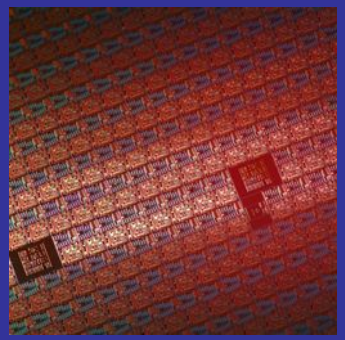
Accelerating the next technology revolution

IEUVI Source TWG
02 Oct 2008



Frank Goodwin

Masashi Ogawa

Agenda

7:00 – 8:00 AM	Breakfast
8:00 - 8:30 AM	Welcome and Review of Last Meeting
8:30 – 10:00 AM	Technical Challenges and Showstoppers
10:00 - 10:30 AM	Coffee Break
10:30 – 11:00 AM	Development Gaps
11:00 – 11:45 AM	Risk Scorecard
11:45 – Noon	Ownership Survey
12:00 – 1:00 PM	Lunch

Discussion Topics from last Meeting

- Were could added investment be made to accelerate the introduction of β and γ EUV Sources?
- What are the barriers to increasing EUV power at the wafer?
- Is LPP or DPP the final answer? Is there a need to look beyond these solutions?

Were could added investment be made to accelerate the introduction of β and γ EUV Sources?

- Source standardization specifications
  - Reduced costs of sources
  - Singular Design supporting multiple exposure tools and generation
- Data sharing
  - Results off of Alpha tools, open disclosure and discussion
- Start earlier with test benches
  - Early learning
- ADT feedback to Beta tool design
  - Maintain support for alpha tool SoCoMos
  - Critical need to increase performance
  - Do not count on 5 mJ resist, not going to happen
- Support smaller source manufacturers
  - LP Photonics

Barriers (Brainstorming)

- Barriers to Increase EUV photon efficiency
  - Inefficient illuminator design
  - Reflective optics
  - Contamination of optics
  - Photon absorption by optics purging gases
  - Limited geometric collection of EUV light
  - Resist sensitivity
  - Spectral filtering
  - Buffer gas and plasma gas intermixing
  - Poor transmission of DMS and collector

- Barriers to Efficient EUV Sources with High Wall Plug Efficiency
  - Poor conversion/radiation efficiency of fuel
  - Low EUV spectral efficiency of fuel
  - Poor coupling of wall plug power to plasma
  - Contamination of optics
  - Photon absorption by optics purging gases
  - Limited geometric collection of EUV light
  - Spectral filtering
  - Buffer gas and plasma gas intermixing
  - Poor transmission of DMS and collector

What are the barriers to increasing EUV power at the wafer?

- SoCoMo Component Trade Offs
  - Reliability vs Increased Source Power
  - Source power increase – COO concerns, efficiency is low
- Source, collector and optical train
  - Optimize entire optical train
  - Need innovation,
    - more efficient optical design of illuminator
      - off-axis illumination, increase complexity
    - debris mitigation
    - thermal management
  - Optimize design of collectors (Media Lario).
    - Example, constraints on NA impacts optimum design
  - illumination system will be complicated if source is not uniform, not clean, not pure spectrum, clean and stable sources are important.
- Increase Power
  - Multiplexing sources; low risk option
- Schedule
  - Priority is on delivery of sources not increasing efficiency

Is LPP or DPP the final answer? Is there a need to look beyond these solutions?

- Timing
  - Stay with current concepts
  - Distractions would further delay tools and work on increasing power
- Novel concepts
  - Keep options open
    - Source multiplexing
    - Fiber lasers
  - Will use whatever performs the best
- Fuel and laser wavelength
  - Is Sn the best fuel
  - Optimize laser for better CE

Today's Meeting - Objectives

- Should we maintain a two technical challenges table?
- Validate the technical challenges and gap analysis.
- Validation of implementation showstoppers per technology.
- When do technical challenges need to be addressed (Score Card)?
- Who owns resolution - survey

Source TWG:
Survey Ranking of DPP Technical Challenges

Ranking (5/08)	Technical Challenge (previous ranking Q3/06)	Gap Analysis
1	Power at IF (3)	
2	Collector lifetime (1)	
3	Debris mitigation (1)	
4	Thermal loading of DMS and Collector	
5	Cost of ownership (4)	
6	Conversion efficiency (9)	
7	Higher efficiency collector designs (6)	
8	Spectral purity (5)	
9	Scalability	
10	Reliability and Stability	

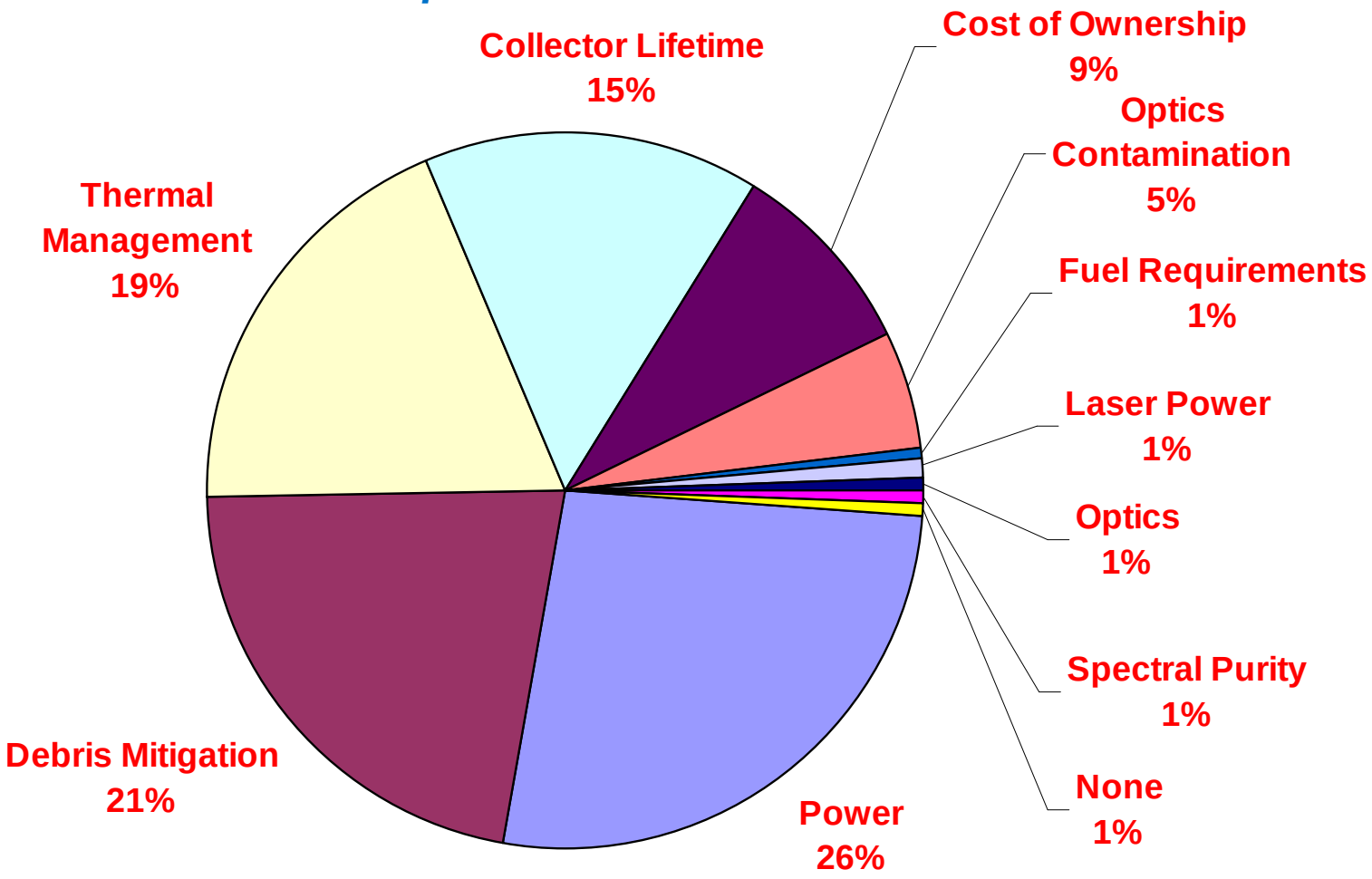
For HVM Implementation of EUVL

Survey: 85 Responses to Source Survey

Manufacturable solutions exist, and are being optimized	
Manufacturable solutions are known but needing further development	
Manufacturable solutions are not known.	

Source TWG: Sn DPP Showstoppers

Primary DPP source detractors preventing implementation of EUV as a litho solution for pilot-line and HVM



Survey: 85 Responses to Source Survey

Source TWG:
Survey of LPP Technical Challenges

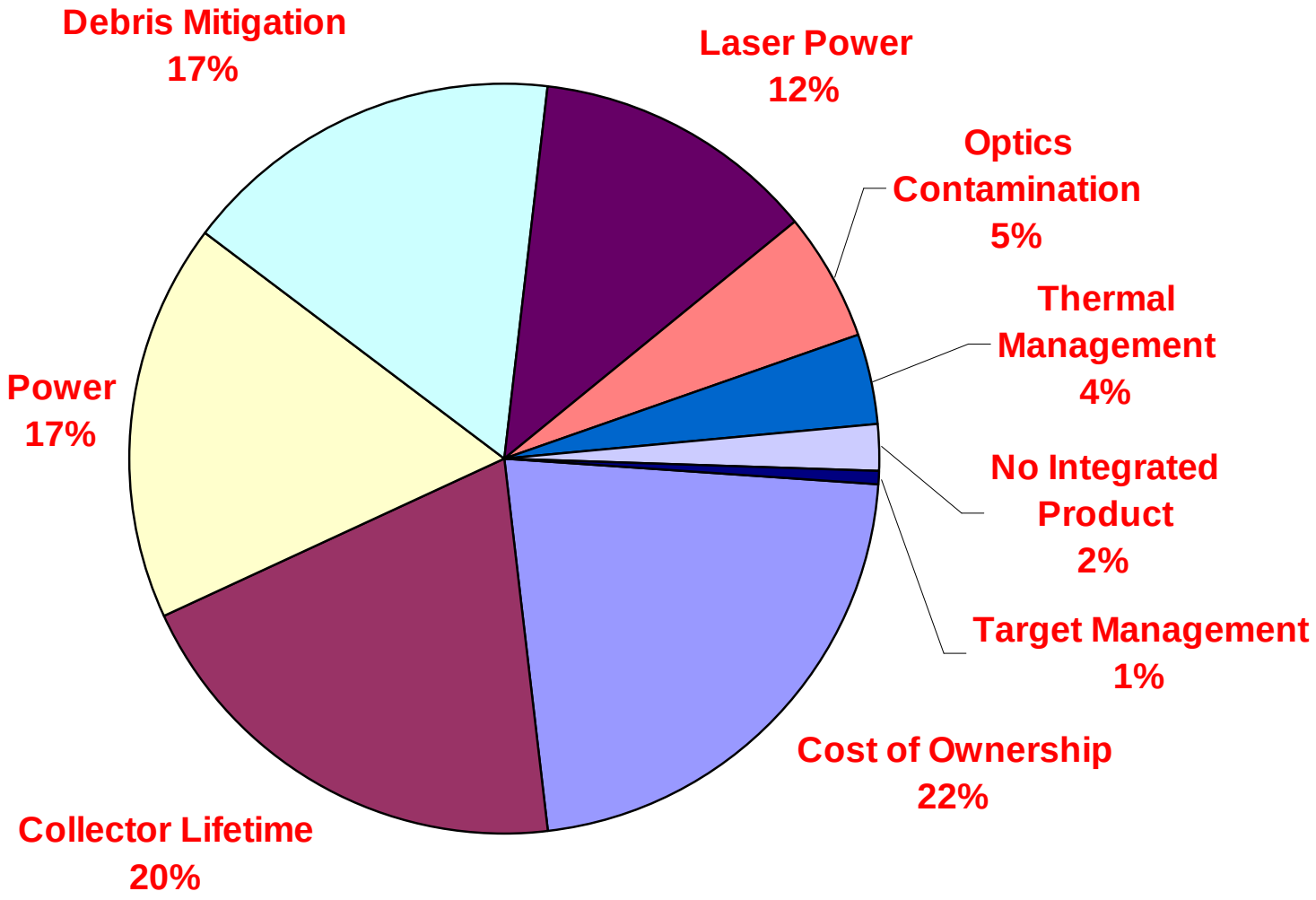
Ranking (5/08)	Technical Challenge (previous ranking Q3/06)	Gap Analysis
1	Power at IF (3)	
2	Debris mitigation (1)	
3	Cost of ownership (4)	
4	Collector lifetime (1)	
5	Laser Power	
6	Conversion efficiency (9)	
7	Thermal loading of DMS and Collector	
8	Scalability	
9	Spectral purity	
10	No Integrated System	

For HVM Implementation of EUVL

Survey: 85 Responses to Source Survey

Manufacturable solutions exist, and are being optimized	
Manufacturable solutions are known but needing further development	
Manufacturable solutions are not known.	

Primary LPP source detractors preventing implementation of EUV as a litho solution for pilot-line and HVM



Year: 2004

EUV Source Technology Status

List of EUV Source Technical Challenges

Ranking from EUV source Workshop, November 2004, Miyazaki, Japan

Rank	Topic	Status
1	Collector lifetime and Debris Mitigation	
2	Cost of ownership	
3	Thermal loading of collectors	
4	Source power	
5	Spectral Purity	
6	Higher efficiency collector designs	
7	Non-collector critical component lifetime	
8	IF Metrology readiness	
9	Conversion efficiency	
10	Laser related issues (High Power feasibility)	
11	Standards for comparison of lifetime	

Difficult Challenges Remain

Challenges Remain

Progress being Made

Source TWG: Development Gaps

- Fundamental Understanding Needed
  - Debris mitigation of LPP sources
  - Power scaling of sources
  - Efficiency of power transmission to IF
  - Reliability and stability
- Engineering Development Needed
  - LPP source/collector/DMS integration
  - Improved debris mitigation and handling of fuel of DPP sources
  - Improvement of source component designs/materials/lifetimes
  - Solutions for spectral filtering, particularly near-IR
  - Design optimization of illuminator
  - Improved cost of ownership

Source TWG: Discussion

- Technical Challenges
  - Agree with survey results
  - Disagree with survey results
- Technology Showstoppers
  - Agree with survey results
  - Disagree with survey results
- Development Gaps
  - Changes? Additions?

Score Card – Technical Challenges

- Two Objectives
  - When do these need to be resolved
  - Does a solution need to be known and demonstrated prior to HVM introduction

DPP Tech. Challenges	Pre-Beta	Beta-level	1st Gen HVM	2nd Gen HVM
Power at IF				
Collector Lifetime				
Debris Mitigation				
Thermal Loading				
Cost of Ownership	X			
Conversion Efficiency				
Efficient Collector Design				
Spectral Purity				
Scalability				
Reliability & Stability				

Urgent ⟷ **Less Urgent**