

## Physical Sciences Innovation Pipeline | May 2020

Program name	Description	TRL 1 - 3	TRL 4 - 5	TRL 6 - 7	TRL 8 - 9
<b>Formulation technologies</b>					
Crop protection	Silica carrier particles that encapsulate active ingredients (AI) to provide UV protection, increased rainfastness and easier formulation of hydrophobic AI	●	●		
Engineered nano-clay for agriculture applications	Novel nano-clay technology with enhanced cation exchange capacity and efficient loading of agricultural actives	●	●		
<b>UAVs and robotics</b>					
Y4	A more efficient quadrotor UAV design with longer duration suitable for industrial applications	●	●	●	
Safety rotor	A lightweight safety feature for minimizing blade impact in UAV operation	●	●	●	
Novel LIDAR	A novel multi pixel solid state LIDAR (Light Detection and Ranging)	●	●		
Biped	A low cost gyroscopically stabilised biped	●			
<b>Sensors, devices and optoelectronics</b>					
Force sensor	Novel method of detecting force and torque for various applications including UAV, robotics and sports	●	●	●	
Self-mixing terahertz laser	A novel sensing and imaging technology in the terahertz spectrum	●	●		
Ultra high sensitivity magnetometer	Ultrasensitive chip-sized detection of magnetic fields; also applicable in other sectors	●			
Microwave circulator	A passive, on chip, superconducting microwave circulator with high bandwidth (~500 MHz), for use in mobile communications and quantum computing	●			
Light emitting field effect transistors	An organic light-emitting field-effect transistor containing a delayed fluorescent material, excitons can be efficiently used for light emission to remarkably enhance the emission efficiency of the transistor and high mobility along with high on/off ratios	●			
Organic lasing materials	Electrically pumped organic semiconductor lasers based upon novel optical cavities and organic semiconductors. Applications in flexible, flat screen displays, sensors, spectroscopy and telecommunications	●			
Automated microwave inspection system	Microwave/millimetre wave inspection technology assisted by automated (robotic) scanning for hyperloop-type transportation systems	●			
New class of colloidal quantum dots (QDs) for optoelectronics	Process for synthesising highly stable QDs with efficient light emission demonstrated in deep red and near IR (process can also be applied to green and blue QDs)	●			
<b>Big data solutions - health, telecommunications</b>					
Digital pathology	The first stand-alone, ultra-fast, fully automated, microscope-free, fully certified analysis and diagnostic platform for pathology slides	●	●	●	●
Advanced mobility analytics	Video analytics technology which focuses on changing the paradigm of current traffic safety management practice by proactively identifying and diagnosing safety issues before they occur using artificial intelligence (AI) and advanced econometrics. Packaged as SaaS	●	●	●	
Orthogonal precoding for sidelobe spectrum suppression	A novel method for increased spectral efficiency in communication systems. Out of band power suppression using blocking reflectors in the allocated spectrum for enhanced gain	●	●		
Blockchain health	A new method of managing health data with focus on privacy preservation and data ownership	●			
<b>Water and environmental</b>					
SeweX	Algorithm based software for H2S, corrosion reduction and sewer network modelling. Potential for SaaS redevelopment. Commercial projects all over Australia and internationally	●	●	●	●
Lodomat	An advanced system for wastewater treatment of sludge utilising anaerobic digestion, free nitrous acid (FNA) to inactivate nitrite oxidising bacteria (NOB), partial nitrification using NOB to remove nitrogen followed by Anammox process and altering ammonium to alkalinity ratio	●	●		
Alkaline digestion of waste glass	A simple process developed for the extraction of sodium silicate from soda-lime glass, characterised by a high utilisation of the raw material and energy embodied in glass	●	●		
PFAS	Innovative technologies to investigate and remediate PFAS (per- and poly-fluoroalkyl substances) contaminated media including soil and other solid contaminated debris, groundwater, waterways and marine	●	●		
E-waste recycling	Recovering gold and other metals from e-waste using low capex/opex hydrometallurgical process	●			
Dewatering process for wastewater sludge	High frequency/low voltage pulse power and ultrasound for dewatering wastewater organic sludge	●			

### Technology Readiness Levels (TRLs)

- TRL 1** Basic principles observed
- TRL 2** Technology concept formulated
- TRL 3** Experimental proof-of concept
- TRL 4** Technology validated in lab
- TRL 5** Technology validated in relevant environment
- TRL 6** Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7** System prototype demonstration in operational environment
- TRL 8** System complete and qualified
- TRL 9** Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

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<b>Advanced materials</b>					
Nanocomposite elastomers	Strong, tough, yet low modulus elastomers enabled by reinforcement with flexible, tough nanofibers of cellulose	●	●	●	
Nanocellulose	High aspect ratio, extremely tough nanofibers of cellulose for reinforcement, paper, concrete and other applications	●	●	●	
Ultra-bright, low power QD displays and lighting	Significantly improve the ability of quantum dots (QDs) to capture incident light and produce a brighter fluorescence emission	●	●		
Carbon matrix composites	A composite material which can be used as a fire resistant or fire retardant polymer. When pyrolyzed, the material produces a high strength of carbon-carbon composite for use in high temperature applications such as brake components for F1 cars, nose cones and flight surfaces of supersonic and hypersonic vehicles and heat exchangers	●			
Carbon fibre conversion from PVC	Method for forming higher strength/lower weight carbon fibre from contaminated waste and virgin polyvinylchloride (PVC)	●			
<b>Mining and energy innovation</b>					
Producing Zeolite from Mining Tailing	A novel technology to use waste and mining tailings to produce high value Zeolite	●	●		
Frother measuring system	An in-situ device to accurately measure frother concentration in a flotation cell to increase efficiency, yield and revenue of a mining process	●	●		
Photorechargeable battery	Integrated photo-rechargeable battery with a high photovoltaic conversion/storage efficiency of 11%, and remarkable rate-capacity and cycling stability	●	●		
Froth deaeration system	A deaerator apparatus that has been demonstrated to achieve significant air reduction of coal froth	●	●		
Record efficiency QD solar cell	Breakthrough on low-cost emerging generation quantum dot solar cells that achieve a verified world record efficiency of 16.6%	●	●		
Solar F2D2- solar farm fault detection & diagnosis	An algorithmic system that has automatic fault detection, performance monitoring and predictive modelling for solar farm photovoltaic (PV) panels	●	●		
Flotation stability improvement system	An in-situ device to improve stability of froth in the mineral flotation process, using specific sound waves	●			
Optimised blast / drill hole location system	An algorithm to indicate the best next blast/drill hole to optimise operation and reduce cost of blast and operation	●			
High voltage pulse power separation system	Integrated separator system & process for preconcentration of materials using high voltage pulse power	●			
Dewatering process for mining tailings	High frequency/low voltage pulse power dewatering process for mining tailings such as copper, coal and red mud	●			
Enzymatic metal processing	Processing of low grade ore to recover valuable metals using an enzyme-driven bioleaching step	●			
Removal of uranium from copper concentrates	Efficient process for the removal of radionuclides and other contaminants from copper concentrates	●			
Bayer process improvement	Cost reduction for alumina production through reduced caustic soda consumption	●			
Improved off-the-road wheels	Safer wheels for pneumatic tyres for off-road earth moving and mining vehicles	●			
<b>Manufacturing technologies</b>					
Fire retardant glulam timber beams	An innovative but 'manufacturing friendly' process for fabricating low depth, glulam timber beams with FRP (fiber reinforced plastics) for improved fire performance at comparable costs to present commercial solutions	●	●		
<b>Medical technologies</b>					
Psychomotor Vigilance Task (PVT) test alternative	A novel method for assessing neuropsychological impairment using EEG (electroencephalogram)	●	●		
Sleep state determination using EEG	A novel method for determining sleep stages using EEG (electroencephalogram)	●	●		
Ultra-low field MRI	Low magnetic field strength enables the instrument to be used at the bedside, unlike conventional MRI scanners that require specially constructed operating environments for patient and staff safety because of the risks posed by high magnetic field	●			
High sensitivity immunoassays	Nanotechnology-enabled amplification of signals in immunoassay to lower limits of detection	●			
Structural PET imaging using quantum entanglement	A method of using Compton cameras to pinpoint the scattering sites when entangled gamma ray photons are involved, which can lead to the visualisation of structural information	●			
<b>Space technologies</b>					
Hypersonix	Reusable scram jet vehicle technology as part of a process for launching small (-100kg) satellites into Low Earth Orbit.	●			

● Recently partnered    ● Asset available for partnering