Edwards Contribution to future EUV Lithography scaling

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The approaching introduction of Extreme Ultraviolet Lithography (EUVL) into high-volume manufacturing (HVM) requires appropriate readiness of all supporting infrastructure with specific attention to the demanding availability and throughput targets required to achieve cost effective production. The transition to 13.5nm light not only places significant demands on the vacuum aspects of the process tool development, but there is also a consequential impact to the supporting equipment which is maintaining the process environment, specifically from the perspective of delivering, not only, sufficient tool availability, but also for other demanding requirements of the vacuum and exhaust gas management sub system.

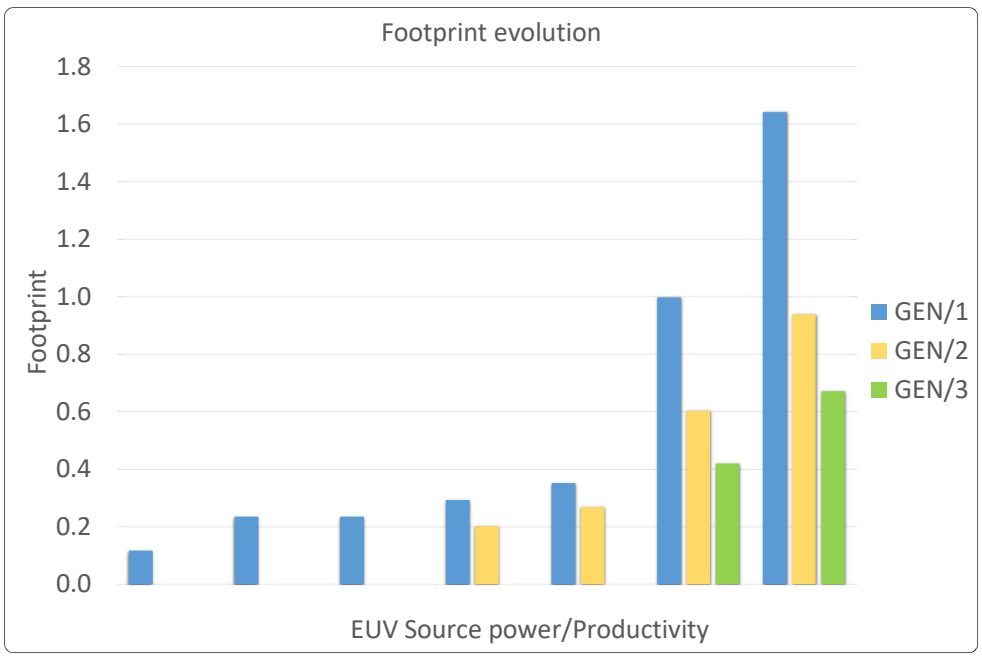
Edwards has been extensively involved in advanced Lithography applications, in particular EUV Lithography, since the early OEM development phase the transition of requirements from a multi capable light source concept infrastructure (DPP and LPP sources), supporting proof of concept EUV tools, into a more dedicated facility for an HVM environment results in a set of design scaling factors. Considerations such as safety, gas flows and temperatures contribute to support the necessary operating vacuum conditions as well as reliability, footprint, design flexibility, utility, total energy and availability aspects to support overall EUV cost efficiency.

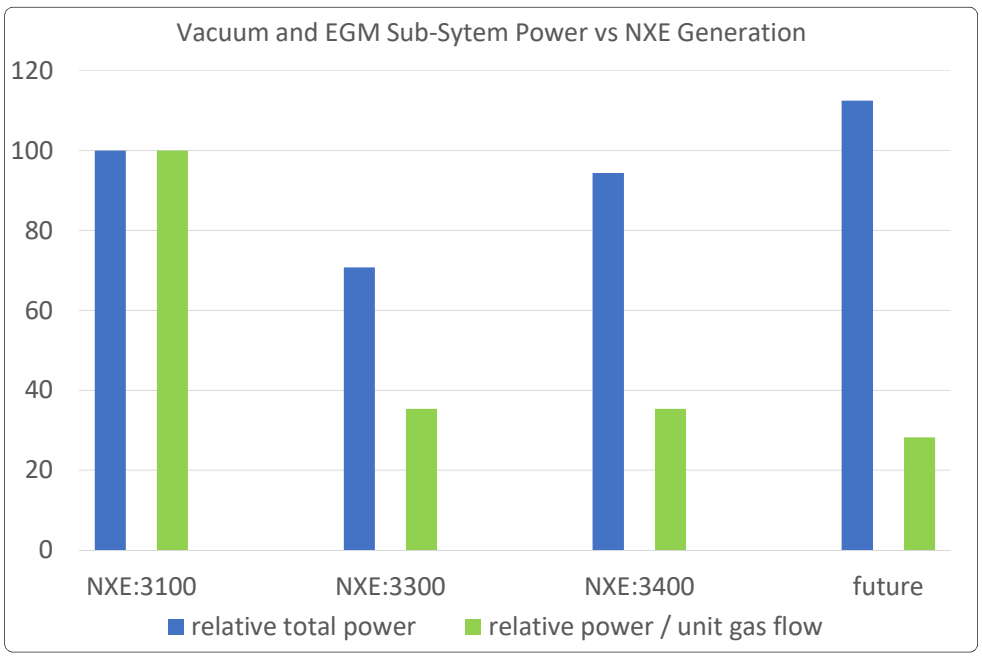
Edwards has have shipped over one hundred dedicated, multi-generational, EUV Zenith sub-systems in the last ten years to support the various EUV tool platform generations. Using the lessons learned from this installed base has been the major process to drive continuous improvement of the system performance.

Footprint and Power Scaling of Source Vacuum Facility Sub-System Equipment

The introduction of the EUV Lithography process into silicon chip designs has, compared to immersion based lithography, quite substantially increased the subfab space requirement overtime. On this aspect the EUV light source has been a more contributory factor in the footprint of the total subfab area. One of the challenges of semiconductor equipment manufacturers is to a avoid pyramid formation between the cleanroom space requirement and the cabinets in the subfab and basement locations. This supporting equipment should remain within the shadow of the tool footprint to enable a most efficient use of expensive cleanroom space.

In the path towards higher NXE tool productivity parameters such as gas flow and pressure have had a substantial increasing effect on the requirements of the subfab vacuum and exhaust gas management equipment. While the EUV source power does not specifically scale proportionally with the system power required to drive the vacuum and EGM facility sub-system the facility needs to have capacity to match the NXE platform evolution. In Edwards' roadmap the subfab package has gone through a number of iterative designs to support a smaller footprint overall.

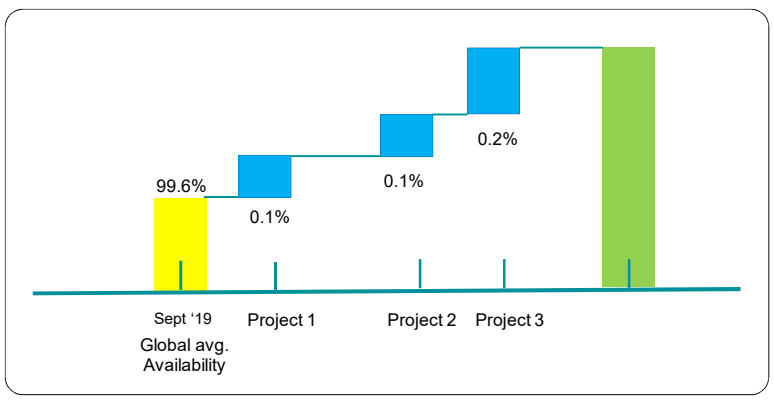




Impact of Vacuum and EGM Sub-System UnAvailability on NXE Operation

The unavailability of the NXE tool is inextricably linked to the availability of the vacuum sub-system equipment. The path towards HVM operation has substantially increased the negative effect of the vacuum sub-system unavailability on the EUV tool operation. Minimising the possible downtime is critical in the path towards effective HVM operation. Utilising an availability matrix analysis in the design phase of the sub-system equipment has enabled a potential availability to be identified and this has lead to a set of organisational and engineering projects focussed on delivering improved availability of the NXE tool overall.

A global way of working has been introduced to manage known issues, where lessons are learned from the installed base of systems and a specific organisation has been introduced to support planned maintenance activities and manage escalations due to unscheduled down situations. Additionally securing spare parts in proximity to customer tools and introducing a methodology of reporting updates all lead towards a robust high volume manufacturing process.



Summary

Edwards has shipped over 100 EUV Zenith vacuum and exhaust gas management sub-systems to the EUV Lithography community in the path towards HVM insertion. This insertion places an increasing and more intelligent requirement on the operation and maintenance of the EUV Zenith sub-system to deliver the necessary NXE tool availability. The broad installed base is crucial in enabling the important learning to drive the roadmap to support the challenging infrastructure required for EUV Lithography in HVM.