European Commission
FP7 Grant Agreement
No: 609837

# Global context of RTD activities in CSP

***Latest joint efforts between Research and Industry for strengthening European CSP leadership (STAGE-STE Workshop)***

***European Economic and Social Committee***

***Brussels, January 23rd, 2018***

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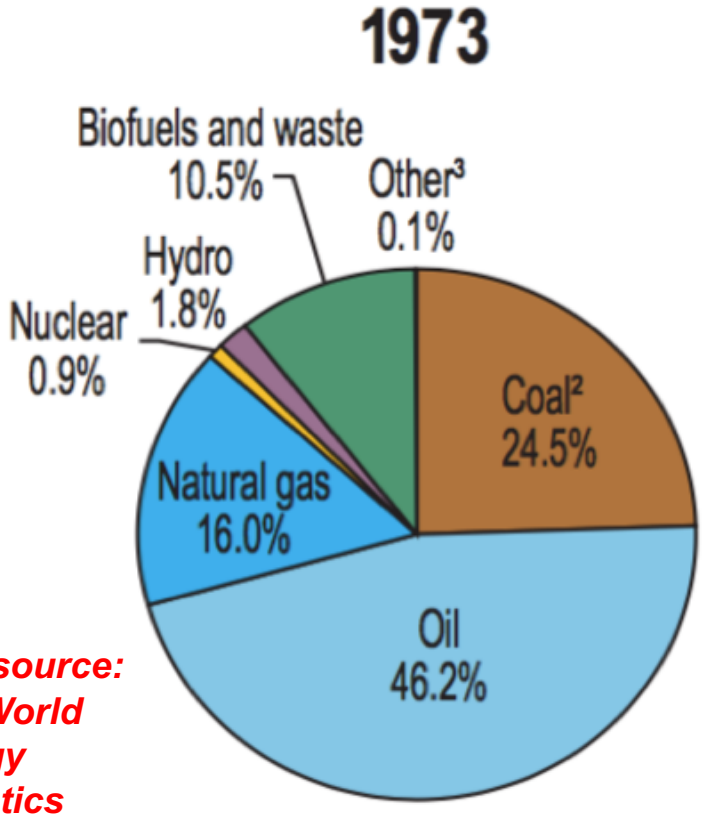
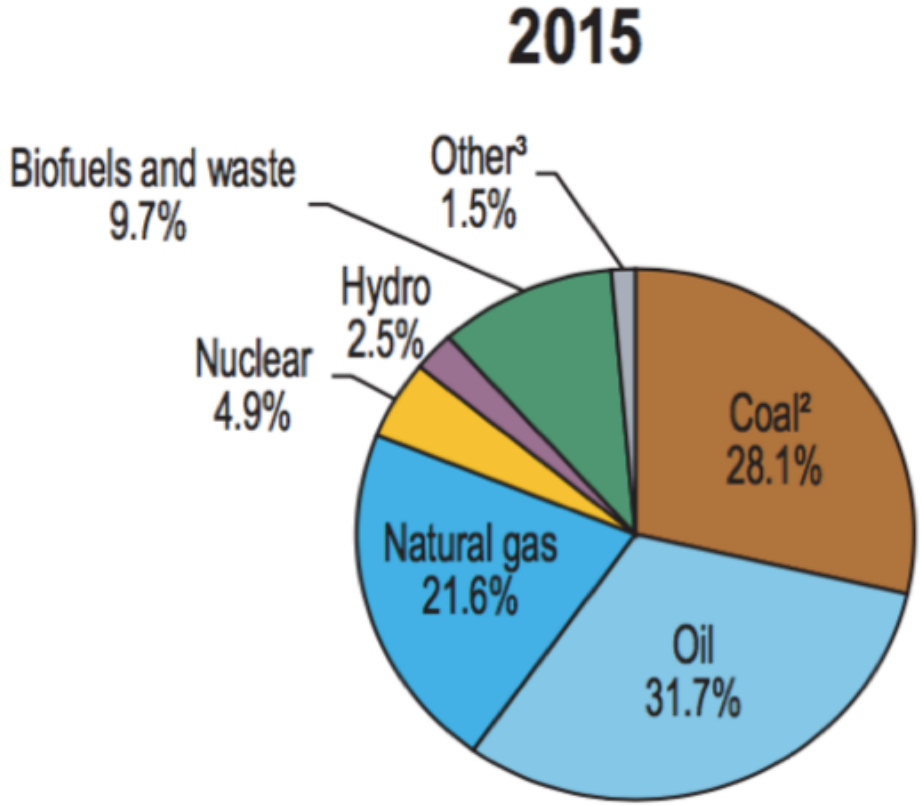
European Energy Research Alliance

*Comité économique et social européen*
*European Economic and Social Committee*

# ENERGY DECARBONIZATION PATH




*Data source: Key World Energy Statistics (IEA, 2017)*

**6 101 Mtoe**

**13 647 Mtoe**

***Carbon based → 86.7 %***

***Carbon based → 81.4 %***

# RENEWABLE ENERGIES POTENTIAL

| Finite Energy Resources | |
|---|---|
| **Energy Resource** | **TW year** |
| Natural Gas | **215** |
| Petroleum | **240** |
| Uranium | **90 - 300** |
| Carbon | **900** |

| Renewable Energy Resource | |
|---|---|
| **Energy Resource** | **TW year/year** |
| Waves | **0.3** |
| Geothermal | **0.3 - 2** |
| Hydraulic | **3 - 4** |
| Biomass | **2 - 6** |
| Ocean thermal conversion | **3 - 11** |
| Wind | **25 - 70** |
| Solar | **23,000** |

1 TW year equals to the continuous production of $10^{12}$ W during one full year (8760 TWh), also equivalent to 1,000 power plants of 1,000 MW installed power each

***Perez, R and Perez, M. "A fundamental look at Energy reserves for the planet". The IEA SHC Solar Update, Volume 50 (2009), 2-3***

**Mankind primary energy consumption (year 2015): 18,12 TW year (IEA, 2017)**

# KEY ROLE OF CSP/STE

## Renewables production data (2015)

- Wind: 838 TWh (0,09 TW year)
- PV: 247 TWh (0,03 TW year)
- Hydro: 3978 TWh (0,45 TW year)

***Total mankind primary energy consumption (2015): 18,12 TW year***

***Key World Energy Statistics (IEA, 2017)***

## Key facts

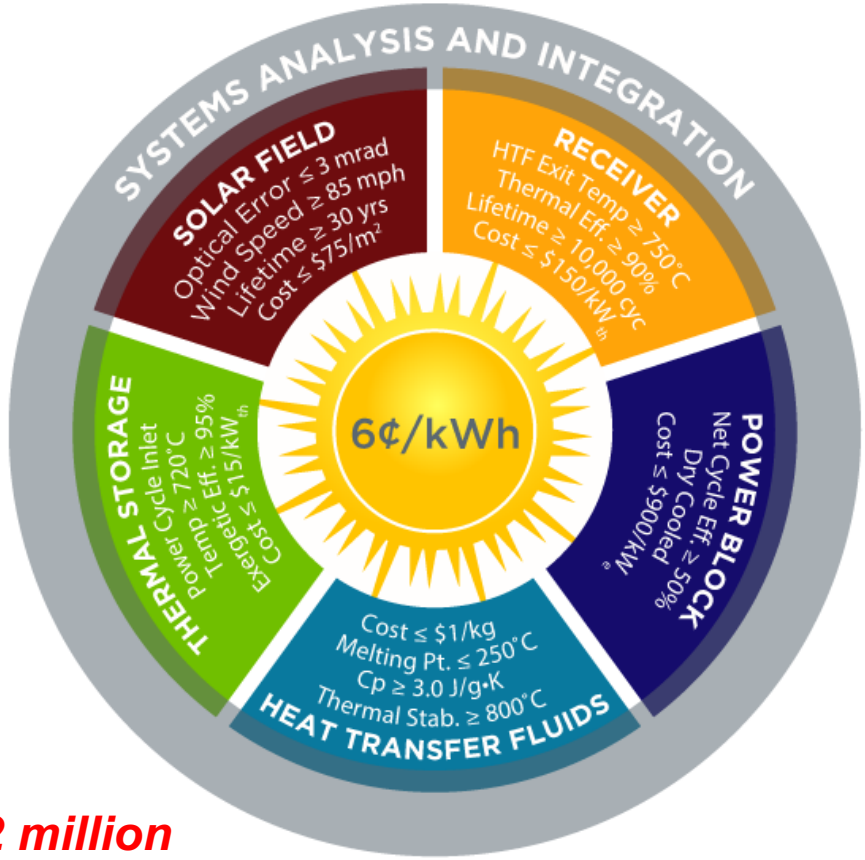
- Decarbonization speed should go much faster
- Development of non-dispatchable renewable technologies (like wind & PV) is limited
- CSP/STE is called to have a key role in any future energy scenario due to dispatchability behavior
- To make this possible, further R&D efforts are needed to achieve existing cost gap (with other renewables)

# SUNSHOT INITIATIVE (USA)

Launched by U.S. Department of Energy (DOE) in 2011 with the goal of making solar electricity cost-competitive with conventionally generated electricity by 2020. In the case of CSP the target was to reduce power generation cost up to 6 $cents/kWh.

## Competitive Programs

- $9M COLLECTS (2016)
- $32M CSP: APOLLO (2015)
- $29M CSP SuNLaMP (2015)
- $1.4M SolarMat II (2014)
- $10M CSP: ELEMENTS (2014)
- $1.1M SunShot Incubator (Recurring)
- $4M PREDICTS (2013)
- $2M SolarMat (2013)
- $10M CSP-HIBRED (2013)
- $27M National Lab R&D (2012)
- $10M SunShot MURI (2012)
- $56M CSP SunShot R&D (2012)
- $0.5M BRIDGE (2012)




***Total investment in CSP (2012-2016): USD 192 million***

# ASTRI INITIATIVE (AUSTRALIA)

## Australian Solar Thermal Reseach Initiative

- **Rationale**
  - Concentrating Solar Thermal (CST) technology will play a major role in the decarbonised energy future.
  - By 2050, CST is expected to be the main source of electricity in large regions of the world (Chile, China, India, MENA, South Africa, USA, Australia, …).
- **Program & Objectives**: Eight-year / **AUD 87 million** to increase technology readiness by:
  - Reducing CAPEX of CST Power Plants (focus on systems),
  - Increase the Capacity Factor,
  - Improving efficiency of CST components and overall
  - Program designed to align to SunShot to facilitate
- **Targeted Impact**:
  - To manufacture and build power plants in Australia creating export markets and jobs.
  - To transform Australia into a global CST leader.

# STAGE-STE IRP (EU)

## Most similar initiative in Europe

- **Full name**: Scientific and Technological Alliance for Guaranteeing the European Excellence in Concentrating Solar Thermal Energy (STAGE-STE)
- **Duration**: February 2014 – January 2018
- **Budget**:
  - EC contribution: **EUR 10 million**
  - In-kind: **EUR 11.2 million**

  } Total: **EUR 21.2 million**
- **Committed manpower**: 2.504,45 pm
- **Coordination & Support Work Packages**: 6 groups of activities addressed to intensify the cooperation to more efficiently coordinate, complement and reinforce the activity of the different R&D European Research Centers on the CSP/STE field
- **Research Work Packages**: Also 6, covering the whole spectrum of topics related with Concentrated Solar Energy (Central receiver system, Line-Focusing; Thermal Energy Storage; Materials for Solar Receivers and STE Components; Solar Thermochemical Fuels; CSP & Desalination)

# STAGE-STE IRP (EU)

| Participant no. | Participant organisation name | Country |
|---|---|---|
| 1 (Coord.) | CIEMAT | SPAIN |
| 2 | DLR | GERMANY |
| 3 | PSI | SWITZERLAND |
| 4 | CNRS-PROMES | FRANCE |
| 5 | FRAUNHOFER | GERMANY |
| 6 | ENEA | ITALY |
| 7 | ETHZ | SWITZERLAND |
| 8 | CEA | FRANCE |
| 9 | CYI | CYPRUS |
| 10 | LNEG | PORTUGAL |
| ~~11~~ | ~~CTAER~~ | ~~SPAIN~~ |
| 12 | CNR | ITALY |
| 13 | CENER | SPAIN |
| 14 | TECNALIA | SPAIN |
| 15 | UEVORA | PORTUGAL |
| 16 | IMDEA | SPAIN |
| 17 | CRANFIELD | UK |
| 18 | IK4-TEKNIKER | SPAIN |
| 19 | UNIPA | ITALY |
| 20 | CRS4 | ITALY |
| 21 | INESC-ID | PORTUGAL |
| 22 | IST-ID | PORTUGAL |

| Participant no. | Participant organisation name | Country |
|---|---|---|
| 23 | SENER | SPAIN |
| ~~24~~ | ~~AREVA~~ | ~~FRANCE~~ |
| ~~25~~ | ~~HITTITE~~ | ~~TURKEY~~ |
| 26 | ACCIONA | SPAIN |
| 27 | SCHOTT | GERMANY |
| 28 | ASE | ITALY |
| 29 | ESTELA | BELGIUM |
| 30 | ABENGOA SOLAR | SPAIN |
| 31 | KSU | SAUDI ARABIA |
| 32 | UNAM | MEXICO |
| 33 | SUN | SOUTH AFRICA |
| 34 | CSERS | LYBIA |
| 35 | CSIRO | AUSTRALIA |
| 36 | FUSP | BRAZIL |
| 37 | IEECAS | CHINA |
| 38 | UDC | CHILE |
| 39 | UCAM | MOROCCO |
| 40 | FBK | ITALY |
| ~~41~~ | ~~CNIM~~ | ~~FRANCE~~ |
| 42 | COBRA | SPAIN |
| 43 | SUNCNIM | FRANCE |
| 44 | UNIV. SEVILLA | SPAIN |

# STAGE-STE IRP (EU)

A. **Main core objective: increased real collaboration among EU research organizations**

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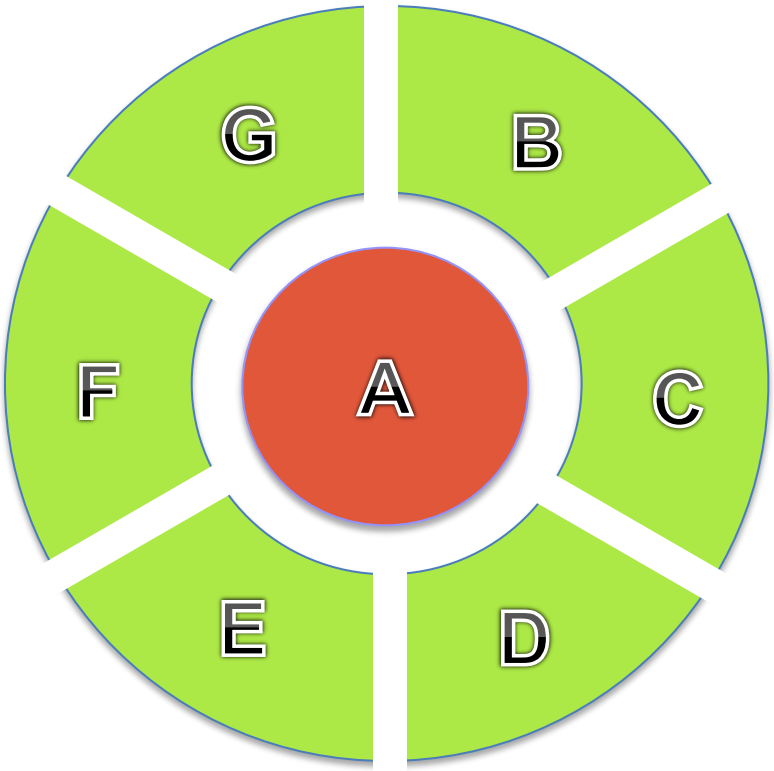


A. Main core objective: increased real collaboration among EU research organizations
B. Cooperative technical and scientific development (WPs 7 to 12)
C. Research infrastructures effective sharing
D. Substantial staff exchange
E. Training and capacity building
F. Alignment of national and EC financial resources + co-sharing
G. International collaboration

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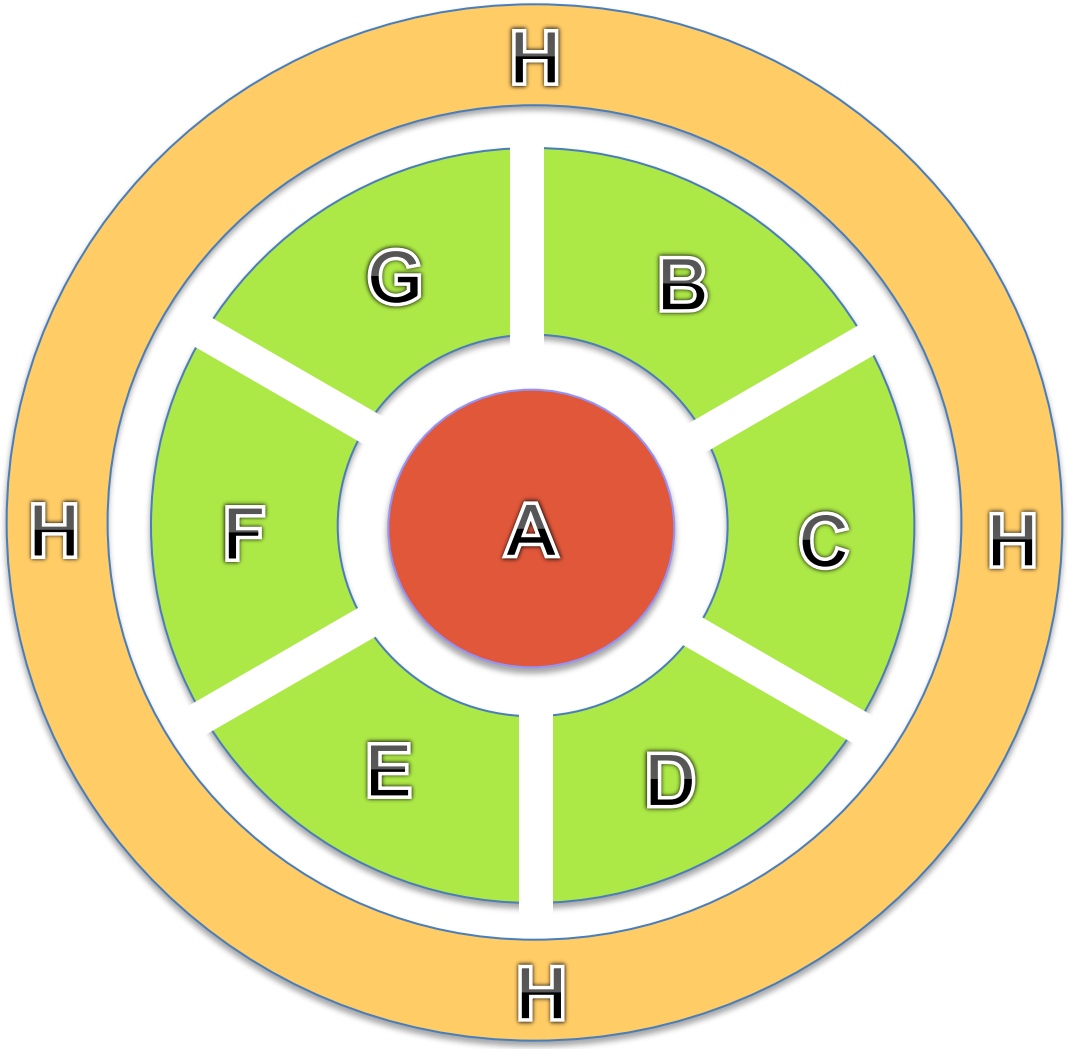


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G. International collaboration
H. Interaction with industry

# TO CONCLUDE …

- During the last 4 years, the existence of IRP STAGE-STE and the EERA JP-CSP has provided a greater cohesion in the CSP/STE sector in Europe, significantly improving research capabilities and the collaboration with industry.
- Results clearly show the strong benefit, added value and cost/effectiveness of this collaboration among the whole European RTD sector.
- Integrated Research Programmes should continue in the future as a very effective way to define and achieve common targets to a whole RTD sector.