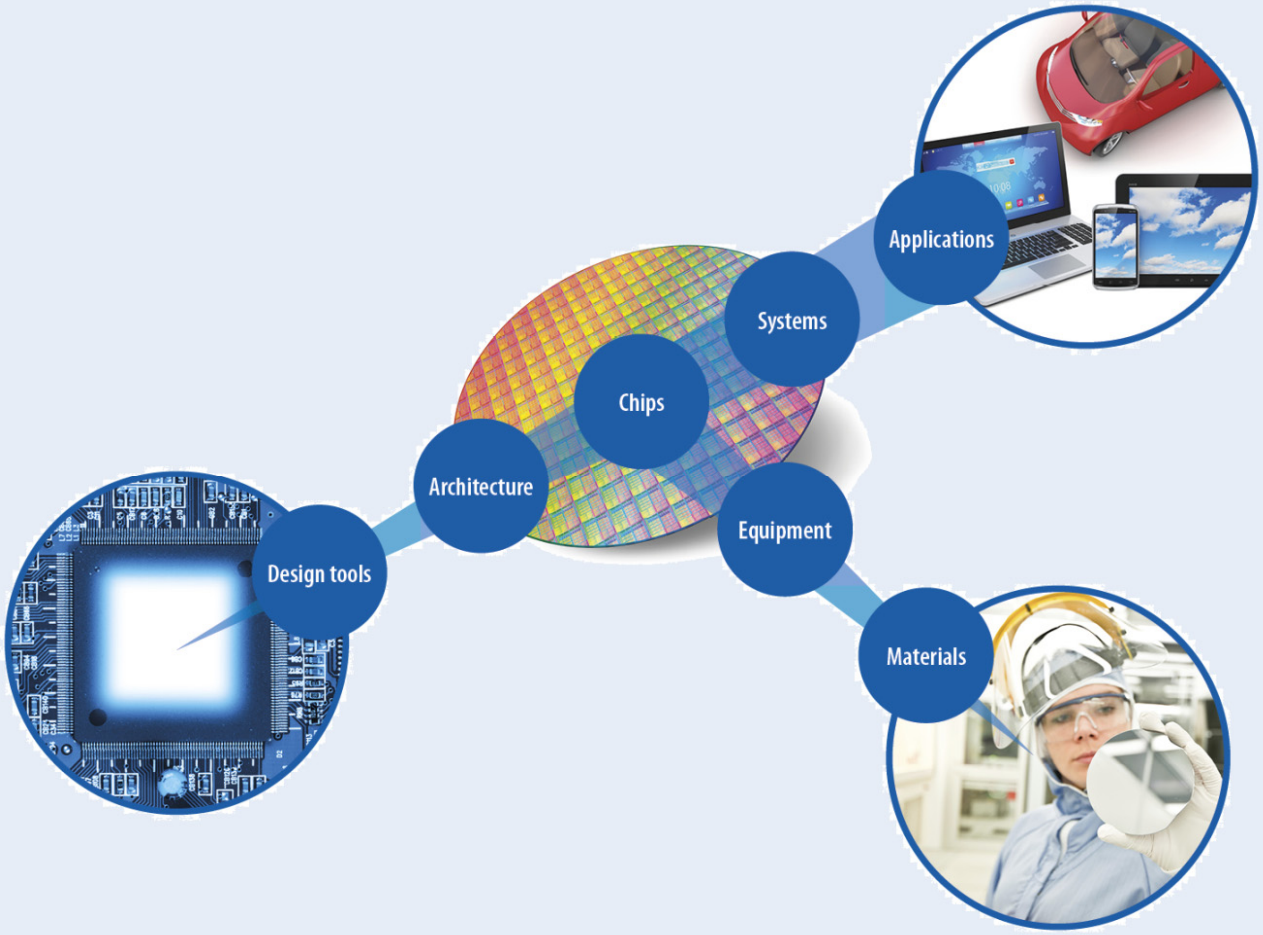

A European Industrial Strategic Roadmap for Micro- and Nano-Electronic Components and Systems

- Implementation Plan -

A report to Vice President Kroes by the Electronic Leaders Group

Contents

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Date 26th June 2014

1 Executive Summary

This document sets out the key elements of an implementation plan in response to the “European Industrial Strategic Roadmap for Micro- and Nano-Electronic Components and Systems". In preparing it, the Electronics Leaders Group has worked in widespread consultation across all stakeholders and the full value chains. The overall objective of the plan is to double the economic value of semiconductor production in Europe in the 2020-25 timeframe.

On the demand side, three focused measures are proposed for first delivery in 2017. They include “Trailblazer” projects in areas of European strengths, a set of "world-class *reference zones*" of testing, integration and dissemination and multi-skills networks of 20 or more competence centres to raise Europe's innovation capacity in all sectors.

On the supply side, achieving the overall goal will require a steady and sustained effort both from the public and private side working together, and making Europe a more attractive location to invest in. The implementation builds on the industrial commitments as demonstrated notably by the investments done in pilot lines in the ENIAC Joint Technology Initiative (JTI) in 2012-13. The plan foresees therefore a steady increase of production in Europe starting with the further exploitation and extension of existing facilities. It also foresees a clear opportunity for more investments facilitated by the reinforced public support at EU and national level.

The ELG sees in particular that the new conditions for supporting investments in Europe including support from H2020 and the new JTI ECSEL, the European Structural Funds, regional and national support as well as the financial instruments available from the EIB, represent an attractive incentive for investors in the field. These need to be brought into focused packages to support investments and easily accessible e.g. through a one-stop front office. The ELG recommends exploring the use of Important Projects of Common European Interest to help achieve such a goal.

Initiatives, such as support to the wider design ecosystem are also proposed as well for the development of technology and products in cross cutting opportunities such as security and autonomy, as well as in emerging areas such as wearable electronics, nano and micro robotics, bioelectronics and 5G communications.

The third track provides for framework and infrastructure – better regulation and harmonisation, international trade, protection of IPR, means to support new businesses and business models. In the training area, actions include designing university programmes, identifying regional 'ICT Training' Centres of Excellence, setting common quality standards for ICT training, and supporting university/industry partnerships to identify needs and to share the responsibility for skills development.

In support of all this, a monitoring and forecasting activity will be established including the evolution of the supply, and the matching between supply and demand.

2 Introduction

On 14 February 2014, the Electronics Leaders Group (ELG) provided to VP Kroes "A European Industrial Strategic Roadmap for Micro- and Nano-Electronic Components and Systems". It was agreed that by 30 June the ELG would deliver an implementation plan and would lay down the detailed actions to achieve the target of doubling the economic value of semiconductors production in Europe by 2020-2025.

This document expands on the means by which the above roadmap is to be implemented. It builds on an extensive consultation of stakeholders – in accordance with the commitment set out to involve the full value chain. The ELG reconfirms its desire for Europe to remain a major microelectronics player at the global level because of its growing strategic importance to Europe's industry. Recent announcements in other parts of the world (especially China) give a renewed sense of urgency for action.

The roadmap makes it clear that implementation has to:

- reflect Europe's engagement in global markets
- be economically sustainable
- build on public and private engagement, both on the demand and supply sides
- engage stakeholders across the multiple electronics value chains

Matching market drivers and capacity building is extremely challenging especially in chip production due to the long lead time to plan and ramp production versus the ability to accurately predict the market. A clear and effective means of monitoring progress and adjusting direction and responding to developments during the implementation of the strategy will be essential.

The roadmap therefore includes three tracks of actions:

1. Demand accelerators making Europe a lead market for electronic components and systems.
2. Preparing and strengthening the supply chain from materials and equipment, to components design and wafer production.
3. Enhancing the framework and infrastructure to attract private investments into component and technology development.

Momentum is building, there is optimism and a firm willingness to work towards doubling the economic value of semiconductors production in Europe.

3 A wide consultation of stakeholders across the electronics value chain

The implementation plan was prepared by a group of Sherpas representing the ELG members. In order to define it, and ensure a wide engagement of actors in the field, the ELG held a series of consultations and discussions including an online open consultation and Stakeholder Engagement Forum involving more than 250 experts.

More than 80 members of the forum met in a workshop to consolidate the input. In addition a series of meetings of experts were organised to discuss the topics of skills, regional development and investment in electronics as well as the needs and involvement of design and fabless industries in Europe.

The purpose of the implementation plan is to provide recommendations to policy actions at European, national, and regional level and to present industry's plans for the further advancement of micro- and nanoelectronics in Europe.

4 Track 1: Demand accelerators

The ELG has identified three market opportunities that industry in Europe is well placed to capture, in order to raise European semiconductor production in line with market developments. These are:

1. the emerging markets for smart connected objects and the 'Internet of Things'
2. the vertical markets where Europe has clear strengths such as automotive, energy, medical and life sciences as well as security
3. the mobile convergence market

The evolution of these markets is driven to a large extent by growing user and societal needs as digital technologies permeate all aspects of our daily lives and enable us to address societal challenges from sustainable healthcare to energy efficiency and low carbon emissions.

By providing the best conditions for the development of a vibrant market for components in the above areas, Europe will become a most attractive region for their development and production with consequent economic value and job creation.

4.1 The approach: Leadership and wide diffusion involving users at the earliest stage

The ELG members are convinced that well targeted public-private partnerships can be effective in ensuring that the best conditions are available for innovative products, services and manufacturing to emerge in response to growing demand.

As the European public sector represents more than 40% of economic activity, it has a key role in setting the right legal and incentivising framework for innovative business development while ensuring safety and security of citizens. It also has a key responsibility to establish the infrastructure to support knowledge and skills development in its population and for its economic prosperity.

For Europe to lead the next wave of digital innovations, it has to combine its efforts, public and private, in measures that allow both the "spearheading" of technology adoption by showing the way as well as the "wide uptake" of innovations across all Europe.

The proposed actions are bold and at a scale to attract private and regional investment and to reach all stakeholders across the value chain including end users.

4.2 Implementation by three focused measures

In addition to pursuing and reinforcing initiatives already launched to maintain Europe's lead in important market sectors for electronics[1], the ELG recommends a number of initiatives to be started in 2014:

i) "Spearheading" measures:

- "Trailblazer" projects demonstrating leadership in areas of European strengths
- a limited set of "world-class *reference zones*" of testing, integration and dissemination

ii) Measures to drive implementation of innovations on a wide scale:

- Multi-skills networks of *competence centr*es to upraise Europe's innovation capacity in all sectors

These three measures are complementary. Trailblazer projects are not geographic in scope; reference zones are geographic in scope; competence centres are organised by expertise.

All three measures will help Europe lead in the three above market opportunities. In particular, trailblazer projects will aim more specifically at reinforcing Europe's electronics industry presence in areas of strengths and capture opportunities in mobile convergence. Reference zones and competence centres will establish Europe as the lead market for Internet of Things and smart connected objects as well as mobile applications and services.

4.3 Trailblazer Projects

Objective and features

Lead the next wave of innovation stemming from smarter digital technologies in areas of European strengths such as automotive, health, energy and security. The projects should be significant and mobilise the resources needed to achieve clear breakthroughs giving Europe's industry a clear competitive advantage and enable it to compete on a global scale, while addressing well identified user needs. These should not be "copy-cat" initiatives, but demonstrate new opportunities from which lessons can be transferred to other European stakeholders.

The next wave of digital innovations is driven by the convergence of technology streams including big data analytics, cloud computing, connected objects and autonomous systems. It will involve the further miniaturisation and integration of components and systems technologies (More Moore and More than Moore).

Examples include:

- Intuitive personal companion
- Autonomous mobility
- Operating theatre and hospital 2020
- Smart homes and buildings
- Resource efficient and healthy agriculture/food production and distribution
- Customised and urban manufacturing
- Digital manufacturing

[1] such as the Electrical Green Vehicle Initiative or Factories of the Future Public Private Partnerships or the Smart Cities and Healthy Ageing European Innovation Partnerships

Implementation

Trailblazer projects are cross-cutting, integrative, industry-led and goal-driven with ambitious objectives and concrete targets. They require cooperation along value chains and value nets and multi-disciplinary R&D&I. They should act, when relevant, as focal points within and between existing initiatives mentioned above. To reach critical mass, the trailblazer projects should be supported at around 100 M€/year from the three pillars in H2020[2] and attract private investments of at least twice the public commitment. This would make a **total investment in each project of at least 1.5 B€ over 5 years (2016-2020)**.

Part of the public funding should come also from Member States' and/or regional programmes.

Support should cover (i) R&D to progress the underlying technologies, (ii) innovation actions aiming at early integration of technology streams and at testing their deployment in real setting resulting in innovative solutions and (iii) include regulatory measures.

In order to prioritise and expedite this, the ELG recommends that priority is given to those trailblazer projects that can mobilise industry from multiple levels of the value chain/net as well as relevant public sector authorities and organisations. Scale and reaching critical mass are essential to deliver on the ambitious targets. The EC and Member States should work together on mobilising the stakeholders including through focused consultations on the above subjects in the next 6 months and introduce these trailblazer projects as part of the next Work Programmes in H2020.

Non-technical issues such as liability, safety and privacy need to be addressed in parallel. Therefore, the ELG recommends that the EC and Member States address these issues with relevant stakeholders as quickly as possible. Important issues to be covered include liability in autonomous systems, privacy and security of smart homes and buildings and the use of smart companions for health monitoring.

What	At least 5 trailblazer projects with well-defined targets to achieve by 2020
When	Consultation/mobilisation – completed mid-2015. Full projects – launched 2016 onwards
Funding	Full projects – H2020, Member States and Regional funding, industry (suppliers and users of ICT)
Budget	Public funding: ~70-100 M€ per year from H2020 + 150-200 M€/year from industry

[2] The three pillars in H2020 are scientific excellence, leadership in enabling and industrial technologies and societal challenges

4.4 World-class reference zones of testing, integration and deployment on smart innovation.

Objectives and features

While trailblazer projects are goal-driven, reference zones are location based. The objective is to set up in Europe a limited number of zones in different geographical locations (e.g. cities or parts of cities, industrial zones, regions etc.) that are equipped with the state of the art facilities needed to innovate, test, integrate and showcase smart digital technologies. The reference zones will have the following main features:

- Access to state of the art broadband, computing (cloud) and sensing infrastructure
- Open data from public sector and from main utility sectors (energy, transport, water, environment agencies, geographic data institutions, hospitals and health systems, education, cultural institutions, etc.)
- Public authorities engaged in innovation in the public sector and in supporting business development
- A critical mass of engagement from private sector companies willing to develop and implement innovative solutions including smart connected objects and IoT based innovations
- A sufficient number of investors (equity and/or loans) ready to support business development in the field
- More importantly, a favourable mind-set of the citizens and public servants in the zones toward innovation including presence of research and innovation and higher education centres

These zones provide for significant testing and integration, well beyond traditional pilots. They should act as magnets for innovators (including start-ups and SMEs) and investors and make Europe "the place to be" when it comes to digital innovations. Zones should actively encourage adoption of their approach by other European regions and cities. By 2018, five cities or large public locations should be up and running delivering new and challenging services based on smart connected objects/IoT technologies.

Implementation

Support to the development of these zones should be through public-private partnerships mobilising resources and stakeholders from all across Europe. Public financial support would be largely through local and regional budgets including notably the use of Structural Funds. H2020 support to innovation should be used as a seed investment.

The ELG recommends that around a 100 M€ per year are invested from H2020 from 2015 on to support the development of 5 reference zones. This should be matched by at least 3 times higher amount from local and regional funds (including ESIF) and a similar amount from the private sector to develop new applications and services in the field. The total amount for such initiative will thus amount to around 700 M€ of investment per year totalling more than 4 B€ in the 2014-2020 timescale. This figure might look excessive but it is to be compared with the 320 B€ that the EU will invest in regional development in the same period.

Two options are proposed to build these zones:

- A "Beauty contest" approach with an expression of interest to identify candidate zones and a committee to pre-select cities or regions ready to engage in this field. This should result in regions/cities competing with comprehensive plans for investments over several years so that the speed of the implementation phase will more than compensate for the longer and more complex selection procedure.

- A "dynamic build-up" of the zones based on successive calls for proposals combining EU, national and regional public and private funding.

What	At least 5 world-class reference zones by 2018
When	Launched 2016 onwards
Funding	H2020 , Member States and Regional funding, industry
Budget	4.2 B€ in total including 600 M€ from H2020, 1.8 B€ from ESIF and national/regional budgets and 1.8 B€ from industry (suppliers of ICT solutions and services)

4.5 Networks of competence centres

Objective and features

The aim is to raise the innovation capacity of all industries and businesses in Europe through the wider uptake of smart digital technologies in all sectors of the economy and across all regions. Smart connected objects, the IoT, cloud and big data analytics will bring radical improvements to most aspects of our personal lives as well as improving industrial processes, products and service. Targeted public-private effort to bring the smart digital technologies to every business anywhere in the EU would significantly accelerate the early exploitation of these technologies.

Non-tech industries and SMEs are usually unaware of the potential of the latest technology on their products and business. They genuinely have difficulty to access technology platforms and the skills needed to develop and test new ideas.

This part of the implementation plan will focus on developing across Europe networks of specialised and excellent competence centres offering “one stop shops” for any business that wants to develop, experiment, produce and commercialise innovative products and services with "digital technology inside".

Each competence centre will:

- build its own excellence in multi-disciplinary digital knowledge and skills (e.g. smart X, IoT, big data and autonomous systems). In order to ensure excellence, and given the large investments needed to reach world level expertise and facilities, the centres have to specialise and cooperate to offer a one stop shop for all skills needed
- offer access to technology platforms and skills for developing and testing innovations
- act as broker between suppliers and users of the technology products
- operate at regional level but build connections across Europe to facilitate market access and partnership building between local and regional businesses and businesses across Europe,

and may be part of, or support to, reference zones. This applies also to connection with manufacturing companies which is extremely important mainly for SMEs

- act also as broker with financial investors including VCs and business angels

With the above capabilities the centres will become the engines of innovation hubs and clusters enabling the widespread uptake of "smart anything everywhere" in Europe.

Implementation

Support for the development will need a joint effort at regional, national and EU level. Regional and national financing (including ESIF) should be used to build and upgrade the skills and research and innovation capabilities at regional level whilst EU support from H2020 should be used to support innovative experiments and for networking across Europe of the centres themselves as well as for partnership building between businesses along value chains and value nets. The facilities should be accessible to anyone in Europe irrespective of their location. The sustainability of these centres should depend on their attractiveness to industry, innovators and investors.

Building on similar actions already launched in 2014-15 in ICT LEIT in H2020[3], the plan is to upscale these actions into EU wide initiatives with complimentary support from H2020, structural funds and regional/local support. In order to reach critical mass and cover the whole of Europe, it is proposed that around 50 M€ are invested from H2020 per year on these actions to be complemented by more than 150 M€ of investments at regional level on a yearly basis (200 M€ per year, 1.2 B€ over 6 years). Private support will be through co-funding of projects and experiments as well as through equity and loan financing to innovations. Total private investments should also be in the order of 1.2 B€ (200 M€ per year).

Linked to the competence centres, a “toolbox” approach could be adopted. The toolbox may be focused to low power and higher security as key differentiating factors.

By working with the Member States and Regions, further leverage can be achieved to establish the critical mass to build on pilots through to full deployment and getting the necessary volumes for mainstream production. A key objective is to address the time lag between opportunities that can be influenced at the technology level and the application level, and thus integrate technology developments more quickly.

What	At least 2 networks of competence centres (minimum 4 per network) by 2015, more than 20 competence centres by 2018
When	Full centres – launched 2016 onwards
Funding	H2020, Member States and Regional funding, Industry (including SMEs) contributions in collaborative research and innovation actions. VCs and Business angels
Budget	1.2 B€ from public sector 50 M€ per year from H2020 and 150 M€ from ESIF and national/regional budgets, 200 M€/year from private sector.

[3] E.g. I4MS (ICT for Manufacturing SMEs)

5 Track 2: Preparing the supply

5.1 The objective

Doubling the economic value of semiconductor production in Europe will require a steady and sustained effort both from the public and private side.

The public side at EU, regional and national level should strive to create the best conditions to attract private investment in semiconductor production[4] in Europe from all over the world, bringing skilled employment and the contribution to the local economy.

The European private side will seize the opportunities arising from market developments and build on Europe's assets such as excellent skills and knowledge, economic stability and a favourable and dynamic business environment.

The public and private side should work together to create a critical mass of support for a common research and innovation agenda and to optimise the economic return on investments.

5.2 The size of the challenge

As explained in the ELG roadmap issued in February 2014, Europe today is lagging seriously behind in terms of investments in silicon production capacity. With its current share of world-wide investment in production capacity, it will be impossible for Europe to reach the target of doubling the value of semiconductor production. The level of investment should gradually and substantially increase to match the above challenge.

To double production by value requires the capacity equivalent to the volume of 70,000 wafer starts per month (300mm equivalent) to be added every two years.

5.3 Positive signs but a lot of efforts still ahead of us.

Investment in the supply side in Europe has been increasing. The following table shows the Europe wide investments (approx.) by the industrial companies that are represented in the ELG:

Item	**2007-2010 (cumulative)**	**2011-2014 (cumulative)**	**2015-2018 Projections needed to reach the doubling**	**Investment level[5] required to double production value**
Capex	4.4 B€	15.7 B€	18.8 B€	35 B€
R&D	7.2 B€	11.4 B€	12.5 B€	

ELG members have shown that their investment in semiconductor production capacity in Europe in recent years has been higher than the sector average. The longer term commitment is a very

[4] From material and equipment through to chip design and wafer manufacturing

[5] This is the total investment required between today and the 2020-2025 timeframe; it assumes that the economic circumstances allow this level of investment to be supported.

positive indicator. ELG members have also announced plans for investments in their European production capacity.

5.4 Role of the public side: A new and ambitious public policy to support the supply.

As clearly highlighted in the ELG roadmap and in the strategy announced by VP Kroes in May 2013, the importance of semiconductors in Europe goes far beyond the prospects of the sector and the hundreds of thousands of jobs that it represents. What is at stake is Europe's capacity to maintain value creation in a global digital sector worth 3000 B€ and employing in Europe millions of people as well as value creation in all the industrial and service sectors that depend increasingly on electronics. Therefore, in addition, to supporting the acceleration of demand, a number of bold measures are required to support the supply and encourage investments to happen in Europe. These will involve regions, national authorities and the EU.

In 2014, the Commission revised its guidelines for state aid rules (regional aid, R&D&I and the General Block Exemption Regulation). It has also provided guidelines on the use of Important Projects of Common European Interest (IPCEI) that are foreseen in the treaty on the functioning of the European Union as a mechanism to provide public support to initiatives that are of clear and wide European interest. These provide a useful framework for an ambitious public policy to be implemented as follows:

- *More focused support to R&D&I* aligned to an agenda proposed by industry, and the role of ECSEL

  This will cover the whole innovation chain including high Technology Readiness Levels (TRLs) that require heavy investment notably in manufacturing pilot lines. Support at EU level and Member States will come partially from the 2.4 B€ of public investment foreseen in the ECSEL Joint Technology Initiative. It will also have to come from normal calls in H2020 and from additional support to R&D&I capacity building at regional and national level, including ESIF support. The total amount to be devoted from the EU, in H2020, including ECSEL, to the components field is expected to be higher than 1.6 B€ over 7 years. It will cover up to Technology Readiness Level 8.

  While ECSEL will focus on higher TRLs (5-8), normal calls in H2020 will focus on more exploratory research that will bring differentiating factors for the industry to compete on a global scale. In ECSEL Member States support is planned to be comparable to EU support and in addition, national programmes including CATRENE will complement that support. Financing from ESIF is also planned to support the upgrade of technology platforms, R&D&I, the capacities at RTOs and academic labs as well as in industrial settings. Hence the total support to R&D&I at regional and national level including participation in ECSEL is expected to be at more than 2.5 B€.

  ECSEL provides the framework for aligning these funding sources around a single agenda set by industry and the academic community; a multiannual strategic research and innovation agenda

of AENEAS and CATRENE[6]. Private investments in ECSEL will at least match the public investments (see below).

- *Support to investments in first production capacity in line within the revised state aid rules.*

This support should come primarily from regional and national authorities, including from ESIF. It is an incentive to encourage private investment in production. The use of the IPCEI can facilitate such investments by allowing public authorities to provide support that is necessary and competitive to other regions world-wide. It also enables cooperation between Member States and between regions to support common and shared investments from various industrial actors grouped in partnerships and alliances in different forms that fit industry business models.

The ELG recommends that public support from R&D&I up to investment in first production is grouped into focused packages using, if needed and where appropriate, the IPCEI to facilitate public investment and avoid uncertainties and delays related to state aid. As explained below, these focused packages should represent significant amounts of public incentives to attract industry and share the costs of new investments in Europe. The order of magnitude of these investments is in excess of a billion Euros, representing almost 20% of investment in a new fab.

- *Providing access to loans financing with favourable conditions to attract investments in manufacturing capacities.*

This includes in particular the access to loan finance offered by the European Investment Bank (EIB) to the Key Enabling Technologies (KET) which is around 60B€. Micro- and nanoelectronics is one of the 6 KETs; it should have access to an important share of the total amount given the heavy investments needed to build new fabs. The financing schemes also includes improved access to finance for SMEs and mid-cap companies active in associated fields such as design and fabless industries and those in the various supply chains such as materials and equipment companies. Depending on the needs of industry the available funds from the EIB for the sector can be anywhere between 10 B€ and 30-40 B€.

By summing all amounts for grants and loans that are today available to the semiconductor industry to invest in production in Europe, a package up to more than 40 B€ can be available provided that industry comes with solid projects for investments that will create growth and jobs in Europe. More than 6 B€ of these amounts can be in the form of grants for R&D and for first production capacities.

The EU needs to facilitate a process to explain the packages and remove the complexity which can be a huge deterrent for inward investment.

5.5 Role of the private side: A clear commitment from industry is the condition for success.

The ELG highlights that industry is investing and has shown willingness to invest further; the objective should be to arrange for a growing percentage of this to be in Europe. It confirms that further investments will be made if the conditions arise from a growing demand against early solid indications of such growth. In planning such future investment, industry will first follow an approach

[6] AENEAS is the **A**ssociation for **E**uropean **N**ano**E**lectronics **A**ctivitie**S;** CATRENE is the **C**luster for **A**pplication and **T**echnology **R**esearch in **E**urope on **N**ano**E**lectronics

exploiting and expanding existing capacities and already on going for 2014-15. Further investments are foreseen and can be derived from current investments in R&D&I and in pilot lines in particular.

- *The way ahead: Building on the Pilot Lines*

In 2012 and 2013 industry commenced an investment of more than 1.23 B€ in manufacturing pilot lines in ENIAC in addition to more than 530 M€ invested by the public sector. These pilot lines follow four tracks as shown in the table below:

	Total costs (M€)	EC funding	MS funding
Materials & Equipment	765	115	88
Power & embedded elect	387	59	66
MEMS & sensors	160	24	36
Next generation CMOS	480	71	77
Total	1 788	267	265

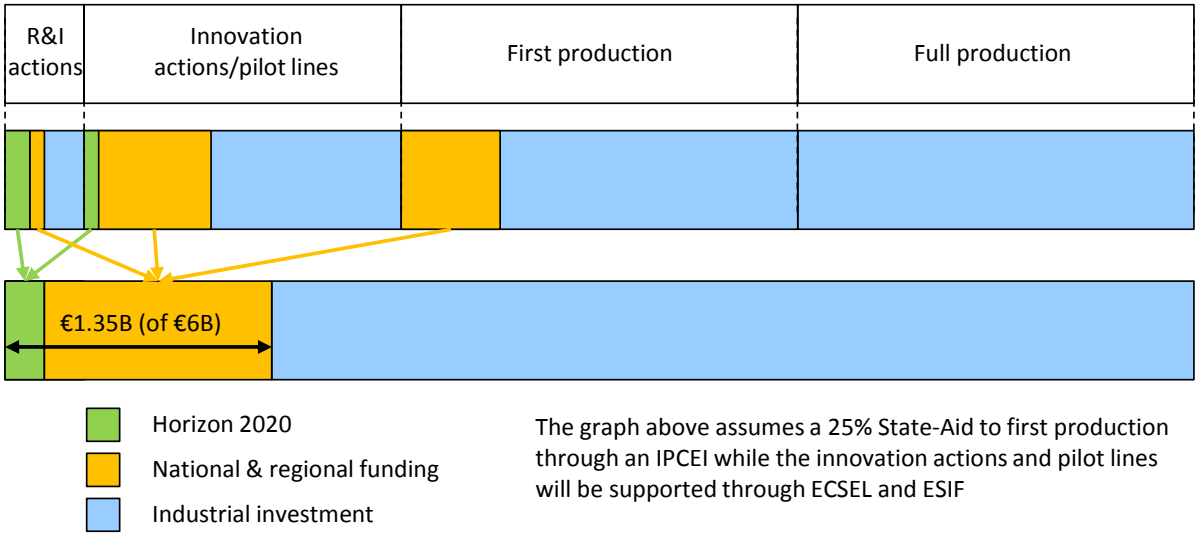
The above investment shows industry commitment to production in Europe. In order for these pilot lines to gradually move into first production and into production capacity **an estimated amount of 20 B€ investmen**t over the next 10 years will be needed.

Extrapolating the industrial investment of 1.23 B€ over 2 years in pilot lines in ENIAC to ECSEL, the ELG expects that more than an additional 4 B€ will be invested by industry in ECSEL in the period 2014 – 2020 on new or existing pilot lines. The pilot projects in turn should then fuel a next wave of investments.

- *From isolated support to R&D and to Pilot Lines towards a focused investment packages in an IPCEI*

The scheme below shows an example of how to build a focused investment package in the form of an IPCEI combining funding from H2020 and ECSEL, regional and national funds and ESIF spanning the full set of activities involved from R&D to full production. It shows how public support can be combined with industrial investment (using also EIB financing if needed) to build new production capacity in Europe.

The ELG recommends that regions and Member States in close cooperation with industry should prepare and submit such schemes to the Commission starting in 2015. These schemes could build on current and future investments in pilot lines in ENIAC and ECSEL. An example is shown in the figure below.



This shows how a number of different funding programmes and sources can be assembled to result in total funding of greater than 20%, and higher for an IPCEI.

- *A one stop front office*

Given the complexity of financing such a scheme (different parts of the value chain funded at different rates and by different agencies), the ELG recommends that a user-friendly "front office" mechanism is set up to provide a "one stop shop" for those wishing to invest in Europe, for both existing and new players, European and global and to facilitate the assembly of a package of funding for a large and strategic project of common European interest.

- *Seizing new opportunities*

Over the decades, the industry has been changing constantly. The initial business model of an IDM (Integrated Device Manufacturer) has been complemented by a range of others, including the fabless/fablite/foundry model. The industry is now becoming a more global and fine-grained network of inter-dependent players. This results in more differentiation, more specialization, more varied ways for cooperation and partnering offering new opportunities Europe should seize.

5.6 Support to the design ecosystem

The design ecosystem in Europe needs strengthening, and in particular, the access to it is critical. A richer ecosystem to serve the many segments of the design sector, especially in the small lot end and specific technologies, such as mixed-signal components, specific packaging or leading edge integrated circuits is needed. In this the reuse of design will account for a large part of the capability to reach the market on time and specific actions will be required.

SMEs, and particularly those in the non-ICT sectors, need an interface between their competences and the complexity of electronic components and systems. To address this, building on calls for design centres, a network of these is necessary. This network can partly be based on RTOs and should expand throughout Europe to allow for innovation where it takes place.

Design is based on skills. Enhancing current skills and investing in re-skilling the workforce has to be addressed so that companies from large to small can find the necessary competences on the market place.

5.7 Preparing the future supply.

Some areas that will see significant demand emerge over the next few years are wearable electronics, nano and micro-robotics, bioelectronics and 5G communications. Within these, the ELG highlights two main cross-cutting opportunities that might offer particular European opportunities: security and autonomy.

In a world where we are increasingly dependent on interconnected devices, we need to develop better traceability of security "end to end" and extending down into the chip design to enhance confidence that secure transactions and communications are truly secure. Provision of all elements of this in Europe could offer a commercial advantage to European end markets.

"Autonomy"– there are many applications where the ability to learn and operate autonomously is an application enabler – especially in monitoring and control, such as learning the living patterns of people to underpin both smart energy and assisted living. When interfacing to people such systems will need to be culturally aware, which should create a natural advantage to European providers to meet the needs of European customers.

These are just two examples, but illustrate the opportunity for identification of business opportunities and markets that would uniquely benefit from being in Europe.

There are new opportunities in advanced computing where Europe can take strong advantage of its presence in low power components. The opportunities spread across the computing continuum from embedded and customised systems up to server farms and future high-end computing.

6 Track 3: Enhanced Framework and Infrastructure

- *Better regulation, international trade and level playing field*

It is proposed to strengthen links between industry and the regulators/authorities to ensure that regulations are developed in a better context to the benefit of both suppliers and consumers. Beyond this, actions are required at international level to expand the WTO ITA (World Trade Organisation Information Technology Agreement) and deal with other trade issues, such as duties on multicomponent ICs, encryption/security in ICs, lack of harmonised certification in the EU and other issues that are hindering business development.

Worldwide harmonisation on a number of issues that are holding back the development of markets needs to be addressed e.g. automotive emissions and safety standards, radio spectrum for intelligent transport systems, regulations and standards for smart grid and smart meters, networking and interface standards for IoT and smart connected objects, wearable healthcare, reliability etc.

At a global level, action is required to harmonise the approach to environmental issues so that environmental standards do not distort business. Work to achieve this needs to be continued through the WSC (World Semiconductor Council) and the GAMS (Government/Authorities Meeting on Semiconductors).

The protection of IPR needs addressing – simplification, speeding up, and reduction of costs. This is required for both speeding up international trade and for SMEs, who are both inhibited by costs and by the complexity. Urgent actions are required to prevent abusive patent litigation, along with developing common quality standards for patents. In addition, there needs to be proper and agreed recognition of the business value of knowledge and know-how, and support for its protection through Non-Disclosure Agreements (NDAs) and International Contract Law.

- *Stimulating new businesses*

It is proposed to investigate and develop means for supporting "mass customisation[7]" i.e. being able to support smaller batches of products for the high value added industries with lower production volumes, SMEs, and to get more rapid early rollout of new ideas that drive demand. There are a number of ways this could be implemented – from developments with 3D chips, standardised interfaces, new means of customising semiconductors, providing standardised platforms where more of the customisation is done in software, etc. and the use of high-level software methods to enable the creation of systems without specific hardware or software knowledge.

In addition, there will be a specific activity aimed at supporting manufacturers of existing products, especially SMEs, to add secure connectivity to them to bring them into the "Smart X, everything connected, era". The competence centres described in section 4.5 will act as brokers between supply and demand providing a "one stop shop".

[7] "Mass customisation" is common in the car industry where there may be a basic "platform" upon which a range of models is built e.g. saloon, coupe, hatchback, estate, SUV, electric and hybrid derivatives. The concept exists in many other industries, from PCs to white goods.

It is anticipated that new business models will emerge or be developed – business has traditionally been built around single companies. However, through alliances and partnerships, it is possible to build the value chain as a virtual company for a product[8] or product family. In some respects, this is an extension of the R&D project through into pilots, first production and then full commercialisation. It also may provide a wider range of opportunities for investors.

- *Skills, realise the full potential*

Develop a campaign to educate the public about the role that electronic components and systems plays in their lives, to increase awareness of the technology, jobs and opportunities that are available, but also to reduce public resistance to concerns about the privacy, security and safety aspect of IoT, smart connected objects etc.

Develop education from secondary schools through to post graduate level to create the next generation of cross-disciplinary "engineers".

While the demand for ICT practitioners is growing by around 3% a year, the number of fresh ICT graduates and skilled workers is not keeping up. A shortage of up to 900,000 ICT professionals is estimated by 2020. The access to a highly skilled workforce of engineers and technicians and to high quality graduates is essential for attracting private investments.

The attractiveness of science, technology, engineering, and mathematics (STEM) needs a boost. Actions on training for teachers, the use of gaming in education, improvement of industrial awareness of innovations in universities (e.g. through exchange programmes), and expanding the skills of ICT students to include cross-disciplinary, entrepreneurship and soft skills should be launched.

In the training area, the proposed actions include designing university programmes with cross-over phases into industry, identifying regional 'ICT Training' Centres of Excellence, setting common quality standards for ICT training, and supporting university/industry partnerships to identify needs and to share the responsibility for skills development.

Develop coordinated through-life education schemes for engineers and scientists working in and with these rapidly evolving technologies.

In the skills area, the proposed actions include changing the ICT public image, increasing women participation in ICT, strengthening the working conditions to make technical/engineering careers more attractive, improving access to education throughout the working life, widening technical courses to include business and management skills, providing opportunities for training in new technology for teachers and lecturers, and assessing the viability of interoperability and complementary skills to facilitate better work. Thus, the need to mix multi-disciplines for the success of projects (e.g., medical, psychology, electronics) is essential.

[8] This is the model typically used in the film industry where a virtual company is put together with investors for the sole purpose of making a film ("the product").

7 Monitoring Progress

The target is ***to double the economic value of the semiconductor component production (physical and virtual) in Europe by 2020-2025.***

The key metric is the output by economic value of the semiconductor component produced in Europe. The starting point is taken as 2012/2013 with the start of the pilot lines. Today, the economic value is in the range of 10% of world production. The ELG will meet annually with the EC to review progress.

In addition to this lagging indicator a number of additional lead indicators will be defined and used to improve the strategy and to take into account changing circumstances.

In support of this, a monitoring and forecasting activity will be established – monitoring for progress, but a forecasting activity to see how demand is building up in order to see that the supply side can match it providing "just in time" supply capacity. This will include an activity to identify and quantify the wider electronic systems community roles in Europe.

Speeding up the reaction of supply to demand can have a very significant effect on the profitability of companies – getting to market 6 months ahead of the competition can improve profits by 12%, providing more money for reinvestment and thus accelerating the growth of businesses, creating more demand, and thus feeding the "virtuous circle".

8 Conclusions

Investments in Europe have already been increased and further investments are being planned. New, improved funding mechanisms are being put in place to support the programs proposed, by sharing the risks associated with the long term, high value investments required. These will provide up to 50-60 B€ of government finance (including grants and loans from different source) to enable total investments in excess of 200 B€ in the European microelectronics value chains.

9 Annex 1 – List of ELG members

- Ben Verwaayen, Chairman
- André-Jacques Auberton-Hervé, CEO of SOITEC
- Carlo Bozotti, CEO of STMicroelectronics International NV
- Rick Clemmer, CEO of NXP
- Hubert Lakner, Chairman of the Board of Directors of the Fraunhofer Group Microelectronics
- Mike Muller, CTO of ARM Ltd
- Reinhard Ploss, CEO of Infineon
- Eamonn Sinnott, Intel Vice President Technology & Manufacturing Group and General Manager Intel Ireland
- Jean Therme, Director of Technological Research of CEA
- Luc van den Hove, CEO of imec
- Peter Wennink, CEO of ASML
- Rutger Wijburg, CEO of Globalfoundries Dresden