CATRENE

Final Report

EUREKA Cluster for Application and Technology Research in Europe on NanoElectronics

CATRENE

Final Report

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EXECUTIVE SUMMARY

CATRENE, the EUREKA Cluster for micro- and nanoelectronics, was started in 2008 and launched its last call for project proposals at the end of 2015. CATRENE was the continuation of the earlier Clusters JESSI, MEDEA and MEDEA+.

CATRENE was a successful Cluster with a large impact on the European high-tech industry, despite the fact that the resources spent in CATRENE project were diminishing with the years. Thanks to its flexibility, CATRENE was able to adapt its focus to topics where European companies were strong like Automotive, Power Electronics, Security, Health as well as Equipment and Materials for micro- and nanoelectronics production. The impact of CATRENE on the European society and economy was rather high. Small and medium size enterprises were largely integrated in projects, which guaranteed a rapid transfer from R&D to innovation and small scale production. More than 1700 publications and presentations assured the broad range dissemination of R&D results inside the academic and commercial environment. More than 200 patents were filed, which demonstrated the innovation power of European R&D and helped European industry to keep and even improve a strong position in the highly competitive world of micro-and nanoelectronics. The economic impact of CATRENE is assessed to be a multiple of the granted funding over the eight years.

CATRENE was able to activate close to 9000 Person Years (PYs) in 20 countries through 51 R&D projects, showing the European scale of activities. More than 40% of the participating organisations were small or medium size companies (SMEs).

While CATRENE was running, the ENIAC Joint Undertaking was established as a new funding instrument for micro- and nanoelectronics . It combined National with EU funding and was constructed in a way to support large pan-European projects. At the same time, it was globally observed that the focus on technology push was changing to the focus on application pull. These two factors lead to changes in the CATRENE project portfolio and to an overall decrease of the effort spent in CATRENE.

At the end of CATRENE, a detailed assessment of the programme was carried out. It lead to an intense discussion, looking at both strengths and weaknesses, on the characteristics of a new and improved EUREKA Cluster for micro- and nanoelectronics. Based on a common industrial strategy for European micro- and nanoelectronics, the complementarity of the new Cluster and ENIAC (or its successor ECSEL) was a must. PENTA, the new EUREKA cluster for micro- and nanoelectronics enabled systems and applications, was constructed on this principle and implemented many of the experiences as collected in CATRENE being able to respond to the challenges of tomorrow.

1 Introduction to CATRENE

Micro- and nanoelectronics is widely recognised as one of the most important key enabling technologies for innovative and, therefore, promising solutions in all kinds of high-tech applications. The EUREKA Cluster CATRENE ("Cluster for Application and Technology Research in Europe for Nanoelectronics") was launched as an instrument focusing on this key technology and its major applications. With the participation of more than 20 European countries in the programme, its main supporters are countries with a strong micro- and nanoelectronics industry. The general ambition of the CATRENE Cluster and its members was to reinforce the global competitive position of the European electronics value chain by leveraging and aligning its individual core competences and strengths in design as well as in its local industrial infrastructures while remaining viable and profitable. At the same time, the European micro- and nanoelectronics industry value chain should guarantee the controlled access to information and communications technology (ICT), applications and products for a smart, sustainable and inclusive European society.

In more detail, the ambition of the CATRENE Cluster was defined as such:

- to provide innovative and sustainable solutions to societal challenges in areas such as energy, mobility, health, communications and safety;
- to strengthen those sections of the value chain where Europe can achieve global competitiveness and gain new market shares through differentiation;
- to enable an adequate level of advanced CMOS manufacturing capability in Europe;
- to foster the advancement of European More-than-Moore production sites and European foundries in the most advanced market areas;
- to set up and support mechanisms to integrate the strengths and capabilities of small and medium-sized enterprises (SMEs) and research institutes;
- and to endorse the creation of R&D platforms for design, equipment, materials, manufacturing and silicon processes.

To achieve these targets, CATRENE aimed at the creation of flexible small and medium sized consortia (complementary to the usually larger consortia in the Joint Undertakings like ENIAC) with partners from at least two countries. The partners performed research and development activities with the guidance and monitoring of experts from the CATRENE Steering Groups and the CATRENE Support Group, who maintained regular contact with the Public Authorities of the participating countries.

CATRENE was launched in 2008 as successor of the JESSI and the MEDEA and MEDEA+ programmes. It ended in December 2015 and is no longer accepting new projects.

The signing members of the CATRENE Frame Agreement included:

EADS (now Airbus group)
Alcatel-Lucent
ASM International
ASML
Bull (now ATOS)
Carl Zeiss
Infineon Technologies
NXP Semiconductors
Robert Bosch
STMicroelectronics
Technicolor

The Steering Board, the highest body of the industry representation in CATRENE, consisted of representatives from each of these companies. Technicolor stepped out of CATRENE in December 2014.

The signing countries supporting the Cluster included:


Austria

Belgium

Finland

France

Germany

Ireland

Israel

Spain

Sweden

The Netherlands

Turkey

The Directors' Committee, the highest body of the Public Authorities representation in CATRENE, consisted of representatives from each of these countries.

Throughout its history, the location of the CATRENE Office was in Paris. Remaining running projects are and will be monitored and supported by AENEAS until their completion.

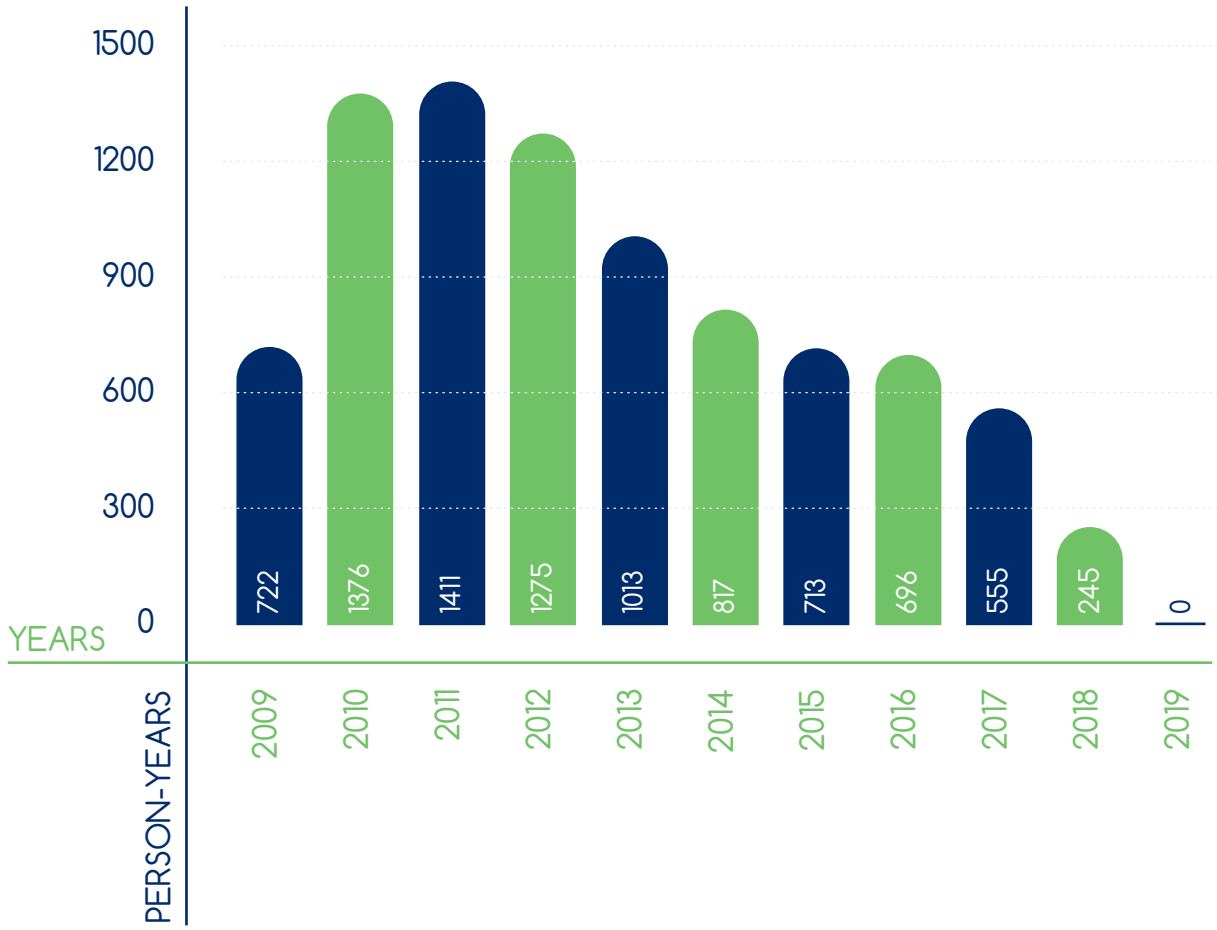
1.1. CATRENE in numbers

Resources, participants and work areas

The following figures and graphs illustrate that CATRENE was accepted and used as instrument for R&D co-operation on a European scale activating close to 9000 person years in more than 20 countries.

CATRENE Calls 1 to 8 labelled resources*

Total PYs: 8813**



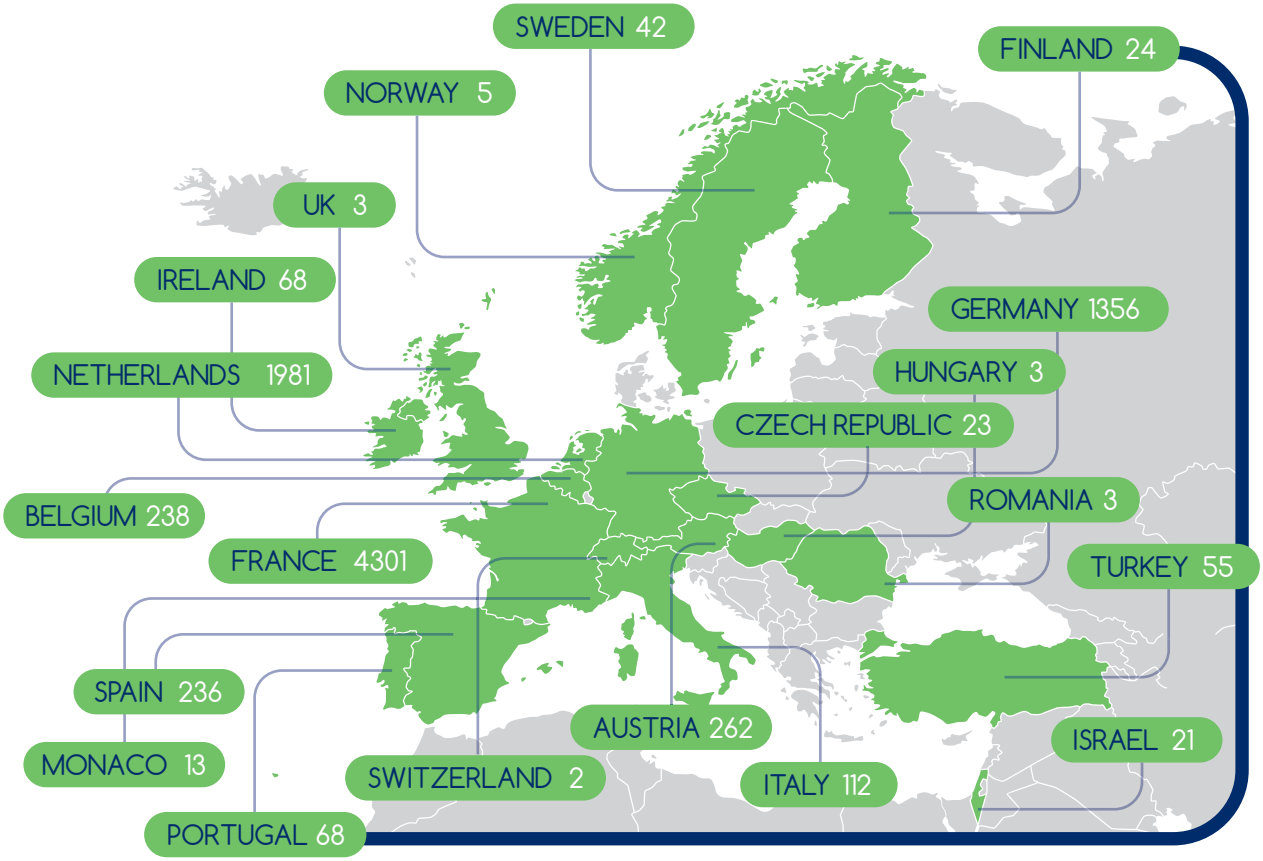
* Data approved on 30/09/2016

** This figure does not include the PYs of MEDEA+ projects which continued running until 2010.

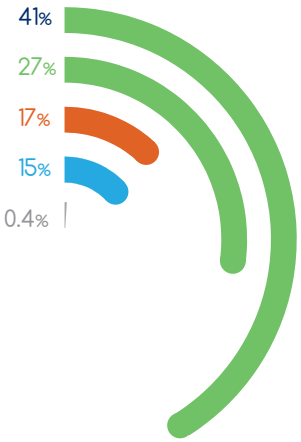
1.2. Structure of CATRENE projects

CATRENE Resources per country as per year end 2015

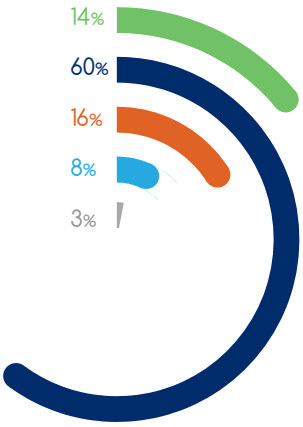
There were 53 projects, 713 participants and 20 participating countries.



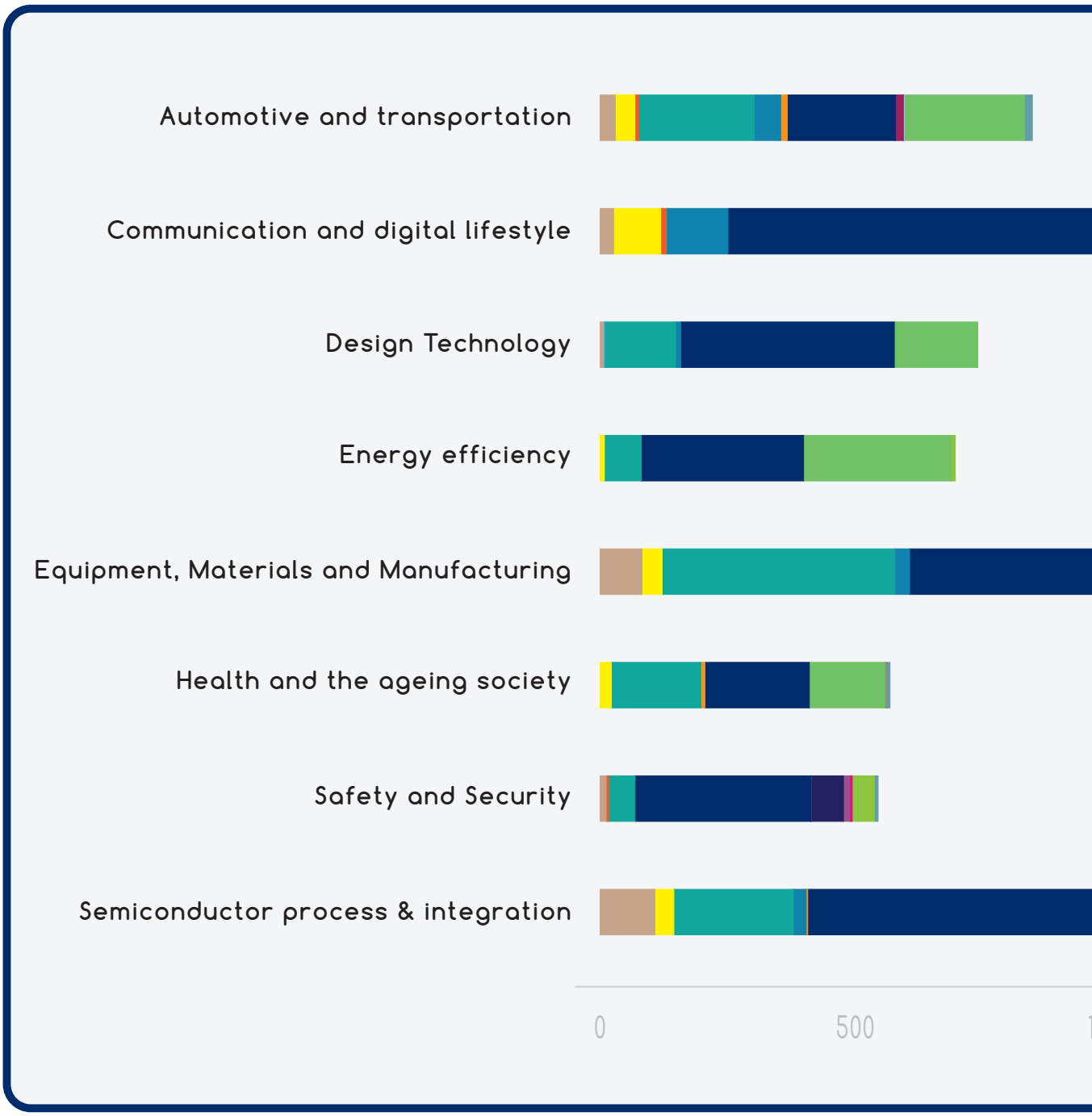
389 participants from 20 countries

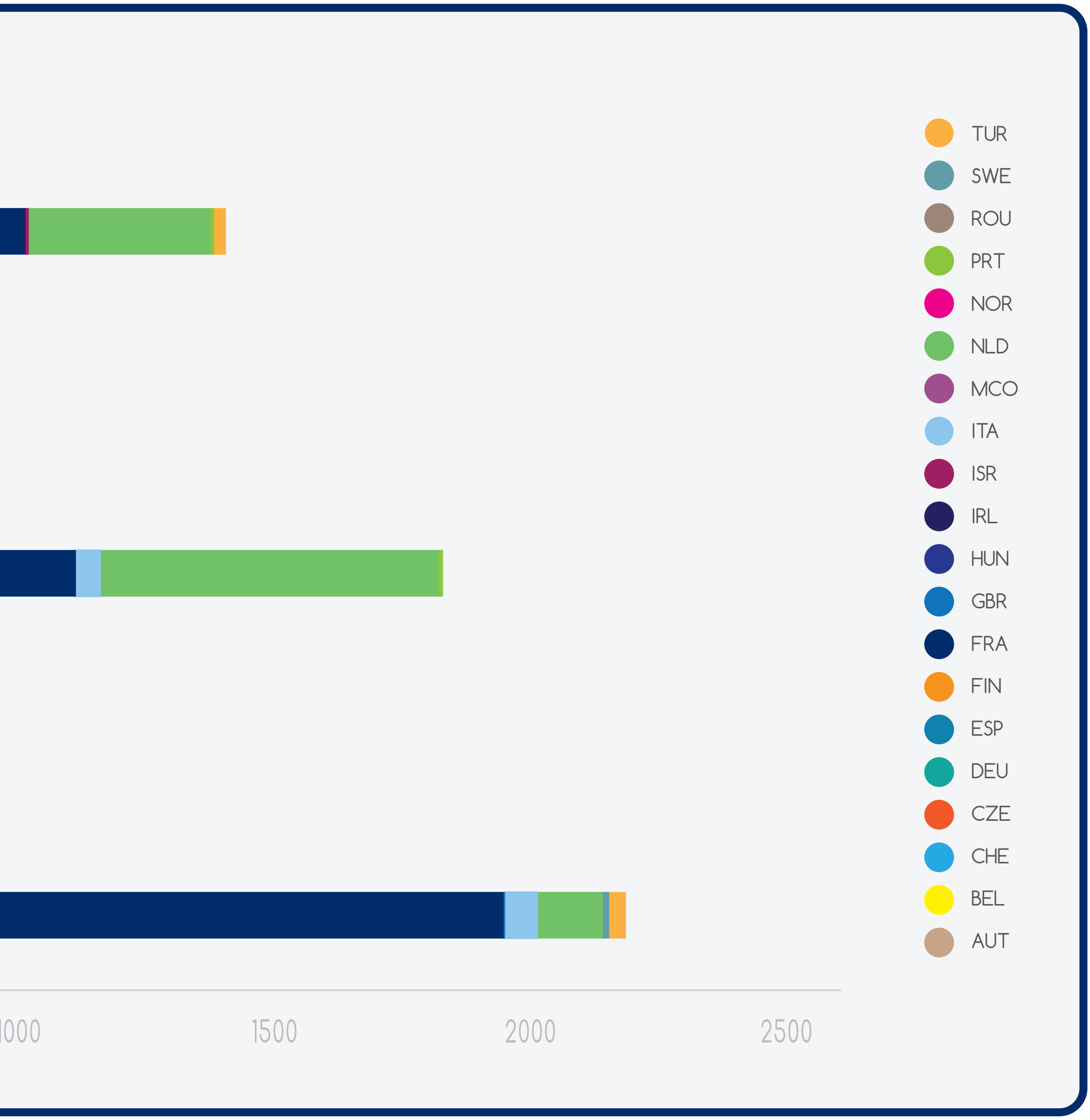


Total resources: 8813 PYs



CATRENE labelled projects – split by work area and country




TUR
SWE
ROU
PRT
NOR
NLD
MCO
ITA
ISR
IRL
HUN
GBR
FRA
FIN
ESP
DEU
CZE
CHE
BEL
AUT
000
1500
2000
2500

2 Impact of CATRENE (report by DECISION[1])

The CATRENE programme aimed to support technological leadership for a competitive European ICT industry. It answered the ambition of Europe and the European companies to deliver micro and nanoelectronics solutions that respond to the future needs of society, building a comprehensive ecosystem around the semiconductor industry, and thereby confirming the ability of Europe's industry to be at the forefront of global competition.

Developing a comprehensive ecosystem around the semiconductor industry:

The CATRENE programme, after 8 years of activity, has supported 51 projects, bringing together close to 400 participants in 20 countries, of which a large share of SMEs (41%), resulting in over 200 patents and 1700 publications reflecting significant advances in both the technologies and the applications of micro and nanoelectronics. The number of patents filed was relatively large, even though many consortia were composed of competing companies. This shows how CATRENE pushed innovation power, and helped the Industry to occupy market segments, as was successfully done in sectors like Power Electronics and Security.

The direct scientific and technical results of CATRENE also impact the European economy on other levels, first on the micro and nanoelectronics ecosystem, and on the electronics industry, as well as on the economy as a whole (in terms of activity, employment, companies, competitiveness) and on the satisfaction of societal needs.

The micro and nanoelectronics ecosystem revolves around the major semiconductor companies, associating partners, materials and other suppliers or contractors, production equipment manufacturers as well as research organisations, with some large companies and a lot of SMEs. This ecosystem is also often localised in the same region as the large company headquarters. The CATRENE projects bring together a number of these ecosystem members, and greatly contribute to strengthen the links between them, and to promote collaboration between companies. This is beneficial to all participants, and particularly to SMEs. A survey on the EUREKA programme has shown that 33% of SMEs involved in EUREKA projects had successfully brought their results to the market at or before the point of project completion (28% for the larger companies)[2]. Nearly a third (31%) of participants reported an increase in employment, of which 40% were SMEs. The number of jobs created was twice as much in SMEs as in larger companies[3].

Four projects were selected as examples in application fields critical for Europe's future to illustrate their impact at different levels. They are shown in three inserts (EXEPT in chip production technology, eGo and NewP@ss in the security application field, and EM4EM in the automotive application field).

For example, the EXEPT project brought together 19 partners, EM4EM 16, NewP@ss 15, and eGo 11. Over the whole 51 projects of the CATRENE programme, there were 389 participants of which 160 SMEs, 128 large companies, and 101 institutes and universities. This co-operation spread over three different types of R&D actors (large industry, SME, academia) brought a lot of added value due to the combination of « science », « innovation » and « market penetration ».

1 DECISION, Espace Hamelin - 17, rue de l'Amiral Hamelin – 75116, www.decision.eu
2 EUREKA Annual Impact Report 2005 page 100, http://www.eurekanetwork.org/content/annual-impact-report-eureka-2005
3 EUREKA Annual Impact Report 2005 page 104, http://www.eurekanetwork.org/content/annual-impact-report-eureka-2005

Consolidating Europe's position in micro and nanoelectronics

The strategic independence of Europe and European industry and services relies on mastering micro and nanoelectronic technologies and competences through a local and competitive semiconductor ecosystem. Over half the work done through CATRENE's projects was targeted to develop Europe's presence and competence in the micro and nanoelectronic technologies themselves. This effort has contributed to the consolidation of the European position in semiconductors, where the European companies held 9.5% of the world semiconductor market in 2015, and 27.1% of the European market. This has led to an increase of the sales of the European semiconductor companies of 4.2 billion € between 2010 and 2015. And at the level below in the value chain, Europe increased its world leadership in lithography equipment for semiconductor production with the ASML-Zeiss partnership, with well over half the world market.

Maintaining European leadership in key applications

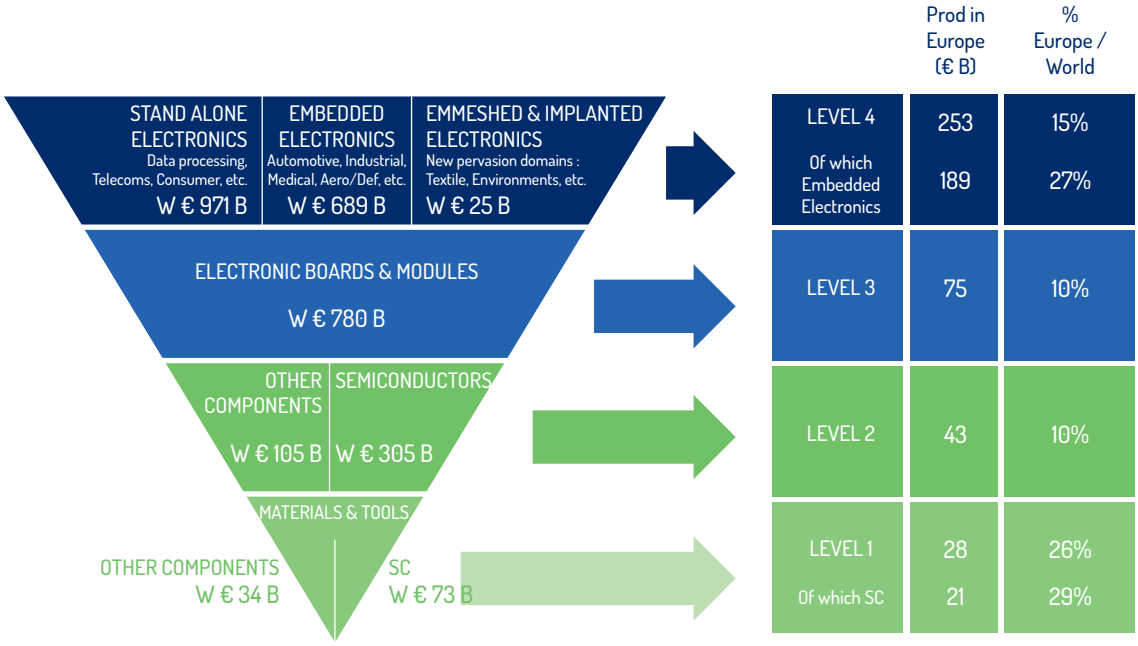
Micro and nanoelectronics represents over 20% of the cost of electronic devices but close to 100% of their performance, and without its contribution the modern world would not exist.

In the future, even more than over the past decades, most of the progress in industry and more still in services will come from electronic innovations enabled by micro and nanoelectronics. Thus the satisfaction of societal needs today and tomorrow relies heavily on electronics. Nearly half of the work done on CATRENE's projects was on developing applications of micro and nanoelectronics that are at the heart of the evolution of societal needs, and that are also domains where Europe is in a leading position and where growth is strong (automotive, energy, security and health, communications).

World production of electronic devices in 2015 was 1,700 billion €, of which Europe was 15%. But if we focus on the embedded and professional systems field, rather than on the consumer segments, Europe's share is nearly double at 27%, significantly higher than our share of the world GDP (22%), and very much more than our share of world population (around 8%). And this embedded and professional field is the fastest growing, at 6% per year between 2012 and 2015, compared with 3.5% for electronic devices on the whole.

Europe is world leader in industrial and automotive electronics, and world second in aerospace defence and security, and in health electronics. In the automotive field, Europe comes second to China for the number of cars manufactured in each region, but ranks first before Japan by country of origin of the auto companies. This has no doubt helped keep European automotive electronics in their leading position.

World Electronic Value Chain in 2015



Source : DECISION

Enabling growth, with more jobs and more sales

Impact evaluations done by Denmark, the Netherlands, Sweden and EUREKA consistently show a significant positive impact of EUREKA programmes on the turnover and employment of participants. The table gives EUREKA's evaluation[4] of the leverage effect of EUREKA projects.

Leverage of EUREKA projects for 1 million € public funds

	AT COMPLETION	ANTICIPATED AFTER 2-3 YEARS
Private funds	1.1 million €	
Additional turnover generated	2.2 million €	10.4 million €
Jobs created or safeguarded	7.7	17.4

Figures derived from EUREKA Network Projects and Eurostars Final Reports

These numbers neither include investment costs to realise the benefits nor all of the other benefits (cost savings, technology transfer, new competences, network, prestige, methods, customer, social and environment benefits...).

[4] EUREKA Annual Report 2015 page 16, http://www.eurekanetwork.org/eureka-newsroom/annual-report

Applying these ratios, the direct impact of CATRENE on its participants would be, for the total 1.7 billion€ invested, 6,200 jobs created or safeguarded at completion of the projects, and 14,100 anticipated after 3 years. Additional turnover of participants would be 1.8 billion € at completion and an anticipated 8.4 billion € after 3 years. Induced and indirect benefits on employment, turnover and growth are considerably greater, as advances in micro and nanoelectronics also bring leverage on the whole of the electronics industry, as well as on large user sectors such as the automotive industry, aerospace defence and security, health, and industrial equipment. Naturally CATRENE's contribution is a factor among others (general and specific economic context, international competition, company strategy and decisions, etc.) that govern the actual evolution of the economy. In addition competence and innovation power created by CATRENE projects in certain sectors like automotive, energy, security and others will boost the "normal" growth. There are many cases (for example in the security field) where CATRENE results were essential for European society to a much larger degree than their actual direct employment and turnover impact. Such benefits, however important they may be, cannot easily be rendered in figures.

Funding future growth

The CATRENE programme has enabled Europe to maintain and even develop its position in critical segments of the micro and nanoelectronics ecosystem and in the user sectors further along the value chain that are fields of excellence for EU industry and companies. This has provided reinforced ecosystems all along the value chain on which to implement the ambitious European Horizon 2020 and Eureka programmes designed to help Europe meet the challenges of our changing and increasingly digital society.

And so, beyond the direct impact of the programme on its participants, CATRENE has indeed contributed to the overall leverage effect of micro and nanoelectronics R&D and innovation on direct and induced turnover and employment all along the value chain. In this highly global field turnover and employment are generated worldwide, but when European companies consolidate their global position this also brings direct and induced benefits to Europe.

EXEPT

EXtreme ultraviolet lithography Entry Point Technology development

The extreme ultra-violet (EUV) lithography process is progressing as a viable semiconductor production technology for technology nodes smaller than 32nm. The CATRENE EXEPT project was set up to explore the possibilities for extending the lithography process to the 22, 16 and even 11nm nodes.

The successful completion of the project puts ASML and the European semiconductor lithography industry at the forefront of chip production expertise worldwide. During the course of the project, technology was developed to enable 22nm imaging at an acceptable cost-of-ownership in high-volume industrial-scale production.

Between 2001 and 2011 ASML took world leadership over its competitors Nikon and Canon in the immersion lithography market, with a market share growing from 22% to 57%. The EUVL technology is the new battleground where Nikon and Canon hoped to regain their lost leading market shares.

The EXEPT project is a direct follow up of the EAGLE (2T301) project (ended in mid 2009) in which technologies were developed for the EUV lithographic NXE:3100 pre-production tool platform made by ASML. In the EXEPT project the focus was also on developing EUV lithographic infrastructure components, for which there is a strong industrial base and competence in Europe.

The EXEPT project, coordinated by ASML, brought together a consortium of fifteen of the leading players in the European semiconductor production equipment industry and institutes.

Results and impact of the EXEPT project:

1. The results of the project reinforce Europe's world-wide leadership in the EUVL market.

2. In the course of the project ASML qualified and shipped six NXE:3100 tools and received 10 orders for the following model, the NXE:3300B (whose technology is partly developed in the EXEPT project). At the end of the project in 2012 the competition (Nikon and Canon) had not yet announced the shipment of their EUV tools, hoping to deliver by 2015.

3. EXEPT developed European competence in the fields of - mask (repair and cleaning) technology, CD metrology, robust reticle handling solutions outside the lithographic tool, especially with respect to molecular contamination, pod cleaning technology, integration of the whole infrastructure into a manufacturable process flow.

4. Business opportunities and jobs:

   The results of the EXEPT project have contributed to an increase of employment and business opportunities in the EUV ecosystem and have put ASML and the European semiconductor production equipment industry in a leading position in the field of EUV lithography. ASML expects the first IC manufacturers to start using EUV for chip production from 2018. With the lead time needed to get systems built, installed in fabs and qualified for production, this means 2016 is the year when the in-principle decision to insert EUV in 2018 will have to be made.

   The turnover of ASML has grown from 4,732 million € in 2012 to 6,287 million € in 2015, and employment has grown from 10,636 (of which 4,620 payroll employees in the Netherlands) to 14,681 employees in 2015 (of which 6,113 payroll employees in the Netherlands). EXEPT contributed to this significant increase in sales and employment, even though EUVL is still a small market.

   The successful development of EUV technology for high volume semiconductor manufacturing shows the potential to position the European industry and expertise in critical technologies in order to keep the competition at bay.

NewP@ss and eGo

Security issues are at the forefront of government, organisations and citizens preoccupations. NewP@ss and eGo provide secure technology bricks complete identification and authentication solutions in a number of applications (border control, physical and logical access control, automotive, health, payment).

The eGo project developed several technologies establishing secure and bidirectional wireless channels between wearable objects or individuals in future internet of things (IoT) scenarios, based on a disruptive bootstrapping scheme using the electrical conductivity of human skin. The highly secure wearable eGo device can be incorporated in a large variety of consumer objects such as a watch, a belt, a jewel, or a corporate badge, located near to the human body but not necessarily in direct contact with it.

In relation with eGo, the NewP@ss project was designed to deliver advanced secure platforms for the third and fourth generation e-Passports, as discussed in the frame of the International Civil Aviation Organization (ICAO). From the end of the NewP@ss project in December 2013, the third e-Passport generation could be deployed in a certain number of European and other countries, while the 4th generation is expected to be deployed circa 2018-2020.

Both projects brought together around Gemalto two consortia of leading players in the European security and semiconductor industries, innovative SMEs, end-users or operators as well as institutes (respectively eleven partners for eGo and fifteen partners for newP@ss).

Results and impact of the projects:

1. Technologically : High performance and highest level of security were topmost requirements for the deliverables related to the secure e-Passport platforms. The final result was a completely new generation of HW and embedded SW platforms, wireless communication capabilities, 16 times faster than the generation of passport currently used, and new generation of cryptographic and embedded biometric capabilities

   For eGo, four demonstrators from four application domains (payment, automotive, access-control and healthcare) were demonstrated. Twenty patents were submitted, paving the way for a promising project standardisation strategy.

2. Industrially : NewP@ss has strengthened the competitiveness of the European industry for e-Passport (ePP) and derived ID documents, a domain where the European industry holds over 90% of the world market. The eGo project outcome provides European industry with a strong basis for entering the emerging IoT and wearable device market as well as other spin-off applications and services that use secure personal devices. Furthermore, these applications are expected to have a large economic, societal and technical impact in the coming years.

3. Market: Already more than 30 countries had adopted the first version of the ICAO e-Passport by mid-2007, and the EU adopted SAC-secured biometry at the end of 2014. Adoption in Europe of third and fourth generation e-Passports is expected to create a market for more than 200 million units.

4. Worldwide more than 600 million units of ePPs have been issued since 2005 by over 120 countries, the installed base should reach 950 million units by 2016. More than 120 countries have introduced electronic Machine Readable Travel Documents (eMRTD) and more than 100 airports in 38 countries are using Automated Border Control.

EM4EM

This project (15 partners including Audi, Daimler, Bosch, Infineon, NXP) handled important design challenges with electric and electronic components associated with building electrically operated vehicles. It deals with electromagnetic compatibility and electromagnetic reliability issues of communication units, which resulted in a significant reduction in electromagnetic emission (EMR) generated by electric powertrain components.

Results and impact of the EM4EM project:

The project introduced solutions that dealt with electromagnetic noise immunity issues with nanoelectronic components (such as ICs, sensors and power devices) and electronic modules needed in future developments in the automotive and semiconductor industries, as well as methodologies to reduce electromagnetic noise-emission generated by power electronic components, modules and systems, and to increase the noise immunity of sensor systems.

In particular the project resulted in a new IGBT module design which demonstrated a reduction, on the semiconductor level, in noise levels of up to 15 dB at low frequencies (less than 10 MHz).

For validation and further exploitation purposes, a set of 26 demonstrators on all four application tiers (semiconductor, component, system and vehicle) were developed to be used in initial products based on EM4EM developed technology, including a complete demonstrator based on a test EV called the eBuggy.

Expertise and competences: EVs require a huge variety of new electronic functions in propulsion, diagnostics, driver-support, navigation and vehicle-to-grid communications. Taking advantage of these innovative market opportunities requires the special expertise and experience found in semiconductor manufacturers participating in EM4EM. And the project deliverables (tried-and-tested models, measurement methods and procedures, simulation tools and methods) can be used by other European businesses to reduce the time-to-market and costs of EMR-optimised components and systems for EVs

Business opportunities and jobs: EM4EM resolves key technical problems affecting Electric Vehicles and will have many commercial spin-offs. Its target to reduce EMR will increase the competitiveness of the European automotive and semiconductor industry on the world market. Reliable operating-equipment integration, optimisation, safety and robustness, which are main project objectives, will also be strong commercial assets. Importantly, the project consortium will also influence other key EV development and production activities and processes, and its drive towards European co-operation will accelerate acceptance and implementation.

Project deliverables will help the European automotive industry and ecosystem to maintain its world leadership. European companies control 35% of world vehicle production, before Japan (24%) and the USA (16%). However Japan has taken the lead in EVs, and it is vital that Europe should build a strong position in this key segment for the future. The market for EV-related products and services deploying EM4EM competence and deliverables will grow. By 2020, there will be a market for more than 13m electric vehicles requiring a lot more electronic components than today's combustion engine vehicles, providing a huge potential for system and semiconductor manufacturers. Power semiconductors and modules, in particular, will experience considerable growth in the upcoming years. The semiconductor market for hybrid- and battery-electric vehicles with annual growth rates approaching 25%, is expected to increase to 5 billion € in 2020, reaching about 15% of the automotive semiconductor market.

3 Project Information

The CATRENE programme opened its 1st Call for Project Proposals on 29 February 2008. Today, a total of 8 calls have been launched resulting in 69 labelled projects.

By 1 October 2016, 34 CATRENE projects had been completed successfully.

CALL	PO received	FP received	Labelled	STATUS OF LABELLED PROJECTS: Cancelled /merged / transferred / suspended	Successfully ended	Active
1ST CALL	**18**	**15**	**14**	**5**	**9**	**0**
Applications	10	8	8	3	5	0
Technologies	8	7	6	2	4	0
2ND CALL	**14**	**10**	**10**	**3**	**7**	**0**
Applications	9	7	7	3	4	0
Technologies	5	3	3	0	3	0
3RD CALL	**15**	**10**	**10**	**3**	**7**	**0**
Applications	7	4	4	2	2	0
Technologies	8	6	6	1	5	0
4TH CALL	**19**	**14**	**10**	**1**	**8**	**1**
Applications	10	8	7	1	6	0
Technologies	9	6	3	0	2	1
5TH CALL	**8**	**5**	**5**	**1**	**3**	**1**
Applications	5	3	3	0	3	0
Technologies	3	2	2	1	0	1
6TH CALL	**13**	**10**	**9**	**3**	**0**	**6**
Applications	9	7	6	2	0	4
Technologies	4	3	3	1	0	2
7TH CALL	**9**	**9**	**8**	**1**	**0**	**7**
Applications	5	5	4	1	0	4
Technologies	4	4	4	0	0	3
8TH CALL	**9**	**4**	**3**	**1**	**0**	**2**
Applications	4	3	3	1	0	2
Technologies	5	1	0	0	0	0
2016	**105**	**77**	**69**	**18**	**34**	**17**

Detailed information about running and successfully ended projects is available in a separate brochure/ folder, which contains all up to now finalised project profiles and project result sheets.

3.1. List of successfully ended or running CATRENE projects (51)

Call 1

CA101 | PANAMA
CA103 | HERTZ
CA301 | HiDRaLoN
CA303 | OPTIMISE
CA501 | COMCAS
CT105 | 3DIM3
CT204 | PASTEUR
CT301 | EXEPT
CT302 | TOETS

Call 2

CA104 | COBRA
CA202 | eGo
CA402 | THOR
CA502 | SEEL
CT205 | REFINED
CT206 | UTTERMOST
CT207 | COCOA

Call 3

CA308 | ICAF
CA403 | RELY
CT208 | REACHING22
CT209 | RF2THZ SISOC
CT305 | SOI 450
CT306 | NGC450
CT402 | 9D-Sense

Call 4

CA109 | SHARP
CA110 | AppsGate
CA111 | UltraHD-4U
CA206 | NewP@ss
CA310 | EM4EM
CA701 | H-INCEPTION
CT210 | DYNAMIC-ULP
CT213 | 3DFF
CT312 | MASTER_3D

Call 5

CA112 | HARP
CA505 | BENEFIC
CA703 | OpenES
CT315 | EmPower

Call 6

CA114 | WiCon
CA116 | CORTIF
CA118 | FITNESS
CA208 | MobiTrust
CT217 | RESIST
CT218 | E450LMDAP

Call 7

CAT120 | CISTERN
CAT121 | EAST
CAT209 | H2O
CAT406 | NEMADE
CAT601 | SiPoB-3D
CAT801 | TSV-HANDY
CAT802 | SAM3

Call 8

CAT408 | NexGen
CAT311 | Trace

3.2. Completed projects achievements

Call			PYs	Partners	Patents
1 Communication and digital lifestyle	CA101	Power Amplifiers and Antennas for Mobile Applications [PANAMA]	196,7	21	18

Dissemination

cumulated total of publications is 157
3 awards have been obtained:
- Best PhD student in microelectronics in The Netherlands for TUD,
- DOW energy dissertation prize for TUD/ NXP,
- Innovation prize during IEEE conference on Antenna for ITB

Call			PYs	Partners	Patents
1 Communication and digital lifestyle	CA103	Energy Efficient Home Networks [HERTZ]	112,2	9	8

Dissemination

7 publications
Contributions to workshops, exhibitions, conferences: 27

Contribution to standardization

DECT ULE
- Leading new standard
- Opening sensor market for DECT RF4CE
- New command set for CL devices Zigbee
- Smartlink, easy commissioning
- Green power, harvesting sensors

Call			PYs	Partners	Patents
1 Automotive and transportation	CA301	High Dynamic Range Low Noise CMOS imagers [HiDRaLON]	224,2	18	6

Dissemination

22 presented conference papers, one journal article

Contribution to standardization

Contribution to EMVA1288 standardization for High Dynamic Range sensors and Time of Flight

Call			PYs	Partners	Patents
1 Automotive and transportation	CA303	Optimisation of Mitigations for soft, firm and hard Errors [OPTIMISE]	155,2	20	1

Dissemination

Over 20 conference and journal papers during the last 12 months of the project

Contribution to standardization

- Avionic: inputs to IEC working group
- Space: new standard defined (RIIF), and used to develop a standardized modelling of aging related effects (xBTI, HCI), and aging failures (TDDB and EM).

Call			PYs	Partners	Patents
1 Energy efficiency	CA501	Communication-centric heterogeneous Multi Core Architectures [COMCAS] **Dissemination** 6 papers at journal and conferences, demonstration at the 2012 Consumer Electronics Show (CES)	273,7	13	5
1 Design Technology	CT105	3D-TSV Integration for Multimedia and Mobile applications [3DIM3] **Dissemination** 101 papers in International Conferences, 2 books **Contribution to standardization** Contribution to the path finding group of 3D Standardization group of SI2	257,6	15	Undisclosed number due to specific context
1 Semiconductor process & integration	CT204	Perishables Monitoring through Smart Tracking of Lifetime and Quality by RFID [PASTEUR] **Dissemination** 13 Journal articles and conference proceedings	143,4	17	0
1 Equipment, Materials and Manufacturing	CT301	EXtreme UV lithography Technology development [EXEPT] **Dissemination** 42 Journal articles and conference proceedings	1043,4	17	53
1 Equipment, Materials and Manufacturing	CT302	Breakthrough in methods and flows used by the test technologies by considering test in the whole value chain from Design to Application [TOETS] **Dissemination** 77 journal articles and conference proceedings **Contribution to standardization** Contributions to IEEE 1149.1-2011 working group and ISO26262 standard (work on the dependability attribute “safety”)	285,1	25	4

Call			PYs	Partners	Patents
2 Communication and digital lifestyle	CA104	Computing Fabric for high performance Applications [COBRA] **Dissemination** 115 contributions to international conferences and publications	237,5	17	13
2 Safety and Security	CA202	Establishing secure, bidirectional wireless channels between objects or individuals in the future internet of thinks [eGo] **Dissemination** 2 scientific publications, demonstration of project results in several industrial exhibitions **Contribution to standardization** Contributions to ETSI and Global Platform standardisation bodies	114,6	11	20
2 Health and the ageing society	CA402	Development of highly efficient, integrated and reliable power electronics technologies for automotive, aeronautics and healthcare applications [THOR] **Dissemination** 90 publications and news articles	233,8	18	10
2 Energy efficiency	CA502	Solutions for Energy Efficient Lighting [SEEL] **Dissemination** Over 50 publications **Contribution to standardization** Contributions to ELMAPS and GTB Working group on light sources	231	23	3
2 Semiconductor process & integration	CT205	Renewed Embedded Flash and other Innovative NVM for Extended Domains of application [REFINED] **Dissemination** 20 publications	187	6	0

Call		PYs	Partners	Patents
2 CT206 Semiconductor process & integration	UlTimaTe Enablement Research on 32/28nm cMOS Technologies [UTTERMOST] **Dissemination** 168 publications or conference papers, 1 PhD thesis	523,7	16	11
2 CT207 Semiconductor process & integration	Development of a complete 3D integration technology platform covering the entire range of processes required from vertical interconnects (TSV, micro bumps...) and robust bonding to innovative packaging approaches [COCOA] **Dissemination** About 70 papers or presentations **Contribution to standardization** Participation to IEEE 1838 Working Group on 3D Design for Test	167,4	12	12
3 CA308 Automotive and transportation	Research, development, and demonstration of future image capture, processing and transmission technologies for Machine Vision, Security/Surveillance and Professional Broadcast. [ICAF] **Dissemination** 9 scientific papers **Contribution to standardization** Contribution to 7 standards	117,1	9	2
3 CA403 Health and the ageing society	Design for Reliability of SoCs for Applications like Transportation, Medical, and Industrial Automation [RELY] **Dissemination** 14 journal articles, 2 books, over 100 conference talks **Contribution to standardization** Contribution to RIIF (Reliability Information Interchange Format)	159,2	14	4
3 CT208 Semiconductor process & integration	Research on optimal Architecture and InteGration of 22/20nm node core digital CMOS technology [REACHING 22] **Dissemination** More than 20 publications **Contribution to standardization** Contribution to the development of FDSOI as a promising technology providing excellent trade-off between performances (speed, power) and cost, well suited for applications under power constraints (e.g., Internet of Things).	222	7	0

Call			PYs	Partners	Patents
3 Semiconductor process & integration	CT209	Establishment of silicon technology platforms for emerging Radio Frequency (RF), Millimeter-Wave (MMW) and TeraHertz (THz) consumer applications [RF2THZ SISOC]	234,5	32	6

Dissemination

240 contributions to international conferences and publications, 3 PhD thesis

Contribution to standardization

Industry standard HiCUM/L2 HBT compact model : RF2THz hardware from ST and feedback from circuit design have allowed TUDD to validate the model for advanced SiGe HBT technology and to identify relevant improvements

3 Equipment, Materials and Manufacturing	CT305	Development of 450 mm SOI substrates, related technologies and equipments [SOI450]	74,1	8	2

Dissemination

Invited paper at 2012 SOI CONFERENCE IEEE / Napa Valley

3 Equipment, Materials and Manufacturing	CT306	Development of a wafer handling platform supporting 450mm transition for European Semiconductor Industry [NGC450]	39	8	0

Dissemination

Over 10 project posters and presentations in various fora

3 Semiconductor process & integration	CT402	Autonomous Nine Degrees of Freedom Sensor Module [9D-Sense]	111	10	2

Dissemination

33 journal articles and conference proceedings

4 Communication and digital lifestyle	CA109	Design and development of scalable and heterogeneous highperformance computing architectures mixing general purpose multi-cores processors with more dedicated acceleration processors [SHARP]	64,1	5	3

Dissemination

18 technical papers, 3 PhD thesis

Contribution to standardization

Contributions to standards PCIe (SW/HW co-validation), MPA and PGAS (HPC/server software), SystemC (system-level verification), and Linux (many-core OS)

Call			PYs	Partners	Patents
4 Communication and digital lifestyle	CA110	Demonstration of an advanced Set Top Box that supports entertainment, home automation, energy management and healthcare applications, on top of its usual functions [APPSGATE]	178,1	14	0

Dissemination

Over 10 papers

Contribution to standardization

As participant of the W3C Model-Based User Interface Working Group, UJF/LIG has contributed to the standardization of languages for describing user Interfaces at multiple levels of abstraction from task modeling to concrete user interfaces.

4 Communication and digital lifestyle	CA111	End to end 4K Ultra High Definition TV for Europe [UltraHD-4U]	143,3	15	2

Dissemination

One book, presentations at major worldwide exhibitions or conferences from the domain (IBC, CES, NAB, MWC)

Contribution to standardization

Contributions to MPEG, VQEG and IEEE P3333

4 Safety and Security	CA206	Crucial improvements in security, functionality and speed for next generation e-passport platforms [NewP@ss]	169,7	15	2

Dissemination

13 presented conference papers, 1 journal article

Contribution to standardization

The project allowed contributions to the following international standardization bodies : ISO JTC1 SC17, SC27, and ISO/IEC 7816; ICAO NTWG and ICBWG; GlobalPlatform Government Task Force, Card, and Device committees; European Commission DG Home art6; CEN/TC 224; ETSI SCP; NFC Forum; Java Card Forum; ISCI and JHAS

4 Automotive and transportation	CA310	Electromagnetic Reliability of Electronic Systems for Electro Mobility [EM4EM]	90,9	16	6

Dissemination

Over 57 papers

Contribution to standardization

Transfer of several EM4EM results to standardization bodies, including the decoupling measurement method for electrical machines in GAKAK767.13/.14/.18.

Call			PYs	Partners	Patents
4 Design Technology	CA701	Unified design methodology and tools to address the system-level design and verification needs for multi-domain microelectronics assisted systems [H-INCEPTION] **Dissemination** 8 participations at events, 29 publications and 9 trainings **Contribution to standardization** Participation in 4 working groups in the Accellera and IEEE committees, with key contributions in SystemC MDVP (Multi-Domain Virtual Prototyping) and IP-XACT MDVP	92	15	0
4 Semiconductor process & integration	CT210	High dynamic range multiprocessor for Ultra Low Power mobile devices [DYNAMIC-ULP] **Dissemination** 35 journal articles and conference proceedings	292,4	11	5
4 Equipment, Materials and Manufacturing	CT312	Manufacturing Solutions Targeting competitive European Production in 3D [MASTER 3D] **Dissemination** more than 30 papers and about 44 presentations including posters at main conferences	170,5	17	6
5 Communication and digital lifestyle	CA112	Heterogeneous Architectures for Parallel Computing [HARP] **Dissemination** 23 publications, 6 PhD theses	101,8	6	3
5 Energy efficiency	CA505	Best Energy Efficiency solutions for heterogeneous multi-core Communicating systems [BENEFIC] **Dissemination** 45 scientific publications, posters	191,2	16	7
5 Design Technology	CA703	Open Embedded System Level Technologies for Next Generation Embedded Systems [OpenES]	145,1	12	N/A at the time of publication

Project focus matrix

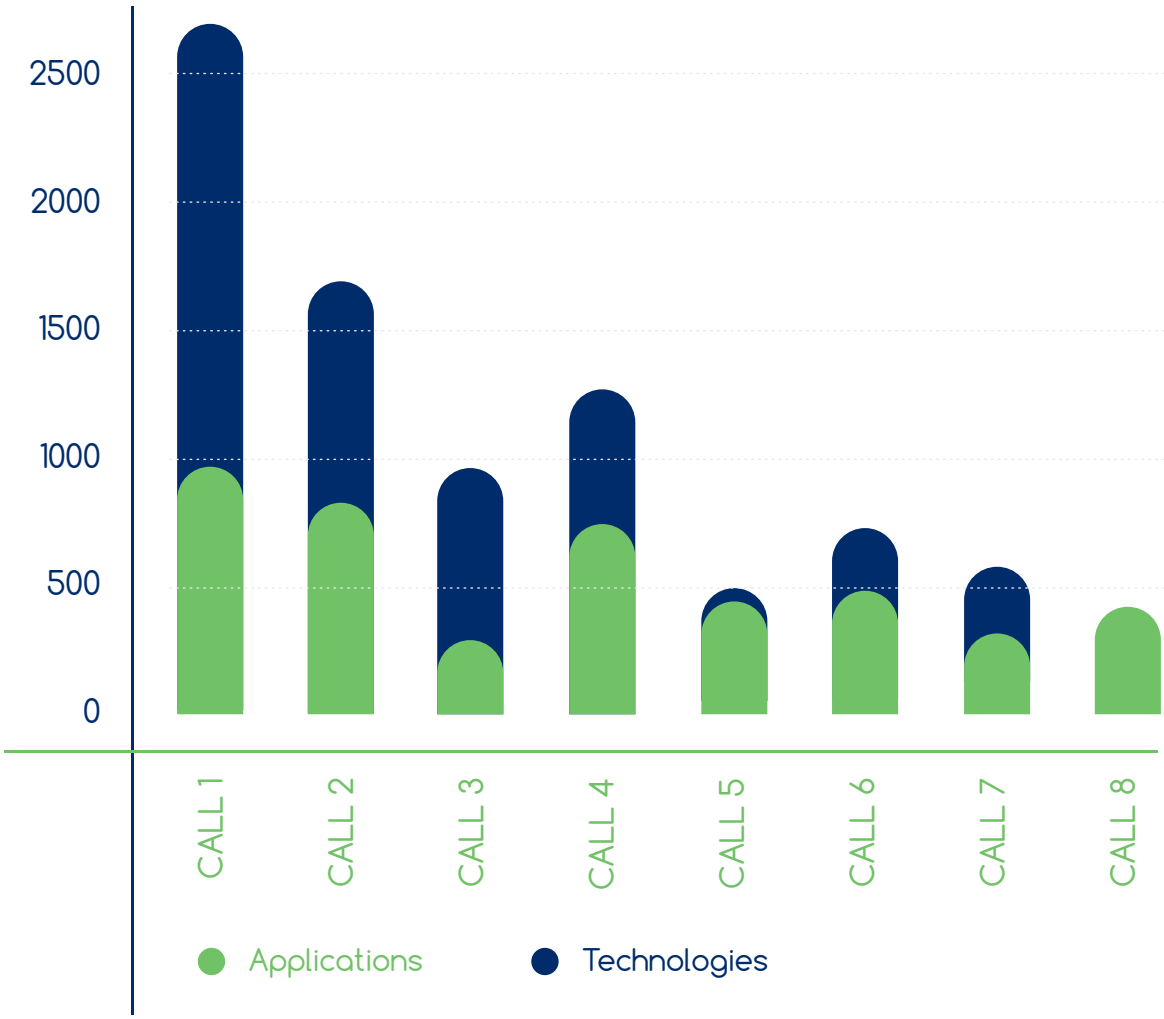
CALL		PROJECT	Communication and Digital Lifestyle	Safety and Security	Automotive and Transportation	Health and the Ageing Society	Energy Efficiency	Design Technology	Semiconductor Process and Integration	Equipment, Materials and Manufacturing
1C	CA101	PANAMA	**				*			
1C	CA103	HERTZ	**				*			
1C	CA301	HiDRaLON	*		*	*				
1C	CA303	OPTIMISE			**		*	**		
1C	CA501	COMCAS	**				**	*		
1C	CT105	3DIM3	*				**	*		
1C	CT204	PASTEUR				*			***	
1C	CT301	EXEPT								***
1C	CT302	TOETS								***
2C	CA104	COBRA	***					*		
2C	CA202	eGo	*	***						
2C	CA402	THOR			*	*	*	*		
2C	CA502	SEEL			**		***			
2C	CT205	REFINED						*	***	
2C	CT206	UTTERMOST						*	***	
2C	CT207	COCOA						*	**	*
3C	CA308	ICAF	***	**						
3C	CA403	RELY			*	*		***		
3C	CT208	REACHING 22						**	**	
3C	CT209	RF2THZ SISOC	*					*	***	
3C	CT305	SOI450								***
3C	CT306	NGC450								***
3C	CT402	9D-Sense		*		*		*	**	
4C	CA109	SHARP	*			*		***		
4C	CA110	APPSGATE	**			*	*			
4C	CA111	UltraHD-4U	***							
4C	CA206	NewP@ss		***						
4C	CA310	EM4EM			***			**		
4C	CA701	H-INCEPTION						***		
4C	CT210	DYNAMIC-ULP	*					**	*	
4C	CT312	MASTER 3D								***
4C	CT213	3DFF				*	*	*	**	

CALL		PROJECT	Communication and Digital Lifestyle	Safety and Security	Automotive and Transportation	Health and the Ageing Society	Energy Efficiency	Design Technology	Semiconductor Process and Integration	Equipment, Materials and Manufacturing
5C	CA112	HARP	**		*		*	*		
5C	CA505	BENEFIC	*				**	**		
5C	CA703	OpenES	*		*			***		
5C	CT315	EmPower			*		**		*	
6C	CA116	CORTIF	***	*				**		
6C	CT217	RESIST			**			***		
6C	CA114	WiCon	**		*			**	**	
6C	CA208	MobiTrust	*	***	*	*				
6C	CA118	FITNESS	***	**				**		
6C	CT218	E450 LMDAP							***	***
7C	CAT801	TSV-HANDY							**	***
7C	CAT209	H2O	*	***		*				
7C	CAT406	NEMADE				***			**	
7C	CAT802	SAM3			*	*	*		***	***
7C	CAT601	SiPoB-3D						***	*	
7C	CAT121	EAST	***					**	***	
7C	CAT120	CISTERN	**	**				**	**	
8C	CAT408	NexGen		**		***		*	**	
8C	CAT311	TRACE			***			**	**	

3.3. Trends and Findings

During the lifetime of CATRENE, quite a number of observations were made which can be summarised as "trends and findings". Part of the observations were made in the context of the CATRENE Assessment, which was performed by independent experts in the year 2013.[1]

The first observation is best illustrated by the figure below showing the trend of the number of labelled person years per year, split into resources for application projects and for technology projects.



[1] Reference to the Assessment report

This evolution reflects two major developments which took place during the life time of CATRENE:

- The micro-and nanoelectronics landscape and the industrial strategy moved from a mainly technology centric view (technology push) into a more balanced approach, comprising the entire value chain (joining technology push and application pull).
- At the same time, the choice of funding instruments in the domain of micro- and nanoelectronics has been complemented by a new instrument, the ENIAC Joint Undertaking, which was created as a programme for pan-European, large projects. Only a few years later, the concept of 'Pilot Lines' was introduced in ENIAC.

These changes triggered a re-arrangement and re-distribution of the different types and topics of collaborative projects. One of the results was that large technology projects were carried out in ENIAC, and no longer in CATRENE. This is clearly reflected in the effort distribution over the years: technology projects nearly disappeared in CATRENE while application project stayed active. This was also reflected in the total effort, which showed a continuous decrease over the years.

The overall conclusion of the above mentioned CATRENE assessment was that, in the light of global developments, CATRENE had been successful. Nevertheless, besides the – rather content related – evolution described in the previous paragraphs, several points that required progress were identified, of which a few are described below:

- **Openness:** CATRENE was created and governed by a very limited number of companies (12 "founding fathers"), which were also the members of the different CATRENE bodies like the Board, Support Group and General Assembly. Small and medium enterprises (SMEs) were not represented in those bodies.
- **Transparency:** The evaluation and monitoring of projects was carried out by highly competent experts, but the process was missing clear key performance indicators (KPIs)
- **Speed:** The time between project application and project start was too long, only in exceptional cases, 9 months could be reached; rather often the delay was more than one year.

One further point, which was assessed several times during the lifetime of CATRENE, was centered around the need for the Cluster to focus on specific themes. The CATRENE White Book, which defined the operation and strategy of the Cluster, identified a selection of 8 thematic areas for collaborative projects.

All of the above mentioned developments, observations and needs were taken into account when implementing the new EUREKA Cluster called PENTA, which supports R&D&I in micro- and nanoelectronics enabled components and systems along the complete value chain. As an example, PENTA instituted a common group of technical experts to evaluate all project proposals, while in CATRENE, technology and application project proposals were assessed by separate groups. PENTA is also managed by AENEAS, an Association of R&D&I actors along the whole electronic components and systems value chain, which allows every interested company in the sector to become member and to apply for a seat in one (or more) of its bodies. PENTA has also introduced KPIs and an improved, transparent process for project evaluation. With respect to strategic focusing, without pre-approval of the relevant Public Authorities supporting a project, PENTA constrains itself to a temporary focus of three thematic areas, which is not exclusive and not permanent; so, that focusing and flexibility can be combined.

4 Activities of the CATRENE Scientific Committee

One of the assets of the CATRENE organisation is a very good synergetic co-operation between large industry, SMEs and the Scientific community. Though being industry driven, CATRENE has made sure, that the Scientific Community is well represented in its governing bodies like the Steering Board and the Support Group. In addition to this, CATRENE installed a specific Working Group, called the "Scientific Committee" with two main tasks to:

- ensure that longer terms topics are included in the work plan of CATRENE
- prepare reports on specific topics as proposed by the CATRENE Steering Board; these reports allow a broad look to upcoming technology and/or application trends and give recommendations on the steps needed for the short- and medium-term oriented CATRENE programme can enter into those new fields.

4.1. Reports of the CATRENE Scientific Committee

Below is the list of the CATRENE Scientific Committee reports published between 2008 and 2014.

The reports can be downloaded on the CATRENE website at: www.catrene.org/web/about/scientific.php

- Semiconductor technologies for Smart Cities (December 2014)
- Integrated power & energy efficiency (April 2013)
- Towards a 'More-than-Moore" roadmap (November 2011)
- "Energy Autonomous Systems: Future Trends in Devices, Technology, and Systems" (Aug. 2009)

4.2. Workshops hosted by the CATRENE Scientific Committee

SCIENTIFIC COMMITTEE WORKSHOP ON SMART CITIES

Date: **14 April 2015**
Location: **Brussels**
Number of participants: **50**

During 2014, the CATRENE Scientific Committee conducted a study on "Semiconductor Technologies for Smart Cities" with the goal to identify the need for micro- and nanoelectronics and smart systems for use in "Smart Cities". The report was designed as the first phase in the investigation of Smart Cities, to be complemented with concrete use cases at a later date. It was released in January 2015 and presented at a workshop on 14 April that year in Brussels. About 50 participants attended the presentations and discussed which micro- and nanoelectronics-based components and systems will be essential for Smart Cities.

Smart Cities can be interpreted as a "system of systems", connecting a huge number of microelectronic applications, and using a large number of sensors, sensor networks and communication infrastructure. This means Smart Cities will be a use case of the so-called internet of things (IoT). Sensors will become the "eyes and ears" of a smart city; and sensor networks will be the "nerves" which feed the "brain" (ICT infrastructure) with the necessary data to monitor and simulate all relevant urban processes. The outcome of the simulations will be used to control production, traffic and logistics within the urban environment. Within the concept of Smart Cities, three major domains have been identified with having a strong need for semiconductors which will be relevant to the European semiconductor industries:

1. Smart, energy efficient (autarkic) sensor systems (cyber-physical systems) at low cost (edge computing / instant data);

2. Highly efficient and secure communication infrastructures (networks & processing capabilities for the Cloud / Big Data);

3. Sufficient power supply to run this new infrastructure (energy supply and ultra-low /zero-power systems).

SCIENTIFIC COMMITTEE WORKSHOP ON SMART SYSTEMS FOR HEALTHCARE AND WELLNESS

Date: **4 February 2014**
Location: **Brussels**
Number of participants: **80**

The CATRENE Scientific Committee released the 'Smart Systems for Health and Wellness' report in February 2014 during a workshop in Brussels that gathered close to 80 participants.

The report and workshop focused on the key role that micro- and nanotechnology can play in finding solutions for this problem. Over the last 60 years, semiconductor technology has progressed tremendously. Following Moore's law, huge computation power has become available into handheld devices, sensors have shrunk in size, and wireless communication has penetrated into the consumer market, to name only a few developments. At the time of the report, the next step was the migration into wearable devices. Already many products were appearing on the market, but with limited functionality and unfit for long term continuous monitoring. More research was needed to obtain that goal. This report focused on the technology challenges that still lied ahead, and discussed possible solutions.

Various technologies were reviewed in the report with the following keywords in mind: prevention (including the promotion of healthy lifestyle through fitness and stress monitoring), diagnostic, therapy and therapy monitoring as well as decentralisation from hospital to home maintenance. Three large applications were targeted: Devices for the healthy, devices to cure, and devices to aid the chronically ill ("stay fit", "get well", "a better live"). The objective was that they operate unobtrusively, need full autonomy and are either wearable or implantable. Small devices (cm to mm size), with a typical power budget between several µW and a few mW were envisaged.

The report received a high level of support from Industry and is still available for download on the CATRENE website.

SCIENTIFIC COMMITTEE WORKSHOP ON INTEGRATED POWER & ENERGY EFFICIENCY

Date: **23 January 2013**
Location: **Paris, Roissy Charles de Gaulle**
Number of participants: **60**

The workshop on "Integrated Power & Energy efficiency" was held in Paris / Roissy Charles de Gaulle on January 23 2013. About 60 people attended this event which provided an excellent overview of the state-of-the art and of the future challenges in this domain. Starting with a general introduction on the role of power electronics in improving energy efficiency, a summary of the main advances in device technology was then presented: Si, SiC and GaN-based active devices were discussed as well as new solutions for passive devices. Integration in systems of wide band gap devices, in particular GaN devices, was also discussed with specific attention paid to thermal management, EMC/EMI. Last but not least the necessity to develop simulation tools for this kind of devices was clearly pointed out.

This workshop was organized in the frame of a working group launched in 2012 by the CATRENE Scientific Committee and headed by G. Meneghesso from University of Padova in Italy. The goal of these working groups, which are regularly set up, is to provide the CATRENE community with a status on specific domains and to propose orientations for future development in these domains in which the European industry is or can be a key player.

5 InterCluster Activities

In 2010, Clusters became increasingly aware of the need for their members to access and use technological domains, which were outside their main area of expertise (for example, water treatment equipment requiring more and more ICT-related technologies). Clusters first agreed to have a regular exchange about evolutions in their respective domains, to support the management of multi-disciplinary inter-Cluster projects, then to share good practices and finally to set up a common representative body with a single spokesperson.

The Inter-Cluster committee and EUREKA as a whole also understood the need to strengthen their relationship. Since 2011, this cooperation has resulted in extended communication between EUREKA Clusters, with exchange of data and information updates in regular joint meetings and agreement on a process to manage inter-Cluster projects. The Committee has constant contacts with the EUREKA Secretariat and the Committee's spokesperson is now invited to EUREKA Executive Group and quarterly network (NPC and HLG) meetings.

5.1. EUREKA's InterCluster initiative on Smart Cities

In November 2014, the Inter Cluster Committee gathering all EUREKA Clusters (ACQUEAU, CATRENE, CELTIC-PLUS, EUROGIA2020, EURIPIDES² and ITEA3 launched a Smart City initiative, mapping all EUREKA projects related to this challenge.

The initiative was launched in order to facilitate the development of smart solutions to the difficult challenges that modern cities and communities around the world face today. Fifty percent of the world's population live in urban areas and this is expected to rise to sixty percent before 2025. This growth places increasing pressure on city infrastructures (transportation, housing, water, power and city services), many of which require enormous redesign and capital expenditure.

These issues, and others, can be mitigated through the adoption of scalable solutions from leading technologies to increase efficiencies, reduce costs, and enhance quality of life.

Cities that take this approach are commonly referred to as Smart City. Frost & Sullivan estimates a world market potential of $1.5 trillion in 2020 for the smart city market in segments of energy and water, transportation, mobility, healthcare, building, infrastructure and governance.

A Smart City is a place where the traditional infrastructures, services and networks are improved and made more efficient with the help of ICT technologies, meeting the needs of its citizens and businesses. Collecting data from smart devices and sensors embedded in roads, power grids, buildings, transportation, infrastructures and others using smart software for digital added value services, is crucial for Smart Cities. The Internet of Things (IoT) appears to be one horizontal enabler for Smart City applications.

5.2. Memorandum of Understanding on Smart Cities

In relation to the initiative, a memorandum of understanding on Smart Cities was signed EUREKA Clusters' Chairpersons, the Swiss 2015 EUREKA Chairman Bruno Moor and the Head of the EUREKA Secretariat Pedro de Sampaio Nunes making Smart Cities a core topic to be addressed in EUREKA.

From left to right: *Denis Rousset, CATRENE, Rudolf Haggenmüller, ITEA 3 Chairman, Nobert Lehner, CATRENE Vice-chairman, Jacques Magen,CELTIC-Plus Chairman, Xavier Chazelle, ACQUEAU Chairman, Gabriel Marquette, EUROGIA2020 General manager, Jean-Luc Maté, InterCluster Chairman and EURIPIDES2, Chairman, Bruno Moor, Swiss EUREKA Chairman, Pedro Nunes, Head of the EUREKA Secretariat et Rémy Renaudin, EURIPIDES2.*

The expected rise of the number of people living in urban areas, established in 60% before 2025, will result in the need of redesigning city infrastructures. Urban areas could mitigate this issue by taking profit of leading technologies to increase efficiency, to reduce costs and to enhance the quality of life.

All parties aim to encourage and facilitate collaborative innovative proposals addressing Smart Cities. It is expected that this initiative could represent up to 2 billion euros by 2020, for which the support of EUREKA Member States is requested.

EUREKA believes that this agreement will increase interest and project participation in this area and will encourage the industry to enable business models and empower people.

Since 2010, more than 100 projects contributing to Smart Cities and representing 1,1 billion euros of public and private funding have been labelled by EUREKA.

5.3. Symposium: EUREKA supports French Tech startups in their conquest of Smart Cities

In conjunction with the 30 year anniversary of EUREKA and the launch of the Smart Cities Initiative, an event was organised by the EUREKA Clusters and the French Directorate General for Enterprise (DGE) giving French Tech companies the opportunity to present their experiences and successes achieved with EUREKA projects. At the same time, French and European cities came to the event to also present their visions and strategies for Smart Cities.

With the presence of Axelle Lemaire, French Secretary for the Digital Sector at the time of the event, more than 200 people attended the event.

6 Communication Activities

6.1. EVENTS

European Nanoelectronics Forum and Innovation Awards

Over the past years, the European Nanoelectronics Forum has been jointly organised by AENEAS, CATRENE, the ENIAC/ECSEL Joint Undertaking and the European Commission.

Each year, between 200 and 325 participants from all over Europe attended the event that took place successively in Paris, Noordwijk, Madrid, Dublin, Munich, Barcelona, Cannes and Berlin.

Plenary sessions have been organised around themes such as “Making Innovation Happen”, “Enabling Smart Solutions” or “Driving Digital Economy” where highly-qualified speakers from within the micro- and nanoelectronics-based eco-system presented keynotes.

The Project Village, a poster and demo exhibition which occupied up to 1200 m², showcased around 70 projects from CATRENE, the ENIAC JU and the European Commission’s FP7/H2020 programme. Its setup and space were designed to be ideal for discussions and networking. The “Speakers Sessions”, held right next to the exhibition area, created an informal setting to present and discuss hot topics.

Feedback in the questionnaires sent to participants at the end of the Forum reflected usually a high level of satisfaction (with 80% of expectations met). Over the years, the feedback received was used to improve the event and has helped make the event the yearly meeting place of the European micro- and nanoelectronics community.

The next European Nanoelectronics Forum will be held on 23-24 November 2016 in Rome around the theme “Innovation along the value chain”.

One of the Forum’s highlights was the CATRENE Innovation Award. This annual award was bestowed a the project with a high level of innovation and far-reaching exploitation potential, market impact and overall benefits for Europe, as well as, creative objectives and effective management. The winner of the award was selected by a group of technical experts.

Here are the different winners since 2012

2012

CT301 | [EXEPT]

CATRENE presented its 2012 INNOVATION AWARD to the project CT301 EXEPT (EXtreme uv lithography Entry Point Technology development) for its crucial role in the building and securing European leadership in EUV lithography through the development of state of the art technologies, tools and infrastructure. the EXEPT project have the potential of generating thousands of high quality jobs in Europe and of delivering cost reductions for the end-user.

The EUV process is rapidly progressing as a viable production technique for less than 32nm semiconductor wafer technology. The CATRENE EXEPT project was set up to explore the possibilities for extending the lithography process to the 22, 16 and even 11nm nodes. The successful completion of the project now puts the European semiconductor lithography industry at the forefront of chip production expertise worldwide. During the course of the project, technology was developed to enable 22nm imaging at an acceptable cost of-ownership in high-volume industrial-scale production.

2013

CA101 | [PANAMA]

The Power Amplifiers and Antennas for Mobile Applications (PANAMA) project was chosen 2013 winner of the CATRENE Innovation Award for its outstanding work in a number of key communications application areas and allied technologies.

As the use of mobile phones, especially the smart variants, grows from strength to strength with increased subscribers chasing even more functionality, capacity and performance, behind-the-scenes issues relating to networks and handsets need to be addressed if this momentum is to be sustained. There is also a growing need for European citizens to be connected 24/7 and have access to services everywhere, a norm for today's society. All this requires more extensive use of high-capacity wireless networks, and communications systems with dynamically reconfigurable multi-standard, multi-mode operation.

2014

CA301 | [EM4EM]

EM4EM wins the 2014 CATRENE Innovation Award and provides solutions to meet new technical challenges for future vehicles with electric drives.

Resolving electromagnetic compatibility and reliability issues required for future developments in the automotive and semiconductor industries, the project EM4EM (Electro Magnetic reliability of electronic Systems for Electro Mobility). As electric mobility becomes of increasing importance for today's society, automotive manufacturers must address significant technical challenges when it comes to the reduction electromagnetic interference in electric vehicles.

EM4EM deliverables (including tried and tested models, measurement methods and procedures as well as simulation tools) will benefit a large number of European businesses by reducing time-to-market and costs of EMR-optimised components and systems for electric vehicles. The demonstrators along the value chain, for example, will help third parties integrate these results quickly into new products.

2015

CA206 | [NewP@ss]

NewP@ss reflects the needs of the next generations of e-Passport currently under discussion at the International Civil Aviation Organisation (ICAO), and their use to facilitate travel and provide access to e-Services. Its advanced, secure passport platform embeds state-of-the-art, near-field communication capabilities and is 16 times faster than the generation of passport currently in use. In addition, the NewP@ss platform has reached the highest level of security required for border-control operations. (A full description of NewP@ass can be found in Section 3.2.6 of this report.)

Brokerage

Starting in 2009, CATRENE joined forces with AENEAS to organise brokerage events with the objective to bring together the European Nanoelectronics Community, to stimulate project ideas and the creation of strong consortia for CATRENE and/or ENIAC/ECSEL JU calls.

With 135 participants in 2009 and over 200 participants in 2014, the event was recognised as a key networking event for the European nanoelectronics community and the first step in the elaboration of both CATRENE and/or ENIAC/ECSEL JU projects.

Below are the reports on the last two Common Brokerage Events.

The AENEAS and CATRENE Common Brokerage Event 2013 was held in Paris on 23-24 January. The objective of this networking event was to provide CATRENE partners and AENEAS members (participating in the ENIAC JU) with the opportunity to brainstorm about future projects and initiate consortia building.

The programme of the event was based on sessions covering the work areas common to both the CATRENE White Book and the ENIAC JU Multi-Annual Strategic Plan:

- Communication and Digital lifestyles
- Automotive and Transport
- Energy Efficiency
- Safety and Security
- Health and the Ageing Society
- Design Technologies
- Equipment, Materials and Manufacturing
- Semiconductor Process and Integration

During each session, a designated leader moderated the discussion around new project ideas along with consortia building.

During the 2013 edition, 28 project ideas were identified and elaborated on.

The **AENEAS/CATRENE Common Brokerage Event 2014** took place in Brussels, Belgium on 05-06 February and was held back-to-back with the ARTEMIS-IA Brokerage Event. The objective of this networking event was to generate ideas for project proposal for the next CATRENE and ECSEL calls and to start consortia preparations.

The programme of the event was based on sessions covering the work areas common to both the CATRENE White Book and the ECSEL JU MASP:

- Communication and Digital lifestyles
- Automotive and Transport
- Energy Efficiency
- Safety and Security
- Health and the Ageing Society
- Design Technologies
- Equipment, Materials and Manufacturing
- Semiconductor Process and Integration

During each session, a designated leader moderated the discussion around new project ideas along with consortia building.

During the 2014 edition, more than 230 participants worked together over the 2 days of the event coming up with more than 40 preliminary project ideas.

6.2. PRESS COVERAGE

Since 2008 with the launch of CATRENE, more than 200 articles have being written on CATRENE. The topics addressed in the various articles vary from the launch of a call, to the success of a project, to the winner of the yearly innovation award or to the release of a new strategic document or position paper.

Press coverage was mostly in specialized technical publications focusing on electronics in countries that strongly supported the programme.

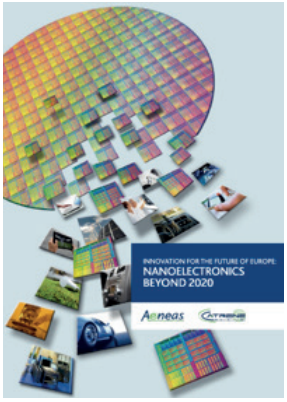
The complete list of articles is available on the CATRENE website at:

www.catrene.org/web/communication/press2015.php

6.3. PUBLICATIONS

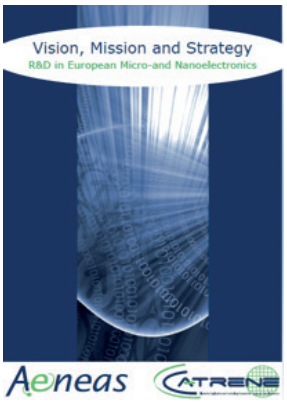
EUROPEAN EDA ROADMAP 2009

The 2009 European Roadmap for design automation in semiconductor products taking the best of technology capabilities for addressing new markets. The 2009 edition mainly focuses on demonstrating a complete top-down design flow, starting at specifications, then System Level Design linking designers to formal customer's specification, parametrisable IPs creation, standards and Design for Manufacturability (DfM) supported by new TCAD (Technology CAD) developments.



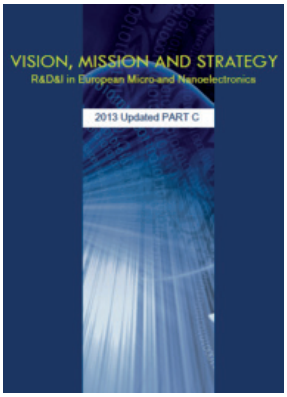
INNOVATION FOR THE FUTURE OF EUROPE: NANOELECTRONICS BEYOND 2020

AENEAS and CATRENE have released, end of November 2012, a new positioning document entitled Innovation for the future of Europe: Nanoelectronics beyond 2020 that describes an ambitious research and innovation programme to help address societal challenges and secure the future of the European nanoelectronics industry.



VISION, MISSION AND STRATEGY – CATRENE WHITE BOOK

This document gives the mission, vision and strategy of the major industrial and research organisations involved in the future of micro- and nanoelectronics in Europe. The time horizon of this document covers the remainder of this decade. Its scope covers the co-operative part of the Research, Development and Innovation (R, D & I) within public-private partnerships. It is intended as strategic document for the two European funding instruments in this field: CATRENE under the EUREKA framework and the ENIAC Joint Undertaking (JU)



VISION, MISSION & STRATEGY - 2013 UPDATED

An update of the Vision, Mission and Strategy document, common to both AENEAS and CATRENE, was undertaken in 2013. The revision concerned only Part C of the document, which describes strategies per domain to a level that it can be used as reference for the creation of projects in ENIAC (to be succeeded from 2014 onwards by ECSEL) and CATRENE.

CONCLUSION

During its life-time of 8 years, CATRENE has been for several years the largest cluster in EUREKA and has activated close to 9000 person years in research and development for micro- and nanoelectronics. This translates to nearly 1 Billion Euros of financial effort. 20 countries have been involved and 51 projects have been handled and monitored.

Focusing on typical European strengths - like energy, security, health automotive - the competitiveness of Europe in these domain has further been improved by providing innovative and state of the art technical solutions.

CATRENE has proven its flexibility and adaptability by following rather rapidly the change in strategy from "technology only" R&D to more application oriented R&D&I. The analysis of the economical and societal impact of CATRENE gives clear evidence that the effort by industry and the funding by the national public authorities was very well and effectively spent.

The new cluster for micro- and nanoelectronics, PENTA, is further adapting to the rapidly changing landscape and strategies and concentrates on the value chain oriented strategy of European industry.

www.catrene.org