
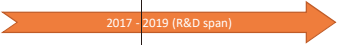









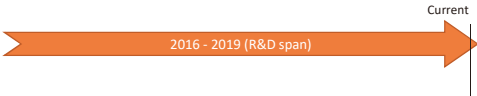
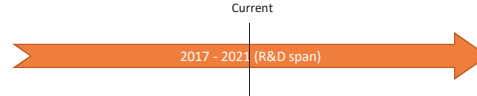


Country	Institute	Category	Related programs (with short summary)	Target / Goal Outcome	Lead person / Organization	Partnership (if any)	Related information
Italy	ENEA	Production	<p>Accordo di Programma ENEA MISE, funded by Italian Ministry of Economic Development/ Development of innovative hydrogen production technologies based on electrochemical and thermochemical routes</p> <p>Current</p> 	<p>i) Feasibility study and experimental testing of a modified S-I thermochemical cycle for hydrogen production from water splitting. ii) experimental investigation into innovative concepts of membrane reformers for hydrogen production from biogas. iii) development of catalysts and components for anion exchange membrane electrolyzers. iv) development of materials solutions and optimized configuration of molten carbonate steam electrolysis</p>	Dr. Turchetti/ENEA	(Domestic) ENEA, University Sapienza of Rome, University of Salerno	
Italy	ENEA	Production/Utilization	<p>BALANCE project: Development of reversible high temperature electrolysers to support the integration of wind and solar energy with the electricity grid. (H2020 - ECRIA - Research and Innovation Action).</p> <p>Current</p> 	<p>i) Realisation of a sufficiently mature European Reversible Solid Oxide Cell (ReSOC) technology.  ii) Demonstration of ReSOC system (6 kWe) for grid balancing services and flexible methanation process.  iii) Development of ReSOC module components: air and fuel electrode, interconnect and coating, stack design, cell and stack manufacturing.  iv) Market analysis for fuels and power, business cases and life cycle analysis</p>	Olivier Thomann, VTT (Finland)	(Domestic): - ENEA - Research Institute. (International): - VTT: Teknologian tutkimuskeskus - Research Institute - Finland - CEA: Commissariat à l'Énergie Atomique et aux Energies Alternatives - Research Institute - France - DTU: Danmarks Tekniske Universitet - University - Denmark - IEN: Instytut Energetyki - Research Institute - Poland - EPFL: Ecole Polytechnique Federale de Lausanne - University and Research Institute - Switzerland - TUD: Technische Universiteit Delft - University - Netherlands - UoB: University of Birmingham - University - United Kingdom	<a href="https://www.balance-project.org/">https://www.balance-project.org/</a>
Italy	ENEA	Production/Utilization	<p>AD ASTRA Definition and development of Accelerated Stress Testing (AST) protocols for Solid Oxide Cells (SOC) for Power to X (P2X) and Combined Heat and Power (CHP) applications. (H2020 - FCH - Research and Innovation Action).</p> <p>Current</p> 	<p>i) Establishment of an enhanced, multidimensional Failure Mode and Effects Analysis (FMEA) matrix for SOC stacks tested in the field.  ii) Development of AST protocols that address realistic failure modes of critical SOC stack components in 2 application profiles: power-to-X (P2X) and combined heat and power (CHP). iii) Target AST durations should be under 3000 hours and represent real-world stack operations of up to 40,000 h.  iv) Implementing degradation mechanisms stochastically into performance models, in order to predict Remaining Useful Life (RUL) in real-time.  v) Define a generalized methodology for the definition of ASTs and predictive models for any suitably selected fuel //electrolyser stack component</p>	S. McPhail (ENEA)	(Domestic) ENEA - Research Institute, University of Genova, University of Salerno, SOLIDpower - Industry (International) • CEA, Commissariat à l'Énergie Atomique et aux Energies Alternatives - Research Institute - France • DTU, Danmarks Tekniske Universitet - University - Denmark • EIFER, European Institute for Energy Research - Research Institute - Germany • EPFL, Ecole Polytechnique Federale de Lausanne - Research Institute - Switzerland • IEES, Institute of Electrochemistry and Energy Systems - Research Institute - Bulgaria • SUNFIRE - Industry - Germany	<a href="https://www.ad-astra.eu/">https://www.ad-astra.eu/</a>
Italy	ENEA	Utilization	<p>qSOFC: reduction of production costs and improvement of the production process quality for high temperature fuel cell systems (H2020 - FCH - Research and Innovation Action)</p> <p>Current</p> 	<p>i) Reduction of stack cost down to 1000 €/kW at 10 MW/year production volume  ii) Demonstration of stack cost-reduction potential to 500 €/kW at mass-production (2000 MW/year)  iii) Reduction of cell manufacturing cost down to 400 €/kW at 10 MW/year production volume  iv) Demonstration of cell cost-reduction potential to 200 €/kW at mass-production (2000 MW/year)  v) Increase production yield in all parts of stack manufacturing value chain to above 95% by automation and quality assurance  vi) Development and validation of cell- and interconnect quality assurance methods which are independent of stack manufacturer or stack design</p>	Markus Rautanen, VTT (Finland)	(Domestic): - ENEA - Research Institute. (International): - VTT: Teknologian tutkimuskeskus - Research Institute - Finland - Elingklinger - Industry - Germany - Elcogen OY - Industry - Finland - Elcogen AS - Industry - Estonia - Haiku Tech Multilayer Ceramics - Industry - Netherlands - MÜKo Maschinenbau GmbH - Industry - Germany - Sandvik Materials Technology - Industry - Sweden	<a href="http://www.qsofc.eu/">http://www.qsofc.eu/</a>

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Italy	ENEA	Utilization	<p>WASTE2WATTS / use of biogas and syngas (from biomass) for small SOFC CHP integrated modules (5-50 kW). (H2020 - FCH2 - Research and Innovation Action)</p> <p style="text-align: center;">Current  </p>	<p>i) Consider 3 bio-waste sources (farms, local OFMSW, landfill) and establish their SOFC-CHP potential (kWe-size ranges, units).  ii) Select, develop and test adapted cleaning methods and sorbent materials to deliver a fuel such that SOFC SoA performance degradation is not affected.  iii) Select catalysts specific for dry- (CO<sub>2</sub>) and mixed (CO<sub>2</sub>/H<sub>2</sub>O/air) CH<sub>4</sub>-reforming, and test them with relevant gas mixtures and potential residual trace pollutants. Evaluate their 'catalytic sorbent' potential, i.e. protecting the SOFC stack from pollution at no added cost.  iv) Test SOFC cells and stacks performance from 2 SOFC manufacturers and suppliers on dilute and other relevant.  v) Study biogas-SOFC thermal integration Apply advanced system optimization tools. Target net system electrical efficiency is 55%.  vi) Cost and environmental assessment for a projected SOFC production line of 25 MWe/yr, against the target of &lt;3500€/kWe. Perform a techno-economic optimization, and a life cycle assessment (LCA). Evaluate the market potential for biogas-SOFC CHP.  vii) Run a Proof-of-Concept test with a SOLIDpower BlueGen-2 (6 kWe) with the project's cleaning solution hardware on this site.</p>	Jan Van Herle, EPFL (Switzerland)	<p>(Domestic) ENEA – Research Institute, SOLIDpower – Industry, BLOKOMP – Industry, Politecnico di Torino – University (International)  – EPFL, Ecole Polytechnique Federale de Lausanne – Research Institute – Switzerland  – CEA, Commissariat à l'Énergie Atomique et aux Energies Alternatives – Research Institute – France.  – SUNFIRE - Industry - Germany  – Arol Energy - Industry - France  – Paul Scherrer Institut - Research Institute - Switzerland  – EREP - Industry - Switzerland</p>	<a href="https://waste2watts-project.net/">https://waste2watts-project.net/</a>
Italy	ENEA	Utilization	<p>BLAZE / coupling BFB gasifier with SOFC modules for CHP applications (H2020 - LC - SC3 - Research and Innovation Action)</p> <p style="text-align: center;">Current  </p>	<p>i) Improving the global reliability and system efficiency of a BFB gasifier combined with hot syngas cleaning &amp; conditioning (exploiting UNIQUE and UNIFHY technologies applied to the EQTEC gasifiers) in order to directly deliver a SOFC compatible syngas, avoiding inefficient cold gas cleaning and expensive Air Separation Unit.  ii) Using an industrial SOFC system that will be safe and efficiently thermally and chemically integrated with the gasifier system. Achieve at the same time the highest resource efficiency and the highest overall and electrical conversion performance of the small to medium biomass CHP plant configurations, reducing overall costs of investments and operation.  iii) Operating in power modulation and with the possibility of leading only a portion of the product gas from the gasifier through the gas cleaning unit to the SOFC system.  iv) Lab scale (few 100 W) and real scale (100 kWth) tests with a system prototype will achieve at the end of the project a TRL of 5.</p>	Prof. Enrico Bocci, Università degli Studi Guglielmo Marconi (Italy)	<p>(Domestic) ENEA – Research Institute, Università degli Studi Guglielmo Marconi – University, Università degli studi de l' Aquila – University, Walter Tosto, Industry.  (International)  – HTCeramik, Industry – Switzerland  – EPFL, Ecole Polytechnique Federale Lausanne – Research Institute – Switzerland  – HyGear, Industry – Netherlands  – VERTECH GROUP – Industry – France  – EUBIA, European Biomass Association – Non – Profit Association  – EQTEC Iberia L.S. – Industry – Spain</p>	
Italy	ENEA	Utilization	<p>INNOSOFc: development, validation and demonstration of a 50kW high efficiency cogeneration system based on high temperature fuel cells</p> <p style="text-align: center;">Current  </p>	<p>i) Design and manufacturing of a 50 kW SOFC system with 60% electrical and 85% total efficiency  ii) System and components enabling for a lifetime of 30000 hours and two-years continuous operation without planned shut-downs.  iii) System efficiency and life-time validation according to IEC standards in 3000 hours demonstration  iv) At least 30% reduction in system costs, below 4000 €/kW  v) 2000 €/kW stack costs  vi) Stack life-time and performance validation in 10000 hours test  vii) Identification of most promising end-users and applications for stationary SOFC systems  viii) Efficient all-European SOFC value chain from component manufacturers to end-users  ix) Boost market penetration of stationary fuel cell products and services</p>	Olli Himanen, VTT (Finland)	<p>(Domestic):  – ENEA – Research Institute.  (International):  – VTT: Teknologian tutkimuskeskus – Research Institute – Finland  – Eirngklinger – Industry – Germany  – Elcogen OY – Industry – Finland  – Convion OY – Industry – Finland  – Forschungszentrum Jülich GmbH – Research Institute – Germany  – Energy Matters – Netherlands</p>	<a href="http://www.innosofc.eu/">http://www.innosofc.eu/</a>

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Italy	ENEA	Production	<p>Accordo di Programma ENEA MISE, funded by Italian Ministry of Economic Development/ Development of innovative hydrogen production technologies based on advanced thermochemical routes for the decarbonisation of energy intensive industries (e.g. iron and steel making processes)</p> <p>Current</p> 	<p>i) Experimental testing of calcium Looping (CaL) process for hydrogen production from off gases produced in iron and steel making processes. This process will be emulated at TRL 7 in the ZECOMIX research Infrastructure; ii) development of an innovative high regenerable calcium based sorbent for cycling CO2 capture; iii) development of catalysts resistant to the carbon deposition during dry methane reforming or steam methane reforming; iv) Optimisation of integrated solutions between CaL process and carbon intensive industries (e.g. cement, iron and steel making processes); v) development of innovative catalysts for plasma assisted thermochemical processes (e.g. methanation, reforming of methane)</p>	Dr. Stendardo/ENEA	(Domestic) ENEA, University of L'Aquila	

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Italy	ENEA	Concentrated Solar Energy	IN-POWER / Developing high efficient concentrated solar power architecture through the development of advanced materials solution to increase overall efficiency while decreasing the energy production cost (HORIZON 2020 - NMBP - IA) 	i) Increase 3 times standard thermal storage capacity by novel materials. ii) Reduce 4 times the land use compared to current parabolic trough collector. iii) Bring leveled cost of electricity below 0.10€/kWh beyond 2020	Dr. Della / LEITAT	(Domestic) - ENEA – Research Institute; - Kolzer - Industry; (International) - CEA (France) – Research Institute; - LEITAT (Spain) –Private Copany; - Votteler (Germany) – Industry; - Geocad H2V SL (Spain) – Private Company; - Fertiberia (Spain) – Industry; - Nematia Technologies (Spain) –Private Company; - Magtel (Spain) – Private Company; - IK4 teknoker (Spain) – Research Institute.  ●● field test, ▲▲ modeling.	<a href="http://in-power-project.eu/">http://in-power-project.eu/</a>
Italy	ENEA	Concentrated Solar Energy	ORC_PLUS / Organic Rankine Cycle - Prototype Link to Unit Storage. The aim is to develop an optimized combination of innovative Thermal Energy Storage-TES, small CSP plant, and ORC system to produce electricity from solar source (Horizon 2020 - Energy - IA) 	i) Develop an innovative Thermal Energy Storage system which is optimised for CSP plants in the scale of 1–5 MWe ii) improve the dispatchability (production on demand) and number of hours of production, regardless of sunlight availability, of an existing small CSP plant coupled with an ORC system (located in a desert area).	Dr. Gaggioli / ENEA	(Domestic): - ENEA – Research Institute; - Enerray – Industry; - Laterizi Gambettola srl – Industry; (International): - Euronovia (France) – Industry; - FZK Fraunhofer (Germany) – Research Institute; - IRESEN (Morocco) –Research Institute; - Energygune (Spain) – Research Institute. ●● field test, ▲▲ modeling	<a href="https://www.orc-plus.eu/">https://www.orc-plus.eu/</a>
Italy	ENEA	Concentrated Solar Energy	SFERA III / Solar Facilities for the European Research Area - Third Phase (HORIZON 2020 - ERI - RIA ) 	Contribute to ensure the long-term sustainability of the European advanced solar laboratories, supporting Europe as a global leader in solar research infrastructures. Those activities include (i) networking activities to further develop the cooperation between the research infrastructures, the scientific community, industries and other stakeholders; (ii) transnational access activities aiming at providing access to all European researchers from both academia and industry to singular scientific and technological solar research infrastructures; and (iii) joint research activities whose sole purpose is to improve the integrated services provided by the infrastructure.	Dr. Sanchez / CIEMAT	(Domestic) ENEA – Research Institute; (International): - ESTELA EUROPEAN SOLAR THERMAL ELECTRICITY ASSOCIATION (Belgium) – Association; - THE CYPRUS INSTITUTE (Cyprus) – Research Institute; - EURONOVIA (France) – Private Company; - CEA (France) – Research Institute; - CNRS (France) – Research Institute; - Fraunhofer ISE (Germany) –Research Institute; - DLR (Germany) – Research Institute; - LNEG (Portugal) – Research Institute; - Evora University (Portugal) – University; - Almeida University (Spain) – University; - IMDEA (Spain) – Research Institute; - CIEMAT (Spain) – Research Institute; - ETH (Switzerland) – Research Institute; - Middle East Technical university (Turkey) – University ●● field test, ▲▲ modeling, ■■ standard,	<a href="https://sfera3.sollab.eu/">https://sfera3.sollab.eu/</a>

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Italy	ENEA	Concentrated Solar Energy	RESLAG / Turning waste into value.  	Valorise the steel slag that is currently not being recycled (right now it is partially landfilled and partially stored in the steel factories) and reuse it as a raw material for 4 innovative applications that contribute to a circular economy in the steel sector with an additional cross-sectorial approach. These applications are demonstrated at pilot level and led by end-user industries.	Dr. Palomo / CIC Energigune	(Domestic): - ENEA Research Institute; - Life Cycle Engineering - Company (International): - CIC Energigune (Spain) - Research Institute; - Arcelor Mittal (Spain) - Industry; - IK4 AZTTERLAN (Spain) - Research Institute; - Imperial College (United Kingdom) - University; - Friedrich Alexander University Erlangen (Germany) - University; - Optimum Cement (France) - Industry; - CEA (France) - Research Institute; - Technical Research Centre of Finland (Finland) - Research Institute; - GE (France) - Private Company; - Fraunhofer Society, Project Group for Resource Strategy and Recycling Technologies (Germany) - Research Institute; - Moroccan Agency for Solar Energy MASEN (Morocco) - National Agency. ●● field test, ▲▲ modeling	<a href="http://www.reslag.eu/">http://www.reslag.eu/</a>
Italy	ENEA	Nextowert	NEXTOWER / Introduction of a set of innovative materials to boost the performance of atmospheric air-based concentrated solar power (CSP) systems to make them commercially viable. (Horizon 2020 - NMBP - IA)  	i) optimize bulk and joining materials for durability at the component level, to achieve 25 years of maintenance-free continued service of the receiver and maximum thermodynamic efficiency at the system level ii) achievement of a new generation of materials allowing for virtually maintenance free operations and increased working temperature	Dr. Rinaldi/ENEA	(Domestic): - ENEA - Research Institute; - CALEF - Organization; - Certimac - Certification company; - Walter Tosto - Industry; - University Sapienza - University; - University of Torino - University; (International): - Warrant Group (Belgium) - Private Company; - LiqTech International (Denmark) - Industry; - SilTronix Silicon Technologies (France) - Industry; - ICCRAM (Spain) - Research Institute; - Sandvik (Sweden) - Industry; - CIEMAT (Spain) - Research Institute; - Fundacion ICAMCyL (Spain) - Organization; - R2M SOLUTION SPAIN (Spain) - Private Company; - Spanish Association for Standardization(Spain) Organization; - KTH (Sweden) - University; - EngiCer (Switzerland) - Private Company; - Greenway CSP (Turkey) - Private Company; - University of Oxford (UK) - University	