# SiNANO Institute Vision – Executive Summary

The SiNANO Institute was set up to orchestrate academic based research in nanoelectronics in Europe. It has engaged its 18 strong membership of leading academic institutions to provide a long range vision of nanoelectronics in Europe and to recommend the critical high priority areas that should be pursued.

The overall view is clear – there is nothing on the horizon to rival the supremacy of silicon CMOS. This technology will continue for the foreseeable future and will be the subject of on-going development and refinement, embracing new materials, new device architectures and layouts.

Over the next decade, this core Si CMOS technology will deliver ever improving chip performance through incorporation of new channel materials (e.g. other Group IV and III-Vs), new gatestacks (e.g. high k dielectrics), new contacting materials, multigated devices, new interconnect regimes (RF, optical) and embedded memory and integration in the 3$^{rd}$ dimension. There is still some room for further shrinkage in the lateral device dimension, perhaps to a few nanometres. Demands for reduced power are likely to lead to the SOI platform becoming mainstream and populated with devices that operate at greatly reduced voltages and are optimised for minimal off-current. Beyond this, the exploitation of quantum phenomena in 1D and 0D nanostructures promises an exciting new era in chip architecture, device density and levels of performance. But major advances in fabrication are required, probably involving “bottom-up” processing techniques. Breakthroughs in the core technology will demand much from the physical and electrical characterization techniques employed and from device simulation.

There are particular strengths in the European academic sector in this core technology (i.e. *More Moore* and *Beyond CMOS* domains) and continuing activity remains important and of strategic significance, whatever industrial scenario develops.

Probably the major challenge and opportunity for Europe is in bringing additional functionality to CMOS (i.e. *More than Moore* domain) - particularly learning how to integrate sensors, actuators, MEMS/NEMS, RF components, optoelectronic and biological systems. Such endeavours would be driven by a wide range of applications of huge societal and economic impact. These include in-body/out-of-body medical monitoring and diagnostics, environmental and transport monitoring, security, ambient intelligence and ecological applications – including energy harvesting, enhancing solar cell efficiencies and ultimately in the control of climate change. The advent of flexible electronics also offers exciting prospects for technological impact.

System design is critical, and new approaches are required to cater for increased variability and complexity issues, the behaviour of non-classical devices and the application-specific components.

There are powerful economic and societal reasons for Europe to maintain a strong presence in the nanoelectronics arena. This will require the timely and effective utilisation of public funding to catalyse and co-ordinate activities, as is the *de facto* position in other regions of the world. The infrastructure which oversees the interrelationships between the three main parties involved (industry, research institutions, academe) needs to be agreed and actively managed. In this uncertain world one thing is very clear – the 21$^{st}$ century will be one of extraordinary technological advancement- much, if not all of it, will depend upon the “intelligence” developed courtesy of nanoelectronics, and of the wisdom of mainstream nations to properly invest in its realization.