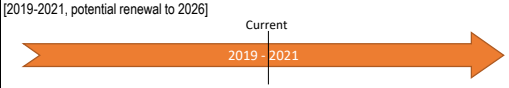
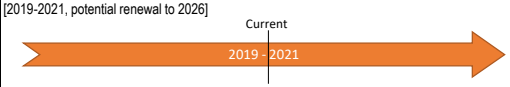
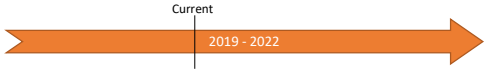
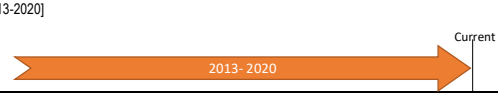
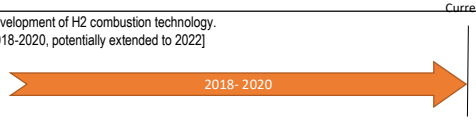
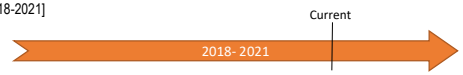
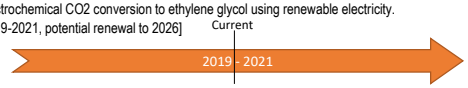
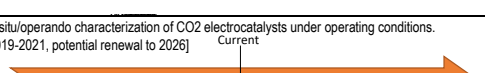
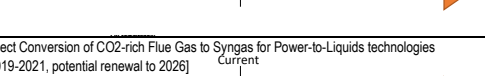
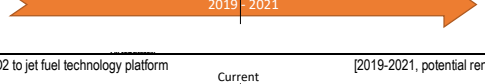
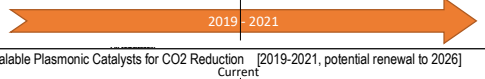
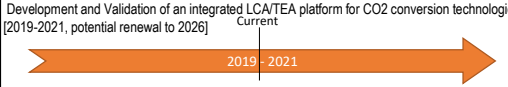
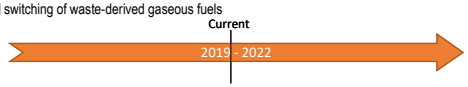
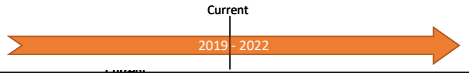
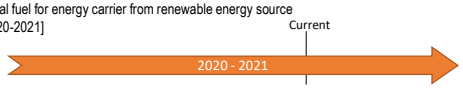
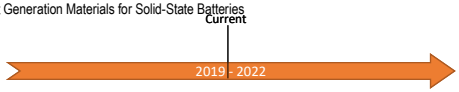
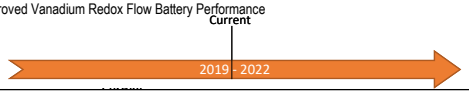
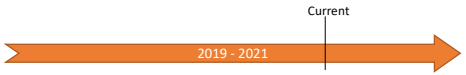
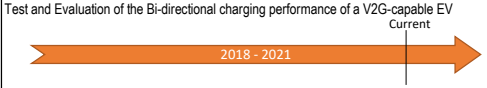
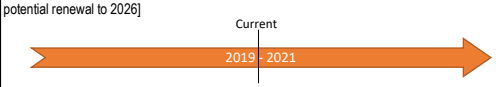
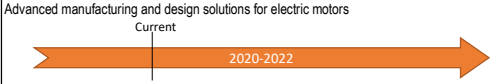
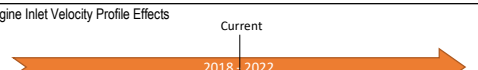
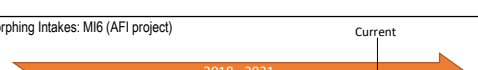
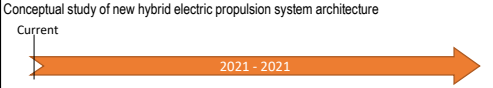
Institute/Country	Theme	Sub Theme	Related programs (with short summary)	Target / Goal Outcome	Lead person / Organization	Partnership (if any)	Related information
National Research Council (NRC) / Canada	Hydrogen	Materials For Clean Fuels Challenge (H2 Production Thrust)	Emissions-free hydrogen production from natural gas decomposition combined with direct carbon fuel cell technology. [2019-2021, potential renewal to 2026] 	Demonstrate technology that utilizes natural gas to produce hydrogen and electricity within a cost of 30% of the incumbent steam methane reforming.	Dr. Will Skrivan	(Domestic) Ekona Power / Prototype demonstration	https://nrc.canada.ca/en/node/1616
			Low-temperature ammonia electrosynthesis from N2 and water. [2019-2021, potential renewal to 2026] 	Discover a catalyst for electrochemical N2 reduction to ammonia as a liquid transport medium for H2.	Dr. Nima Shaigan & Dr. Claudie Roy	(Domestic) University of British Columbia (International) Imperial College London, UK / Materials development	https://nrc.canada.ca/en/node/1616
			High Performance Membrane Electrode Assemblies for Alkaline Solid Electrolyte Water Electrolysis (AEMWE). [2019-2021, potential renewal to 2026 	The development and investigation of high performance membrane electrode assemblies for AEMWE.	Dr. Claudie Roy	(International) Helmholtz-Institut Erlangen-Nürnberg for Renewable Energy, Germany / Materials development	https://nrc.canada.ca/en/node/1616
			Functionalized Boron-Nitride Nanotubes for Energy Applications 	The development of novel boron-nintride nanotube catlysts for plasma-assisted conversion of CO2 and methane into syngas and production of ammonia as a hydrogen carrier	Dr. Kenneth Bosnick	(Domestic) McGill University	https://nrc.canada.ca/en/node/1616
		Vehicle Propulsion Technologies	Materials assessment and quality control of fuel cell technologies for surface transport applications. [2013-2020] 	Development of methods, equipment and protocols for quality control of fuel cell components.	Eddy Zuppel	(Domestic) Canadian industry - Mercedez-Benz Canada, Hydrogenics, etc. (International) Fraunhofer ISE (Germany), NREL (USA), CEA (France), HySA (South Africa)	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program
			Process development including membrane manufacturing and conditioning/additives impact for fuel cell technologies [2013-2020] 	Development of a high-throughput low-cost process to manufacture membranes for fuel cells	Eddy Zuppel	(Domestic) NRCan, Ballard (International) NREL (USA), 3M (USA), Solvay (Italy)	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program
			Systems-level analysis including hydrail, supply chain, refueling stations, and air filter stations for fuel cell vehicles. [2013-2020] 	Development of systems level analysis on Canada-specific use cases for hydrogen fuel cell technologies.	Eddy Zuppel	(Domestic) Canadian Nuclear Laboratories, Transport Canada, Metrolinx, NrCan	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program
			Data Management and Analysis of Hydrogen Refueling Stations [2019-2021] 	Develop core competencies in regard to the analysis of Hydrogen refueling station data, gain expertise in the applicable fueling protocols, and build data analysis template on the existing data	Eddy Zuppel	(Domestic) Natural Resources Canada, Transport Canada, Measurement Canada, HTEC	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program
			Development of H2 combustion technology. [2018-2020, potentially extended to 2022] 	Supported development of a H2-fuelled gas turbine combustion system for a multi-national OEM through high-pressure rig testing.	Nanthan Ramachandran	(Domestic) Multi-national Engine OEM	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre

		Combustion Technologies for Stationary Applications	Next generation land-based gas turbine combustors [2018-2021] 	Develop and optimize a a novel gas turbine fuel injection system for hydrogen-enriched fuels.	Dr. Patrizio Vena	(Domestic) Multi-naitonal Engine OEM	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre
			Hydrogen enriched turbulent flame behaviour [2018-2021] 	Gain a fundamental understanding of physical mechanisms that govern hydrogen-enriched flames	Dr. Patrizio Vena	(Domestic) University of British Columbia	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre
			Low Emission Burner development for turbine application. [2018-2021] 	Develop low emission combustion technologies for turbine application of gaseous fuels with H2 enriched blends	Dr. Sean Yun	(International) Korean Institute of Machinery and Materials	https://nrc.canada.ca/en/research-development/research-collaboration/programs/bioenergy-systems-viable-stationary-applications-program
National Research Council (NRC) / Canada	CCUS	Materials For Clean Fuels Challenge Program (CO2 Conversion Thrust)	Development of ion-exchange membranes tailored for electrochemical CO2 reduction reaction. [2019-2021, potential renewal to 2026] 	Develop ionomer materials to reduce the electrical resistance and overpotential for electrochemical CO2 reduction.	Dr. Ken Shi	(Domestic) Simon Fraser University, Ionomr Technologies	https://nrc.canada.ca/en/node/1616
			Electrochemical CO2 conversion to ethylene glycol using renewable electricity. [2019-2021, potential renewal to 2026] 	Develop catalysts that convert CO2 to ethylene glycol at current densities >100 mA/cm2 using gas diffusion electrodes	Dr. Claudie Roy	(Domestic) University of Toronto	https://nrc.canada.ca/en/node/1616
			CO2 conversion to syngas from bicarbonate solutions coupled with direct air capture. [2019-2021, potential renewal to 2026] 	Develop catalysts that convert CO2 to syngas directly from a basic capture solution at current densities >100 mA/cm2 using a bipolymer membrane	Dr. Ken Shi	(Domestic) University of British Columbia	https://nrc.canada.ca/en/node/1616
			In-situ/operando characterization of CO2 electrocatalysts under operating conditions. [2019-2021, potential renewal to 2026] 	Development of novel characterization techniques for CO2 electroreduction catalysts	Dr. Robert Black	(Domestic) McMaster University	https://nrc.canada.ca/en/node/1616
			Direct Conversion of CO2-rich Flue Gas to Syngas for Power-to-Liquids technologies [2019-2021, potential renewal to 2026] 	Development of catalysts to directly convert flue gas into syngas.	Dr. Samira Lotfi	(Domestic) Universite de Sherbrooke	https://nrc.canada.ca/en/node/1616
			CO2 to jet fuel technology platform [2019-2021, potential renewal to 2026] 	Development of new reverse-water gas shift catalysts and reactor designs for CO2 conversion to jet fuel	Dr. Patrick Mercier	(Domestic) Polytechnique Montreal	https://nrc.canada.ca/en/node/1616
			Scalable Plasmonic Catalysts for CO2 Reduction [2019-2021, potential renewal to 2026] 	Development of new plasmonic catalysts via ultra-fast laser texturing for photoelectrochemical CO2 conversion.	Dr. Yaser Abu-Lebdeh	(Domestic) University of Ottawa	https://nrc.canada.ca/en/node/1616

			Renewable Syngas from Photocatalytic CO2 Conversion [2019-2021, potential renewal to 2026] 	Development of new photocatalysts and pore structures for photochemical CO2 dry reforming to syngas	Dr. Dongfang Yang	(Domestic) University of Toronto	https://nrc.canada.ca/en/node/1616
			Development and Validation of an integrated LCA/TEA platform for CO2 conversion technologies evaluation [2019-2021, potential renewal to 2026] 	Develop of technoeconomic and life cycle analysis of new CO2 conversion technologies.	Dr. Farid Bensebaa	(Domestic) University of Calgary, University of Alberta, University of Toronto	https://nrc.canada.ca/en/node/1616
National Research Council (NRC) / Canada	Renewable Enegy	Advanced Clean Energy Program	Fuel switching of waste-derived gaseous fuels 	Demonstration clean energy generation through production of gaseous fuels via gasification and bioelectrochemical treatment of solid and liquid wastes, respectively, for the application of fuel-switching in dual-fuel internal combustion engines.	Dr. James Butler	(Domestic) Ecole Polytechnique, Tomlinson Environmental Services, Natural Resources Canada	https://nrc.canada.ca/en/research-development/research-collaboration/programs/bioenergy-systems-viable-stationary-applications-program
			Hydrothermal Liquefaction of Low Quality Wet Feedstocks, its blends, and Characterization of Biocrude 	Conversion of food waste to biocrude in various blends utilizing hydrothermal liquefaction and subsequent utilization in internal combustion engines.	Dr. Devinder Singh	(Domestic) Natural Resources Canada, Old Dominion University	https://nrc.canada.ca/en/research-development/research-collaboration/programs/bioenergy-systems-viable-stationary-applications-program
			Demonstration and Further Development of Natural Gas/Renewable Natural Gas - Diesel Dual Fuel Vehicle Technology 	Development and implementation of advanced CI Natural Gas/Renewable Natural Gas-diesel dual fuel technologies to reduce barriers to the adoption in HDVs and reduce CO2, PM and NOx emissions compared to the stock HDVs.	Dr. Hongsheng Guo	(Domestic) Environment and Climate Change Canada, Natural Gas Innovation Fund, Hiller Truck Tech Inc., Innovative Fuel Systems	https://nrc.canada.ca/en/research-development/research-collaboration/programs/bioenergy-systems-viable-stationary-applications-program
			Promising opportunity to reduce Iron and Steel industry energy/feedstock needs and CO2 emissions utilizing residual CO-rich gases 	Utilizing the emissions from the steel industry to biochemically convert to natural gas to displace fossil energy and reduce emissions	Ms. Ruxandra Albu Cimpoia	(Domestic) Canadian Steel Producers Association, McMaster University, CTTEI, Natural Resources Canada	https://nrc.canada.ca/en/research-development/research-collaboration/programs/bioenergy-systems-viable-stationary-applications-program
			An integrated TEA/LCA platform to evaluate bioenergy production from different biomass sources 	Integration of lifecycle analysis and technoeconomic platforms as a comprehensive decision making tool on the production of various gaseous and liquid biofuels from biomass sources, including residuals and MSW	Dr. Farid Bensebaa	(Domestic) Queen's Unviersity, Agriculture Canada, Environment and Climate Change Canada, Natural Resources Canada	https://nrc.canada.ca/en/research-development/research-collaboration/programs/bioenergy-systems-viable-stationary-applications-program
		Aerospace Research Centre	Metal fuel for energy carrier from renewable energy source [2020-2021] 	Validate the potential of using metal fuel as an energy carrier for renewable energy sources	Dr. Sean Yun	(Domestic) McGill University	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre

National Research Council (NRC) / Canada	Energy Management Systems	Advanced Clean Energy Program	Next Generation Materials for Solid-State Batteries 	To design and synthesize composite electrolyte materials and fabrication processes with greater flexibility and chemical stability along with processes	Dr. Yaser Abu-Lebdeh	Domestic (University of British Columbia)	https://nrc.canada.ca/en/research-development/research-collaboration/programs/energy-storage-grid-security-modernization-program
			Improved Vanadium Redox Flow Battery Performance 	To understand and model phenomena occurring in the VRFB and their mechanisms from a fundamental perspective in order to improve specific materials and components.	Dr. Roberto Neagu		https://nrc.canada.ca/en/research-development/research-collaboration/programs/energy-storage-grid-security-modernization-program
			End of Life Lithium Ion Battery Options – Remanufacturing, Repurposing and Recycling 	To develop testing standards and diagnostic tools for the remanufacture/repurpose of end of life batteries, investigate the potential for direct anode regeneration, develop novel elemental separation techniques of anode and cathode materials, and understand the economic and environmental impact of recycling.	Ben Yu		https://nrc.canada.ca/en/research-development/research-collaboration/programs/energy-storage-grid-security-modernization-program
			Energy Storage Model Development with IEA ECES Annex 32 	The development of standardized, scientifically proven datasets / test cases and open-source models for energy storage systems	Darren Jang	(Domestic) Carleton University, University of Victoria (International) IEA ECES Member Countries	https://nrc.canada.ca/en/research-development/research-collaboration/programs/energy-storage-grid-security-modernization-program
			Combustion optimization and system optimization of a micro gas turbine for CHP with power and heat storages 	Optimize and technology demonstration of a micro gas turbine for CHP with power and heat storages	Dr. Zekai Hong	(Domestic) OERD, University of Toronto	https://nrc.canada.ca/en/research-development/research-collaboration/programs/bioenergy-systems-viable-stationary-applications-program
		Vehicle Propulsion Technolgies	Enabling the manufacturing of advanced solid-state batteries 	This project has the overall objective to unlock the challenges related to the materials and manufacturing processes of solid-state batteries by investigating a number of innovative technologies to produce advanced SSEs from both inorganic and polymeric materials.	Dr. Alexis Laforgue	(Domestic) Natural Resources Canada, Blue Solutions, University of Sherbrooke (International) AIST (TBC) (Japan)	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program
			Next generation Li-ion battery anode for electrical vehicles 	Develop the next generation of anode materials to enable higher-energy density and lower cost Li-ion batteries that will accelerate all-electric vehicles mass market penetration and reduce CO2 emissions from transportation.	Dr. Mathieu Toupin	(Domestic) Natural Resources Canada, Mason Graphite, Nouveau Monde Graphite, NanoXplore, Mercedes-Benz Research & Development North America, Tekna	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program
			Test and Evaluation of the Bi-directional charging performance of a V2G-capable EV 	Test and evaluate the bi-directional charging performance of a V2G-capable EV	Dr. Yeong Yoo	(Domestic) Transport Canada	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program
			Electric Vehicle Battery Cell Testing 	Evaulate the durability of battereis for electric vehicles	Dr. Dean MacNeil	(Domestic) Transport Canada	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program
			Electric Vehicle Diagnostics and Propagation Testing 	To evaluate the potential for thermal propagation of an unspecified thermal event with an electric vehcile and its effect on the vehicle and vehicle occupants	Dr. Dean MacNeil	(Domestic) Transport Canada	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program

National Research Council (NRC) / Canada	Other	Materials for Clean Fuels Challenge Program (AI-Accelerated Materails Discovery)	Artificial intelligence accelerated materials discovery for platinum-group-metal-free acid-stable oxygen evolution reaction catalysts. [2019-2021, potential renewal to 2026] 	Utilize high-throughput computational simulation and artificial intelligence to screen for new mixed metal oxides for oxygen evolution reaction	Dr. Isaac Tambyln	(Domestic) University of Toronto (International) Carnegie Mellon University (USA) / algorithm and materials development	https://nrc.canada.ca/en/node/1616
			Automated robotics and unsupervised learning for the discovery of oxygen evolution reaction catalysts. [2019-2021, potential renewal to 2026] 	Automated robotics and deep-learning platform to iteratively discover new materials for the oxygen evolution reaction	Dr. Isaac Tambyln	(Domestic) University of Toronto (USA) / platform and materials development	https://nrc.canada.ca/en/node/1616
		Vehicle Propulsion Technologies	Advanced manufacturing and design solutions for electric motors 	This project aims at developing electric motor solutions for the automotive and aerospace sectors via the use of advanced manufacturing and innovative designs.	Dr. Jean-Michel Lamarre	(Domestic) Natural Resources Canada, Dana-TM4, Polycontrols (International) Boeing (USA)	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program
			Electric Vehicle Life Cycle GHG Analysis 	Evaluate and compare life cycle GHG emissions of electric (EVs) and conventional vehicles (CVs).	Dr. Miyuru Kannangara	(Domestic) Transport Canada, Environment and Climate Change Canada	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program
			Devices for reduction of emissions from heavy duty automotive vehicles using conventional and renewable, low carbon fuels 	The project aims to support broad adoption of low carbon and renewable fuels and advanced ICE solutions in HDV and rail applications by improving the exhaust treatment chain.	Dr. Roberto Neagu	(Domestic) Natural Resources Canada	https://nrc.canada.ca/en/research-development/research-collaboration/programs/vehicle-propulsion-technologies-program
		Advanced Aircraft	Preformance Improvement of small propulsor for UAV application 	Validate high altitude performance and improvement of small propulsor for the UAV application	Dr. Hamza Abo el ella	(Domestic) Carleton university, OEM	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre
			Engine Inlet Velocity Profile Effects 	Design, build and complete scaled testing of distortion-tolerant fan for a variety of flow conditions to serve as a test bed/proof of concept for future full-scale engine BLI studies.	Dr. Faezeh Rasimarzabadi	(Domestic) Bombardier Aerospace (International) GKN Aerospace Engine Systems (UK)	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre
			Morphing Intakes: MI6 (AFI project) 	Proof-of-concept of a morphing engine intake to optimize the aerodynamic performance for an aircraft operating with boundary layer ingestion.	Dr. Wajid Chishty	(Domestic) Royal Military College, University of Toronto, Queen's	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre
			Low Order Simulation of Flying Taxis 	Evaluation of key fuel properties for new Sustainable Aviation Fuels (alternative fuels) to reduce its certification time through combustion testing with international partners	Dr Francois Fortin	(Domestic) UTIAS	
			National Jet Fuel Combustion Project 	Evaluation of key fuel properties for new biofuels (alternative fuels) to reduce its certification time through combustion testing with international partners	Mr. Pervez Canteenwalla	(International) International consortium including FAA (USA), engine OEMs, more than 10 universities from USA, UK and DLR	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre
			Hybrid Electric Aircraft Testbed 	NRC's first electric aircraft project. Involves the development of an airborne electric propulsion test-bed demonstrator that will be used to evaluate various hybrid-electric propulsion systems, configurations, and component technologies, as well as gather experimental data to inform evolving certification requirements.	Dr. Daniel Booth	(Domestic) Carleton University	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre
			Conceptual study of new hybrid electric propulsion system architecture 	Feasibility study of a new conceptual architecture of hybrid electric propulsion system	Dr. Hamza Abo el ella		https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre

		Clean Energy Sources	Research Platform for Serial Hybrid Electric Drvie Train for aeropropulsion 	Build a research test platfrom for system optimization of serial hybrid electric aeropropulsion system	Dr. Osvaldo Arenas	(Domestic) Ryerson university	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre
			Alternative Fuels to 100LL 	Evaluation of candidate unleaded fuels that will replace 100 low-lead fuel that is currently used by the piston-powered General Aviation fleet	Mr. Pervez Canteenwalla Mr. Peter Earle	(Domestic) Transport Canada, Environment and Climate Change Canada, Canadian Owners and Pilot Association (International) Federal Aviation Administration (USA)	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre
			Impact of Alternative Fuels on Afterburner Performance 	Evaluating the effects of Sustainable Aviation Fuels on military aircraft engines with afterburner technology to enable their use in the Royal Canadian Air Force fleet	Dr. Wajid Chishty	(Domestic) Department of National Defence	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre
			Impact of Alternative Fuels on Hot Section Life 	Evaluating the effects of Sustainable Aviation Fuels on military aircraft engines turbine component durability to enable their use in the Royal Canadian Air Force fleet	Dr. Kuiying Chen	(Domestic) Department of National Defence	https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/aerospace-research-centre