ASMI INVESTOR DAY 2021
GROWTH THROUGH INNOVATION

Benjamin Loh
President and CEO
September 28, 2021
Cautionary Note Regarding Forward-Looking Statements:

This presentation contains “forward-looking statements”. All statements in ASMI’s Investor Day 2021 presentations, other than statements of historical fact, are forward-looking statements. Forward-looking statements involve risks and uncertainties that could cause actual results to differ materially from those in the forward-looking statements. These risks and uncertainties include, but are not limited to, economic conditions and trends in the semiconductor industry generally and the timing of the industry cycles specifically, product demand and semiconductor equipment industry capacity, worldwide demand and manufacturing capacity utilization for semiconductors, currency fluctuations, corporate transactions, financing and liquidity matters, the success of restructurings, the timing of significant orders, market acceptance of new products, competitive factors, litigation involving intellectual property, shareholders or other issues, commercial and economic slowdown or disruption including due to natural disasters (including pandemics), terrorist activity, armed conflict or political instability, changes in laws including import/export regulations, changes in tax and exchange rates, epidemics and other risks indicated in the Company’s reports and financial statements. Investors are cautioned not to place undue reliance on these forward-looking statements, which speak only as of the date of this presentation. The Company assumes no obligation nor intends to update or revise any forward-looking statements to reflect future developments or circumstances. Forward-looking statements are not guarantees of future performance, and actual results, developments and business decisions may differ materially from those envisaged by forward-looking statements.
KEY TAKEAWAYS

#1 Strong digitalization trends driving significant growth in the semiconductor and WFE market

#2 ASMI is the leader in ALD and expanding in Epi, technologies that are expected to outgrow the WFE market driven by key inflections such as gate-all-around (GAA)

#3 Strengths in innovation, early customer engagements and product differentiation enables advanced cost effective solutions for customers

#4 Strategic objectives are maintaining leadership in logic/foundry, expansion in memory, share gains in the Epi market, growing spares and services and increasing focus on sustainability

#5 We target to grow revenue to €2.8-€3.4 billion by 2025 representing a CAGR of 16-21% with an operating margin of 26-31%
More than 5 decades of experience

Innovation helping to advance Moore’s Law

Revenue 22% CAGR

Revenue per headcount expansion 44%

Operating Margin Expansion

11% Points

Market leader in single-wafer ALD

Market share of ~55%¹

Increased share in Epi

Grew share to ~15%

Expanded manufacturing

Singapore end 2020

Patents in force

↑ 41% (2020: 2,094)

GHG emission scope 1 & 2

↓ 15%²

KEY HIGHLIGHTS AT A GLANCE 2016-2020

¹ ASM internal data
² Intensity per mtCO₂e/million € R&D investment

ASMI INVESTOR DAY 2021
MARKET OPPORTUNITIES
Global semiconductor revenue (US$ billion)

- Doubling to US$1 trillion by 2030

Megatrends driving the semiconductor market:
- Autonomous vehicles
- Edge computing
- Security
- Smart home
- Smartphones
- Industry 4.0
- AI
- Autonomous vehicles

Source: VLSI Research, ASMI Aug 2021
WFE SPENDING EXPECTED TO INCREASE STRONGLY

WFE Market forecast (US$ million)

WFE growth driven by secular trends of AI, 5G, EV, edge computing etc

Multi-year investments announced across all market segments

Further scaling, 3D transitions and GAA driving investments in advanced CMOS

Government sovereign efforts could add further investments

Source: VLSI Research Sept 2021
WITH INCREASING MIX OF MOST ADVANCED NODES

Most advanced nodes (7nm and below) are structurally the fastest growing parts of the WFE market – ASMI strength

Source: Gartner July 2021
3D and new materials increasingly required for next generation semiconductors

**Elements used now, or expected to be used in the next decade**

- FINFET TO GAA
- DRAM HIGH-K METAL GATE
- 3D-NAND STACKING
- PLANAR TO 3D-DRAM
- NEW MATERIALS
ADDRESSABLE MARKETS EXPECTED TO MORE THAN DOUBLE BY 2025

**Single-wafer ALD market outlook (US$ billion)**
- 2020: 1.5 (≈55%)
- 2025: 3.1~3.7 (>55% target)

**Epi market outlook (US$ billion)**
- 2020: 0.8 (~15%)
- 2025: 1.5~1.8 (>30% target)

ASMI internal market data
STRENGTHS & INNOVATION
STRENGTHS AND INNOVATION

**Strengths**

Focus on deposition especially ALD and Epi

Strong history in innovation

Leading products and applications

Early customer engagements

- Market leader in single-wafer ALD
- Expanded market position in Epi
- ASMI growing 1.5x faster than WFE market in 2016-2020
Global networked R&D model

Close and early collaboration with imec, universities, customers

More than two decades of accumulated knowhow in ALD materials and chemistries

Decades of experience in developing ALD and Epi reactors and processes

STRONG HISTORY IN INNOVATION
### LEADING PRODUCTS AND APPLICATIONS

<table>
<thead>
<tr>
<th>ALD</th>
<th>EPI</th>
<th>INTEGRATED SURFACE CLEAN CAPABILITY</th>
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<tr>
<td><img src="image1" alt="ALD Machine" /></td>
<td><img src="image2" alt="EPI Machine" /></td>
<td><img src="image3" alt="Surface Clean Machine" /></td>
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</table>

- **ALD**
  - Broadest portfolio of ALD products and applications
  - Innovative strength in ALD reactor design
  - Strength in chemistries and applications using new materials
  - Superb cost of ownership, film performance, high flexibility in precursor delivery

- **EPI**
  - Superb isothermal reactor design with best in class close-loop direct wafer temperature control
  - Low cost of ownership and outstanding monolayer film control for advanced CMOS
  - Continued innovation to provide outstanding performance and cost of ownership for power/ analog/sensor market

- **INTEGRATED SURFACE CLEAN CAPABILITY**
  - Developed wide range of critical surface clean technologies
  - Clustered with both Epi and ALD
EARLY CUSTOMER ENGAGEMENTS

Working with all major logic/foundry and memory customers to develop solutions for forthcoming technology inflections
STRATEGY
Strategic objectives:

- Maintain leading ALD share in logic/foundry, expand in memory
- Increase Epi market share
- Selective growth in Vertical Furnace and PECVD niches
- Grow spares and services business
- Accelerating progress in sustainability
- Drive continued strong financial performance
Strategic objectives:

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- Drive continued strong financial performance

How:

- Increase R&D investments especially in fastest growing segments – ALD and Epi
- Continue enabling customer roadmaps with most innovative products and applications
- Strengthen culture and develop our people
- Accelerate commitment to sustainability
- Maximize potential from growing installed base and increase outcome-based services
- Expand and optimize manufacturing and supply chain
EXPANSION IN R&D CAPACITY

Expansion in progress
- Tama, Japan

Planned expansions
- Helsinki, Finland
- Phoenix, USA
- Dongtan, South Korea

Includes:
- Significant increase in headcount across all sites
- Significant increase in lab metrology and development related tools
LEADING WITH INNOVATIVE PRODUCTS AND APPLICATIONS

New industry ALD workforce with superb performance and cost of ownership

Synergis™

- Synergis MX
- Synergis NT
- Synergis ML
- Surface Clean

**Metal Oxides**
- Patterning high-k

**Metal Nitrides**
- Work function, conducting nitrides

**Metals**
- Metallization

**Clean / Treatment**
- Interfacial engineering / clustered Films

Innovative hardware and process control for new Epi applications

**VERACE-CL**
- Edge Pyrometer
- Center Pyrometer
- Quartz Pyrometer

**ES**

**LMS XL**

**AEGIS**
STRENGTHENING CULTURE, DEVELOPING OUR PEOPLE

Leadership & Development
Strengthening our talent pool by focusing on long-term career progression with training for all employees and our future leaders.

Growing Engagement
We are making the changes that matter. Engagement initiatives have driven improvements for all at ASMI.

Strengthening our Culture
A renewed focus on our culture and values. Shaping a culture of compassion, inclusivity, innovation, and drive to deliver.

Inclusion & Diversity
We have implemented Employee Resource Groups to create a workplace where employees can be their true selves.

PEOPLE ARE OUR BIGGEST ASSET
Sustainability targets
Addressing climate change is imperative
Fostering inclusion and diversity in our employee base
Innovating to reduce energy consumption and emissions on our equipment

Net zero
Reduce environmental footprint of our operations
100% renewable electricity by 2024
Aim to be net zero by 2035 (scope 1, 2 and 3 emissions)
Increasing revenue through a rapidly growing installed base

Increasing value to our customers

Increasing revenue through introduction of more outcome-based services

Number of systems

8,000 —

Growing installed base

Transactionals

Outcome-based services

Growing installed base

Transactionals to outcome-based services

Services

Outcomes

Transactionals Spares

Transactionals Labor

Refurbished equipment

Spares as a Service

Complete Kit Management (CKM)
New Singapore manufacturing facility

1st floor in production since Q4 2020

Increased flexibility to meet customer demand

2nd floor design work started and production ready by early 2023

This new facility has been designed with high sustainability standard

Supply chain optimization

- Strengthened base of world class EMS partners

- Increased multiple sourcing
Strong digitalization trends driving significant growth in the semiconductor and WFE market

ASMI is the leader in ALD and expanding in Epi, technologies that are expected to outgrow the WFE market driven by key inflections such as gate-all-around (GAA)

Strengths in innovation, early customer engagements and product differentiation enables advanced cost effective solutions for customers

Strategic objectives are maintaining leadership in logic/foundry, expansion in memory, share gains in the Epi market, growing spares and services and increasing focus on sustainability

We target to grow revenue to €2.8-€3.4 billion by 2025 representing a CAGR of 16-21% with an operating margin of 26-31%
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Global R&D network enables early R&D collaboration with partners and customers globally

R&D organization driving innovation, accumulating over two decades of ALD experience

Current R&D portfolio is well aligned with customer roadmaps to further extend Moore’s Law

Inflections creating new deposition opportunities
GLOBAL NETWORKED R&D ORGANIZATION

- Equipment and applications development in the Netherlands, USA, Japan and Korea
- Finland and Belgium focus on advanced process and chemistry innovations
- Co-located with University of Helsinki in Finland, and with imec in Belgium
R&D IN NUMBERS

- €172 million gross R&D spending (13% intensity)
- 613 permanent R&D employees, 26 nationalities
- of which 44% having an advanced degree
- 2,094 patents in force

R&D spending: 2020 full year; others: 2020 end of year
R&D DRIVING INNOVATION AND ALIGNMENT WITH CUSTOMERS ROADMAPS
R&D DRIVING INNOVATION FOR MORE THAN TWO DECADES

- **1995**: Approximate start of R&D
- **2000**: Approximate adoption for manufacturing
- **2005**
  - Low-k Dielectric
  - Selective Epi S/D
  - High-k – Metal Gate
- **2010**
  - ALD for Patterning
  - Enabling FinFET
- **2015**
  - ALD for gap-fill and SiN
- **2020**: Extending Immersion

**ASMI INVESTOR DAY 2021**
R&D DRIVING INNOVATION FOR MORE THAN TWO DECADES


Approximate start of R&D
Approximate adoption for manufacturing

Low-k Dielectric
Selective Epi S/D
High-k – Metal Gate
Enabling FinFET
Extending Immersion
ALD for Patterning
ALD for gap-fill and SiN

We will continue to drive innovation


Approximate start of R&D
Approximate adoption for manufacturing

Low-k Dielectric
Selective Epi S/D
High-k – Metal Gate
Enabling FinFET
Extending Immersion
ALD for Patterning
ALD for gap-fill and SiN

We will continue to drive innovation
R&D PORTFOLIO ALIGNED WITH CUSTOMERS

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- **Current R&D** aimed at further scaling and architecture changes to extend Moore’s Law
- **ASMI is engaged with R&D partners and customers** on post 3D-NAND concepts, Fork-Sheet (second generation) GAA and several technologies that will be needed beyond 2028

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1 Gate-all-around; 2 Fork Sheet; 3 High Volume Manufacturing; 4 Production Tool of Record; 5 Development Tool of Record; 6 Joint Development Program
MAJOR ROADMAP TRENDS

Everything going 3D to enable scaling
- Conformal thickness, composition and electrical properties requires more ALD…

Thinner films, complex stacks, more interfaces
- Atomically engineered surface clean and preparation technology

Many new materials are needed

Bottom-up selective deposition to supplement top-down deposition and etch
These 3D transitions and materials lead to opportunities for ASMI in ALD and Epi markets.
WHAT IS ALD?

Clean surface before ALD
First precursor pulse comes in
Precursor reacts with, and attaches to surface

A first ALD layer is completed
A second ALD layer is completed
Many ALD layers form a high quality thin film material
Unmatched capability to conformally cover 3D structures with complex materials, with near perfect composition and electrical properties control.
# Core Strength: Materials and Precursor Chemistry

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NEW CHEMICALS OR “PRECURSORS” ARE NEEDED TO BE ABLE TO MAKE THESE NEW MATERIALS WITH ALD WITH THE RIGHT QUALITIES
INFLECTIONS CREATING DEPOSITION OPPORTUNITIES
EXAMPLE INFLECTIONS IN THIS PRESENTATION

Gate-all-around

DRAM and VNAND Scaling

3D-DRAM

Selective ALD
<table>
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<th>FinFET to Gate-All-Around Inflection</th>
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<tr>
<td><strong>≤ ~3nm</strong></td>
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<td>Last planar generation prior to HK/MG</td>
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<tr>
<td>First planar generation with HK/MG</td>
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<td>Upto 6 generations of FinFET</td>
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<tr>
<td>First generation GAA</td>
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<tr>
<td>More ALD More Epi</td>
</tr>
<tr>
<td>More ALD More Epi</td>
</tr>
</tbody>
</table>


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GATE-ALL-AROUND CREATES ALD/EPI OPPORTUNITIES

- Bulk Si Epi
- Buried Power Rail
- SiGe/Si Channel (>3x!) Epi
- Dielectric Liner and Wall
- Spacer Main and Inner
- STI Fill - Bottom Isolation
- Source/Drain Epi (slower!)
- SAC Spacer / Dielectric Fill
- High-k, Dipole Layers
- Metal Gates N/P, Multi Vt
- Metal Gate Fill
- Dielectric Gate Cap
- Metal 0
- Deep Contact

Note: for simplicity, not all individual layers are shown or listed. Each layer may consist of a few individual ones.

Epi/ALD in current FinFET
Additional passes for GAA → New SAM

GAA (2024) and Fork-sheet (2026~2028)
### Logic/foundry ALD and Epi

<table>
<thead>
<tr>
<th>Average # of Layers (a.u.)</th>
<th>Planar</th>
<th>HKMG</th>
<th>FinFET</th>
<th>GAA</th>
</tr>
</thead>
</table>

- **Advanced Epi and ALD** technologies enable gate-all-around architecture inflections
- Epi from one single channel to three or more channels
- **New materials** needed to maintain electrical performance: many multi-VT metals and dipole layers, better conductors, low-k spacers and gap-fills
- **Transition to gate-all-around** will drive significant SAM expansion in Epi and ALD

*Source: ASMI*
Most effective way to scale is up

Capacitors do not scale anymore

Common:
- Higher aspect ratios
- Increased parasitics

Source micrographs: TechInsights | DRAM schematic: ASMI
NEAR TERM SCALING NEEDS NEW MATERIALS FOR MEMORY

**DRAM**
- **Capacitors**
- **Cells**
- **Periphery**

**3D-NAND**
- **Cells**
- **Periphery**

**Common:**
- Higher aspect ratios
- Increased parasitics

**Capacitor does not scale anymore**

**Large area consumed by Periphery**
- High-k / Metal Gate, Epi channel to scale Periphery

**New ALD materials improve electrical performance**
- Better conductors for word and bit line
- Better insulators, airgaps and low-k

**Most effective way to scale is up**

- **Multi-tiers** beyond 128 stacks
- **Periphery** under cell

**New ALD materials improve electrical performance**
- Better vertical channel material
- Better conductors for word line
- Better gap-fills

Source micrographs: TechInsights | DRAM schematic: ASMI
Monolithic 3D-DRAM is likely to happen around 2026

- Scale beyond 64Gb/chip limit for DIMM package
- Eliminate expensive EUV steps

**Key opportunities**

- Channel: Si from Si/SiGe 64 (initially) Epi multi-layer stack
- Second generation 3D-DRAM: capacitor scaling with ALD Ultra High-k MIM cap

Source: ASMI
SELECTIVE ALD ENABLES ADVANCED TECHNOLOGIES

- Top-Down (litho-etch) supplemented with Bottom-Up (selective, self assembly) technologies
- Delivers expanded toolbox for smart process integration strategies
- Expected customer benefits
  - Reduced cost: potentially eliminating litho-etch steps
  - Improved die performance and yield: eliminating effects of edge placement errors
SELECTIVE ALD ENABLES ADVANCED TECHNOLOGIES

- ASMI leading in customer adoption of Selective ALD technologies
- Combinations of integrated ALD with ALE (Atomic Layer Etch) developed
- “There is plenty of room at the bottom”: Selective ALD presents a potentially large SAM expansion

Toposelective SiN ("TS SiN"): in production for 3D-NAND

Dielectric on Dielectric ("DoD"): JDP for 2nm foundry/logic
Today’s R&D portfolio targeting a cumulative multi billion € ALD and Epi SAM expansion
KEY TAKEAWAYS

#1 Global R&D network enables early R&D collaboration with partners and customers globally

#2 R&D organization driving innovation, accumulating over two decades of ALD experience

#3 Current R&D portfolio is well aligned with customer roadmaps to further extend Moore’s Law

#4 Inflections creating new deposition opportunities
MARKET OUTLOOK & OPPORTUNITIES
FORWARD-LOOKING STATEMENTS

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# KEY TAKEAWAYS

1. Strong digitalization trends driving significant growth in the semiconductor and WFE market

2. We grew faster than the deposition and WFE market over the 2016-2020 timeframe

3. The single-wafer ALD market is expected to grow from ~US$1.5 billion in 2020 to approximately US$3.1 - US$3.7 billion in 2025, outgrowing the WFE market

4. The Epi market is expected to grow from ~US$0.8 billion in 2020 to approximately ~US$1.5 - US$1.8 billion in 2025, outgrowing the WFE market

5. The transition from FinFET to gate-all-around (GAA) is expected to represent a market growth of ~US$1.2 billion for single-wafer ALD and Epi combined by 2025
MARKET OUTLOOK
Global semiconductor revenue (US$ billion)

Doubling to US$1 trillion by 2030

Source: VLSI Research, ASMI Aug 2021
DIGITAL TRANSFORMATION DRIVES STRUCTURAL GROWTH

Global semiconductor revenue (US$ billion)

Doubling to US$1 trillion by 2030

Megatrends driving the semiconductor market

- Security
- Smart home
- Industry 4.0
- Autonomous vehicles
- Edge computing
- Smartphones
- AI

Source: VLSI Research, ASMI Aug 2021
WFE SPENDING EXPECTED TO INCREASE STRONGLY

WFE Market forecast (US$ million)

- WFE growth driven by secular trends of AI, 5G, EV, edge computing etc
- Multi-year investments announced across all market segments
- Further scaling, 3D transitions and GAA driving investments in advanced CMOS
- Government sovereign efforts could add further investments

Source: VLSI Research Sept 2021
WITH INCREASING MIX OF MOST ADVANCED NODES

WFE market by technology node

Most advanced nodes (7nm and below) are structurally the fastest growing parts of the WFE market – ASMI strength

Source: Gartner July 2021
FY 2016-2020 PERFORMANCE
WE HAVE OUTPERFORMED THE WFE MARKET

ASMI US$ equipment revenue grew with **24% CAGR** over 2016-2020,
vs 15% CAGR for the Deposition and WFE markets

ASMI growing **1.5x faster** than the Deposition and WFE markets

**ASMI Equipment revenue (US$ million)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue (US$ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>503</td>
</tr>
<tr>
<td>2020</td>
<td>1,197</td>
</tr>
</tbody>
</table>

ASMI internal market data
WE HAVE OUTPERFORMED THE WFE MARKET

ALD single-wafer market (US$ billion)

- Single-wafer ALD market CAGR of 18% ahead of WFE 15%
- ASMI increased its market share driven by continued strong position in logic/foundry and inroads in memory ALD

Epi market (US$ billion)

- Epi market CAGR of 8% below WFE of 15%
- Largely explained by lower Epi market in 2020, impacted by a sharp drop in power/analog market
- ASMI more than doubled its market share in 2016-2020, driven by inroads in the advanced CMOS segment

Historical market data: ASMI

Historical market data: VLSI Research
EXAMPLE APPLICATIONS EXPECTED TO DRIVE ASMI GROWTH

**ALD HIGH-K GATE AND VT TUNING**
- FinFET
- High-k, dipole layers for multi-VT

**ALD DIELECTRIC GAP-FILL**
- Seam free gap-fill in high aspect ratio features

**ALD METAL**
- Better conductors
- Multiple work function metals

**ALD PATTERNING SPACERS & EUV LAYERS**
- Continued pitch scaling new EUV patterning materials

**CMOS EPI**
- Channel Epi for Fin
- Epi nanosheets for GAA

**SELECTIVE ALD**
- Performance, cost and yield self-aligned deposition

Source: Intel 1 | TechInsights 3,4,8 | imec 2,5 | ASMI internal 6,7,9,10
**Market outlook (US$ billion)**

- **2016**: 
  - ASMI Market share: ~45%
  - Market outlook: 0.8

- **2020**: 
  - ASMI Market share: ~55%
  - Market outlook: 1.5

Historical market data: ASMI
Outlook in 2021: Growth to US$3.1 - US$3.7 billion by 2025\(^1\)

**Logic/foundry (~US$1.2 billion growth\(^2\))**
- High-k gate & Vt tuning
- Metals
- Patterning spacers & EUV layers
- High aspect ratio gap-fill

**Memory (~US$0.7 billion growth\(^2\))**
- High-k gate & Vt tuning
- Metals
- Patterning spacers & EUV layers
- High aspect ratio gap-fill
- Selective ALD

\(^1\) Range based on $90-110 billion WFE
Center is ~US$3.4 billion at US$100 billion WFE

\(^2\) Compared to 2020

ASMI Market share

Historical market data: ASMI | Future market data: ASMI
EPITAXY MARKET OUTLOOK

Market outlook (US$ billion)

Historical market data: VLSI
Outlook in 2021: Growth to US$1.5 - US$1.8 billion by 2025\(^1\)

Logic/foundry
- Channel
- Source/drain contact

Memory
- High Performance DRAM

Power, Analog, Wafer

\(^1\) Range based on $90-110 billion WFE
Center is ~ $1.7 billion at $100 billion WFE

ASMI Market share

- 2016: 0.6 (\approx 5\%)
- 2020: 0.8 (\approx 15\%)
- 2025: >30\% target

Historical market data: ASMI  |  Future market data: ASMI
Growth largely driven by node progression and move to gate-all-around

ALD High-k gate & Vt tuning
ALD Metal
ALD patterning spacers & EUV layers
CMOS Epi
KEY TAKEAWAYS

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#4 The Epi market is expected to grow from ~US$0.8 billion in 2020 to approximately ~US$1.5 - US$1.8 billion in 2025, outgrowing the WFE market

#5 The transition from FinFET to gate-all-around (GAA) is expected to represent a market growth of ~US$1.2 billion for single-wafer ALD and Epi combined by 2025
ASMI INVESTOR DAY 2021
ASMI PRODUCTS & APPLICATIONS

Hichem M’Saad
Executive Vice President,
Global Products

September 28, 2021
FORWARD-LOOKING STATEMENTS

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# KEY TAKEAWAYS

#1 Leader in ALD with the largest portfolio of products, applications, and materials in an ever expanding market

#2 Growing market share in Epi with new innovations and well engaged in forthcoming gate-all-around (GAA) transition

#3 Selectively growing our offering in Vertical Furnace and PECVD

#4 New innovations increasingly focused on sustainable solutions with energy usage reduction

#5 Transitioning from transactional to outcome-based business model in service to provide the best value to our customers
LEADER IN ALD
GROWTH OF ALD IN THE SEMI INDUSTRY: ALD IS THE NEW CVD

2003
3 to 4 layers
Al₂O₃, ZrO₂

2008
10+ layers
HfO₂, ZrO₂, TiN, TaN

2013
20+ layers
HfO₂, ZrO₂, ŽAZ, SiO₂, SiN, PSG, BSG...
TiC, TiN, TaN,

2018
50+ layers
Co, FFW, HfAlO, ZrAlO...

2021
70+ layers
IGZO, Mo, WN...

DRAM MIM capacitor + Logic HKMG + FEOL eDRAM MIM
+ Patterning materials + Ternary metal oxides
+ Metal + Quaternary metal oxides

ASMI INVESTOR DAY 2021

Infineon NOLA DRAM www.future-fab.com
DRAM HSG structures ASMI
Intel 45nm transistor Chipworks
IBM FEOL eDRAM Chipworks
Intel 22nm FinFET transistor Chipworks
Samsung 30nm SDRAM Chipworks
IMEC GAA 2020
IGZO via CRD/IMEC 2020

Intel 45nm transistor Chipworks
Intel 22nm BEOL capacitors Chipworks
PEALD SDDP on Resist ASMI

Intel 22nm FinFET transistor Chipworks
IMEC GAA 2020
IGZO via CRD/IMEC 2020

ASMI INVESTOR DAY 2021
BROADEST ALD PORTFOLIO

**XP4 Platform**
- **Pulsar™**
  - High quality Oxides
  - High-k Dipole
- **EmerALD™**
  - Carbides and Nitrides
  - Work function

**XP8 Platform**
- **Synergis™**
  - Metal Oxides
  - Patterning high-k
  - Synergis MX
- **Synergis™**
  - Metal Nitrides
  - Work function, conducting nitrides
  - Synergis NT
- **Synergis™**
  - Metals
  - Metallization
  - Synergis ML
- **Surface Clean**
  - Interfacial engineering / clustered films

**Product Architecture**
- Metal
- Oxides
- Carbides and Nitrides

**Material**
- Metals
- Nitrides

**Applications**
- Metallization
- Interfacial engineering / clustered films
- Surface Clean

ASMI INVESTOR DAY 2021
**BROADEST ALD PORTFOLIO (CONTINUED)**

**XP8 Platform**

**Product architecture**

- DCM
- QCM
- QCM

**Material**

- Silicon Nitrides
- HT Silicon Oxides / Metal Oxides / Metal Nitrides
- Doped Oxides

**Applications**

- Patterning Spacer SiO
- HAR gap-fill SiO for Slit / Dummy and Staircase Fill
- Gap-fill SiN
- LT SiN Liner
- HQ SiN Liner
- Patterning Spacer SiN
- EUV underlayer
- HQ SiO
- HQ SiO for TSV Liner
- Seam free gap-fill
- Low-k Liner
- Seafmfree gap-fill SiN
- Air Gap SiN
- Cut Mask gap-fill SiO
- HQ SiO

**Silicon Oxides / Metal Oxides / Metal Nitrides**

- Patterning Spacer SiO
- HT SiO for liner
- Cut Mask gap-fill SiO
- EUV underlayer
- HQ SiO

**HT Silicon Oxides / Doped Oxides**

- HAR gap-fill SiO for Slit / Dummy and Staircase Fill
- HQ SiO for TSV Liner
- Seam free gap-fill
- Low-k Liner

**Silicon Nitrides**

- Gap-fill SiN
- LT SiN Liner
- HQ SiN Liner
- Patterning Spacer SiN
- Seam free gap-fill SiN
- Topological Selective (TS) SiN
- Air Gap SiN
• **Extremely fast and efficient** precursor cycle times with minimized reactor volume
• **Consistent delivery** of solid chemistry with close-to-wafer pulsing valves
• **Chamber design for excellent** within wafer uniformity and consistent reactor to reactor matching
• Flexible architecture enables **up to quinary (5 element) films**
**ASMI ALD – PRECISION ALD PERFORMANCE**

### Gap-fill SiO / SiN

<table>
<thead>
<tr>
<th>ASMI ALD gap-fill Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>• High Film Quality (Low Wet Etch Rate)</td>
</tr>
<tr>
<td>• Void Free Fill &gt; Seam free Fill</td>
</tr>
<tr>
<td>• Extreme Aspect Ratio Fill (50:1 - 100:1)</td>
</tr>
</tbody>
</table>

#### Conventional ALD vs. ASM ALD

<table>
<thead>
<tr>
<th>Voids</th>
<th>Void free</th>
</tr>
</thead>
</table>

**better gap-fill performance**

### Liner SiO / SiN

#### ASMI ALD Liner Technology

<table>
<thead>
<tr>
<th>High Quality Conformal Deposition</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Same WER top and bottom</th>
</tr>
</thead>
</table>

**excellent film quality**

<table>
<thead>
<tr>
<th>Tunable Conformality</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Film Quality – Conformal Wet Etch Rate</td>
</tr>
<tr>
<td>Extreme Aspect Ratio (50:1 - 100:1)</td>
</tr>
</tbody>
</table>
GROWING WITH EPI
EXPANSION OF EPI SAM

- Si
- SiGe
- GAA
- SiP
- SiAsP
- SiB
- SiGeB
- Super FET
- Trench-MOS
- IGBT
- Thin
- Thick

- nMOS
- pMOS

- Channel
- S/D
- Power
- Wafers

- Reduced pressure
- Atmospheric

- Epi products

ASMI in 2020
EPI PORTFOLIO

Platform
(Flexibility & high throughput density)

Reactor innovation
(Intrepid ES & ESA)

Full range of ALE surface cleans
(Previum)

XP4 4+0, 3+1

XPE 4+2

ISOTHERMAL

VERACE-CL

AEGIS

V3

NEXT

VP

Edge Pyrometer
Center Pyrometer
Quartz Pyrometer

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TECHNOLOGY INFLECTIONS ARE DRIVING EPI INNOVATION

GAA integration

GAA
S/D SiP

GAA

SiGe Cap
Si
SiGe
Si
SiGe

S/D
Epi
Epi
S/D

NMOS SiP

Monolayer Epi

SiGe1
SiGe2
SiGe3

3D Epi
GAA DEVICE: EPI DEFINED

FinFET

Channel thickness

Litho/Etch defined

GAA

Channel thickness

90°

Epi defined
Conventional temperature control can’t meet the stringent layer to layer (LtL) uniformity requirements for wafers. Specified uniformity is $\pm 1\text{Å}$, but conventional methods cause large variations at the edge.
Verace-CL enables outstanding WiW and LtL uniformity of ~1Å (Mono Layer Control)
Key to enabling gate-all-around nanosheet stack structure
EPI YIELD ENHANCEMENT FOR HIGH POWER DEVICES

Single pass: excellent electrical performance, better yield (less defects), and lower cost

- Conventional: Needs 5 passes, with interface defects
- Intrepid ESA: Single pass with no interfacial defects, clean reactor after 100µm deposition

Reactor architecture advantage allows one pass thick Epi deposition
SELECTIVE EXPANSION IN VERTICAL FURNACE AND PECVD
New Vertical Furnace platforms: A400 DUO and New 300mm platform

Significant wins in China

Multitude of applications: LPCVD, Cure, Oxidation
Expanding Aurora k 3.0 low-k technology to more layers

Technology node vs. average number of layers

- 5nm
- 3nm
- 2nm

- k 3.0
- k 2.5

Developing innovation gap-fill capability with carbon-based films

Source: Chipworks
COMMITMENT TO SUSTAINABILITY
As a leading supplier of WFE equipment, ASMI has embarked on integrating sustainability in our product life cycle in the areas of innovation, design, system operation, and refurbishment.

**In innovation**
- Engineering innovation such as Green Chiller, smart Power Distribution Unit (4.2% saving)
- Process innovation – more efficient reactor cleans or precursor usage (>16% saving)

**In design**
- New insulation techniques / materials to reduce heat losses
- Optimized Power Supply / RF generators to reduce electrical usage

**System operation**
- Partnering with abatement companies to reduce effluents while optimizing fuel consumption
- Developing smart system idling (15% energy savings)

**In refurbishment**
- Active program to recycle and re-use of older generation equipment
- Extend the life of components / eliminate consumable parts through optimized parts cleaning
ENERGY REDUCTION THROUGH DESIGN INNOVATION

QCM advantage for cost and energy

Throughput CoO Energy consumption

DCM QCM

<table>
<thead>
<tr>
<th></th>
<th>Liner</th>
<th>GF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput</td>
<td>195</td>
<td>200</td>
</tr>
<tr>
<td>CoO</td>
<td>71</td>
<td>70</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>84</td>
<td>81</td>
</tr>
</tbody>
</table>
FROM TRANSACTIONAL TO OUTCOME-BASED SERVICES
FROM A TRANSACTIONAL TO OUTCOME-BASED MODEL

Services portfolio

Transactional

- Transactional spares
- Transactional labor

Outcome-based services

- Refurbished equipment
- Spares as a Service
- Complete Kit Management (CKM)

FROM A TRANSACTIONAL TO OUTCOME-BASED MODEL
KEY TAKEAWAYS

#1 Leader in ALD with the largest portfolio of products, applications, and materials in an ever expanding market

#2 Growing market share in Epi with new innovations and well engaged in forthcoming gate-all-around (GAA) transition

#3 Selectively growing our offering in Vertical Furnace and PECVD

#4 New innovations increasingly focused on sustainable solutions with energy usage reduction

#5 Transitioning from transactional to outcome-based business model in service to provide the best value to our customers
ASMI INVESTOR DAY 2021

FINANCIAL UPDATE: GROWTH THROUGH INNOVATION

Paul Verhagen
CFO

September 28, 2021
FORWARD-LOOKING STATEMENTS

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# KEY TAKEAWAYS

**#1**
ASMI has grown to be a leader in ALD, creating significant value for all stakeholders.

**#2**
Revenue target of €2.8-€3.4 billion by 2025, representing a CAGR of 16-21%, outgrowing WFE market.

**#3**
Operating margin target ranging from 26% to 31% in 2021-2025 generating strong free cash flow.

**#4**
Capital allocation policy unchanged. Investment in growth remains the key priority with excess cash returned to shareholders.
KEY HIGHLIGHTS AT A GLANCE FY16-FY20

- **Annualized total shareholder return**: 39%
- **Total cash returned to shareholders**: €1.4 billion
- **Accumulated free cash flow**: €411 million\(^1,2\)
- **ROIC**: \(\uparrow 11\% \) points
- **Revenue 22% CAGR**
- **Gross margin**: \(\uparrow 3\% \) points
- **Operating margin**: \(\uparrow 11\% \) points
- **GHG emission scope 1 & 2**: \(\downarrow 15\% \)\(^3\)

\(^1\) Excluding proceeds from patent litigation and arbitration settlement in FY19
\(^2\) Excluding ASMPT dividends
\(^3\) Intensity per mtCO\(_2\)e/million € R&D investment
HISTORICAL KEY
FINANCIAL PERFORMANCE
FY16-FY20
Total cumulative shareholder return in %

1 Up to September 22, 2021

2 Peers’ average consists of Applied Materials, ASML, KLA, Lam Research, and Tokyo Electron
Dividends gradually increased from €0.40 per ordinary share in FY10 to €2.00 in FY20.
**Revenue (€ million)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019¹</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY16</td>
<td>598</td>
<td>737</td>
<td>818</td>
<td>1,125</td>
<td>1,328</td>
</tr>
</tbody>
</table>

**22% CAGR**

**Net earnings (€ million)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019¹</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY16</td>
<td>135</td>
<td>168</td>
<td>157</td>
<td>170</td>
<td>285</td>
</tr>
</tbody>
</table>

**Revenue growth key drivers:**

- Growth in end markets and WFE market
- Increased market share in ALD and epitaxy
- Growth in spares and services

**Net earnings:**

- Net earnings development is not fully consistent with revenue growth mainly due to annual fluctuations in currency results, tax and income from ASMPT

¹ Excluding proceeds from patent litigation and arbitration settlement in FY19
² FY17: Excludes €285 million gain on sale of ASMPT stake
### MARGIN EXPANSION AND EARNINGS GROWTH

#### Gross margin (in %)

- **FY16**: 44%
- **FY17**: 42%
- **FY18**: 41%
- **FY19**: 43%
- **FY20**: 47%

#### Operating margin (in %)

- **FY16**: 14%
- **FY17**: 15%
- **FY18**: 15%
- **FY19**: 20%
- **FY20**: 25%

**Gross margin expansion key drivers:**
- Application mix
- Operating leverage and productivity improvements
- Supply chain improvements
- Reduced margins in FY17/18 due to investments in new product introductions

**Improved operating margin key drivers:**
- Development gross margin
- Operating leverage and productivity improvements in SG&A and R&D

1 Excluding proceeds from patent litigation and arbitration settlement in FY19
**Free cash flow (FCF)**

- Strong improvement FCF in FY19/FY20 driven by improved profitability
- Reduction in FY20 FCF is due to some delayed customer payments just after year end

**Cash returned to shareholders**

- Almost €2 billion cash returned since FY10 of which:
  - Approximately €1 billion in share buyback, €0.5 billion in dividends and €0.5 billion in return of capital

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Excluding ASMPT dividends  
Excluding proceeds from patent litigation and arbitration settlement in FY19
INCREASED R&D INVESTMENTS TO SUPPORT VALUE CREATING GROWTH

R&D expenses (€ million)

Increased gross R&D investments\(^2\) from €102 million to €172 million, resulting in 13% gross and 10% net R&D as a % of revenue

---

1 Excluding proceeds from patent litigation and arbitration settlement in FY19
2 Gross R&D expenses excludes capitalization, amortization and impairment
INCREASED CAPITAL EXPENDITURES TO SUPPORT MANUFACTURING EXPANSION

Capital expenditures, gross (€ million)

<table>
<thead>
<tr>
<th></th>
<th>FY16</th>
<th>FY17</th>
<th>FY18</th>
<th>FY19</th>
<th>FY20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>34</td>
<td>47</td>
<td>68</td>
<td>51</td>
<td>99</td>
</tr>
</tbody>
</table>

FY18
- Completed our new facility in South Korea to strengthen our position in this key market

FY20
- Completed our new facility in Singapore, substantially expanding our manufacturing capacity
DISCIPLINED MANAGEMENT OF WORKING CAPITAL

Working capital amount (€ million) and days

Working capital days in the range of 42 to 82 days
- Changes in working capital days mainly caused by DSO ranging from 50 to 75 days
- DIO improved from 59 to 42 days
- Payables remained stable around 30 to 35 days
- Other working capital remained stable around 17 to 24 days

1 Excluding proceeds from patent litigation and arbitration settlement in FY19
TARGETS
FY21-FY25
## Financial Targets Towards FY25

<table>
<thead>
<tr>
<th></th>
<th>FY16</th>
<th>FY20</th>
<th>FY25</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue</strong></td>
<td>€598 million</td>
<td>€1.3 billion</td>
<td>€2.8 to €3.4 billion&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Revenue growth</strong></td>
<td>13% CAGR (FY12-FY16)</td>
<td>22% CAGR (FY16-FY20)</td>
<td>16 - 21% CAGR (FY20-FY25)</td>
</tr>
<tr>
<td><strong>Gross margin %</strong></td>
<td>44%</td>
<td>47%</td>
<td>46 - 50% (FY21-FY25)</td>
</tr>
<tr>
<td><strong>SG&amp;A % revenue</strong></td>
<td>15%</td>
<td>12%</td>
<td>High single digit (FY25)</td>
</tr>
<tr>
<td><strong>R&amp;D (net) % revenue</strong></td>
<td>15%</td>
<td>10%</td>
<td>High single digit to low teens (FY25)</td>
</tr>
<tr>
<td><strong>Operating margin %</strong></td>
<td>14%</td>
<td>25%</td>
<td>26 - 31% (FY21-FY25)</td>
</tr>
</tbody>
</table>

<sup>1</sup> In constant currencies
## NON-FINANCIAL TARGETS

<table>
<thead>
<tr>
<th>Category</th>
<th>Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG emissions</td>
<td>Net zero by 2035, including scope 1, 2 and 3 emissions</td>
</tr>
<tr>
<td>Renewable electricity</td>
<td>100% renewable electricity by 2024</td>
</tr>
<tr>
<td>Safety</td>
<td>Recordable overall injury rate less than 0.1 cases per 100 employees by 2025</td>
</tr>
</tbody>
</table>
ASMI expects to outgrow the WFE market over the next five years

- ALD leadership > Maintain market leadership in logic/foundry and grow memory
- Epi > Gain market share
- Spares and services > Grow outcome-based services
- PECVD and Vertical Furnaces > Selected growth

1 Excluding proceeds from patent litigation and arbitration settlement in FY19
SUSTAINABLY HIGHER GROSS MARGIN

Gross margin (in %)

<table>
<thead>
<tr>
<th>Year</th>
<th>2016 (FY16)</th>
<th>2017 (FY17)</th>
<th>2018 (FY18)</th>
<th>2019' (FY19)</th>
<th>2020 (FY20)</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>44</td>
<td>42</td>
<td>41</td>
<td>43</td>
<td>47</td>
<td>44</td>
</tr>
</tbody>
</table>

Sustainably higher gross margin:

- Revenue growth
- Operating leverage
- Cost efficiencies
- Supply chain improvements
- Mix
- Application mix

1 Excluding proceeds from patent litigation and arbitration settlement in FY19
SG&A GRADUALLY DECREASE AS % OF REVENUE

**SG&A (as % of revenue)**

Gradually decreasing to high single digit by FY25

SG&A as % of revenue will decrease benefiting from operating leverage due to revenue growth and targeted productivity improvements

1 Excluding proceeds from patent litigation and arbitration settlement in FY19
**R&D Investments**

- Advanced R&D for coming inflections in logic/foundry and memory segments
- Lab expansions & equipment upgrades

**Excluding proceeds from patent litigation and arbitration settlement in FY19**
Key drivers for improved operating margin:

- Higher gross margin
- Productivity improvement in SG&A and to a lesser extent in R&D
Effective Tax Rate (ETR) (in %)

- FY16: 2%
- FY17: 1%
- FY18: 9%
- FY19: 14%
- FY20: 15%
- FY21-FY25: ETR gradually increasing to low twenties:
  - Full utilization of historic NOLs (Net Operating Losses)
  - Expiring tax incentives in coming years
  - FY21 ETR expected to be high teens
DISCIPLINED MANAGEMENT OF WORKING CAPITAL AND CAPEX

- We expect working capital days to range from 55-75 days

- Higher capital expenditures in FY18 and FY20 for capacity expansion

- Future capital expenditure spend ranging from €60-€100 million annually

1 Excluding proceeds from patent litigation and arbitration settlement in FY19
CAPITAL ALLOCATION STRATEGY

Priority 1
Invest to support future growth
- R&D
- Capex
- M&A

Priority 2
Maintain a strong balance sheet
- Increase targeted minimum cash position towards €600 million in coming years

Priority 3
Sustainable dividend payments

Priority 4
Return of excess cash to shareholders through share buybacks
KEY TAKEAWAYS

#1 ASMI has grown to be a leader in ALD, creating significant value for all stakeholders

#2 Revenue target of €2.8-€3.4 billion by 2025, representing a CAGR of 16-21%, outgrowing WFE market

#3 Operating margin target ranging from 26% to 31% in 2021-2025 generating strong free cash flow

#4 Capital allocation policy unchanged. Investment in growth remains the key priority with excess cash returned to shareholders
WRAP UP
ASMI is the leader in ALD and expanding in Epi, technologies that are expected to outgrow the WFE market driven by key inflections such as gate-all-around (GAA).
THANK YOU