Round	ID	Technology name	Transport mode	Short Description	Provider	Technology Readiness Level	Time To Market	Needed supporting measures	Energy Source	Nominal Power (kW)	Efficiency (%)	CO2 Emissions (g/kWh)	NOx Emissions (g/kWh)	SO2 Emissions (g/kWh)	PM10 emissions (g/kWh)	MTBF (H)	Life Cycle Cost (€/kW)
1	EN01	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.	Greencar Consult GmbH & Co. KG, Itzehoe, Germany	TRL 5 to 6	1 to 2 years		liquefied petroleum gas	1000	approx. 40%	tbd	tbd	tbd	tbd	tbd	tbd
1	EN02	Directly driven propeller	Maritime	Slow speed engine directly connected to propeller shaft, 20 year life time, running 5500 h/a.	Wärtsilä, Man B&W	9	<1	N.A.	HFO	85,000	28	2000	50	35	1.4	5000	20500
1	EN03	Mechanically connected propeller	Maritime	Medium speed engine connected by a reduction gear to the propeller shaft, 20 year life time, running 5500 h/a	Wärtsilä, Man B&W	9	<1	N.A.	HFO	15,000	26	2360	35	38	1.5	4500	23200
1	EN04	Diesel-Electric propulsion	Maritime	Medium speed engine producing electricity. Propeller shaft rotated by an electric motor, 20 year life time, running 5500 h/a	Wärtsilä, Man B&W	9	<1	N.A.	HFO	15,000	25	2400	37	41	1.6	4000	27400
1	EN05	Podded azimuthing propulsion	Maritime	Medium speed engine runs generator. Electric motor is inside azimuthing thruster, 20 year life time, running 5500 h/a.	ABB azipod; Rolls-Royce Mermaid	8	<1	N.A.	HFO	40,000	27	2170	33	37	1.5	3000	26400
1	EN06	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.	Rolls-Royce Aquamaster, Siemens Schottel	8	<1	N.A.	HFO	5,000	27	1960	33	37	1.5	3500	28100
1	EN07	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.	MAN B&W	9	<1	N.A.	MDO	5,000	21	3650	37	42	1.8	4000	59900
1	EN08	Gas turbine	Maritime	Gas turbine connected by reduction gears to the propeller shaft, 20 year life time, running 5500h/a.	GE, Rolls-Royce, Solar	9	<1	N.A.	MGO	5,000	20	3940	11	45	1.5	3900	64800
1	EN09	Steam turbine	Maritime	Steam turbine running propeller shaft mechanically, 20 year life time, running 5500 h/a. Working alone.	Dresser-Rand	9	<1	N.A.	HFO/LNG, emissions and costs calculated with HFO	35,000	16	6620	58	64	2.6	4500	65300
1	EN10	Water jet	Maritime	High speed diesel running water jet mechanically, 20 year life time, running 5500 h/a.	Wärtsilä, Man B&W	9	<1	N.A.	MDO	40,000	22	3600	37	41	1.9	3500	59600
			Inland waterways	High speed diesel running water jet mechanically, 20 year life time, running 5500 h/a.													
1	EN11	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.	Wärtsilä, Man B&W	8	<1	N.A.	LNG and HFO (as pilot fuel)	17,100	30	1530	4	0	0.2	4000	23600
1	EN12	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)	Bombardier	8	2		Diesel	570 kW		3.5	2		0.025		
1	EN13	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.	Ansaldobreda / Aichi Rapid Transit Co	6	5	Modify existing locomotives	Electric	210kW (stream)	0.9	No typical emmision value of ICE are usable					
1	EN14	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.	All third binary producers	6	5	Modify existing locomotives	Electric	Depending by the loco in the system		No typical emmision value of ICE are usable					
1	EN15	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	Vossloh Locomotives and Greencar Consult	6			liquefied petroleum gas	1100			0.9		0.001		
1	EN16	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	Mitsubishi, Daimler, Volvo, Toyota	9	3	Legislation / emission limits esp. for small trucks	electricity		same as Diesel engine	ca. 25% less than Diesel	ca. 25% less than Diesel	ca. 25% less than Diesel	ca. 25% less than Diesel		ca. +50% more than Diesel engine
1	EN17	M2eHybrid Freightliner	Road	Support engine plus auxiliary drive to operate an elevating platform of the truck; combination of 6 cylinder engine plus electrical engine	Daimler Benz	9	<1	dto.	electricity	diesel engine: 186 kW/252 PS; electrical engine: 44 kW/60PS	reduces 25-30% fuel consumption	reduces 25-30% CO2		ca. 25% less than Diesel	ca. 25% less than Diesel		n.a.
1	EN18	Fuel cell technology	Road	> 3,5 ton transporter running on renewable fuel cell technology	Daimler Benz	9	<1	dto.	hydrogen		double as much as Diesel (ca. 70%)	close to 0	close to 0	---	---		n.a.
1	EN19	Fuso Canter Eco Hybrid	Road	Light-duty truck on hybrid technology	Daimler Benz	9	<1	dto.	electricity	diesel engine: 145 kW, e-motor: 35 kW	25% less fuel consumption	25% less than Diesel		ca. 25% less than Diesel	ca. 25% less than Diesel		n.a.
1	EN20	Atego BlueTec Hybrid	Road	12 ton rigid truck on hybrid technology	Daimler Benz	9	<1	dto.	electricity	diesel engine: 160 kW, e-motor: 44 kW	15% less fuel consumption	15% less than Diesel		ca. 15% less than Diesel	ca. 15% less than Diesel		
1	EN21	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	Hug Engineering	9	<1	Incentives for compensation of high investment costs	MGO			Increase by 2%	Reduction by 90%	Increase by 2%	Reduction by 97%		
2	EN24	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	Various	6-7	1-5		CNG	around 250 kw	approcimately 45%	610	0.3	minimal	0.003		
2	EN33	Selective Catalytic Reduction	Inland Waterways	Technology for reduction of NOX emissions by injection of urea solution into the exhaust gas	Various	9	<1	Incentives for compensation of high investment costs; research in cost efficient solutions for IWT	MGO			Reduction by 7.5%, if engine may be tuned to operation at optimized fuel consumption	Reduction by 81 - 90%	Reduction by 7.5%, if engine may be tuned to operation at optimized fuel consumption	Reduction by 35%		
2	EN36	Particulate matter filter	Inland Waterways	Technology for reduction of PM emissions	Various	9	<1	Incentives for compensation of high investment costs; research in cost efficient solutions for IWT	MGO, reuires low sulphur fuel			Increase by 2%		Increase by 2%	Reduction 85%		
2	EN39	Gas engines	Inland Waterways	Engines running on natural gas (different solutions available, pure gas engines, gas-diesel engines, dual fuel engines)	Wärtsilä, Rolls Royce, Jenbacher, Caterpillar)	6	>10	Classification rules, regulations allowing the usage of LNG on inland waterways and terminals , set up of infrastructure, further development of engine	Natural gas	Approximately 1000 kW	Approximately 40 %	Reduction by 10 up to 25 % compared with diesel engine (CCNR I Standard)	Reduction by 90 % compared with diesel engine (CCNR I Standard)	Reduction by 100 % compared with diesel engine (CCNR I Standard)	Reduction by 80-95 % compared with diesel engine (CCNR I Standard)		
2	EN42	CCNR I Engine	Inland Waterways	Most existing engines comply with CCNR I Standard	Various	9	<1	None	MGO, MDO	0 - 3000 KW	Approximately 40 %	660 - 680 (refernce engine output power)	9 (service condition)	0.4 (if sulphur content 1000 ppmm as today requested)	0.2 (service condition)		
2	EN45	CCNR II Engine	Inland Waterways	Today new engines have to comply with CCNR II standard	Various	9	<1	Incentives for accelerated exchange of existing engines	MGO, MDO	0 - 3000 KW	Approximately 40 %	660 - 680 (refernce engine output power)	6 (test stand, in service condition = 8)	0.4 (if sulphur content 1000 ppmm as today requested)	0.15 - 0.2 (test stand, in service condition 0.2)		

Round	ID	Technology name	Transport mode	Short Description	Provider	Technology Readiness Level	Time To Market	Needed supporting measures	Energy Source	Nominal Power (kW)	Efficiency (%)	CO2 Emissions (g/kWh)	NOx Emissions (g/kWh)	SO2 Emissions (g/kWh)	PM10 emissions (g/kWh)	MTBF (H)	Life Cycle Cost (€/kW)
2	EN48	CCNR III Engine	Inland Waterways	Still under negotiation	Various	9	3	Incentives for accelerated exchange of existing engines	MGO	0 - 3000 KW	Approximately 40 %	661 - 680 (refernce engine output power)	4.0 - 6.6 (test stand conditions)	0.004	0.11 - 0.2 (test stand conditions)		
2	EN51	CCNR IV Engine	Inland Waterways	Still under negotiation	Various	3	6	Incentives for accelerated exchange of existing engines	MGO	0 - 3000 KW	Approximately 40 %	662 - 680 (refernce engine output power)	0.4 (test stand conditions)	0.004	0.025		
2	EN54	Kaplan propeller in nozzle	Inland Waterways	Nozzle around Kaplan propeller creates additional thrust; highly effective at large propeller loads, Source DST;		9	<1			approx. 1000 KW/propeller		20 % reduction compared with ordinary propeller (e.g. Wageningen Series)	20 % reduction compared with ordinary propeller (e.g. Wageningen Series)	20 % reduction compared with ordinary propeller (e.g. Wageningen Series)	20 % reduction compared with ordinary propeller (e.g. Wageningen Series)		
2	EN57	High scew propller	Inland Waterways	Nozzle around high skew propeller creates additional thrust; highly effective at large propeller loads, Source DST;		9	<1			approx. 1000 KW/propeller		25 % reduction compared with ordinary propeller (e.g. Wageningen Series)	25 % reduction compared with ordinary propeller (e.g. Wageningen Series)	25 % reduction compared with ordinary propeller (e.g. Wageningen Series)	25 % reduction compared with ordinary propeller (e.g. Wageningen Series)		
2	EN58	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.	AnsaldoBreda	9	<1	None	Electric Diesel			The technology is expected to reduce energy consumption by 1% to 5%				N.A.	
2	EN59	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.	Siemens	2	5	funding of R&D projects for testing components for higher DC voltages Standardization for new railway traction power supply system (EN)	Electric			Increased line voltage 4kV is the theoretic investigation of a DC system based on 4kV instead of 3kV. This is not just maximizing current 3kV voltage as this is already done; it is rather a new system which requires then new onboard components etc. The Technical Specifications for Interoperability (TSI) do not allow such new supply systems to be built at present					
2	EN60	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.	Siemens	7	2	None	Diesel			The technology is expected to reduce energy consumption by 3% to 5%					
2	EN61	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					Wind			4% reduction estimated by 2050					
2	EN62	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.		9	<1		Diesel			5% reduction estimated by 2050					

Round	ID	Technology name	Transport mode	Short Description	Provider	Technology Readiness Level	Time To Market	Needed supporting measures	Energy source produced	Renewable (Y/N)	Life Cycle Cost (€/kW)	CO2 Emissions (g/kWh)	NOx Emissions (g/kWh)	SOx Emissions (g/kWh)	PM10 emissions (g/kWh)
1	FU01	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)		1	<1	N.A.						Target to reduce by 90% sulphur	
			Railway												
			Road												
			Inland Waterways			9	<1			N				Reduction of SOX emissions by 99.5 % comparedd wirth fuel containing 2000 ppmm suphur	Reduction of PM emissions by 17% compared
1	FU02	Ethanol and bio-diesel	Maritime	Investigation about using alternative fuels.		3	3								
			Maritime												
			Road												
1	FU03	CGN (compressed natural gas)	Multimodal	Cleaner fuel for yard handling equipment (Prime movers)		9	<1	Depends on infrastructure available in each country, namely underground pipping and setting up of enough refilling stations							
			Inland Waterways			1	> 10	Classification rules, regulations allowing the usage of CNG on inland waterways and terminals , set up of infrastructure, development of engine and tank solutions; incentives for compensation of high investment costs; eductaion of staff for operation of engine systems;	natural gas	N		Reduction by 10 up to 25 % compared with diesel engine (CCNR I Standard)	Reduction by 98.5 % compared with diesel engine (CCNR I Standard)	Reduction by 100 % compared with diesel engine (CCNR I Standard)	Reduction by 97.5 % compared with diesel engine (CCNR I Standard)
1	FU04	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	Being tested by LA Port Authority		<1	Installation of solar pannels	Solar	Y					
			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 container boxes		9	<1	Installation of solar pannels							
1	FU05	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	ABB, Cavotec, Siemens	9	<1	Ports have to buy and install equipment and vessels have to install onboard equipment required to utlise the concept					Depending on vessel's size, it can burn one ton	Depending on vessel's size, it can reduce emission by half	
1	FU06	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	system implemented by APMT in the port of Rotterdam	7	1					Expectation to reduce emissions by 45% per year			
			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	HFO (Reference)	Maritime	Heavy fuel oil		9	<1	common technology today	Oil	N		670	10...15	4	0.2
			Railway												
			Road												
1	FU08	LNG	Maritime	Liquefied natural gas		8	<1	better logistics	Natural gas	N		460	1	0	0
			Railway												
			Road												
			Inland Waterways			6	>10	Classification rules, regulations allowing the usage of LNG on inland waterways and terminals , set up of infrastructure, development of engine and tank solutions; incentives for compensation of high investment costs; eductaion of staff for operation of engine systems;	natural gas	N		Reduction by 10 up to 25 % compared with diesel engine (CCNR I Standard)	Reduction by 98.5 % compared with diesel engine (CCNR I Standard)	Reduction by 100 % compared with diesel engine (CCNR I Standard)	Reduction by 97.5 % compared with diesel engine (CCNR I Standard)
1	FU09	LBG	Maritime	Liquefied biogas	one demonstration unit in Nethelands?	6	3	tax reduction or support	Landfill gas, sewage	Y		460	1	0	0
			Railway	Liquefied biogas											
			Road	Liquefied biogas											
1	FU10	Vegetable oil	Maritime	Different oil seeds (palm, rape seed, sunfower)		7	1	shortage of raw material is the limiting factor		Y		630	10...15	0	0.1
			Railway												
			Road												
1	FU11	Algae oil	Maritime	Oil from algae		2	5	more research needed	Algae plants	Y					
			Railway												
			Road												
1	FU12	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.	Adriatica Oli / Romanin Petroli	8	<1	EGR & SCR	Oils	Y	1/2,5	50% Reduction	7/15% Reduction	0	65% Reduction
			Road												
			Maritime												
1	FU13	Electricity	Road	Electricity is today produced from fossil fuels, nuclear energy and renewable energy sources	various	1	<1	Infrastructure	Electrical	Y	large variations	681	0.94	3.65	0.27
			Railway												
1	FU14	Hydrogen	Road	Hydrogen is today mainly produced from steam reforming of fossil gas - some production from electricity and renewable sources	various	1	<1	Large investments in filling infrastructure are needed; regulative support is still crucial to even out price disadvantages	chemical	Y	large variations	From electrolysis: 1,4 times from electricity generation SMR: 360 Biomass: various	From electrolysis ,1,4 times emeissions from electricity generation for SMR neglectable	From electrolysis ,1,4 times emeissions from electricity generation, for SMR: neglectable	From electrolysis ,1,4 times emeissions from electricity generation, for SMR: neglectable
			Inland Waterways			8	>30	Classification rules, regulations allowing the usage of hydrogen on inland waterways and terminals , set up of infrastructure, development of engine and tank solutions; incentives for compensation of high investment costs; eductaion of staff for operation of engine systems;	chemical						
1	FU15	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	various	1	<1	Presently investments in filling infrastructure are still needed; regulative support is still crucial (taxes or targets)	Chemical	Y	January 2010, biodiesel was 100% more expensive than diesel (per energy equivalent) (product prices)	Typically 45% below fossil diesel	0.17	0.48	0.02
			Railway												
			Maritime												
1	FU16	bioethanol	Road	Bioethanol sold in Europe is mainly produced in Europe, Brazil and China, from sugar cane, sugar beet and corn	various	1	<1	Presently investments in filling infrastructure are still needed; regulative support is still crucial (taxes or targets)	Chemical		January 2010, biodiesel was 70% more expensive than diesel (per energy equivalent) (product prices)	Typically 70% below diesel (sugar cane)			
			Railway												
			Maritime												
1	FU17	Bio-DME	Road	Bio-DME					Chemical	Y					
			Railway												
			Maritime												

Round	ID	Technology name	Transport mode	Short Description	Provider	Technology Readiness Level	Time To Market	Needed supporting measures	Energy source produced	Renewable (Y/N)	Life Cycle Cost (€/kW)	CO2 Emissions (g/kWh)	NOx Emissions (g/kWh)	SOx Emissions (g/kWh)	PM10 emissions (g/kWh)
1	FU18	Biogas	Road	Biogas is mainly produced from bio-wast, agricultural recidues and residues from sewage treatment plants	various	1	<1	Presently investments in filling infrastructure are still needed; regulative support is still crucial (taxes or targets)	Chemical		Compared to traditional fuels prices for gaseous fuels vary more widely due to inter alia higher transport cost and smaller markets. Typical prices for gaseous hydrogen delivered in larger quantities in the US were 4 USD/kg or 15 eurocents pr KWh (http://www.hydrogenassociation.org/marketreport/pdf/fullReport.pdf)	Typically 80-90% below liquid fossil fuels	very low	very low	very low
			Railway												
			Maritime												
			Inland Waterways			2	>10	Classification rules, regulations allowing the usage of biogas on inland waterways and terminals , set up of infrastructure, development of engine and tank solutions; incentives for compensation of high investment costs; eductaion of staff for operation of engine systems, production of sufficient amount of biogas in sustainable way;	chemical	Y		Typically 80-90% below liquid fossil fuels	Reduction by 98.5 % compared with diesel engine (CCNR I Standard)	Reduction by 100 % compared with diesel engine (CCNR I Standard)	Reduction by 97.5 % compared with diesel engine (CCNR I Standard)
1	FU19	HVO (hydrotreated vegetable oil)	Road	Biofuel from sustainable cultivation of palm oil	OMV Austria	8	2	Standardization/certification system for the production of biofuels	Palm oil	Y	n.a. (ca. 20% > Diesel)	60% les than Diesel emissions (= 2.645 kg/l CO2 + 17% w:t CO2e, i.e. ca. 3.1 kg/l CO2e)	./. 15% compared to Diesel	--	n.a.
1	FU20	Liquid Methane Gas	Road	Methane gas chilled to -130-160℃	Volvo	9	1	Gas station infrastructure	Natural gas and biogas (mix)	Y	30% cheaper than Diesel	up to 80% less than Diesel	n.a.	--	--
1	FU21	Bio-DME	Road	Dimethylether from natural gas or biomass	Volvo (Chemrec)	7	3	Mass availability, station infrastructure	Natural gas, black liquor from pulp industry	Y	volatile: in the range of ./. 25% to +70% of Diesel	95% less than Diesel	n.a.	--	--
1	FU22	Fuel cell	Road	Hydrogen from electrolysis	Daimler Benz	2	5	Legal regulations (emission limits)	Water power, wind, solar, geothermy	Y	100% more expensive than Diesel	close to 0	close to 0	--	--
			Inland Waterways	Electrochemical cell that converts a source fuel (typical Hydrogen or Oxygen) into an electric current without thermal combustion	various	8	>30	Classification rules, regulations allowing the usage of hydrogen on inland waterways and terminals , set up of infrastructure, development of engine and tank solutions; incentives for compensation of high investment costs; eductaion of staff for operation of engine systems;	chemical						
1	FU23	Nuclear Power	Inland Waterways	Nuclear Power											
			Maritime												
1	FU24	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		1									
			Maritime												
2	FU25	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.		9	<1		Wind	Y		10%-15% reduction expected in fuel consumption			
2	FU26	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.					Electrical	N		2.6% reduction estimated by 2020			
2	FU27	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.	SNCF	6	5		Electrical			The technology is expected to reduce energy consumption by 2% to 5%			
2	FU28	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.	Siemens	1	<1		Electrical			The technology is expected to reduce energy consumption by 0,05% to 8%			
2	FU29	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	Dr Klingner Matthias Fraunhofer Institut Verkehrs und Infrastruktursysteme Zeunerstraße-Dresden	4	fuel cell hybrid systems are not ready for wide commercialization because of: (a) their too high specific costs at component level (i.e. the fuel cell), (b) technological problems that are not completely solved mainly related to the integration of fuel cell system with turbomachinery technology, and (c) the long time (hours) required for start-up and shut-down.		Eletrical	N	high costs in particular at component level	ultra low emissions	ultra low emissions	0 (This system is highly intolerant to sulphur)	0
2	FU30	Flettner rotor	Maritime	It is a vertical cylinder rotating around its axis that converts prevailing wind into propulsive energy.		9	<1		Wind	Y		0.1% reduction estimated by 2020			
2	FU31	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.	Bombardier	2	3	The distance between adjacent substations may be even less depending on intensity of traffic and load of trains	Thermic			The technology is expected to reduce energy consumption by 0,5% to 1,5%			
2	FU32	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.	Siemens	1	3		Electrical			The technology is expected to reduce energy consumption by 0,5% to 2%			
2	FU33	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.	Siemens	5	2		Electrical			The technology is expected to reduce energy consumption by 1% to 10%			

Round	ID	Technology name	Transport mode	Short Description	Manufacturer	Technology Readiness Level	Time To Market	Needed supporting measures	Average Loading Cycle Time (moves/hour)	Cost per Move (€)	MTBF (H)	Power Supply	Energy Consumption (kW/ton)	CO2 Emissions (g/ton)	NOx Emissions (g/ton)	SOx Emissions (g/ton)	PM10 emissions (g/ton)	Life Cycle Cost(€/ton)
1	HT01	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		9	<1	installation of electric grids at the terminal from where energy is obtained										
1	HT02	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		7	<1	N.A.										
			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														
1	HT03	Hybrid hydraulic drive for Terminal tractors	Multimodal	Storing braking energy into hydraulic system for acceleration and system		9	1								reduction of equivalent to 19 tonnes of Nox			
1	HT04	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	Seoho, Yaskawa	9	<1	additional modification to RTG's circuit and engine controls	17			Normal consumption at 1800rpm is abt 17 litres/hour. New system offers savings bw 10-15%		RTG operating in normal Terminal environment (19 hours/day) emits up to 379 tonnes per year. This system targets a reduction bw 10-15%				
			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	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.	Inventor: Braun; Paul-Wilhelm	7	2	N/A	N/A	N/A								
1	HT06	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		9	<1	Terminal civil works and adapt handling equipment	17									
1	HT07	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		9	<1			no cost per move is given but capital cost per unit is higher, abt 15K Euros more than traditional engines		normal diesel						
1	HT08	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		9	<1											
1	HT09	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		8	<1	N.A.										
1	HT10	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.	i.log	9	2	Metrocargo platform	0,67 train/h		unknown	Electricity		No typical emmision value of ICE are usable	No typical emmision value of ICE are usable	No typical emmision value of ICE are usable	No typical emmision value of ICE are usable	unknown
1	HT11	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	TTS Liftec, several others	9	<1											
1	HT12	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.	Transfennica	9	<1											
1	HT13	Automated container terminal	Maritime	Automatic stacking crane system (ASCs), case Port of Hamburg Terminal operator HHLA (Hamburger Hafen und Logistik AG).	Kalmar													
1	HT14	Roll trailer technology	Maritime	Loading and unloading of Ro-Ro vessels with general cargo and cargo units	several													
1	HT15	Double stack on cassette or roll trailer	Maritime	Loading of two containers on a roll trailer of cassette	(Concept)													
1	HT16	Barge-mothership system	Maritime	Independently ice going technology. Modular barges, avoiding load transfer.	Aker Arctic	5												
1	HT17	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.														
1	HT18	E/S Orcelle Green Flagship	Maritime	vision for zero emission car carrying														
1	HT19	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.														
1	HT20	Barge Express (BEX)	Inland Waterways	BEX is an integrated concept for large scale barge container transport aiming at automated handling at barge terminals														
1	HT21	Maasvlakte	Maritime	The Deltaport terminal uses AGVs in transporting containers from the stacked storage area (served by rail-mounted gantry cranes) to the apron.														
1	HT22	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.														

Round	ID	Technology name	Transport mode	Short Description	Manufacturer	Technology Readiness Level	Time To Market	Needed supporting measures	Average Loading Cycle Time (moves/hour)	Cost per Move (€)	MTBF (H)	Power Supply	Energy Consumption (kW/ton)	CO2 Emissions (g/ton)	NOx Emissions (g/ton)	SOx Emissions (g/ton)	PM10 emissions (g/ton)	Life Cycle Cost(€/ton)
1	HT23	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.														
1	HT24	Floating Container Terminal (FCT)	Maritime	The FCT collects and distributes containers originating from small calls, and bundles these currents with containers														
1	HT25	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.														
1	HT26	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.														
1	HT27	Thamesport	Maritime	Fully automated yard stacking equipment														
1	HT28	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.	Schenck Process, Kockums Industries	9	2					Eletrical						Low maintenance requirements
1	HT29	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.	Mr. L. Berglund with support from Stiftelsen Innovationscentrum SIC.	7												
2	HT30	Autoload	Multimodal	Automatic loading/unloading of railway waggons, automated loading of roll trailers and cassettes	Pesmel	9			12 truck/h.With the current systems, an entire truck can be loaded or unloaded in less than 5 minutes.									Automatic loading and unloading systems represent a cost savings to the customer, since the charging process is done quickly and thus increases the flexibility in storage.
1	HT31	ZF AS Tronic mid	Multimodal	New transmission system for terminal tractors that cuts fuel consumption by around 15%	Terberg	9	<1	N.A.										
			Maritime	New transmission system for terminal tractors that cuts fuel consumption by around 15%														
2	HT31_a	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		9	1	installation of solar pannels										
1	HT32	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	Kalmar	5	1								reduction of equivalent to 19 tonnes of Nox			
			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	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.														
2	HT33	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.		5	4	Uncertain whether it needs total and integrated transport system to utilise its full potential?										
2	HT34	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.	Prof. Schuszter Mathias Zentrum für Angewandte Forschung und Technologie-Dresden	4								Low emissions, based on sustainable principles. The goals are in conformity with the aims of the Specific Programme "Sustainable Surface Transport"	Low emissions, based on sustainable principles. The goals are in conformity with the aims of the Specific Programme "Sustainable Surface Transport"	Low emissions, based on sustainable principles. The goals are in conformity with the aims of the Specific Programme "Sustainable Surface Transport"	Low emissions, based on sustainable principles. The goals are in conformity with the aims of the Specific Programme "Sustainable Surface Transport"	
2	HT35	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.														
2	HT36	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	Flexiwaggon AB	9	2		Individual loading and unloading of waggons. To load or unload an entire train set takes 10-15 minutes.									

Round	ID	Technology name	Transport mode	Short Description	Owner	Technology Readiness Level	Time To Market	Needed supporting measures	Type of packaging allowed	Possibility to recicle	Special procedures allowed	Life Cycle Cost (€)
3	CP1	Cardboard pallets	Multimodal	ecological and sustainable being made of recycled materials and completely recyclable, have low weight but good strength		9	<1		pallet	Y		
3	CP2	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.		2			boxes			
3	CP3	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		9	<1					
3	CP4	Cargo hold tank coatings	Multimodal	Innovative cargo hold tank coatings to reduce abrasion and corrosion.		9	<1					
3	CP5	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.	several owners	9	<1		pallet			
3	CP6	Polyethylene flexitanks	Multimodal	Polyethylene flexitanks for wine and food-grade liquids together with non-hazardous chemicals and specialty oils.	POWERTEX, Waterplex	9	<1		solution for liquids			

Round	ID	Technology name	Transport mode	Short Description	Owner	Technology Readiness Level	Time To Market	Needed supporting measures	Size	Efficiency (%)	Power Supply	CO2 Emissions (g/kWh)	NOx Emissions (g/kWh)	SOx Emissions (g/kWh)	Life Cycle Cost (€)
1	HC01	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 CO_2 when exposed to the air during dismantlement while Supotec produces 69kg of CO_2. 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.	Hanjin Shipping										
1	HC02	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.	Several	8									
1	HC03	Temperature control units	Road	CryoTech: Liquid CO_2 modules for temperature for multi temperature control (cooling/heating)	Thermo King	9	<1	---	35-49 kg	4,500 - 20,000 BTU/hr; capacity: -30℃ to +50℃	liquid CO_2 / recycled fuel	only a fraction of a cooling gas (1/-13000)	--	--	
3	HC04	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.		9	<1								
3	HC05	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.		9	<1								
3	HC06	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.	Funded by the U.S. Department of Energy; Partnership with Emerson Climate Technologies Inc. and Carrier Corp	2	3								
3	HC07	Software program QUEST	Maritime	QUEST is a CO_2 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.	Quest Software	9	<1								
3	HC08	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.	Mitsubishi	9	<1								

Round	ID	Technology name	Transport mode	Short Description	Owner	Technology Readiness Level	Time To Market	Needed supporting measures	Dimensions (mm)	Weight (Kg)	Space productivity (m^2)	Heating/Cooling unit	Power Supply	Energy Consumption (kW/ton)	CO2 Emissions (g/kWh)	NOx Emissions (g/kWh)	SOx Emissions (g/kWh)	Necessary treatments	Life Cycle Cost (€)
1	LU01	Transhipment of standard semi - trailers from the road to the rail	Railway	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	There are different producers of transhipment	4	2	European and national project subsidies and	Corner height of up to 4.04 m in the lauding gauge	up to 40 to	Volume : ~141.137m³	Y	Change fuel energy (Lorry) to rail energy mix.	0.111 kWh/toKm Rail:Road=1:3	Rail:Road=1:4	0.061 g/tokm	0.022 g/tokm		
			Road																
			Multimodal																
1	LU02	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	StoraEnso	9													
1	LU03	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.	Actiw Oy	8													
1	LU04	Trailer stand	Maritime	Simple system to lash trailers	Finnlines	9													
1	LU05	2,5 wide container	Multimodal	Allows two pallets to be loaded side by side	Containership, several others	9													
2	LU06			Equip a Diesel-electric shunting engine with a serial hybrid	Alstom, Voith, Vossloh	6	2	Modify existing locomotives					Diesel				--		
2	LU07			Equip a Diesel-electric shunting engine with a parallel hybrid	Tognum	6	2	Modify existing locomotives					Diesel		./. 25%		--	ca. 25%	
2	LU08			Fuel cell to provide the energy for a shunting locomotive	Ballard, Proton Motors, Vossloh, Voith	5	5	Modify existing locomotives					hydrogen		0+		--	0	
2	LU09			Energy storing unit for non-electrified railway tracks	n.n.	5	4	Modify existing locomotives					electricity				--	0	
2	LU10	Waste energy feed system		Waste energy feed system for Diesel tracks		10	0	modern vehicles					Diesel		./. 10%	./. 10%	--	ca. 10%	
2	LU11	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	TULOMSAŞ	8	<1	N.A	-	-	-	Y	Electric	-	6,1 (96% Reduction)	53 (91% Reduction)	2.6 (83% Reduction)	N.A	-
2	LU12	Metering technology for traction energy consumption	Railway	Several sensors to measure energy consumption (circuit breaker, roof systems)	Faiveley Transport	high / successful pilots	available						electric - DC, electric - AC	20%	n.a.	n.a.	--		
2	LU13	Braking energy recovery	Railway	Recovery of dynamic braking energy and restitution to national grid / Reversible DB Substaion	Alstom	high / successful pilots	medium-term		Substation: 5m x 2.8m x 2.9m	7 tons			100% of breaking energy regenerated	saving	Reduktion im Umfang der Bremsenergie	Reduktion	---		
2	LU14	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	Bombardier Transportation GmbH	high / successful pilots	available			1.3-2.7 tons				saving potential 25-30%	saving potential 25-30%				
2	LU15	Superconducting traction transformer	Railway	Cooling system/Underfloor HTS transformer with 4 reactors	Siemens AG	high / successful pilots	available		20-50% less volume: 0.65m x 1.5m x 2.5m	30-40% less weight: 5.6 tons	see columns I/J	Y		6.4 kwh/kg*yr	n.a.	n.a.	--		saving: 0.09-0.2 €/kwh; payback time ca. 2.5-5.5 years
2	LU16	Medium Frequency Traction Transformer	Railway	Insulation and cooling system by an HV Module	Siemens AG	high / successful pilots	available		lower	lower		Y			n.a.	n.a.	--		
2	LU17	Waste heat recovery	Railway	Recover of aircon power in DMUs by a waste driven HVAC	Bombardier Transportation GmbH	high / successful pilots	medium-term		reduction by up to 80%	reduction by up to 80%				Saving potential: 10-48% (17-137 Mwh)	Reduktion im selben Umfang	Reduktion	--		

Round	ID	Technology name	Transport mode	Short Description	Owner	Technology Readiness Level	Time To Market	Needed supporting measures	Mass (Kg)	Capacity (m^3)	Propulsion	Loading units transported	Energy Consumption (kWh/ton)	CO2 Emissions (g/Km)	NOx Emissions (g/Km)	SO2 Emissions (g/Km)	Life Cycle Costs (€/ton)
1	VE01	Hybrid Locomotive	Railway	Hybrid Locomotive was developed with the goal of creating the cleanest, most fuel-efficient high-horsepower diesel locomotive ever built.	TÜLOMSAŞ	8	<1	N.A	207-ton	-	hybrid diesel-electric	-	-	-	-	-	-
1	VE02	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.	Norfolk Southern	9	<1	N.A		-	electric	-	-	0	0	0	-
1	VE03	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	Daimler Benz	9	<1	dto.	15000	4,54 tons/cbm	hybrid	bulk	25-30% less than Diesel	ca. 25% less than Diesel	ca. 25% less than Diesel	--	n.a.
1	VE04	Fuel Cells	Road	3,5 ton F-Cell Sprinter is a transporter running on renewable fuel cell technology.	Daimler Benz	9	<1	dto.	3500	2 tons/cbm	fuel cell	KEP	50% of av. Diesel consumption	close to 0	close to 0	---	n.a.
1	VE05	Fuso Canter Eco Hybrid	Road	Light-duty truck on hybrid technology	Daimler Benz	9	<1	dto.	7500	3,6 tons/cbm	hybrid	pallets / bulk	ca. 25% less than Diesel	ca. 25% less than Diesel		--	n.a.
1	VE06	Atego BlueTec Hybrid	Road	12 ton rigid truck on hybrid technology	Daimler Benz	9	<1	dto.	12000	5,1 tons/cbm	hybrid	pallets / bulk	ca. 15% less than Diesel	ca. 15% less than Diesel		--	n.a.
1	VE07	Hybrid vehicles	Road	Hybrid power-trains combine diesel engines with an electric engine and batteries.	Volvo, Scania, DAF, Mitsubishi Fuso, Hino, Kenworth and others	9	<1	None except possibly financial	all kind of fuels; the effect of the technology is on energy efficiency	today only smaller vehicles, but larger vehicles are expected	5-30% improvement on efficiency (highest urban, lowest on highway)	5-30% reduction	5-30% reduction	5-30% reduction	5-30% reduction	over time probably similar to conventional vehicles	today higher than conventional vehicles, over time probably lower than conventional vehicles
1	VE08	Plug-in hybrid vehicles	Road	As above, but vehicles can be charged from the Grid	Eaton, Toyota, International, Ford, EPRI, volvo, proterra, chrysler and others	9	<1	- Charging infrastructure is not required but is important to benefit from the potential of the technology	Electricity and all kinds of fuels	today only smaller vehicles, but larger vehicles are expected	5-100% improvement depending on operations (highest on shorter routes/urban with good recharing possibilities)	5-100% reductions depending on operatons	5-100% reductions depending on operatons	5-100% reductions depending on operatons	5-100% reductions depending on operatons	over time probably simiar to conventional vehicles	today higher than conventional vehicles, over time probably lower than conventional vehicles
1	VE09	Electric vehicles	Road	Battery-electric vehicles	Toyota, Honda, Mercedes,	9	1	Charging infrastructure	Electricity	Today 15-~220kw, larger	2-3 times higher than diesel	100% reduction tank to wheel	100% reduction tank to wheel	100% reduction tank to wheel	100% reduction tank to wheel	When reaching maturation	today higher than conventional vehicles, over
1	VE10	Euro VI vehicles	Road	Euro VI is compulory for new trucks from 2013, replacing Euro V				None	Diesel	All sizes	Similar or slightly below Euro V	Similar or slightly above Euro V	80% below Euro V	Unchanged	50% below Euro V	unchanged	slightly higher than euro V
1	VE12	Vehicles on Biodiesel	Road	Vehicles certified for EN14214 biodiesel	MAN, Scania, Mercedes, Caterpiller, DAF	9	<1	Filling infrastructure	biodiesel	All sizes	Unchanged	Similar tank to wheel	Moderately increased for first generation	reduced	reduced	similar as conventional vehicles	Purchase cost similar to conventional vehicles; maintenance cost slightly
1	VE13	Vehicles on Bioethanol	Road	(ED95)	Scania, Fiat,	9	<1	Filling infrastructure	Bioethanol	All sizes	Same as for diesel engines	Similar tank to wheel	20% below diesel engines	minimal	65% below diesel engines	similar as conventional vehicles	Purchase cost and maintenance cost similar to conventional vehnicles
1	VE14	Vehicles on bio-DME	Road		Volvo	9		Filling infrastructure			Potentially better than diesel engines	92% for farmed wood DME according to 2009/28/EC	Reduced	Reduced	Reduced		
1	VE15	Vehicles on biogas	Road	CNG/LNG vehicles. These vehilces usually satisfy Euro VI requirements	Peterbilt, Mercedes, Volvo, Daimler and others	9	<1	Filling infrastructure	Biogas	all sizes	Similar to diesel engines	0-20% reduction tank to wheel	Significantly reduced	Minimal	Significantly reduced	Similar as conventional vehicles	Purchasing cost 10-20% above conventional vehicles; maintenance cost similar to
1	VE16	Barge-mothership system	Inland Waterways	Independently ice going technology. Modular barges, avoiding load transfer.	Aker Arctic	5											
1	VE17	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.													
1	VE18	E/S Orcelle Green Flagship	Maritime	vision for zero emission car carrying													
1	VE19	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.													
1	VE20	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.													
1	VE21	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.													
			Inland Waterways														
1	VE22	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.	Swedish Rail Energy	8	<1	N.A	35-40 tons	50 tons				75 % Reduction			
1	VE23	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.	TULOMSAŞ	8	<1	N.A	-		Electric		-	6,1 g/kWh (96% Reduction)	53 g/kWh (91% Reduction)	2.6 g/kWh (83% Reduction)	-
1	VE24	Metering technology for traction energy consumption	Railway	Several sensors to measure energy consumption (circuit breaker, roof systems)	Faiveley Transport	high / successful pilots	available						?	n.a.	n.a.	--	
1	VE25	Brake energy recovery system	Railway	Reversible DC Substation for recovering of dynamic braking energy and restitution to national grid	Alstom	high / successful pilots	medium-term		7 tons		100% of breaking energy regenerated		saving	Reduktion im Umfang der Bremsenergie	Reduktion	---	
1	VE26	Onboard energy storage systems	Railway	Moved to LU14, as this is a regarded as an innovative unit	Bombardier Transportation GmbH	high / successful pilots	available		1.3-2.7 tons				saving potential 25-30%	saving potential 25-30%			

Round	ID	Technology name	Transport mode	Short Description	Owner	Technology Readiness Level	Time To Market	Needed supporting measures	Mass (Kg)	Capacity (m^3)	Propulsion	Loading units transported	Energy Consumption (kWh/ton)	CO2 Emissions (g/Km)	NOx Emissions (g/Km)	SO2 Emissions (g/Km)	Life Cycle Costs (€/ton)
2	VE29	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/	various	9	available						saving potential 10-26%	reduction potential 10-26%	reduction potential 10-26%	reduction potential 10-26%	
2	VE30	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/	various	9	<1	legislation					up to 30% reduction	up to 30% reduction	up to 30% reduction	up to 30% reduction	
2	VE31	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.	Bombardier	9	<1		Weight reduction by 30% over traditional bogies	N.A.	Electric Diesel	wagons		0.3% reduction estimated by 2050			
2	VE32	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										1.9% reduction estimated by 2050			
2	VE33	Low rolling resistance tires	Road	Tires which are designed to minimize the energy wasted as heat as the tire rolls down the road		9	<1		N.A.	N.A.		N.A.	N.A.	10% reduction estimated by 2050			
2	VE34	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	Bombardier	9	<1				Electric	wagons					
3	VE35	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	Vehicles on Hydrogen	Road	Hydrogen is converted to electricity in fuel cells	Mercees, BMW, Think, Vision Industries and others	8	5	Filling infrastructure	Hydrogen	today mainly smaller vehicles, but larger vehicles are expected	20-50% improvements	100% reduction tank to wheel	100% reduction tank to wheel	100% reduction tank to wheel	100% reduction tank to wheel	Unknown	unknown

Round	ID	Technology name	Transport mode	Short Description	Owner	Technology Readiness Level	Time To Market	Needed supporting measures	Coverage (Km)	Tracking/Tracing allowed	Authomatic Identification	TLC Media	Life cycle cost
1	NA01	Train Control System	Railway	An award winning new technology for complete train control and tracking system based on a special GPRS based method.	TCDD	9	<1	N.A.	~30000km.	Y	Y	Y	150000
1	NA02	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.		9	<1	Mandatory on all ships from 300 gross tonnage and upwards.	50 - 100	Y	Y	Y	GPS (Global Positioning System), VHF
1	NA03	AIS Application-Specific Messages	Maritime	Flexible message type extending the usage and variety of information to be transmitted through AIS		6	3	Requires updates to onboard systems	50 - 100				VHF radio
1	NA04	Satellite AIS	Maritime	Satellite detection of AIS signals from ships, using Low earth Orbit satellites	ESA, Norway, Denmark, Germany, Luxembourg, The	7	2	No additional measures needed onboard ships	(Ship to satellite ~1000 km) Global coverage can be achieved with 6	Y	Y		
1	NA05	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.		9	<1	Mandatory equipment from 2012, See SOLAS Ch V, Reg 19 for details.	N.A.	N	N	N	
1	NA06	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.	E.g. UK Department for Transport (DfT) is an active developer	6	5	Requires dedicated equipment onboard	Long range, >1000 km	Y			Terrestrial 250kW 0.1MHz
1	NA07	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.									
			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.									
			Road	Global Navigation Satellite Systems (GNSS) is the standard generic term for satellite navigation systems ("sat nav") that provide autonomous geo-spatial									
1	NA08	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.		9	<1		~20km	Y	N		
1	NA09	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	Canada	9	<1						
1	NA10	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.	Canada	7	5						

Round	ID	Technology name	Transport mode	Short Description	Owner	Technology Readiness Level	Time To Market	Needed supporting measures	Coverage (Km)	Tracking/Tracing allowed	Authomatic Identification	TLC Media	Life cycle cost
1	NA11	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		9	<1	Mandatory on all ships from 300 gross tonnage and upwards. See SOLAS Ch V	global	Y	Y		Satellite e.g. Inmarsat C/mini-C
1	NA12	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.									
1	NA13	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.									
1	NA14	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.									
1	NA15	WiMax - Worldwide Interoperability for Microwave Access	Maritime	Long range, high bandwidth wireless Internet		8			10 - 50	N	N		2.3 - 5 GHz MIMO-SOFDMA
			Railway	Long range, high bandwidth wireless Internet									
			Road	Long range, high bandwidth wireless Internet									
1	NA16	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%.	Technofysica	9	<1						
2	NA17	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 .	Transas	9	<1	Enhancement of national and international legal framework for data exchange in order to fully exploit data exchange with logistics operators		Yes	Yes		
2	NA18	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.	Daimler	9	<1						

Round	ID	Name	Description	Geographical Coverage	Transport Modes Involved	Technologies Involved	Energy Consumption Reduction	Carbon Footprint Reduction	Potential for Transferability
1	BP01	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.	National	Railway		5% (APU reduces idle fuel consumption by 83%)	40% reduction	High
1	BP02	TDS	TDS (Train Control System based on a new GPS application method)	National	Railway	-	-	-	High
1	BP03	Traffic Management System	GEKKO is a system to provide guidance to energy efficiency driving and timetable optimization, developed for Danish State Railways	National	Railway	3G, GPS, GPRS, WLAN	15%		High
1	BP04	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	National	Railway		5%		High
1	BP05	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.	National	Railway	-	60%	0.5	High
					Road				
1	BP06	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.	National	Railway	Metrocargo system	95% (in hours)		High
1	BP07	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.	European	Railway		none	Using carbon-free rail transport, a customer sending a 1,000 ton unit train from Hamburg to Munich can avoid altogether 20 tons of carbon compared to regular trail transport. Compared to truck transport, he even saves 55 tons of carbon. Every day more than 5,400 freight trains run by DB Schenker Rail relieve Europe's roads of the burden posed by around 100,000 truck journeys. This avoids 23,000 tons of carbon emissions – every day.	High
1	BP08	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	European	Maritime				
1	BP09	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).	European	Maritime			ETS removes 95-99% of Nox emitted from the stack	
2	BP10	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	European	Railway		The technology is expected to reduce energy consumption by		
2	BP11	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.	European	Railway		The technology is expected to reduce energy consumption by 1% to 7%		
2	BP12	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	European	Railway		The technology is expected to reduce energy consumption by 2% to 6%		
3	BP13	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.	European	Railway				