DUV Products and Business Opportunity

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Business Line DUV
DUV demand is at a record high and expected to remain strong for the foreseeable future driven by both the Advanced and the Mature market segments.

Innovation in technology for the Advanced Logic and Memory market will continue; we extended the roadmap on all wavelengths, with performance and productivity improvements on the NXT platform to support the industry’s cost and energy efficient scaling.

The Mature market including More than Moore applications presents a growth opportunity by building on the XT portfolio in combination with solutions addressing the specific requirements of market segments like power devices, sensors.

With the aim to optimize the installed base for our customers, there is an increased focus on value added services in combination with productivity and performance upgrades.
• Markets
Advanced Logic and Memory
Mature Logic and Analog nodes, and More than Moore markets
Installed base
DUV business outlook improved significantly
Driven by strong markets, increased process complexity and installed base growth

2018

In 2018 our forecast assumed a reduction in immersion demand due to EUV adoption, market growth in line with historical trends
DUV business outlook improved significantly
Driven by strong markets, increased process complexity and installed base growth

2021

Drivers include technology innovation, increase in process complexity resulting in more demand at all wavelengths, and growth in the installed base business opportunity
DUV addresses numerous market segments

Advanced segments (≤28 nm)

Mature segments (≥ 40nm)

- EUV
- ArFi
- ArF
- KrF
- I-Line

Source: ASML
Projection of lithography layers by technology

Lithography layer count grows, driven by DUV and EUV

Source: ASML
Our end markets are increasingly interdependent
Requiring an integral portfolio of solutions

5 nm

EUV
ArF
KrF
I-Line

ArFi

Public

Slide 8
29 Sept. 2021
## DUV product portfolio to support all market segments

<table>
<thead>
<tr>
<th>Wavelength</th>
<th>NA, Half pitch</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArFi</td>
<td>critical 1.35 NA, 38 nm</td>
<td><strong>NXT:2000i</strong> 2.0 nm</td>
<td>275wph</td>
<td><strong>NXT:2050i</strong> 1.5 nm</td>
<td>295wph</td>
<td><strong>NXT:2100i</strong> 1.3 nm</td>
<td>295wph</td>
</tr>
<tr>
<td>ArFi</td>
<td>mid - critical 0.93 NA, 57 nm</td>
<td><strong>XT:1460K</strong> 5 nm</td>
<td>205wph or 7.5 nm</td>
<td>228wph</td>
<td><strong>NXT:1470</strong> 4 nm</td>
<td>300wph</td>
<td>NEXT</td>
</tr>
<tr>
<td>KrF</td>
<td>0.93 NA, 80 nm</td>
<td><strong>XT:1060K</strong> 5 nm</td>
<td>205wph</td>
<td><strong>XT:1060K + PEP</strong> 5 nm</td>
<td>220wph</td>
<td><strong>XT:860M</strong> 7 nm**</td>
<td>240 - 250wph</td>
</tr>
<tr>
<td>KrF</td>
<td>0.80 NA, 110 nm</td>
<td><strong>XT:400L</strong> 20 nm**</td>
<td>230wph</td>
<td><strong>XT:400M</strong> 20 nm**</td>
<td>250wph</td>
<td>NEXT</td>
<td></td>
</tr>
<tr>
<td>i-line</td>
<td>0.65 NA, 220 nm</td>
<td><strong>XT:400M</strong> 20 nm**</td>
<td>250wph</td>
<td>NEXT</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Product:** Matched Machine Overlay (nm)/Throughput(wph)

**Product status:** Released, Development, Definition

**Wavelength:** ArF, ArFi, KrF

**NA:** 0.80 - 1.35

**Wavelength:** i-line

**NA:** 0.65

**Wafer inner field:** **Wafer inner field**
NXT transition improves KrF and ArF productivity significantly

**KrF**

- XT:860N 2021: 260 wafers per hour
- NXT:870 2022: 330 wafers per hour

**ArF**

- XT:1460 2019: 205 wafers per hour
- NXT:1470 2021: 300 wafers per hour

**NXT:1470 first litho system to show >300wph**
We will support our customers’ wafer demand
By increasing factory output and scanner productivity

~1.7X growth

ASML manufacturing wafer output capability

Yearly system capability x system productivity (wph)

2019 2020 2021 2022

ArFi ArF KrF I-Line
Markets

• Advanced Logic and Memory

Mature Logic and Analog nodes, and More than Moore markets

Installed base
NXT:2050i in volume manufacturing at customers
20% overlay improvement, faster reliability and productivity ramp-up

5,000 wafers per day in 18 days

180 hours reliability in 13 weeks

Faster ramp

Higher availability
NXT:2100i makes a 20% step in on product overlay vs the NXT:2050i for a typical DRAM application

**Reticle handler**
Faster conditioning and lower reticle-to-reticle temperature variation

**Wafer table**
Improved overlay & lifetime improvements

**Alignment 12 colors**
65 marks, small marks, combined layout

**Improved scanner metrology software**
Improved setup repro for overlay

**Projection optics**
Improved lens and cross matching control

**2D Reticle stage grid calibration**
Reducing impact of reticle load errors on overlay

**Optical sensors**
Improved camera & thermal conditioning

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**NXT:2100i**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Performance</th>
</tr>
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<tbody>
<tr>
<td>Throughput</td>
<td>≥295wph</td>
</tr>
<tr>
<td>MMO</td>
<td>≤1.3nm</td>
</tr>
<tr>
<td>On Product Overlay</td>
<td>≤1.4nm (DRAM)</td>
</tr>
</tbody>
</table>
NXT platform reduces capital investment, fab space
NXT brings 17% footprint reduction with 100k wafer starts per month

Use case:
100 kwspm
5 ArF (dry) layers
20 KrF layers

<table>
<thead>
<tr>
<th>Fab pattern area</th>
<th>XT</th>
<th>NXT</th>
</tr>
</thead>
<tbody>
<tr>
<td>172m²</td>
<td>5 x XT:1460K (205wph)</td>
<td>4 x NXT:1470 (300wph)</td>
</tr>
<tr>
<td>140m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>482m²</td>
<td>14 x XT:860N (260wph)</td>
<td>12 x NXT:870 (330wph)</td>
</tr>
<tr>
<td>421m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>654m²</td>
<td>561m²</td>
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</table>
Markets
Advanced logic and memory
• Mature logic and analog nodes, and More than Moore markets
Installed base
We support the growth in mature Logic and Analog nodes delivering ~30% improved productivity for the same process capability
**Mature Markets: differentiated application space**

Strong growth expected short- and long-term driven by existing and new applications

<table>
<thead>
<tr>
<th>Substrate Size [mm]</th>
<th>Substrate Thickness [µm]</th>
<th>ANALOG</th>
<th>MATURE LOGIC</th>
<th>OPTICAL SENSORS</th>
<th>NON - OPTICAL SENSORS</th>
<th>POWER</th>
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<tbody>
<tr>
<td>300 mm</td>
<td>Thick</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
<td></td>
<td>Si</td>
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<tr>
<td></td>
<td>Standard (775)</td>
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<tr>
<td></td>
<td>Thin</td>
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<tr>
<td>200 mm</td>
<td>Thick</td>
<td>Si</td>
<td>Si</td>
<td>SiGe SOI</td>
<td>AITIC GaN on Si</td>
<td>Si</td>
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<tr>
<td></td>
<td>Standard (725)</td>
<td></td>
<td></td>
<td>SiGe SOI</td>
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<tr>
<td></td>
<td>Thin</td>
<td></td>
<td></td>
<td>Glass</td>
<td>Ceramic Si</td>
<td></td>
</tr>
<tr>
<td>150 mm</td>
<td>Thick</td>
<td>Si</td>
<td>Si</td>
<td>SiGe SOI</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standard (675)</td>
<td></td>
<td></td>
<td>SiGe SOI</td>
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<tr>
<td></td>
<td>Thin</td>
<td></td>
<td></td>
<td>Glass</td>
<td>Ceramic GaAs</td>
<td></td>
</tr>
</tbody>
</table>

Materials: Si: Silicon, AITiC: Aluminum-Titanium-Carbon, GaN: Gallium Nitride, SiGe: Silicon Germanium, SiC: Silicon Carbid, SOI: Silicon on Insulator, GaAs: Gallium Arsenide
More than Moore market supported by the XT platform with application specific alignment and wafer handling options

**XT platform: ArF, KrF, i-line**

**Wafer handling options**
- Wafer size: 150/200/300 mm
- Wafer thickness: 0.3 - 1.5 mm
- Materials: Si, GaN on Si, glass, Ceramic
- Warpage
- Wafer table flow and burl pitch

**Alignment options**
- Alignment through glass
- Backside alignment
- SMASH extensions to 200 mm

Devices with many variations in substrate (thickness)
Markets
Advanced Logic and Memory
Mature Logic and Analog nodes, and More than Moore markets
• Installed base
Over 1,000 systems exposed more than 1 Million wafers in 2020
16 systems exposing more than 2 million 300 mm wafers per year

> 1.000.000
Wafers per year

> 1.500.000
Wafers per year

> 2.000.000
Wafers per year
Opportunities for the installed base productivity
Wafer per day products

Expand fab capacity at minimal lead time and investment

Enhancement packages

Wafer per day services
# DUV immersion – upgrade roadmap

System modularity creates fab flexibility customers

<table>
<thead>
<tr>
<th>Machine</th>
<th>190wph</th>
<th>230wph</th>
<th>250wph</th>
<th>275wph</th>
<th>295wph</th>
<th>330wph</th>
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</thead>
<tbody>
<tr>
<td><strong>NXT:1950i</strong></td>
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<tr>
<td><strong>NXT:1960Bi</strong></td>
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<tr>
<td><strong>NXT:1965Ci</strong></td>
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<tr>
<td><strong>NXT:1970Ci</strong></td>
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<tr>
<td><strong>NXT:1980Di</strong></td>
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<tr>
<td><strong>NXT:1980Ei</strong></td>
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<tr>
<td><strong>NXT:1980Fi</strong></td>
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<td><strong>NXT:2000i</strong></td>
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<tr>
<td><strong>NXT:2100i</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Matched Machine Overlay</th>
<th>5.5 nm</th>
<th>4.5 nm</th>
<th>4.5 nm</th>
<th>3.5 nm</th>
<th>2.5 nm</th>
<th>2.0 nm</th>
<th>1.5 nm</th>
<th>1.3 nm</th>
</tr>
</thead>
</table>

- System
- Node extension package
- Productivity package
- Under study
Services and upgrades extend value and life of tool
Main upgrades over NXT scanner life

Example: NXT:1960Bi

DUV products and business opportunity

Key messages

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