Program (October 2009)



- **ISMI maintains its focus on planning a cost-effective 450 mm transition.**
- **ISMI's first two 450 mm metrology tools are installed and operational; installation of the first process equipment has begun.**
- **ISMI's Interoperability Test Bed (ITB) has achieved its objective of enabling the evaluation of early prototypes to accelerate the development of factory integration standards; work is nearing completion for this phase of the program.**
- **ISMI's 450 mm Wafer Bank continues to enable the development of 450 mm equipment prototypes; 180 sintered and single crystal wafers are currently on loan to suppliers developing 450 mm equipment.**
- **Device makers driving the 450 mm transition have aligned on a target for wafer edge exclusion volume (1.5 mm) and the mechanism for wafer orientation (notch).**

# Key Messages - ISMI 450mm Program, cont. - October 2009



- **ISMI has begun development of a common Demonstration Test Methodology for 450 mm equipment**
- **In conjunction with interested suppliers, ISMI is developing guidelines for equipment platforms**
- **Environmental performance targets for 450 mm equipment are aggressive – ISMI will engage with the supply chain to work together to find solutions**
- **Progress has been made – more is required. Many challenges remain to realize readiness for a comprehensive 450 mm infrastructure at advanced technology nodes**
  - **ISMI will continue to engage constructively with interested suppliers to develop and validate solutions**

# Next Steps



**Looking ahead to 2010, ISMI's 450 mm Program will**

- Increase the scope of test wafer and metrology capabilities**
- Complete, and begin application of, the Demonstration Test Methodology for 450 mm equipment**
- Evaluate 450 mm AMHS solutions**
- Evaluate 450 mm equipment mainframes**
- Expand ISMI Wafer Bank loans, improve wafer quality, and validate shipping boxes**
- Coordinate and communicate to enable the 450 mm transition**

## For Further Information ...



<http://ismi.sematech.org/wafersize/index.htm>

-Or-

**Tom Jefferson, ISMI Program Manager**

[tom.jefferson@ismi.sematech.org](mailto:tom.jefferson@ismi.sematech.org)

# THANK YOU !!!

# Questions and Discussion

