Round	ID	Category	Technology name	Transport mode	Short Description	Comments - Year 1	Comments - Year 2	Comments - Year 3
1	EN01	D – Merged	Monovalent LPG engine	Railway	A 12-cylinder Deutz TBG 620 V12 engine is host to the conversion from diesel to LPG. The new LPG option for locomotives offer improved emissions, lower fuel consumption and quieter operation.			
1	EN02	A – Very important	Directly driven propeller	Maritime	Slow speed engine directly connected to propeller shaft, 20 year life time, running 5500 h/a.	Emissions referred to the power used for pushing the vessel forward = thrust power PT		
1	EN03	A – Very important	Mechanically connected propeller	Maritime	Medium speed engine connected by a reduction gear to the propeller shaft, 20 year life time, running 5500 h/a	Emissions referred to the power used for pushing the vessel forward = thrust power PT		
1	EN04	Z – Not relevant	Diesel-Electric propulsion	Maritime	Medium speed engine producing electricity. Propeller shaft rotated by an electric motor, 20 year life time, running 5500 h/a			
1	EN05	Z – Not relevant	Podded azimuthing propulsion	Maritime	Medium speed engine runs generator. Electric motor is inside azimuthing thruster, 20 year life time, running 5500 h/a.			
1	EN06	B – Important	Mechanical azimuthing thrusters	Maritime	The engine runs generator. An electric motor is located inside the ship where it runs propeller shaft. 20 year life time, running 5500 h/a.	Emissions referred to the power used for pushing the vessel forward = thrust power PT		
1	EN07	A – Very important	Diesel-mechanic propulsion with high speed engine	Maritime	High speed engine connected by a reduction gear to the propeller shaft, 20 year life time, running 5500 h/a.	Emissions referred to the power used for pushing the vessel forward = thrust power PT		
1	EN08	Z – Not relevant	Gas turbine	Maritime	Gas turbine connected by reduction gears to the propeller shaft, 20 year life time, running 5500h/a.			
1	EN09	Z – Not relevant	Steam turbine	Maritime	Steam turbine running propeller shaft mechanically, 20 year life time, running 5500 h/a. Working alone.			
1	EN10	Z – Not relevant	Water jet	Maritime	High speed diesel running water jet mechanically, 20 year life time, running 5500 h/a.			
				Inland waterways	High speed diesel running water jet mechanically, 20 year life time, running 5500 h/a.			
1	EN11	B – Important	Diesel-Electric propulsion with dual fuel engine	Maritime	Medium speed engine using LNG (Liquefied Natural Gas) as primary fuel and HFO (Heavy Fuel Oil) or MDO (Marine Diesel Oil) as pilot fuel. The engine runs generator. An electric motor runs propeller shaft. 20 year life time, running 5500 h/a.	Why electrical power? Higher weight - reduced effect. It is a special case of Wärtsilä. Should include mono fuel technologies - LNG.		Although providing reduction in emitted NOx and PM, a better solution would be a monofuel LNG engine (e.g. lean burn, high pressure gas injection). Also, the combinaation diesel-electric is most suited for vessels with an varying operational profile (e.g. offshore vessel).
1	EN12	Z – Not relevant	C.L.E.A.N. Diesel Power Pack	Railway	Bombardier's new C.L.E.A.N. Diesel Power Pack is the lowest emission propulsion system available for diesel multiple units (DMUs)			
1	EN13	X – Need info	Stream(or TramWave) / Linimo	Railway	Magnetic traction system. It could be used in combination with conventional electric traction in cargo handling areas to speed handling and transfer operations. It should be possible to increase power capacity.	Not mature yet, low impact in know technology?		From a MARINTEK perspective this is not a viable technology. However, more info are needed to assess this technology
1	EN14	Z – Not relevant	Third binary application	Railway	It should be possible to use underground hybrid uptake system in railways applications. The idea is to use this technolgy for decreasing cargo handling operations in terminal areas. Present limits are voltage (1200V D.C. vs 3000V D.C. or A.C. system) and safety conditions.			
1	EN15	C – Low importance	LPG Engine for Diesel Locomotives	Railway	A propulsion system for a four-axle, standard-gauge, centre-cab locomotive using a liquefied petroleum gas (LPG) engine instead of conventional diesel	Includes EN01		
1	EN16	A – Very important	Full/parallel hybrid	Road	Electrical support of engine power by saving and re-use of break-energy; combination of 6 cylinder engine plus electrical engine	Merged with EN17, EN19, EN 20. Currently expensive technology, however, an important step to get out of fossil sources		
1	EN17	D – Merged	M2eHybrid Freightliner	Road	Support engine plus auxiliary drive to operate an elevating platform of the truck; combination of 6 cylinder engine plus electrical engine			
1	EN18	B – Important	Fuel cell technology	Road	> 3,5 ton transporter running on renewable fuel cell technology	Requires better description, practical application on large scale not possible in 10 years?	Much research carried out the last 20 years but no significant breakthrough within cargo transport. Necessarry to study the life cycle impact of hydrogen production and distribution. Although the technology has a siginificant greening potential the CapEx is very high. (The fuel cell technology is also described in FU26	
1	EN19	D – Merged	Fuso Canter Eco Hybrid	Road	Light-duty truck on hybrid technology			
1	EN20	D – Merged	Atego BlueTec Hybrid	Road	12 ton rigid truck on hybrid technology			
1	EN21	A – Very important	Exhaust abatement system	Inland Waterways	Emission reduction system comprising a reactor for selective catalytic reduction of NOX and a reactor containing a particulate matter filter for reduction of particulate matter	Specific ex. On how to reduce Nox, emission reduction technology	System for reducing emission of particles and Nox.	
2	EN24	B – Important	Improved Gas Engine	Road	Integrated approach using electronic valve motion management, enhanced cylinder head cooling, near-to-valve port fuel injection system, advanced integrated control	Ref the GREEN Project: http://fens.sabanciuniv.edu/icat2006/icat2000-2006/tr/data/b2-1-Monica%20Ringvik_GREEN_ICAT2006_v2.pdf	Suggeest rename technology to "improved engine/partload control"	Note that this engine technology is also in development for other transport modes, and for all otto/gassoline-engines. Thus, reconsider classification of technology application (transport mode)
2	EN33	D – Merged	Selective Catalytic Reduction	Inland Waterways	Technology for reduction of NOX emissions by injection of urea solution into the exhaust gas			
2	EN36	D – Merged	Particulate matter filter	Inland Waterways	Technology for reduction of PM emissions			

Round	ID	Category	Technology name	Transport mode	Short Description	Comments - Year 1	Comments - Year 2	Comments - Year 3
2	EN39	A – Very important	Gas engines	Inland Waterways	Engines running on natural gas (different solutions available, pure gas engines, gas-diesel engines, dual fuel engines)		Will have a signinficant impact on local emissions to air…	
2	EN42	C – Low importance	CCNR I Engine	Inland Waterways	Most existing engines comply with CCNR I Standard		Appears to be a description of an engine emission standard, and test facilities and not a technology per se. Important technologies are those who would make such advances in emission reduction popssible.	
2	EN45	C – Low importance	CCNR II Engine	Inland Waterways	Today new engines have to comply with CCNR II standard		Appears to be a description of an engine emission standard, and test facilities and not a technology per se. Important technologies are those who would make such advances in emission reduction possible.	
2	EN48	B – Important	CCNR III Engine	Inland Waterways	Still under negotiation		Appears to be a description of an engine emission standard, and test facilities and not a technology per se. Important technologies are those who would make such advances in emission reduction possible.	
2	EN51	B – Important	CCNR IV Engine	Inland Waterways	Still under negotiation		Appears to be a description of an engine emission standard, and test facilities and not a technology per se. Important technologies are those who would make such advances in emission reduction possible.	
2	EN54	C – Low importance	Kaplan propeller in nozzle	Inland Waterways	Nozzle around Kaplan propeller creates additional thrust; highly effective at large propeller loads, Source DST;		Fairly proven technology, more information should be provided for shoving the novelty of the technology.	
2	EN57	C – Low importance	High scew propller	Inland Waterways	Nozzle around high skew propeller creates additional thrust; highly effective at large propeller loads, Source DST;		Fairly proven technology, more information should be provided for shoving the novelty of the technology.	
2	EN58	X – Need info	Reduction of Vehicle Coasting Loss	Railway	The purpose of the Reduction of vehicle coasting loss technology is to eliminate loss of traction inverter and induction motors due to the magnetizing current during the coasting by means of optimisation of traction software and is relevant for both AC and DC services.		Need more information to assess this technology properly. Further, technology should be formally assessed by railway experts	cost effectiveness issue
2	EN59	X – Need info	Increased system voltage 4kV DC	Railway	The DC 4kV system may be seen as an upgraded DC 3kV System. Only by using higher nominal voltages both transmission efficiency and regeneration can be improved considerably. The DC 4 kV system indicates considerably improved energy efficiency and permit increased substation spacing.		Technology should be formally addressed by mode experts within the consortium	moving away DC is preferable - no point to keep DC; US already started removing DC loco with AC loco
2	EN60	X – Need info	Hybrid DE propulsion	Railway	The new technology is a diesel hybrid propulsion system. For the traction motors permanent magnet synchronous (PMSM) motor are used. The PMSM were chosen because they are more lightweight, more compact and have a higher efficiency compared to other electric machines. The energy supply of these traction motor is a diesel machine with a PMSM generator. The generator supplies its energy alternatively to a diode or to an IGBT rectifier. Both types of rectifiers were investigated.		Technology should be formally addressed by mode experts within the consortium	Quite promising but little known about it.
2	EN61	C – Low importance	Counter rotating propeller	Maritime	Thrust system consisting of a pair of propellers behind each other which rotates in opposite directions, so that the aft propeller recovers some of the rotational energy in the slipstream from the forward propeller		Proven technology, also often regarded as too expensivce solution for the maritime transport sector.	
2	EN62	C – Low importance	Diesel turbo compound	Road	Turbocompound systems can be used to affect engine operation using the energy in exhaust gas that is driving the available turbocharger. A first electrical device acts as a generator in response to turbocharger rotation. A second electrical device acts as a motor to put mechanical power into the engine, typically at the crankshaft. Apparatus, systems, steps, and methods are described to control the generator and motor operations to control the amount of power being recovered. This can control engine operation closer to desirable parameters for given engine-related operating conditions compared to actual.		Applicable for very large container vessels, power above 30 MW, unsure about cost efficiency for road vehicles.	

Round	ID	Category	Technology name	Transport mode	Short Description	Comment - Year 1	Comment - Year 2	Comment - Year 3
1	FU01	C – Low importance	Ultra-low sulphur diesel	Maritime	Switch from industrial diesel oil (IDO 0,5% sulphur) to ultra-low sulphur diesel (ULSD 0,005%) for PMs and RTGs. For IWW: Maximum sulphur content: 10mg/kg fuel (= 10 ppmm)	Relevant for bemchmarking. IWW: Precondition for application of various emission reduction technologies (PM filter, EGR, oxidation catalysts, …)	Relevant for bemchmarking. IWW: Precondition for application of various emission reduction technologies (PM filter, EGR, oxidation catalysts, …)	
				Railway				
				Road				
				Inland Waterways				
1	FU02	A – Very important	Ethanol and bio-diesel	Maritime	Investigation about using alternative fuels.	Includes FU10, FU11, FU 12, FU15, FU16, FU19		
				Maritime				
				Road				
1	FU03	A – Very important	CGN (compressed natural gas)	Multimodal	Cleaner fuel for yard handling equipment (Prime movers)			
				Inland Waterways		High space requirement for systems may lead to insufficient cruising ranges	High space requirement for systems may lead to insufficient cruising ranges	
1	FU04	C – Low importance	Solar power network	Maritime	A 6.600 square-meter solar panel able to generate clean energy which will reduce reliance on oil and cut electricity-related greenhouse gas emissions	Difficult to generate large amounts of energy. IWW: Not of relevance, too little power avaiable		
				Inland Waterways	A 6.600 square-meter solar panel able to generate clean energy which will reduce reliance on oil and cut electricity-related greenhouse gas emissions			
				Multimodal	The use of clean energy generated by solar pannels may allow handling of containers in an entirely carbon-neutral way, or by using cranes that actually generate electricity when lowering			
1	FU05	B – Important	Alternative maritime power (AMP)	Maritime	AMP is a shore-side power source, a conversion process to transform the shore-side power voltage to match the vessel power system and a vessel that is fitted with a system capable of taking on electrical power while at dock	Should include suggestion BP09 AMECS (Advanced Emission Control System) found in Best practice category		
1	FU06	B – Important	wind energy	Maritime	Wind turbines which will generate clean energy to power 14 Container Terminal Quay cranes, reefer containers, repair workshops and other power consumption needs	See also skysails. IWW: Not of relevence, too little power		
				Inland Waterways	Wind turbines which will generate clean energy to power 14 Container Terminal Quay cranes, reefer containers, repair workshops and other power consumption needs			
1	FU07	C – Low importance	HFO (Reference)	Maritime	Heavy fuel oil	Use as reference		
				Railway				
				Road				
1	FU08	A – Very important	LNG	Maritime	Liquefied natural gas	See Norwegian supply vessels. IWW: High space requirement for systems may lead to insufficient cruising ranges, being however larger than in the case of using CNG	See Norwegian supply vessels. IWW: High space requirement for systems may lead to insufficient cruising ranges, being however larger than in the case of using CNG	
				Railway				
				Road				
				Inland Waterways				
1	FU09	Z – Not relevant	LBG	Maritime	Liquefied biogas	Low technology level - other fuels more relevant		
				Railway	Liquefied biogas			
				Road	Liquefied biogas			
1	FU10	D – Merged	Vegetable oil	Maritime	Different oil seeds (palm, rape seed, sunfower)	Merge with FU02		
				Railway				
				Road				
1	FU11	D – Merged	Algae oil	Maritime	Oil from algae	Merge with FU02		
				Railway				
				Road				
1	FU12	D – Merged	Biodiesel (compared to Diesel)	Railway	Biodiesel is meant to be used in standard diesel engines and is thus distinct from the vegetable and waste oils used to fuel converted diesel engines. Biodiesel can be used alone, or blended with petrodiesel.	Merge with FU02		
				Road				
				Maritime				
1	FU13	B – Important	Electricity	Road	Electricity is today produced from fossil fuels, nuclear energy and renewable energy sources	Energy source provided is both renewable/non-renewable		
				Railway				
1	FU14	C – Low importance	Hydrogen	Road	Hydrogen is today mainly produced from steam reforming of fossil gas - some production from electricity and renewable sources	Includes FU22. Energy source provided is both renewable/non-renewable. IWW: Niche solutions (e.g. ZEM SHIP in Hamburg), first small applications (e.g. boats), then auxiliary engines, large scale applications not expected for decades; factors as cost, lifetime and reliability are far from being satisfactory ;		
				Inland Waterways				
1	FU15	D – Merged	biodiesel	Road	Biodiesel sold in Europe is mainly produced from european rapeseed. From 2014 and onwards it is expected that second generation BTL at industrial scal will boost developments	Merge with FU02		
				Railway				
				Maritime				

Round	ID	Category	Technology name	Transport mode	Short Description	Comment - Year 1	Comment - Year 2	Comment - Year 3
1	FU16	D – Merged	bioethanol	Road	Bioethanol sold in Europe is mainly produced in Europe, Brazil and China, from sugar cane, sugar beet and corn	Merge with FU02		
				Railway				
				Maritime				
1	FU17	Z – Not relevant	Bio-DME	Road	Bio-DME	Something between biodiesel/bioethanol - not relevant anylonger	Something between biodiesel/bioethanol - not relevant anylonger	
				Railway				
				Maritime				
1	FU18	A – Very important	Biogas	Road	Biogas is mainly produced from bio-wast, agricultural recidues and residues from sewage treatment plants	Includes FU20. IWW: High space requirement for systems may lead to insufficient cruising ranges	Includes FU20. IWW: High space requirement for systems may lead to insufficient cruising ranges	
				Railway				
				Maritime				
				Inland Waterways				
1	FU19	D – Merged	HVO (hydrotreated vegetable oil)	Road	Biofuel from sustainable cultivation of palm oil	Merge with FU02		
1	FU20	D – Merged	Liquid Methane Gas	Road	Methane gas chilled to -130-160℃	Merge with FU18	Merge with FU18	
1	FU21	Z – Not relevant	Bio-DME	Road	Dimethylether from natural gas or biomass	Same as FU17	Same as FU17	
1	FU22	D – Merged	Fuel cell	Road	Hydrogen from electrolysis	Merge with FU14. IWW: Niche solutions (e.g. ZEM SHIP in Hamburg), first small applications (e.g. boats), then auxiliary engines, large scale applications not expected for decades; factors as cost, lifetime and reliability are far from being satisfactory ;	Merge with FU14. IWW: Niche solutions (e.g. ZEM SHIP in Hamburg), first small applications (e.g. boats), then auxiliary engines, large scale applications not expected for decades; factors as cost, lifetime and reliability are far from being satisfactory.	
				Inland Waterways	Electrochemical cell that converts a source fuel (typical Hydrogen or Oxygen) into an electric current without thermal combustion			
1	FU23	C – Low importance	Nuclear Power	Inland Waterways	Nuclear Power	IWW: Not relevant!	IWW: Not relevant!	
				Maritime				
1	FU24	Z – Not relevant	Carbon capture and storage (CCS)	Inland Waterways	Means of mitigating the contribution of fossil fuel emissions to global warming, based on capturing carbon dioxide (CO2) from large point sources. A potentially useful way of dealing with industrial sources of CO2 is to convert it into hydrocarbons where it can be stored or reused as fuel or to make plastics.	Not an energy/fuel source. CCS will only be a viable option when shipboard technologies and storage facilities are developed commercially and even then the technical challenges and economical advantages of this option are yet to be clearly defined	Not an energy/fuel source. CCS will only be a viable option when shipboard technologies and storage facilities are developed commercially and even then the technical challenges and economical advantages of this option are yet to be clearly defined	
				Maritime				
2	FU25	A – Very important	Sky sails system	Maritime	It uses large towing kites for the propulsion of the ship. The tractive forces are transmitted to the ship via a highly tear proof, synthetic rope.		Interesting as a auxiliary propulsion, cost efficient utilisation of renewable anergy. More work should be targeted for developing improved solutions (simplicity of operation, efficiency of the kite, lowering the cost).	
2	FU26	B – Important	Waste heat recovery system	Maritime	It passes exhaust gases from the ship's main engine through a heat exchanger to generate steam for a turbine driven generator the electrical power generated assists ship propulsion or supplies shipboard services.		This is proven tehcnology and applied in larger vessels. For smaller vessels and transport modes, the technology is also there but so far not cost efficient.	
2	FU27	X – Need info	New electrification and energy management	Railway	The idea of the 2x1500V is to use existing/or new feeders and to set their potential to a potential different with the catenary. These feeders are power supplied with new converters installed in existing substations.		2 x 1.5 kV DC system may be of interest only for increase of capacity of the power supply system (upgrade of existing systems when traffic is increased). They are always in competition with additional substations and / or lowering catenary impedances. The profitability of the 2 x 1.5 kV DC system must be carefully evaluated against alternative solutions, when energy savings are more an interesting side effect than the original reason for such investments	more info are necessary
2	FU28	X – Need info	Reduced line impedance	Railway	The approach of the new technology "reduced line impedance" is the reduction of the losses along the line of electrified railway systems. The losses are caused by the impedance/ resistance of the contact line system and the current which is supplied to the locomotive vehicles. The reduction of the impedance/ resistance is caused by higher conductivity of the materials of the contact line systems and/or by enlarged cross sections of contact line systems.		Reduced line impedance of the overhead catenary line (OCL) or railway electric grid is the reduction of losses in the wires. The scope of the strategic assessment reports is the entire European railway system with its different electrification systems and covering both electric and diesel traction. The voltages covered are >1000V. Rail systems with only 750V are not covered in Railenergy.	cost effectiveness despite energy saving

Round	ID	Category	Technology name	Transport mode	Short Description	Comment - Year 1	Comment - Year 2	Comment - Year 3
2	FU29	C – Low importance	Fuel cell hybrid system	Multimodal	Develop fuel-cell systems that are capable of meeting the demands of heavy-duty transport for road, rail and marine applications. These systems will be:-Highly efficient, above 60%-Power dense,-Powerful units of 200kW plus,-Durable, robust and reliable. The two FC technologies considered are: -Polymer Electrolyte Fuel Cell (PEFC) technology and -Solid Oxide Fuel Cell (SOFC) technology. The scientific and technological approach is based on: -FC CLUSTERING -FC HYBRIDISATION	An important objective is the development of high power Fuel Cell Clusters (FCC) that groups FC systems with other technologies, including batteries, thermal energy and energy recuperation. The essential requirements for heavy duty transport are: · power levels above 200 kW, · power density about 200 kW/t, · system efficiency about 60%, · hydrogen and/or hydrocarbon fuelled, · robustness and longevity, · improved environmental impact	Building on comments from year 1.However, the investment cost of such systems are very expensive (high cost of material, which is not likely to change in the future), and dependent of governmental funding. There have been few advances within this area, and progress towards commercialisation is very slow.	
2	FU30	C – Low importance	Flettner rotor	Maritime	It is a vertical cylinder rotating around its axis that converts prevailing wind into propulsive energy.		Too much energy loss, "old" technology which never have had its real breaktrhough in the market	
2	FU31	X – Need info	Reuse of converter energy loss	Railway	Energy produced by operation of power and auxiliary converters, braking rheostat, main transformer and inductors is dissipated in the external ambient by using cooling fluids: air, water and oil. The research objective has been to recover part of this waste energy for a possible reuse on the vehicle. On the top of the air outlet channel has been located a diathermic oil heat exchanger. The outlet hot air transfers the heat to the finned tubes heat recover and then to the oil.		The auxiliary converter block models the loco auxiliary converters and dispatch the power supply to loco cooling systems (e.g. traction motor cooling, cooling tower for converters, etc.). It receives the required cooling power from those subsystem models and calculates the total amount of electric power to sink from the DC bus of the traction converter or from the DC supply if the loco has no line converter. The loco auxiliary converter control system should implement proper strategies to forward the power availability from recovery to the cooling equipment.The propulsion system functionality and characteristics are strictly depending on control algorithms and regulations. The overall efficiency of propulsion system could be improved with optimized control algorithms developed for: • Reduction	how cost effective; energy saving
2	FU32	X – Need info	Parallel substations for AC 25 kV railway power supply systems	Railway	The approach of the new technology “parallel substation for AC 25 kV railway power supply systems” is the balancing load flow control in three-phase distribution, which might cope with the challenges arising from connecting substations in parallel to a three-phase high-voltage transmission grid.		The main advantage of electric traction is a higher power-to-weight ratio than traction systems such as diesel or steam that generate power on board, but which must carry their own fuel supply. Electricity enables faster acceleration and higher tractive effort on steep gradients.Alternating current can be transformed to lower voltages inside the locomotive. This allows much higher voltages and therefore smaller currents along the line, which means smaller energy losses along long railways.	more info are necessary
2	FU33	X – Need info	Trackside energy storage	Railway	Introduction of trackside energy storage units to absorb energy generated by braking vehicles and stores it until the storage unit can feed it back into the power supply system at a later point when vehicles are accelerating. The storage system operates in parallel with the existing traction power supply system and is based on double-layer capacitor technology.		Trackside energy storage systems provide the added capacity to optimize the investment in rolling stock and improve ridership. By capturing the regenerative braking energy and then using it when needed to accelerate, energy'll save , eliminate under and over-voltage conditions and cut the use of resistor banks, which waste regenerative energy and provide unwanted heat in stations and underground structures.	not new; rather complicate the existing system

Round	ID	Category	Technology name	Transport mode	Short Description	Comments - Year 1	Comments - Year 2	Comments - Year 3
1	HT01	A – Very important	Diesel to electric power convertor (RTGs)	Multimodal	RTGs fitted with electrical components in place of traditional hydraulic parts. Conversion will eliminate black emissions and lower noise levels of engines	RTG= rubber tyred gantry crane	RTG= rubber tyred gantry crane	Information does not disclose actual impact of technology, however (i.e. difficult to quantify), the technology will lead to reduce the amount of emissions to air, and particularly reduce local emissions.
1	HT02	Z – Not relevant	VSE (variable speed engines)	Maritime	Application of VSE on RTGs will adjust the speed of the RTG crane engine to match the load demand by regulating the air/fuel ratio for fuel combustion. Engine speed can be reduced from 1500rpm to 800 rpm reducing this way fuel consumption	Same as HT04	Same as HT04	
				Multimodal	Application of VSE on RTGs will adjust the speed of the RTG crane engine to match the load demand by regulating the air/fuel ration for fuel combustion. Engine speed can be reduced from 1500rpm to 800 rpm reducing this way fuel consumption			
1	HT03	A – Very important	Hybrid hydraulic drive for Terminal tractors	Multimodal	Storing braking energy into hydraulic system for acceleration and system	Merged with HT31m HT32	Merged with HT31m HT32	Merged with HT31m HT32
1	HT04	Z – Not relevant	RTG power convertor	Maritime	PSA has fleet of 820 RTGs worlwide powered by diesel engines. PSA decided on acquisition and installation of energy saving speed- device called power convertor on existiing and new RTGs. More suitable for terminals where RTGs are not intensively used, ie remain inactive for long period between container moves. Fuel savings achieved by reducing from 1800rpm to 1200rpm during standby time			
				Multimodal	PSA has fleet of 820 RTGs worlwide powered by diesel engines. PSA decided on acquisition and installation of energy saving speed- device called power convertor on existiing and new RTGs. More suitable for terminals where RTGs are not intensively used, ie remain inactive for long period between container moves. Fuel savings achieved by reducing from 1800rpm to 1200rpm during standby time			
1	HT05	C – Low importance	Timing device for engine start-stop	Multimodal	Applied on yard equipment (Straddle carriers) to shut down the engine after a period of inactivity. This is a timing device that controlls engine shutdown and start-up depending on activity level.		Need more information to determine greening impact of the technology	This is proven technology in automotive industry. Expected greening potential needs to be further investigated.
1	HT06	B – Important	Mains-powered RTG (MP-RTGs)	Multimodal	Mains-powered RTGs transfer the power generation from the engine of the yard crane to a far more efficient power station. Power station can be up to 40% more efficient than equipment engine. Upfront capital cost is higher		Further investigation needed to assess its greening potential on a large scale basis.	
1	HT07	A – Very important	Low emission engines	Multimodal	Replacement of old handling equipment by new machines fitted with Euro III/ IV ccompliant engines. While the upfront capital cost is higher in abt 15K euros/unit, these engines burn diesel more efficiently, give the engine more power while reducing emission of CO2 and providing up to 5% reduction on fuel consumption			
1	HT08	B – Important	ZF transmission systems	Multimodal	Installation in the new PM (prime movers) of new transmission system operating based on Automatic-Manual transmission concept. Reduction of fuel consumption by 10% when compared with older exisiting transmission systems	Relevance to cargo handling?	Relevance to cargo handling?	More information needed to area of application. Will have an impact on local emissions from terminal operations.
1	HT09	B – Important	Green schemes to improve RTGs emissions and noise	Multimodal	Addition of a super-capacitor on RTGs. When RTGs engine is running, it charges the super capacity at the same time, and when super capacitor is fully charged, it will supply electricity to the cranes when it is hoisting a container	Name technology - possible to merge with other RTG technology?	Name technology - possible to merge with other RTG technology?	More infrormation about the maturity of this technology is also needed.
1	HT10	A – Very important	Horizontal container (un)loading	Railway	Metrocargo is an innovative solution for containers cargo handling in overhead electrified railways, it's a containers horizontal movement system from an automated platform to train wagons. This technology is ready to experimentation. Metrocargo will be tested on new Maersk's Platform in Vado Ligure (SV), Italy.			
1	HT11	B – Important	Cargo Cassette and Translifter for cargo cassette	Maritime	Wheelless cassette is a loading platform which is used together with a translifter in a cassette system. Cassettes are specially designed depending on the cargo and handling type. Translifter is a steerable lifting trailer which together with cassettes replaces roll trailers in Ro-Ro (Roll on-Roll off-ship) and StoRo (Stowable Ro-Ro) handling.			
1	HT12	Z – Not relevant	Conro - combined container - roro	Maritime	The basic concept is to double the capacity for containers, which are carried as Lo-Lo (lift on – lift off –ship) in separate compartments fore and aft, with Ro-Ro cargo under the deck. The bow section has a hatchless container hold with movable cellguides for combinations of 20, 40 and 45 feet containers in four different compartments housing in total 192 TEU (twenty-foot equivalent unit). On the aft deck containers are carried four high in movable cellguides for 20, 40 and 45 feet units, giving in total of 150 TEU.	Not a technology	Not a technology	

Round	ID	Category	Technology name	Transport mode	Short Description	Comments - Year 1	Comments - Year 2	Comments - Year 3
1	HT13	X – Need info	Automated container terminal	Maritime	Automatic stacking crane system (ASCs), case Port of Hamburg Terminal operator HHLA (Hamburger Hafen und Logistik AG).	What is the greening potential? Merged with HT27, HT21	What is the greening potential? Merged with HT27, HT21	See comment from Y1 and Y2
1	HT14	Z – Not relevant	Roll trailer technology	Maritime	Loading and unloading of Ro-Ro vessels with general cargo and cargo units	Benefit for greening?	Benefit for greening?	
1	HT15	Z – Not relevant	Double stack on cassette or roll trailer	Maritime	Loading of two containers on a roll trailer of cassette	not a technology	not a technology	
1	HT16	Z – Not relevant	Barge-mothership system	Maritime	Independently ice going technology. Modular barges, avoiding load transfer.	Still on ceoncept stage	Still on ceoncept stage	
1	HT17	Z – Not relevant	EU-CargoExpress project	Maritime	Cargo vessel for small and medium sized ports. Catamaran style Container Ship with on-board loading equipment and very low fuel consumption.	Still on ceoncept stage	Still on ceoncept stage	
1	HT18	Z – Not relevant	E/S Orcelle Green Flagship	Maritime	vision for zero emission car carrying	Still on ceoncept stage	Still on ceoncept stage	
1	HT19	Z – Not relevant	Distivaart	Maritime	Pallet river vessel. The capacity of the River Hopper is max. 520 pallets, which is equal to 20 truck combinations. The pilot phase involved four breweries and four supermarket chains.	result of pilot not included	result of pilot not included	
1	HT20	B – Important	Barge Express (BEX)	Inland Waterways	BEX is an integrated concept for large scale barge container transport aiming at automated handling at barge terminals			Should have more information about greening potential. Still, such concepts may contribute to increase use of intermodal transport solutions and reduce vessel/barge turn around time in port.
1	HT21	D – Merged	Maasvlakte	Maritime	The Deltaport terminal uses AGVs in transporting containers from the stacked storage area (served by rail-mounted gantry cranes) to the apron.	Merge with HT13	Merge with HT13	
1	HT22	Z – Not relevant	Self unloading Vessels	Maritime	3 concept variants: 1) Ro-Ro based (Port hopper and OCC (one container call)); With a vehicle containers are driven onto an elevator on board of a vessel. A crane on board puts the containers into their position. 2) bow transhipment; A crane on board puts the containers directly onto the quay (or onto trailers at the quay). Transhipment takes place along the bow. 3) sideways transhipment. A crane on board puts the containers sideways onto the quay (or onto trailers at the quay). To receive enough crane stability 'legs' are put at the quay.			
1	HT23	Z – Not relevant	Rollerbarge	Multimodal	Rollerbarge is a terminal facility for horizontal transhipment of containers and swap bodies between rail or road transport and barge vessels using a rolling move.	Unclear greening potential	Unclear greening potential	
1	HT24	C – Low importance	Floating Container Terminal (FCT)	Maritime	The FCT collects and distributes containers originating from small calls, and bundles these currents with containers			
1	HT25	X – Need info	Shwople Barge	Inland Waterways	The “Shwople” concept, for loading and unloading trains, has been developed to address the road to inland waterways loading and unloading process.			Should have more information about greening potential. Still, such concepts may contribute to increase use of intermodal transport solutions and reduce vessel/barge turn around time in port.
1	HT26	Z – Not relevant	Container Pallet Transfer (CPT) System	Maritime	The idea of pre-loading containers and trailers on mega-pallets capable of carrying up to 20 x 20 ft containers with a total weight of 400 tons.	Not applicable ref. EU project Create3s		
1	HT27	D – Merged	Thamesport	Maritime	Fully automated yard stacking equipment	Merge with HT13 if applicable	Merge with HT13 if applicable	
1	HT28	B – Important	Automatic RoRo cargo unit handling	Multimodal	The concept is based on self (un)loading of units using a roll-on/roll-off system with a special train of platform cars, called a train loader. The performance of a train loader is often limited by the operation of the stockpile and reclaim system and the capacity of the train loader surge bin. While both are separate systems, they operate in concert to achieve a given performance. Poorly designed reclaim systems, or insufficient train loader surge capacity can significantly downgrade train-loading performance.		Easy cargo tranfer between road and rail, and if implemented on a large scale it can contribute to reduce emission from trucking, while reducing congestion on road as more cargo ius shifted from road to rail. However, more studies are needed to identify its greening potential. (MARINTEK not responsible for this comment, should be confirmed by partner providing the info and the category)	Evaluate whether HT28 and 29 can be combined?
1	HT29	X – Need info	G 2000 Ro-Ro	Multimodal	The G2000 Ro-Ro is an innovative concept based upon an integral train with a new design.The load-bearing component is not the bottom but the roof of the wagons. Plastics or composite materials are used rather than traditional steel. The train set can be swung open and lorries and semi-trailers can be backed into the hull of the train. Lifting devices in the train body sides allow for loading of swap bodies and containers that are lifted directly off lorries that are driven into the train. Transshipment is possible underneath the overhead contact line.		TRL was 7 in 1998. In the same year the principal step in the development of this technology was to calculate the economics of train operations based upon the G2000 RoRo train. (MARINTEK not responsible for this comment, should be confirmed by partner providing the info and the category)	See comment from Y2

Round	ID	Category	Technology name	Transport mode	Short Description	Comments - Year 1	Comments - Year 2	Comments - Year 3
2	HT30	X – Need info	Autoload	Multimodal	Automatic loading/unloading of railway waggons, automated loading of roll trailers and cassettes		More information needed to assess greening potential	
1	HT31	D – Merged	ZF AS Tronic mid	Multimodal	New transmission system for terminal tractors that cuts fuel consumption by around 15%	Merge with HT03 - need more info if applicable	Merge with HT03 - need more info if applicable	
				Maritime	New transmission system for terminal tractors that cuts fuel consumption by around 15%			
2	HT31_a	X – Need info	Solar power network	Multimodal	The use of clean energy generated by solar pannels may allow handling of containers in an entirely carbon-neutral way, or by using cranes that actually generate electricity when lowering container boxes		Is the systme to be used in combination with kinetic energy? This needs to be determined before assessment can be done. Further, space capacity for installation of equipment can be an issue. How do the system account for terminal operations 24hours a day?	In addition to comment from y2, more information about size of installed solar pannels is needed.
1	HT32	D – Merged	Hybrid propulsion technology for Terminal tractors	Multimodal	System to be applied on terminal tractors aiming at reducing pollution. The hybrid technology helps to reduce or even eliminate emissions during idling which is 50% of a PM cycle	Merge with HT03 - need more info if applicable	Merge with HT03 - need more info if applicable	
				Maritime	System to be applied on terminal tractors aiming at reducing pollution. The hybrid technology helps to reduce or even eliminate emissions during idling which is 50% of a PM cycle			
2	HT32_a	C – Low importance	River-Sea Push Barge System	Maritime	The river-sea push barge is a transport system in which one and the same push barge is used for the sea- and the river leg in a transport chain.		Much research has been carried out within the field. However more information is needed on market uptake and technology readyness. River–sea transport is an interesting intermodal transport concept by definition, because seaport transshipment is avoided. Nevertheless, the concept has not been widely developed in Europe. River conditions, draft restrictions in particular, generally form a major impediment. This restricts physical opportunities for this concept to a very limited number of transport corridors, and even then it is faced by limitations influencing the economic attractiveness of such a concept (Konings and Ludema, 2000).	See comment Y2.
2	HT33	C – Low importance	Combined Traffic Carrier Ship/Barge (CTCB)	Maritime	A shortsea concept based on a new type of shortsea vessel: the Trans Sea Lifter (TSL). This vessel is able to carry floating unit load carriers, in particular barges generally used in inland navigation, between inland waterways that are separated by the open sea.		Similar concept studied in EU project Create3S. Questions on investment cost, evironmental impact due to significant use of ballast water and energy consumption for ballasting operation. Also questions related to reduced load factor.	See comment Y2 (also see VE21)
2	HT34	C – Low importance	Intermodal loading unit	Multimodal	New technical solutions for intermodal loading units including containers, dedicated adaptors and mobile internal fixtures in order to shift the main transportation route for goods from the road onto rail and inland waterways in a sustainable way. The technical activities will be focused on the development and design of large ISO containers and ISO compatible roll-off containers with the dimensions of 2 550 x 2 900 x 7 450 mm. These dimensions comply with the recommended directive of the European Commission for intermodal loading units.		More information needed before assessment can be made. Uncertain whether this is an ongoing development project. A better description of the technology per se is needed.	See comment Y2. Also, this requires a change in defacto use of standards for containers for Europe. Unsure of the level of R&D necessary and greening potential
2	HT35	D – Merged	Coaster Express (CoEx)	Maritime	Short sea transport concept directed to bundling the transport flows, scaling-up the short sea facilities and standardization and automation of the transition processes.		Same as "Best Practice", BP08	
2	HT36	B – Important	FlexiWaggon	Railway	Flexiwaggon can combine lorries, buses, cars, containers on one and the same waggon. Individual loading and unloading of waggons. Loading and unloading is done horizontally which means no consideration is necessary for overhead contact lines. The emissions will be reduced by 75%, including carbon dioxide emissions		Similar to the Train loader System and Autoload? Possible to merge the technologies?	More details needed for claimed energy savings. However, solutions like this are important for increasing level of intermodal transport solutions. Thus efforts are needed.

Round	ID	Category	Technology name	Transport mode	Short Description	Comment year3
3	CP1	C – Low importance	Cardboard pallets	Multimodal	ecological and sustainable being made of recycled materials and completely recyclable, have low weight but good strength	Limited greening effect
3	CP2	C – Low importance	Modularized Boxes	Multimodal	Containers modularized and standardized worldwide in terms of dimensions, functions and fixtures. Easy to handle, store, transport, interlock, load, unload, construct and dismantle, compose and decompose. Environment friendly materials with minimal off-service footprint.	This already exist in avaition also the ISO container is standardised world wide.
3	CP3	C – Low importance	Passive controlled atmosphere system	Multimodal	Passive controlled atmosphere system in which the fruit itself creates the desired environment. Lower oxygen levels slow down the respiration process of the fruits.	Limited greening effect on transport operation. More information is needed on the level of innovation and technology maturity
3	CP4	C – Low importance	Cargo hold tank coatings	Multimodal	Innovative cargo hold tank coatings to reduce abrasion and corrosion.	Limited greening effect on transport operation. More information needed on area of applicability and potential gain. What is cost-benefit?
3	CP5	C – Low importance	Software for optimal pallet configuration	Multimodal	Software for optimal pallet configuration to reduce shipping costs. The user enters primary package or box dimensions and rapidly assembles optimal pallet configurations.	Limited greening effect
3	CP6	X – Need info	Polyethylene flexitanks	Multimodal	Polyethylene flexitanks for wine and food-grade liquids together with non-hazardous chemicals and specialty oils.	Possible negative greening impact if tanks are disposable after use. More information is needed about technology and area of applicability

Round	ID	Category	Technology name	Transport mode	Short Description	Comment - Year 1	Comment Year 2	Comment Year 3
1	HC01	Z – Not relevant	e-Reefer containers	Multimodal	Hanjins eco-friendly reefer containers: When a reefer container is produced 'Urethane Foam' and 'Blowing Agent' are injected between the inside and outside plates for insulation. This 'Blowing Agent' consists of 'HCFC – 141b', which has high Global Warming Potential and produces approximately 23 tons of CO2 when exposed to the air during dismantlement while Supotec produces 69kg of CO2. Thus, in order to save the environment, MCIQ (Maersk Container Industry Qingdao) created 'SuPoTec (Sustainable Polyurethane Technology)' as a substitution for 'HCFC – 141b' and has been adopting it to all of its reefer containers.	Difficult to benchmark. Related to policy implications. Lack information.	Difficult to benchmark. Related to policy implications. Lack information.	
1	HC02	B – Important	Intelligent temprature unit	Multimodal	Current refrigerated boxcars will be built with energy efficient cooling systems, GPS (Global Positioning System) tracking, fresh air exchange and the ability to remote monitoring the systems, sometimes from thousands of km away on a network. RFID (Radio Frequency Identification) for tracking services are the main support in management systems of perishable goods.	Should this be moved to innovative units & treatments category?	Should this be moved to innovative units & treatments category?	Appears to be similar to HC04, although with a bigger service specter Possible with a merge? This technology will only grow in importance due to increase in safety measures and more efficient cargo handling.
1	HC03	B – Important	Temperature control units	Road	CryoTech: Liquid CO2 modules for temperature for multi temperature control (cooling/heating)	What is the benefit of this technology and possibilities for benchmarking	What is the benefit of this technology and possibilities for benchmarking	This is proven technology and currently being applied by the industry. Hence, technology is considered as important.
3	HC04	B – Important	RFID tag antenna with temperature alarm sensor	Multimodal	RFID tag antenna with ultra-low cost temperature alarm sensors which is capable of detecting temperature violations above a critical temperature threshold.			This technology can be applied on containers, thus not limited to road. More research needs to be carried out for improving cost efficiency of production and operation. Also, more information needed to determine greening potential
3	HC05	C – Low importance	Natural refrigerants	Multimodal	Natural refrigerants are chemicals which occur in nature's bio-chemical processes. They do not deplete the ozone layer and make negligible contribution to global warming. Their high efficiency means they make a much lower, indirect contribution to global warming than many synthetic refrigerants.			
3	HC06	C – Low importance	Systems to Reduce Heating Costs in Cold Climates	Multimodal	The project will investigate two cooling approaches during the compression process. In one approach, relatively large amounts of oil are injected into the compressor to absorb heat generated throughout the compression stage. In the second approach, a mixture of liquid and vapor refrigerant from the expansion stage is injected at various points during compression to provide cooling. The added steps improve the compression process while also reducing energy losses due to friction in the expansion stage.			
3	HC07	C – Low importance	Software program QUEST	Maritime	QUEST is a CO2 emission friendly software with focus on maintaining a constant cargo temperature. It regulates the return air temperature and allows the supply air temperature to fluctuate without exposing the cargo to chill damages.			
3	HC08	C – Low importance	Truck Refrigeration Unit TDJS35HP	Road	Truck refrigeration unit enables simultaneous temperature control of two separate cargo compartments with different temperature settings entirely by heat pump.			

Round	ID	Category	Technology name	Transport mode	Short Description	Comment - Year 2	Comment - Year 3
1	LU01	Z – Not relevant	Transhipment of standard semi - trailers from the road to the rail	Railway Road Multimodal	Semi-Trailers are the largest segment of the loading devices in European long-distance transportation. Trailers are 45% of the German long-distance transportation. Market share in the German long-distance transportation for semi-trailer rises steadily. But only 2% of the German semi-trailer have the ability for lifting by crane and thus are available for the existing Combined Transport (CT). In the meantime a large number of transhipment technologies have been developed with the objective to ensure a technically and economically optimal transhipment of semi-trailers without ability for lifting by crane to rail and to enable and strengthen the use of/for CT.	Description of challenge rather than a technology solution	
1	LU02	C – Low importance	SECU unit	Multimodal	The SECU (Stora Enso Cargo Unit) is ISO certified for 93.5 gross tonnes. The dimensions are 3.6 x 3.6 x 13.8 m	Must be possible to expand the scope - Not a technology rather a creative use of the exsisting system - is it applicable for other areas of transport - eg. Container size not allowed on road?	This is prroven technology and less relevant for R&D.
1	LU03	C – Low importance	Loading plate	Maritime	Actiw LoadPlate was developed to meet customer demands for quick loading of standard cargo space: sea containers, trailers. Solution is suitable for loading difficult cargo that is hard to containerise.		Proven technology in several transport sectors. Less relevant for R&D
1	LU04	C – Low importance	Trailer stand	Maritime	Simple system to lash trailers	Applicable RoRo ship - what else	Have little impact on greening of transport. More to safety of sea transport
1	LU05	C – Low importance	2,5 wide container	Multimodal	Allows two pallets to be loaded side by side	Flexibility & optimized use of carrier. Relevant to policy implications rather than technolgy issue	See comment Y2
2	LU06	D – Merged			Equip a Diesel-electric shunting engine with a serial hybrid	To be merged with hybrid technology?	Hybrid technologies possibly to be pooled under one category. Fuel cells are still not adequate in termns of energy density and operational life. Need also to check fuel cell energy inputs
2	LU07	D – Merged			Equip a Diesel-electric shunting engine with a parallel hybrid	To be merged with hybrid technology?	possible merger candidate with hybrids. Again real limitations on range and energy density.
2	LU08	D – Merged			Fuel cell to provide the energy for a shunting locomotive	To be merged with hybrid technology?	
2	LU09	D – Merged			Energy storing unit for non-electrified railway tracks	To be merged with hybrid technology?	See NS project and limitations
2	LU10	X – Need info	Waste energy feed system		Waste energy feed system for Diesel tracks	Need more information on aplicaiton areas	Technoology relelvant for all modes on heavy load. More details about the concept is necessary before a proper evaluation can be done. Also, need info on mode of transport targeted for techn. Technology proven for maritime industry (deep sea transport).
2	LU11	C – Low importance	APU (Auxiliary Power Unit)	Railway	An auxiliary power unit (APU) is a device on a locomotive whose purpose is to provide energy saving and to reduce the polluting emissions. Locomotive engines cannot use antifreeze in their cooling systems for technical reasons related to reactions of antifreeze chemicals on internal engine parts. Therefore, during cold weather, a locomotive engine must either be working to transport freight or idling to prevent freezing.The APU keeps the main engine warm, reducing fuel consumption and emissions while the main engine is shut down and also APU reduces railway noise levels	This technology is standard within road, to some extent maritime, thus more information is needed to assess its novelty in railway application. Should be further pursued by railway experts within the consortium	APU could be replaced by shore supply power
2	LU12	X – Need info	Metering technology for traction energy consumption	Railway	Several sensors to measure energy consumption (circuit breaker, roof systems)	On-board energy meters for electric stock provide consumption data which are more reliable than those generated by simulation. These data facilitate energy debiting and monitoring of energy saving measures. The installation of energy meters in railway vehicles facilitates the exact measurements of energy consumption. This serves mainly two purposes:1)provide consumption data for an exact energy billing system 2)provide consumption data for the identification and assessment of energy saving measures.In diesel traction the energy supply is on-board and therefore the energy consumed can be clearly attributed to one single vehicle (nevertheless an additional diesel flow meter can have an additional benefit). In contrast, in electric systems energy consumption is usually measured at the substations only which does not allow for an exact assignment to one single vehicle, since several vehicles may be in the same feeding section.	more info are needed
2	LU13	B – Important	Braking energy recovery	Railway	Recovery of dynamic braking energy and restitution to national grid / Reversible DB Substaion	This is proven technology and applied within the railway industry today, meaning more information is needed to evaluate its novelty.	

Round	ID	Category	Technology name	Transport mode	Short Description	Comment - Year 2	Comment - Year 3
2	LU14	B – Important	Onboard energy storage systems	Railway	Supercaps, batteries, flywheels, hybrid storage; A flywheel is a mechanical device with a significant moment of inertia used as a storage device for rotational energy.Flywheel energy storage, or the rotational energy of a flywheel, and rechargeable electric traction batteries are also used as storage systems.Batteries are electrochemical energy storage systems.A supercapacitor is a tool offering very high electrical capacitance in a small package.A hybrid train is a locomotive, railcar or train that uses an onboard rechargeable energy storage system (RESS), placed between the power source (often a diesel engine prime mover) and the traction transmission system connected to the wheels	Energy storage devices called ultracapacitors could lower the cost of the battery packs in plug-in hybrid vehicles.Ultracapacitors could also dramatically improve the efficiency of another class of hybrid vehicle that uses small electric motors.Ultracapacitors offer a way to extend the life of a hybrid vehicle's power source, reducing the need to oversize its battery packs. Unlike batteries, ultracapacitors don't rely on chemical reactions to store energy, and they don't degrade significantly over the life of a car, even when they are charged and discharged in very intense bursts that can damage batteries. The use of hybrid locomotives can reduce locomotive exhaust emissions and energy consumption, while providing an adequate or equitable amount of power to operate trains.Hybrid vehicles and electric vehicles use a system of storing energy, which is rechargeable. The rechargeable electricity energy system, as it is commonly known, uses supercapacitors as its storage system. NB: Should be formally aevaluated by railway expert within the consortium.	Lots of exeperimnetal activity but little proven application and acceptance
2	LU15	X – Need info	Superconducting traction transformer	Railway	Cooling system/Underfloor HTS transformer with 4 reactors	Research and development work is in hand for a high-capacity pulse-tube cryocooler that is at the heart of a cooling system of superconducting traction transformers that supports an overhead line voltage of 25 kV on the Shinkansen (bullet train) lines.The requirements in the specification of the cryocooler provide for a cooling capacity of 1 kW or more at a temperature of 65 K,percent Carnot of 18 % or more (Th=300 K).The development challenge to meet this specification is to reduce the weight of Shinkansen vehicles, the weight reduction being achieved by applying superconductivity to the coils of traction transformers which are some of the heaviest items of equipment on the vehicle.Regarding normal oil-cooled traction transformers that are currently mounted on Shinkansen trains,those mounted on the N700 series since April 2008 are the lightest design to date,with a mass-to-capacity ratio of 0.69.Provided that the AC loss becomes 1 kW or less,assuming capacity to be 4 MVA,there is a prospect that superconducting traction transformers offer an advantage over normal traction transformers in terms of their mass-to-capacity ratio,even if the mass of the cooling equipment for generating subcooled liquid nitrogen to replace the oil-cooling is added.	How cost effective is this?
2	LU16	X – Need info	Medium Frequency Traction Transformer	Railway	Insulation and cooling system by an HV Module	Evaluation of medium-frequency topologies based on available and emerging power semiconductors, Laboratory test-setup.for city train it leads to low rated efficiency and strong overload (160% due to reasons of installation space and mass) and average efficiency.High speed train: Conventional AC15kV traction transformer vs. MF-transformer □ MF-transformer increases the efficiency by 3-5% □ MF-transformer saves mass (axle loads!) and can allow new vehicle concepts □ MF- technology can be provided at higher investment cost, but cost for conventional traction transformer will increase (copper and iron price) □ MF- technology reduces energy usage/costs	This is outside MARINTEK domain and the status of the Category should be decided by rail experts in the project
2	LU17	X – Need info	Waste heat recovery	Railway	Recover of aircon power in DMUs by a waste driven HVAC	A waste heat recovery unit (WHRU) is an energy recovery heat exchanger that recovers heat from hot streams with potential high energy content, such as hot flue gases from a diesel generator or steam from cooling towers or even waste water from different cooling processes such as in steel cooling.Each Diesel Multiple Unit (DMU) car shall be equipped with two roof-mounted, Heating, Ventilation and Air Conditioning (HVAC) units. The HVAC units shall be removable and selfcontained, and shall utilize scroll compressors using R400-series refrigerants for cooling. R134a refrigerant may be proposed with Customer approval. A non-chemical refrigerant system may also be proposed for consideration by the Customer.The DMU shall have a main air distribution duct in the ceiling of the car, which shall supply the main ceiling air diffusers and supplementary side wall air diffusers located above the side windows. Heating shall be provided by forced air overhead heat in the HVAC units and by convection floor heaters along the base of the side walls in the car interiors. Freeze protection shall be provided at the side door thresholds and all fresh water system components that may be exposed to freezing conditions.	Useful only in passenger applications

Round	ID	Category	Technology name	Transport mode	Short Description	Comments - Year 2	Comments - Year 3
1	VE01	B – Important	Hybrid Locomotive	Railway	Hybrid Locomotive was developed with the goal of creating the cleanest, most fuel-efficient high-horsepower diesel locomotive ever built.		
1	VE02	A – Very important	Electric Locomotive	Railway	NS 999 is an entirely electric locomotive that uses a lead-acid energy storage system without the use of a diesel engine and with zero exhaust emissions.		
1	VE03	A – Very important	Hybrid Truck	Road	The M2e Hybrid Freightliner; Support engine plus auxiliary drive to operate an elevating platform of the truck; combination of 6 cylinder engine plus electrical engine	Includes VE05, VE06, VE07, VE08	
1	VE04	C – Low importance	Fuel Cells	Road	3,5 ton F-Cell Sprinter is a transporter running on renewable fuel cell technology.	This technology represents a limited 2001 demonstration project. The fuel cell technology is generally described at VE11	In general the technology is still too immature, and is not commercially viable. Not cost efficient for many decades. Possibly for pilot projects, but not for commercial application. Hence, categorized as C - lowimportance
1	VE05	D – Merged	Fuso Canter Eco Hybrid	Road	Light-duty truck on hybrid technology	merge with VE03	
1	VE06	D – Merged	Atego BlueTec Hybrid	Road	12 ton rigid truck on hybrid technology	merge with VE03	
1	VE07	D – Merged	Hybrid vehicles	Road	Hybrid power-trains combine diesel engines with an electric engine and batteries.	Time to market refers to low volume market introduction. More large scale is probably 1-2 years ahead. Hybridizaton will often be done in combination with alternative fuels	
1	VE08	D – Merged	Plug-in hybrid vehicles	Road	As above, but vehicles can be charged from the Grid	Time to market refers to low volume market introduction. More large scale is probably 3-4 years ahead	
1	VE09	A – Very important	Electric vehicles	Road	Battery-electric vehicles	Electricity and hydrogen (when used in fuel cells) have no harmful emission when used. Relevant emissions occur when producing the fuels.	
1	VE10	A – Very important	Euro VI vehicles	Road	Euro VI is compulory for new trucks from 2013, replacing Euro V		
1	VE12	Z – Not relevant	Vehicles on Biodiesel	Road	Vehicles certified for EN14214 biodiesel		
1	VE13	Z – Not relevant	Vehicles on Bioethanol	Road	(ED95)	for NOx and PM emissions refer to http://www.lowcvp.org.uk/	
1	VE14	Z – Not relevant	Vehicles on bio-DME	Road		No decision has been made on market introduction.	
1	VE15	Z – Not relevant	Vehicles on biogas	Road	CNG/LNG vehicles. These vehilces usually satisfy Euro VI requirements		
1	VE16	Z – Not relevant	Barge-mothership system	Inland Waterways	Independently ice going technology. Modular barges, avoiding load transfer.	Covered in the engine technology category	
1	VE17	Z – Not relevant	EU-CargoExpress project	Maritime	Cargo vessel for small and medium sized ports. Catamaran style Container Ship with on-board loading equipment and very low fuel consumption.	Covered in the engine technology category	
1	VE18	Z – Not relevant	E/S Orcelle Green Flagship	Maritime	vision for zero emission car carrying	Covered in the engine technology category	
1	VE19	Z – Not relevant	Distivaart	Inland Waterways	Pallet river vessel. The capacity of the River Hopper is max. 520 pallets, which is equal to 20 truck combinations. The pilot phase involved four breweries and four supermarket chains.	Covered in the engine technology category	
1	VE20	C – Low importance	River-Sea Push Barge System	Inland Waterways	The river-sea push barge is a transport system in which one and the same push barge is used for the sea- and the river leg in a transport chain.		Despite several research efforts the concept has still to prove commercial success. The lack of technology information reflects the decision on category.
1	VE21	C – Low importance	Combined Traffic Carrier Ship/Barge (CTCB)	Maritime	A shortsea concept based on a new type of shortsea vessel: the Trans Sea Lifter (TSL). This vessel is able to carry floating unit load carriers, in particular barges generally used in inland navigation, between inland waterways that are separated by the open sea.		The operational and cost efficiency of such a solution must be thoroughly investigated before more R&D efforts are targeted for this. Many projects have been concluded on similar concepts, and very few solutions have been realized by the industry.The lack of technology information reflects the decision on category.

Round	ID	Category	Technology name	Transport mode	Short Description	Comments - Year 2	Comments - Year 3
				Inland Waterways			
1	VE22	B – Important	Road-rail cargo interchange	Railway	The Flexiwagon rail project will allow containers to be moved by road and by train by loading trucks onto railcars.	Should be formally evaluated by railway experts	
1	VE23	D – Merged	APU (Auxiliary Power Unit)	Railway	An auxiliary power unit (APU) is a device on a locomotive whose purpose is to provide energy saving and to reduce the polluting emissions.	Merged with LU11	
1	VE24	D – Merged	Metering technology for traction energy consumption	Railway	Several sensors to measure energy consumption (circuit breaker, roof systems)	Merge with VE25	
1	VE25	B – Important	Brake energy recovery system	Railway	Reversible DC Substation for recovering of dynamic braking energy and restitution to national grid	Includes VE24	
1	VE26	D – Merged	Onboard energy storage systems	Railway	Moved to LU14, as this is a regarded as an innovative unit		
2	VE29	B – Important	Aerodynamic drag improvements	Road	Aerodynamic mirrors, cab side extenders, integrated cab roof fairings, aerodynamic front bumper, full fuel tank fairings, trailer side skirt fairings, trailer gap fairing, rear mounted trailer fairing. Ref to the "Reducing heavy -duty long haul combination truck fuel consumption and CO2 emissions report" http://www.nescaum.org/documents/heavy-duty-truck-ghg_report_final-200910.pdf/	There should be more focus on design of the truck/lorry, and not only on the appendixes. Ref to aviation and car industry	
2	VE30	X – Need info	Combinated vehicle	Road	Trailer weight and size increase (Rocky Mountain doubles, 28 foot triplets, Turnpike doubles). Ref to the "Reducing heavy -duty long haul combination truck fuel consumption and CO2 emissions report" http://www.nescaum.org/documents/heavy-duty-truck-ghg_report_final-200910.pdf/	More information is needed about technology/vehicle in order to perfrom a proper evaluation	Still more information needed.
2	VE31	C – Low importance	Innovative bogie	Railway	New-generation of powered bogie with axles directly driven by synchronous motors is already available for light rail vehicles. Traction, running gear and braking technologies are combined in the bogie in order to form a highly integrated mechatronic system.	A question whether this is research or scaling of already existing solutions? Also, what is the real gain by applying this technology (ref timeline and potentail for CO2 reduction). More information should be provided before proper evalualtion	see 2ES5 electric loco below. Whole life cost benefits?
2	VE32	C – Low importance	Friction control measure	Railway	Some energy expended by the train is lost to wheel-to-rail friction. Reductions in wheel-to-rail resistance can be made via improved lubrication. Efficient lubrication systems, such as top-of-rail lubrication systems, reduce wheel and rail wear and reduce fuel consumption	What is the real gain by applying this technology (ref timeline and potentail for CO2 reduction). More information should be provided before proper evalualtion	infrastructure category?
2	VE33	C – Low importance	Low rolling resistance tires	Road	Tires which are designed to minimize the energy wasted as heat as the tire rolls down the road	This is an important area, but under constant focus by tyre producers. Question about novelty ?	
2	VE34	X – Need info	Dual Voltage Locomotive	Railway	A locomotive designed to work with bot DC and AC and with different voltages, allowing to operate transport between different countries (e.g. Italy and Austria) without the necessity of loco change	Need to be formally addressed by rail experts	Need more information on technology, and whether it is proven or not. In example, does it mean that the locomotive has two engines. Also, how big is this market, meaning if it is relevant for other EU countries?
3	VE35	B – Important	Electrification ofTrucks on Highways	Road	The eHighway concept introduces the idea of diesel-electric hybrid trucks which can work like a electric trolley when overhead electric lines are available and work as a diesel		
1	VE11	Z – Not relevant	Vehicles on Hydrogen	Road	Hydrogen is converted to electricity in fuel cells		

Round	ID	Category	Technology name	Transport mode	Short Description	Comments Year 2	Comment year 3
1	NA01	B – Important	Train Control System	Railway	An award winning new technology for complete train control and tracking system based on a special GPRS based method.		
1	NA02	A – Very important	Automatic Identification System (AIS)	Maritime	Ship-to-ship, ship-to-shore and shore-to-ship system. Main purpose is collision avoidance, ship tracking and tracing. Works on VHF (Very high frequency, 30–300 MHz) radio frequency.	Includes NA03, NA04	
1	NA03	D – Merged	AIS Application-Specific Messages	Maritime	Flexible message type extending the usage and variety of information to be transmitted through AIS	Merge with NA02	
1	NA04	D – Merged	Satellite AIS	Maritime	Satellite detection of AIS signals from ships, using Low earth Orbit satellites	Merge with NA02	
1	NA05	B – Important	ECDIS	Maritime	An Electronic Chart Display and Information System (ECDIS) is a computer-based navigation information system that complies with International Maritime Organization (IMO) regulations and can be used as an alternative to paper nautical charts. IMO refers to similar systems not meeting the regulations as Electric Chart Systems (ECS). An ECDIS system displays the information from electronic navigational charts (ENC) and integrates position information from the Global Positioning System (GPS) and other navigational sensors, such as radar and automatic identification systems (AIS). It may also display additional navigation-related information, such as Sailing Directions and fathometer.		
1	NA06	Z – Not relevant	eLoran (Enhanced Loran)	Maritime	Long-Range Navigation system. a low-frequency, terrestrial navigation system operating in the 90 to 110 kHz frequency band and synchronized to coordinated universal time. Enhanced Loran is an internationally standardized positioning, navigation, and timing (PNT) service for use by many modes of transport and other applications. It is the latest in the long-standing and proven series of low-frequency, LOng-RAnge Navigation (LORAN) systems and takes full advantage of 21st century technology. eLORAN is an independent, dissimilar, complement to Global Navigation Satellite Systems (GNSS). It allows GNSS users to retain the safety, security and economic benefits of GNSS, even when their satellite services are disrupted.		
1	NA07	A – Very important	Global Navigation Satellite Systems or GNSS (GPS etc.)	Maritime	Global Navigation Satellite Systems (GNSS) is the standard generic term for satellite navigation systems ("sat nav") that provide autonomous geo-spatial positioning with global coverage. GNSS allows small electronic receivers to determine their location (longitude, latitude, and altitude) to within a few metres using time signals transmitted along a line-of-sight by radio from satellites.	Changed status from C to A-very important. Due to tracking & tracing of cargo and transport modes, navigation. Infromation from such services are important input to logistics systmes	
				Railway	Global Navigation Satellite Systems (GNSS) is the standard generic term for satellite navigation systems ("sat nav") that provide autonomous geo-spatial positioning with global coverage. GNSS allows small electronic receivers to determine their location (longitude, latitude, and altitude) to within a few metres using time signals transmitted along a line-of-sight by radio from satellites.	Changed status from C to A-very important. Due to tracking & tracing of cargo and transport modes, navigation. Infromation from such services are important input to logistics systmes	
				Road	Global Navigation Satellite Systems (GNSS) is the standard generic term for satellite navigation systems ("sat nav") that provide autonomous geo-spatial positioning with global coverage. GNSS allows small electronic receivers to determine their location (longitude, latitude, and altitude) to within a few metres using time signals transmitted along a line-of-sight by radio from satellites.	Changed status from C to A-very important. Due to tracking & tracing of cargo and transport modes, navigation. Infromation from such services are important input to logistics systmes	
1	NA08	C – Low importance	radar	Maritime	Radar is an object detection system that uses electromagnetic waves to identify the range, altitude, direction, or speed of both moving and fixed objects such as aircraft, ships, motor vehicles, weather formations, and terrain.	Changed status from Z to C. C because the technology is mature and used in combination with AIS. Especially in ports. Also, radar in itself does not directly enable greening of operations.	
1	NA09	Z – Not relevant	Radarsat 1 and 2	Maritime	RADARSAT-1 is a sophisticated Earth observation satellite developed by Canada to monitor environmental changes and the planet's natural resources. Launched in November 1995, RADARSAT-1 provides Canada and the world with an operational radar satellite system capable of timely delivery of large amounts of data. Equipped with a powerful synthetic aperture radar (SAR) instrument, it acquires images of the Earth day or night, in all weather and through cloud cover, smoke and haze. Canada's next-generation commercial radar satellite offers powerful technical advancements that will enhance marine surveillance, ice monitoring, disaster management, environmental monitoring, resource management and mapping in Canada and around the world. This project represents a unique collaboration between government and industry. MacDonald, Dettwiler and Associates Ltd. (MDA) will own and operate the satellite and ground segment. The Canadian Space Agency helps fund the construction and launch of the satellite and will recover this investment through the supply of RADARSAT-2 data to the Government of Canada during the lifetime of the mission.		

Round	ID	Category	Technology name	Transport mode	Short Description	Comments Year 2	Comment year 3
1	NA10	Z – Not relevant	Radarsat Constellation	Maritime	The RADARSAT Constellation is the evolution of the RADARSAT Program with the objective of ensuring data continuity, improved operational use of Synthetic Aperture Radar (SAR) and improved system reliability. The three-satellite configuration will provide complete coverage of Canada's land and oceans offering an average daily revisit, as well as daily access to 95% of the world to Canadian and International users. The mission development has begun in 2005, with satellite launches planned for 2014 and 2015.		
1	NA11	C – Low importance	LRIT	Maritime	The Long Range Identification and Tracking (LRIT) of ships was established as an international system on 19 May 2006 by the International Maritime Organization as resolution MSC.202(81). This resolution amends chapter V of the International Convention for the Safety of Life at Sea (SOLAS), regulation 19-1 and binds all governments which		
1	NA12	B – Important	GEO satellites	Maritime	A geosynchronous Satellites is a satellite whose orbital track on the Earth repeats regularly over points on the Earth over time. If such a satellite's orbit lies over the equator and the orbit is circular, it is called a geostationary satellite.		This is proven technology and the majority of work efforts are focused on improving the technology (i.e. increasing bandwidth and quality of service). Hence, category C is suitable.
1	NA13	B – Important	LEO satellites	Maritime	A low Earth orbit (LEO) is generally defined as an orbit within the locus extending from the Earth's surface up to an altitude of 2,000 km. Given the rapid orbital decay of objects below approximately 200 km, the commonly accepted definition for LEO is between 160 - 2,000 km (100 - 1,240 miles) above the Earth's surface.		This is proven technology and the majority of work efforts are focused on improving the technology (i.e. increasing bandwidth and quality of service). Hence, category C is suitable.
1	NA14	B – Important	Inmarsat	Maritime	Inmarsat plc (LSE: ISAT) is a British satellite telecommunications company, offering global, mobile services. It provides telephony and data services to users worldwide, via portable or mobile terminals which communicate to ground stations through eleven geosynchronous telecommunications satellites. Inmarsat's network provides communications services to a range of governments, aid agencies, media outlets and businesses with a need to communicate in remote regions or where there is no reliable terrestrial network.		This is proven technology and the majority of work efforts are focused on improving the technology (i.e. increasing bandwidth and quality of service). Hence, category C is suitable.
1	NA15	B – Important	WiMax - Worldwide Interoperability for Microwave Access	Maritime	Long range, high bandwidth wireless Internet		More research is needed to further develop the technology for maritime application.
				Railway	Long range, high bandwidth wireless Internet		
				Road	Long range, high bandwidth wireless Internet		
1	NA16	B – Important	Route optimisation system (scheduling)	Inland Waterways	The advising Tempomaat (ATM) is a system enabling an economically optimised operation of a vessel. The core of the ATM is formed by a computer programme advising the skipper on the most economical combination of route and speed, enabling the vessel to arrive on time with a most efficient use of fuel leading to a reduction of fuel consumption and emissions by approximately 10%.	Used on ship, both for IWW, port operations and at sea. Thus, this is also relevant for Maritime.	
2	NA17	B – Important	River Information Services (RIS)	Inland Waterways	River Information Services (RIS) are customized information services for inland waterway transport and make it possible to coordinate logistical processes with actual transport situations on a constant basis. RIS play a key role in making cargo transport and passenger services on waterways more efficient leading to a reduction of fuel consumption by approximately 5 %, while at the same time increasing traffic safety .		
2	NA18	B – Important	Predictive cruise control (PCC)	Road	The PCC assistance system uses map and satellite-based route previews and saves substantial amounts of fuel. Unlike a conventional cruise control system that tries to maintain a preset speed, regardless of how the terrain changes, the PCC system looks for its route a mile in advance and adjusts engine output to the uphill and downhill gradients ahead. Based on this information, the on-board computer calculates the optimum speed to use the momentum of the truck to maximize fuel economy.		

Round	ID	Category	Name	Description	Comments year 3
1	BP01	D – Merged	APU (Auxiliary Power Unit)	An auxiliary power unit (APU) is a device on a locomotive whose purpose is to provide energy saving and to reduce the polluting emissions.	Merged with VE23, describing the same technology
1	BP02	B – Important	TDS	TDS (Train Control System based on a new GPS application method)	
1	BP03	B – Important	Traffic Management System	GEKKO is a system to provide guidance to energy efficiency driving and timetable optimization, developed for Danish State Railways	
1	BP04	A – Very important	Traffic Flow Management	A system for online optimisation of rail traffic flow to have mininum delays and minimum energy consumption, developed by emkamatik on behalf of SBB	
1	BP05	Z – Not relevant	Biodiesel (from exhausted oils)	Biodiesel can be used in pure form (B100) or may be blended with petroleum diesel at any concentration in most injection pump diesel engines.	Does not belong in this category - same suggestin already in fuels& sources of energy FU02
1	BP06	X – Need info	Horizontal container movement	Metrocargo is an innovative solution for containers cargo handling in overhead electrified railways, it's a containers horizontal movement system from an automated platform to train wagons. This technology is ready to experimentation. Metrocargo will be tested on new Maersk's Platform in Vado Ligure (SV), Italy.	Does not belong in this category - same suggestion covered in cargo handling and transfer HT10
1	BP07	A – Very important	Carbon-free rail freight transport	Now you can have your goods transported carbon-free on all European rail freight transport routes. DB Schenker Rail replaces the electricity required for your freight transport with regenerative energy that comes 100% from renewable sources in Germany. This helps to avoid carbon emissions right from the outset. Even the smallest quantities can be transported in this way without carbon emissions, on a national and international scale.	
1	BP08	B – Important	Integrated shortsea transport	The concept of Coaster Express (CoEx) is a short sea transport concept directed to bundling the transport flows, scaling-up the short sea facilities and standardization and automation of the transition processes.	
1	BP09	D – Merged	AMECS (Advanced Emission Control System)	New technology consists of a bonnet placed over the ship's stack at berth or anchorage to collect emissions from the exhaust stack. The captured emissions are conveyed through a duct to a dock or barge mounted Emission Treatment System (ETS). Manufacturer claims this system is more efficient and cheaper than AMP (see FU05).	Included in fuel sources and energy FU05 technology
2	BP10	X – Need info	Active filtering	The use of active filters algorithms for harmonic reduction was developed, especially for low frequency such as 75Hz in the Netherlands. The input filter inductor's dimensions can be reduced and consequently the weight saving is achievable. The traction inverter is used to compensate low frequency harmonic. The basic idea is to measure the 75Hz harmonic from the dc-link voltage and to use this signal to perform a proper action: - on the modulation index of the inverter in PWM mode	Greening potential considered to be quite low, thus questions are raised regarding the significance of the technology. Technology category to be determined by rail experts. Also, is this really best practice? Possible for Rail experts to show successful industry application?
2	BP11	X – Need info	Rail energy management systems	The proposed technology concerns an optimized MV (Medium Voltage) loads management for cooling systems. When the maximum cooling performance are not requested, for example at low speed or during the train stops, fans and pumps can operate at reduced speed or turned off in order to reduce the energy consumption and the environmental impact.	Should be formally evaluated by NewRail, also reagrding the Category. Is this really best practice? Also, how novel is this technology, since this is proven for road decades ago, given that it is refersed to cooling of engines (e.g. load and temperature controlled cooling systems). Categor to be C-low importance?
2	BP12	X – Need info	Energy Efficient Train Operation	The concept of EETROP concerns saving of energy and other resources through better planning and handling of train operations. Introducing energy efficiency and power management in timetabling as well as in real-time operations enable timetable constructors, dispatchers and drivers to manage their traffic in the most efficient way, still regarding the underlying mandatory conditions as punctuality, capacity, etc.	Description of technology is to vague. Need to become more specific if a proper evaluation is to be carried out. To be evaluated by rail experts.
3	BP13	A – Very important	EREX (ERESS)	The Erex system, has been designed by the European Railway Energy Saving Solution (ERESS), to help railways to save money and reduce CO2 emissions by providing exact energy consumption data. It provides an efficient, reliable, and flexible energy settlement process, enabling railway undertakings to understand their use of energy and thereby save energy and costs. Erex has been configured with a virtual platform with almost unlimited capacity.	