The Graphene Flagship: Status and Next Steps
-Greek Participation-

GRAPHENE FLAGSHIP

GRAPHENE FLAGSHIP

European Commission

Future and Emerging Technologies Flagships are…

- **Ambitious large-scale, science-driven, research initiatives.**
- **Visionary goal.**
- **Scientific advance → technological innovation → novel benefits for society.**

Scale: 10 year project period,
1 B€ project cost (500 M€ from EC)
Graphene (coordinated by Chalmers)
and the ***Human Brain Project*** (EPFL).
New flagships are in progress.

2013, October 1: **Project start with a 30 month ramp up phase.**
2016, April 1: **Enter Horizon 2020 phase.**

IMPLEMENTATION

7th Framework Programme

Ramp-up phase, 74-142 partners, 2013-2016

Horizon 2020

Core Project 1
156 partners,
2016-18

Core Project 2
≈ 145 partners,
2018-20

Core Projects 3
> 120 partners,
2020-

National projects

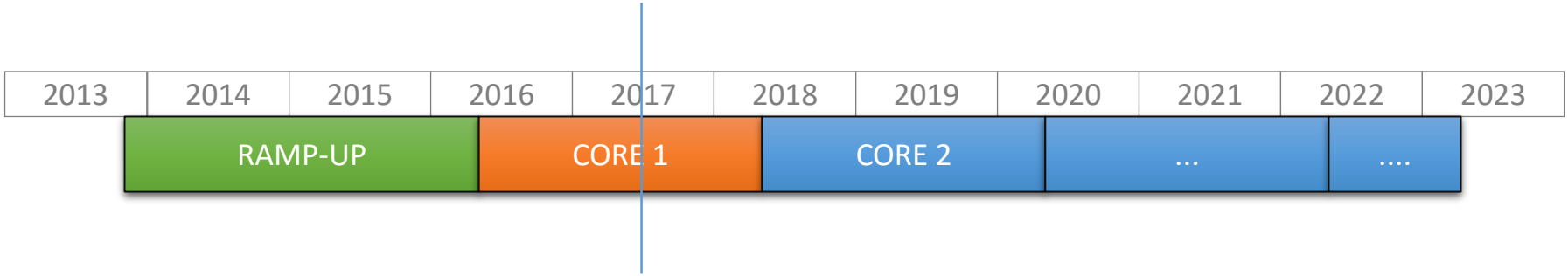
FLAG-ERA

Regional projects

Other EU projects

EC funding until the end of H2020 will be ≈380 M€:
9th Framework Programme ?

WHERE WE ARE NOW



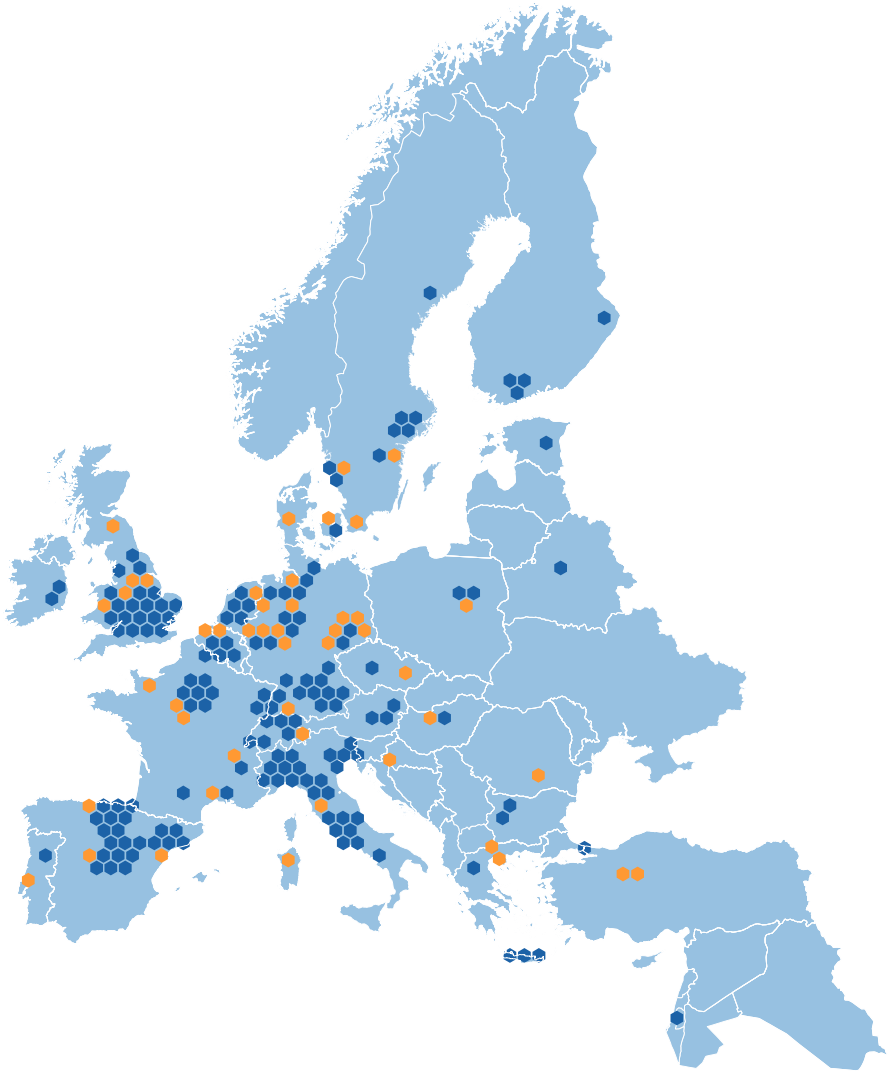
Flagship today

Core 1 started on April 1, 2016:

- 156 partners in 23 countries; about 1/3 industry, 1/2 academia and 1/6 other
- 15 S&T work packages, 5 supporting work packages
- 450 full-time equivalent persons, over 1,300 individuals
- 72 Associated Members, many of whom are involved in 18 Partnering Projects

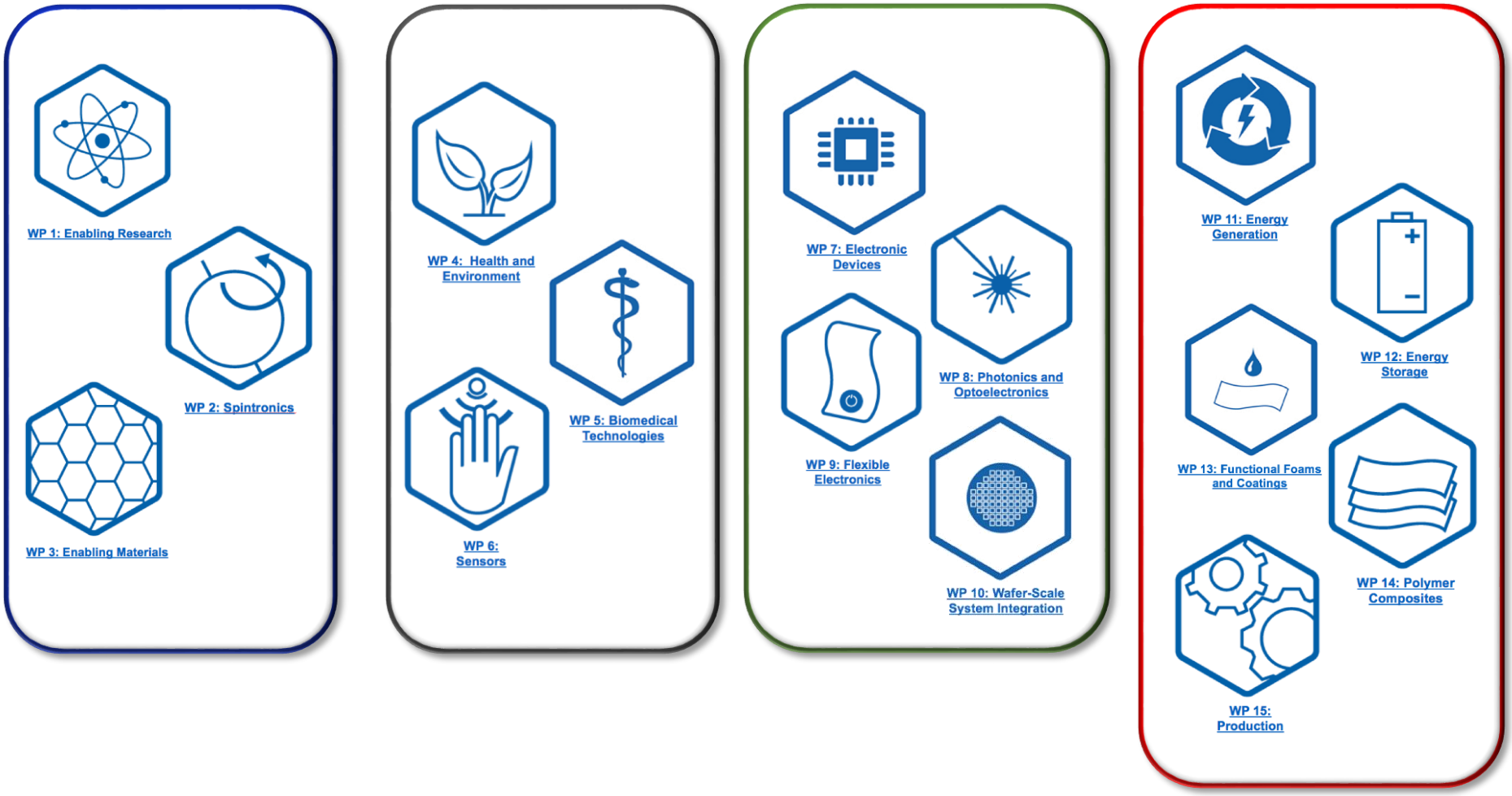
Output includes thus far

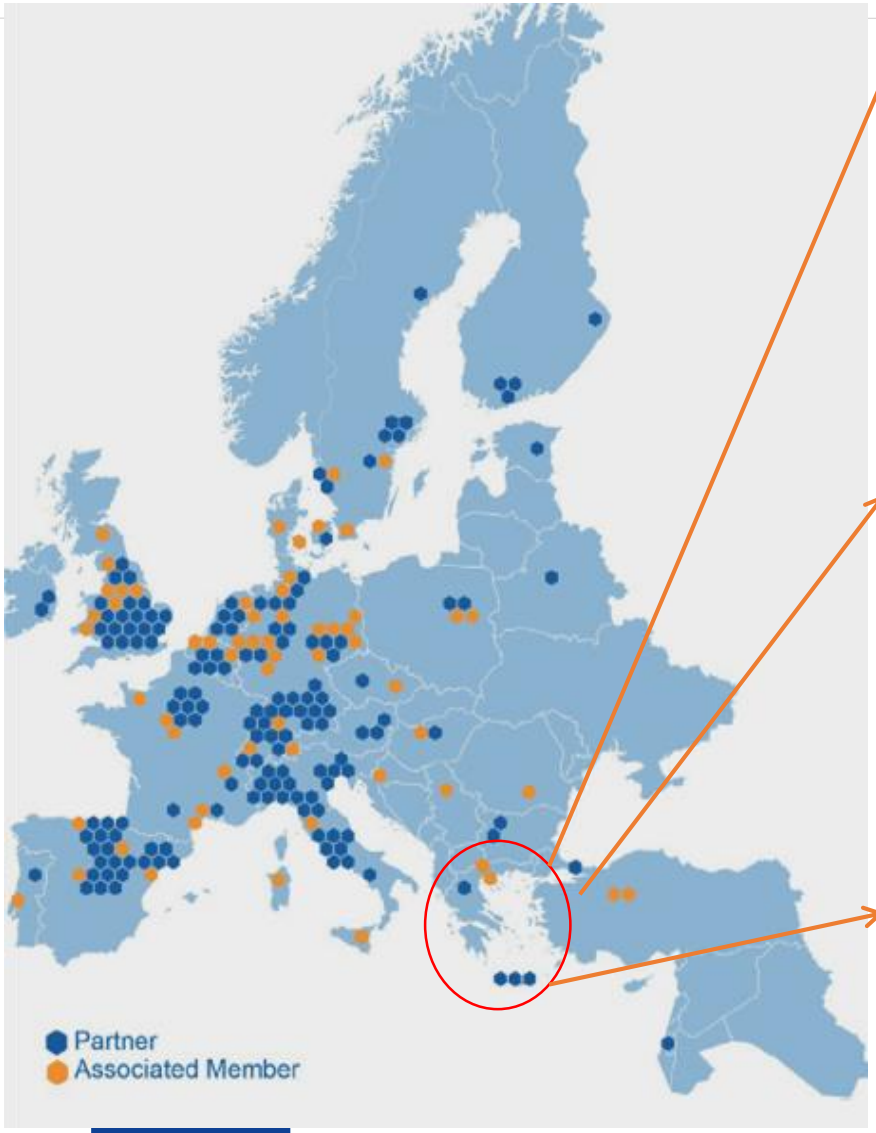
- Nearly 1,500 publications with over 21,000 citations
- About 40 patents applied and 20 products launched
- Some 350 hired graduate students



Core 1 – Scientific Work Packages

ORGANISED IN 4 DIVISIONS





❑ Three institutes of the ICE-HT, Institute of Electronic Structure and Laser (IESL) and Institute of Computational Mathematics (ICAM) have joined their research teams and created in 2011 the Graphene Center, which is the main pillar research for graphene in Greece

❑ Together with TEI & University of Crete and the University of Ioannina are actively participating in the corresponding European Graphene Flagship platform.

❑ Also Graphene Flagship's associate members are the Aristotle University as well as Organic Electronic Technologies (OET)

Funded by
the European Union

Core 1 – Greek Participation

WP14 Polymer Composites/ LEADER- Member of the Executive Council
Partner: **FORTH/ICEHT**
PI: **Prof. Costas Galiotis/** Budget: 340k (Ramp Phase), 363

FORTH
Institute of Chemical Engineering Sciences

❑ **Current Goals (FORTH, CNR, UNIMAN[2017-2020]**

- Hierarchical composite structures for aerospace and automotive industries
- Electrically conductive applications of GRM-elastomer composites
- GRM-metal nanostructures – as polymer additives

WP11 Energy Generation/ DEPUTY LEADER
PI: **Prof. Emmanuel Kymakis** Budget: 500k (Ramp Phase), 497k (Core1) 910k (Core2)

TEI of Crete
Technological Educational Institute of Crete

Current Goals (TEIC, IIT, Tor Vergata) [2017-2020]

- Development and validation of a 1kWp graphene-perovskite solar farm in Crete (SH project)
- Development of self-powered textile (SH project)
- Extension of perovskite solar cells stability to industrial standards through GRMs interfacial engineering

Greek Participation

WP8 Photonics & Optoelectronics/ WP Partner
PI: **Prof. Elefterios Lidorikis**, Budget: 248k (Ramp Phase), 248k (Core1) 197k (C

❑ **Current Goals (FORTH, CNR, UNIMAN[2017-2020]**
- PDs for VIS, SWIR and MIR based on hybrids of graphene and semiconductor
- and/or nanoparticles
- MIR pyro-electric detectors based on graphene and pyroelectric materials
- Waveguide-integrated PDs fabricated with scalable methods and materials

WP7 Electronic Devices/ WP Partner
PI: **Prof. Maria Kafesaki**, WP Partner/ Budget: 31k (Ramp Phase), 54k (Core1

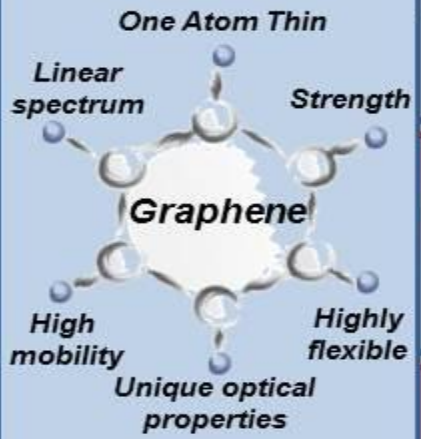
UNIVERSITY
OF CRETE

❑ **Accoplishments**
✓Graphene based field effect transistor
✓Logic switches
✓RF Power detectors
✓Microwave photonic

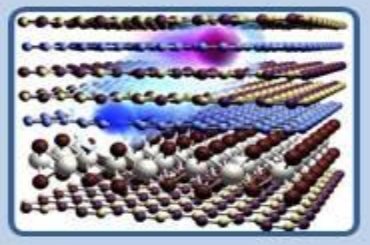
Roadmap

GRAPHENE FLAGSHIP

Platform



Hybrid 2d structures



Industrial
Academic

Industrial workshare
Academic workshare

System Integration

- Flexible electronic
- Superfast optical communication
- Ultrafast low-power electronics
- Self-powered devices
- Automotive
- …

Components

- Transistors
- Spin valves
- Flexible displays
- RF tags
- Ultra-light batteries
- Solar cells
- Ultrafast lasers
- Composite materials
- Prostheses
- Sensors
- …

Production techniques

- Large scale synthesis
- On demand growth
- Nanoribbons
- Growth on flexible substrates
- Inks
- Interfaces
- Doping
- Superstructures
- Toxicology
- …

2013

2016

Industrial workshare
Academic workshare

2023

Vision beyond 2023

ICT

- Faster
- Cheaper
- Flexible

Energy storage and conversion

- Efficient
- Cost effective
- Renewable
- Sustainable

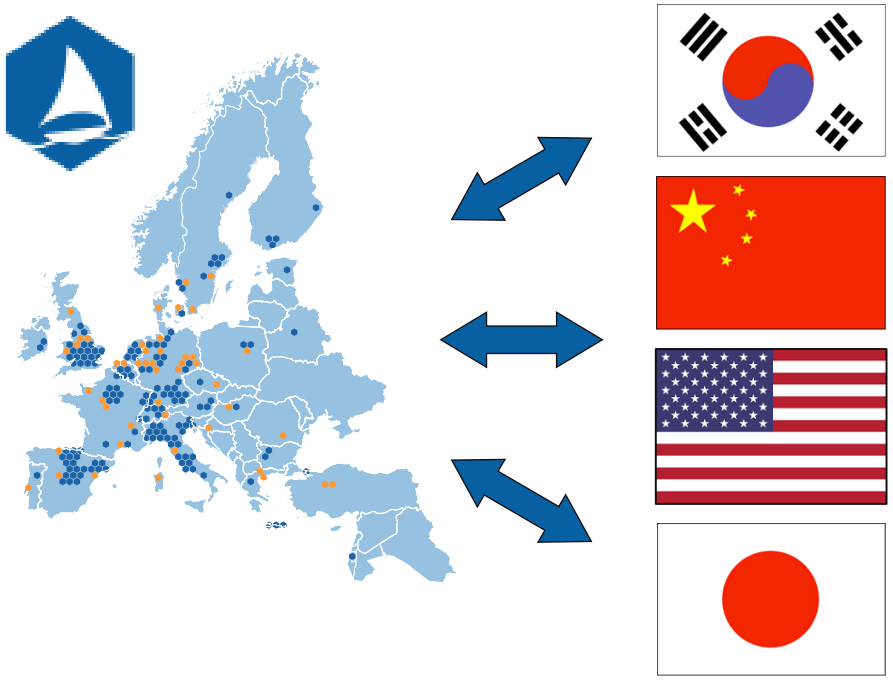
Health

- Cost effective
- Bio compatible

- **Societal benefits**
- **Jobs**
- **Education**

FLAGSHIP IN THE GLOBAL CONTEXT

- Graphene Flagship is recognized as the world leader in its field; GrapheneWeek conference brings together world leaders in this discipline.
- The flagship's international collaboration focuses on the academic domain (bilateral workshops with the US, Japan, Korea and China, mobility program)
- Strong push on graphene technologies in Asia and increasing interest by global companies (China, Korea)



GRAPHENE WEEK

SHAPING THE GRAPHENE SCIENTIFIC COMMUNITY SINCE 10 YEARS

2008	Miramare-Trieste, Italy
2009	Ötz Valley, Austria
2010	Maryland, USA
2011	Ötz Valley, Austria
2012	Delft, The Netherlands
2013	Chemnitz, Germany
2014	Gothenburg, Sweden
2015	Manchester, UK
2016	Warsaw, Poland
2017	**Athens, Greece**
2018	**San Sebastian, Spain**

- OPEN FORUM
  COST + GRAPHENE FLAGSHIP
- ROADMAP OF GRAPHENE AND OTHER 2D MATERIALS
- ETHICS FORUM
- COMMERCIALIZATION
- INDUSTRIALIZATION AND STANDARDIZATION
- INSIDE NATURE RESEARCH
- WOMEN IN GRAPHENE
- FRINGE SESSION INTERFACES
- GRAPHENE CONNECT: NEW MATERIALS AND DEVICES

https://graphene-flagship.eu