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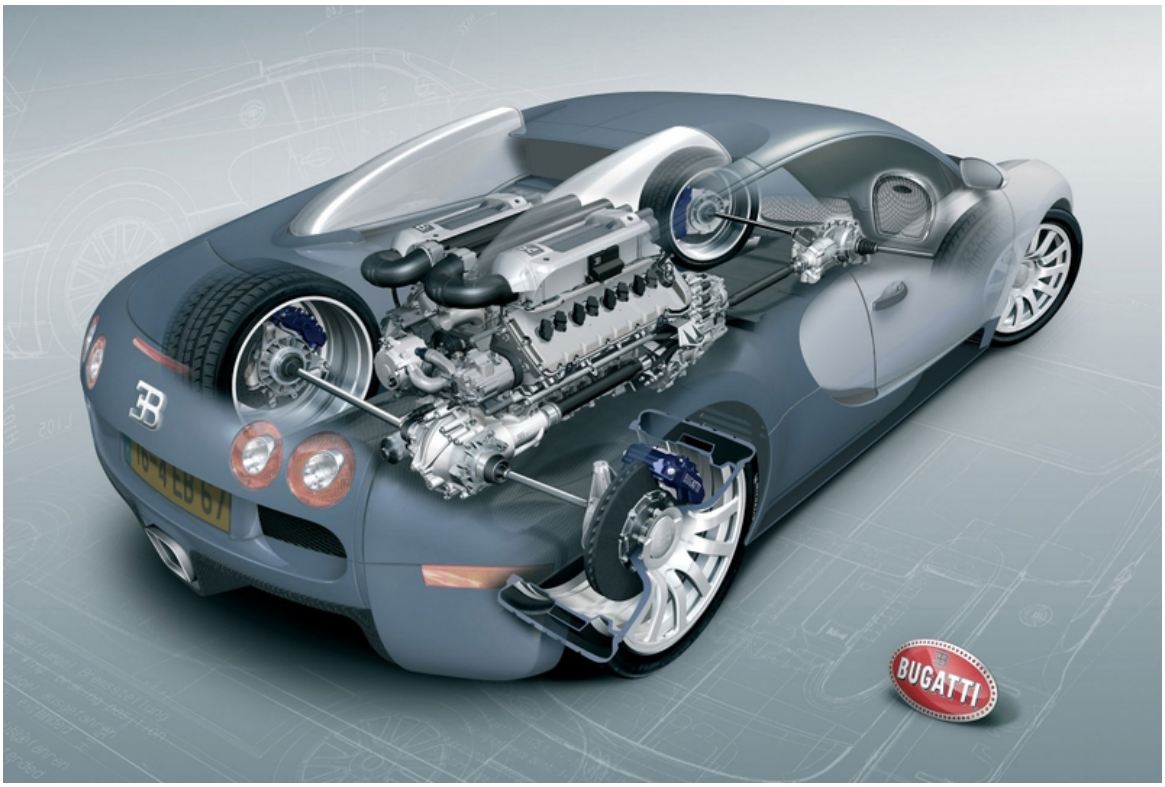
VN-KERB TURBO SOLUTIONS LTD

Round 1 Seed Enterprise Investment Scheme Funding

Due Diligence Pack & FAQ's



Bugatti Veyron with Compound Boosting

This Due Diligence pack is issued to IFAs or individuals for their exclusive use who, in the belief of the directors of VN-KERB Turbo Solutions Limited, are Certified High Net Worth Individuals for the purposes of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005, defined as a person with annual income of not less than £100,000 or who has capital assets, excluding their house and pension, of at least £250,000 and who has a signed certificate in the format set out in page 31 of the Information Memorandum or in the case of IFAs are advising aforementioned individuals.

Due Diligence Pack Index

Project Summary

Industry Background

Background to the EU CO_2 Emission Standards for Passenger Cars and Light-Commercial Vehicles Regulation (EC) 443/2009

The law requires that the new cars registered in the EU do not emit more than an average of 130 grams of CO_2 per kilometre (g CO_2/km) by 2015. This means a fuel consumption of around 5.6 litres per 100 km (l/100 km) of petrol or 4.9 l/100 km of diesel.

The average emissions of a new car sold in 2014 was claimed to be 123.4g CO2/km, well below the 2015 target. However, in 2014 and 2015 it started to become clear that the car industry was not actually beating the targets, or even meeting them. Rather it was either misinforming the car buying public, or in the case of Volkswagen, actually CHEATING!

In November 2014, the US Environmental Protection Agency, EPA fined Hyundai and Kia $100 million for emissions violations on 1m cars imported into the US that emitted more Green House Gases, GHGs than the levels claimed by the manufacturers. They were also stripped of $200 million worth of GHG emissions certificates.

A further $50 million was levied for audit and testing costs on ensuring future vehicles sold in the US reach the manufacturers claimed, and legislated emissions levels. No fines have been levied yet by Europe or rest of the world for these transgressions.

On 28th June 2016, the US EPA and the Federal Trade Commission, FTC fined Volkswagen $14.7 billion in order to settle allegations of cheating emissions tests and deceiving customers. The affected vehicles include 2009 through 2015 Volkswagen TDI diesel models of Jetta, Passat, Golf and Beetle as well as the TDI Audi A3. No fines have been levied yet by Europe or the rest of the world for these transgressions.

By 2021, phased in from 2020, the fleet average to be achieved by all new cars is 95 grams of CO_2 per kilometre. This means a fuel consumption of around 4.1 l/100 km of petrol or 3.6 l/100 km of diesel.

The 2015 and 2021 targets represent reductions of 18% and 40% respectively compared with the 2007 fleet average of 158.7g/km.

The graph above shows the effect of legislation on conventional & hybrid ICE powered passenger vehicles cars in future. The Golf Diesel will be unable to meet emission standards in 2025 and the Diesel Hybrid exceeds allowances by 2032.

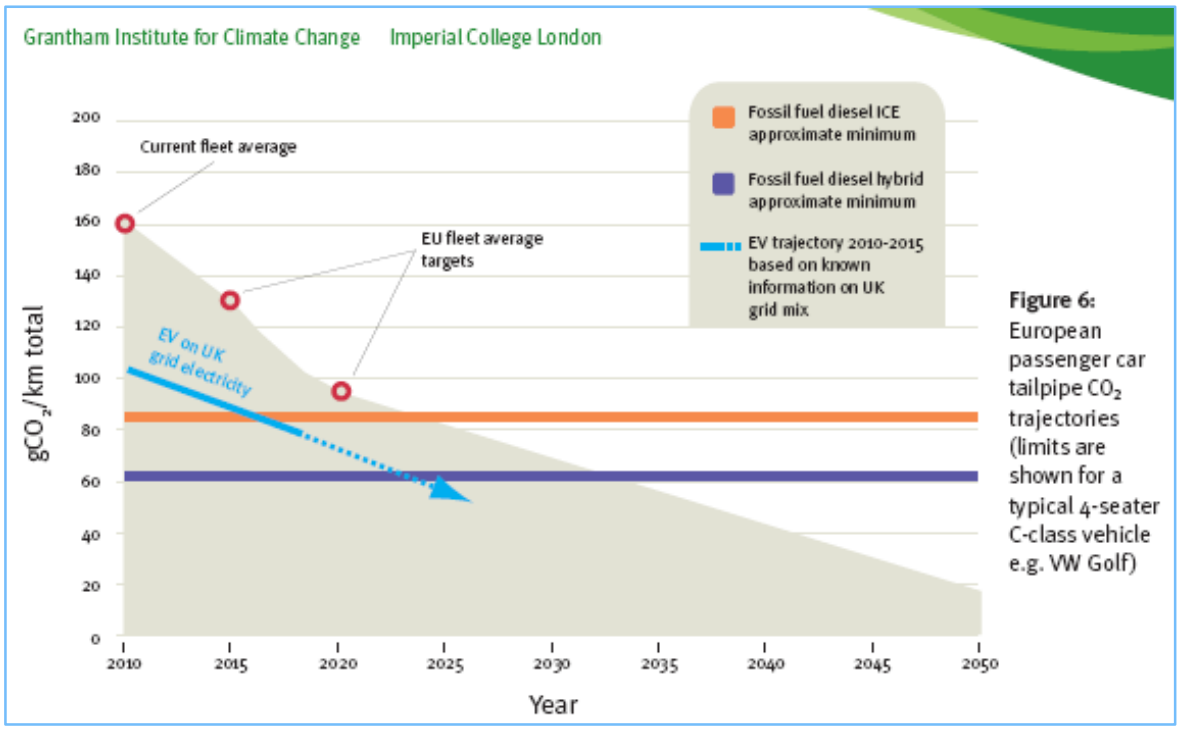


Figure 6: European passenger car tailpipe CO_2 trajectories (limits are shown for a typical 4-seater C-class vehicle e.g. VW Golf)

In Summary, the Global Internal Combustion Engine, Automotive and Static Plant industries need a 'new' clean fuel solution that can integrate with existing ICE technology, meet legislation relating to the 2020 reductions in CO_2 emissions and beyond, or they will cease to exist in their current form, so what next?

Industry Strategy

Engine right-sizing is a key trend in the automotive industry, both in the Light and Heavy duty sectors, this will see the majority of road cars fitted with boosted engines in Europe and other key regions by 2020.

What is engine right-sizing?

This is the transition from existing vehicle designs to cars that are smaller, more efficient, and with more space, but ideally with no less performance. Since the industry is under increasing pressure to deliver on hitting the targets for emissions legislation, as demonstrated in the previous section, this is now one of the key trends in the automotive industry, and boosted engines are part of the solution.

However, maintaining acceptable engine performance requires compound boosting which is highly expensive, or Variable Geometry Turbocharging (VGT) which is also expensive, and only suited to turbo-diesel engines. Unfortunately, in this application it also creates excessive exhaust back pressures which automatically incurs a fuel consumption penalty.

Using twin turbos is an alternative but expensive and more complex solution. This cannot always provide the required engine performance whilst still creating excessive exhaust back-pressure. Supercharged/turbocharged solutions avoid elevated backpressure but lead to a significant real world fuel consumption penalty as the supercharger is mechanically driven by the engine for example the VW "TwinCharger" and here even the manufacturer is unhappy at the application costs involved.
(see https://www.carthrottle.com/post/volkswagens-superb-twincharger-engine-meets-its-maker)

Of the many E-boosting systems proposed for light duty applications, many require 42 Volt architecture creating further expense and complexity for the manufacturer and eventually for the customer.

Heavy duty applications all involve turbo compounding and/or Variable Geometry Turbo (VGT) systems, which result in elevated exhaust back pressures and thus incur fuel consumption penalties.

VN-KERB-TS Technology Development Programme

Following 2 years of R&D by Professor Cairns of Nottingham University, the project is focused on delivering an automotive-ready solution, in line with the industry established Automotive Technology and Readiness Levels, (Complete guide in Schedule 4). This aligns R&D project deliverables to industry accepted parameters for technology acceptance into manufacturing. In particular, it lays out the required level the technology must achieve and the parameters it must deliver on prior to industry adoption, and therefore commercialisation. Should the solution deliver on all of its targets, this process facilitates a straightforward and industry accepted route for integration into manufacturing, and therefore monetisation of the technology.

Timings & Costs

The Company proposes to raise an initial £150,000 via a single SEIS raise by issuing 150 Ordinary Shares at £1000 per share. This will fund Phase 1 Rig testing to Technology Readiness Level 4 (TRL4) at a budgeted cost of £125k and cover the period April 17-April 19. This is a 'Go – No Go' break point. If the trial is successful it will deliver sufficient results to move the project onto Phase 2 and a further EIS round of funding by the end of 2018.

Stage 1 of the programme will be completed within 24 months of fundraise closing. Costs are estimated at £126,000 including a 10% payment (£25,000, being 10% of the full cost of £250,000) of the negotiated development licence fee. Note: All Legal, Accountancy and 3rd Party costs as indicated on Page 18 of this IM and (estimated at £24,000) will be made before project commencement. Project expenditure at £126,000 including a 10% overrun / contingency fee.

HMRC Advanced Assurance for Seed Enterprise Investment Scheme has been granted. (See Schedule 1)

Phase 2 on-engine demonstration will deliver the technology solution integrated into an engine, energy recovery system and turbo to demonstrate the solutions effectiveness, efficiency and emissions on a transient rig, which means as close to road-going conditions as can be achieved in a test facility. This will take 2 years and the solution will target Technology Readiness Level 6, TRL6 and is budgeted at £900K.

Stage 2 will take place over a 24-month period from funding close and costs are estimated at £810,000 including a minimum second payment (£50,000 being 20% of the full cost of £250,000) of the negotiated development licence fee. Note: All Legal, Accountancy and 3rd Party costs (estimated at £90,000) will be made before project commencement. Project expenditure estimates include a 10% overrun / contingency fee.

Once TRL 6 is reached there are two options, namely:

1. Obtain Advanced Propulsion Centre (APC) funding to take the technology to full production, with OEM and suppliers onboard with a £10-20m total project cost including partners, and a 2-3 year project duration. If the Directors take this option the actual cost to VN KERB-TS will be significantly less, as much of the work will be performed and paid for by consortium participants

2. Commercialise the company at TRL6 / 7 stage i.e. A trade sale.

Examples of similar technology trade sales, at this stage of development, TRL6/7 can be found here:

Tier 1 Manufacturer 'Valeo' purchased CPT VTES
(See http://www.valeo.com/medias/upload/2012/10/2632/valeo-acquires-electric-supercharger-technology.pdf)

UK consultancy Integral Powertrain Ltd formed a joint venture with Tier 1 manufacturer 'Magna' on SuperGen (See http://www.integralp.com/technologies/supergen)

A 'rights of use' & 'development of' Licence (deriving from the UK Patent Application number; GB891 723 016) utilising the Kinetic Energy Recovery Boosting Solution in a Turbo application within the Global Automotive Industry, has been negotiated with the beneficial owner of the IP, Viridis Navitas AC-IP Ltd (VN-AC-IP) This will allow VN KERB Turbo Solutions Ltd (VN-KERB-TS) to complete a technology application development programme.

The programme will be conducted in conjunction with industry partners, third party OEM technical suppliers and led by Professor Alasdair Cairns of Nottingham University. All additional IP created by this development will be owned jointly by VN-KERB-TS and VN-AC IP for their mutual benefit, on a royalty free basis. All stages of the programme will be developed with clear 'Go' – 'No Go' break points.

Summary of Success Factors

1. Legislation is forcing the automotive, van and truck manufacturing industries to continuously reduce CO_2 emissions from their engines. This is forcing manufacturers to design, build and operate low emission vehicles. Therefore, any solution that assists or delivers on those reductions will very likely become a commercial success.

2. Professor Alasdair Cairns, of Nottingham University is Technical Director and a shareholder of VN KERB TS. This is to ensure his continued contribution of expertise in the scientific and technical development input, and to assist in the integration of the solution into existing processes and technologies; in particular, the project deliverables against the Technology Readiness Levels required by the automotive industry prior to adoption. His background, experience and R&D skills in this area are second-to-none in this field, Worldwide.

3. Using the UK's premier University for Automotive R&D, with its extensive automotive test facilities will significantly reduce the risk, cost and time- to-market of the solution development, which is where VN-KERB-TS will make money.

4. The VN KERB TS management team operates on a 'equity for services' agreement thus negating salary costs.

5. VN KERB TS pays a fixed £5k pa admin fee, this covers all monthly/annual accounting, fiscal reporting, VAT returns, shareholder administration and daily administration thus reducing OPEX.

6. As a result of points 4. & 5. above, the majority of money raised is applied directly to the project delivering further proofs, prototypes, IP, knowledge/know-how and equipment and therefore, accelerated time to revenues.

7. Using Universities, the scientific community and industry specialist outsource suppliers on fixed-price, fixed-deliverable contracts underpinned with quality metrics and Service Level Agreements means that VN KERB TS is able to predict and control costs, quality and timescales.

8. The VN KERB TS licence model delivers profitable revenues without the need for extensive company scaling and monetary requirements. Furthermore, this makes a potentially disruptive solution complementary to the goals and strategies of most Governments and Industrial manufacturers, i.e. to reduce CO_2 efficiently, and create local jobs and taxation.

10. Working with other industry specialists where technology solutions already exist means less R&D, less money and less time required to go to market, and therefore time to revenues.

Summary of Risk Factors

The Company's Final Stage of business development involves a degree of risk, inasmuch as:

- An investment in the Company is speculative because, although it has access to a substantial amount of research and data compiled regarding the VN KERB TS project, and has a full IP exploitation Licence granted by the IP owner, the technology not been proven. Therefore, there is a possibility that the process may not deliver the desired results and the project could fail

- Although best endeavour has been used to verify all the scientific research and data the Company is relying on for this project, it may transpire not to be reliable

- The market uptake for a KERB TS type product is unproven. The project's success is driven by legislation that forces the automotive, van and truck manufacturers to continuously reduce emissions from their engines. This is forcing manufacturers to build 'low emission' and 'fuel-efficient' machines, however there is no guarantee that the KERB TS will become the industry's 'preferred' solution

Estimates of potential value and costs may not be reliable inasmuch as:

- The potential licence income values are illustrations based on the available industry information

- The estimates are subject to market input variables that cannot be determined until the unit is developed and ready for market

- The illustrations of potential income value may, accordingly, not be reliable despite the Directors best efforts to judge them accurately.

Seed Enterprise Investment Scheme

A condition of HMRC's approval of SEIS is that the conditions relating to the Company and its trade have be complied with throughout the three-year period following the issue of the Shares Although it is the intention that the Company's activities should qualify under the SEIS, if the conditions are not complied with, the Company would have breached the SEIS legislation and SEIS income tax relief would be withdrawn.

SEIS Information

The summary below provides an indicative guide to the tax implications stemming from an investment in VN-KERB Turbo Solutions Ltd and is based on current understanding of UK tax law and practice. It does not set out all of the rules or regulations that must be adhered to and should not be interpreted as the provision of tax, legal or financial advice. Investors are strongly recommended to seek independent professional advice on the tax consequences of acquiring, holding and disposing of SEIS qualifying Shares before proceeding with an investment into the Company.

The Round 1 NFSH raise has been structured with the intention to enable investors to claim SEIS reliefs on the amount of their subscription, as described below. The amount and timing of these reliefs will depend on the individual circumstances of each investor and may be subject to change in the future.

The illustrations included in this section are for indicative purposes only and should not be construed as forecasts or projections of the likely performance of the Company.

In order to access the tax reliefs described it is necessary to be a UK resident taxpayer and subscribe for SEIS qualifying Shares. The summary below gives only a brief outline of the available tax reliefs and assumes that an investor is an additional rate taxpayer.

1. SEIS Income Tax Relief:

Investors who are not connected to an SEIS Qualifying Company can claim income tax relief of up to 50% on amounts subscribed for SEIS qualifying Shares, subject to an aggregate investment limit of £100,000 during any one tax-year. Income tax relief is given by way of a reduction in an investor's tax liability for the tax-year in which the investment is made. The total income tax relief cannot exceed an amount that reduces the investor's liability to nil. Similar to EIS, an investor can "carry back" a SEIS investment to the prior year for income tax relief purposes, and so from 2013/14 onwards it is possible for an investor to make a total investment of £200,000 if the full £100,000 is carried back to 2012/13.

Income Tax Relief for 2013/14 (example)	
Gross Investment in qualifying SEIS shares	£25,000
Less Income Tax Relief @ 50%	(£12,500)
Net cost of Investment	£12,500

2. SEIS Capital Gains Tax ("CGT") Re-Investment Relief:

This relief is currently available for chargeable gains arising in the tax-years 2014/15 and 2015/16 (the latter is the year in which the SEIS shares will be issued). If an investor disposed of an asset which gave rise to a chargeable gain in 2014/15, and reinvests all or part of the amount of the gain in shares which also qualify for SEIS income tax relief, then by electing to "carry back" to 2014/15 the amount reinvested will allow a full deferral of the original CGT liability and the original gain will be fully exempt from CGT.

If an investor disposes of an asset which gives rise to a chargeable gain in 2015/16, CGT re-investment relief will also be available for a SEIS investment made in 2015/16. This will allow for a full deferral of the current CGT liability but the future exemption from CGT (on the original gain, which is brought back into CGT charge when the SEIS shares are disposed) will be restricted to 50% of the gain only.
The asset does not have to be disposed of first; the investment in SEIS shares can take place before disposal of the asset, providing that both disposal and investment occur in the 2015/16 tax-year. Alternatively, an investment into SEIS made in 2015/16 can be "carried back" to 2014/15 for both income tax and CGT re-investment purposes.

CGT Re-Investment Relief examples: full exemption (2014/15) and partial exemption (2015/16)

	2014/15	2015/16
Gross investment in qualifying shares	£25,000	£25,000
Less income tax credit	(12,500)	(12,500)
Less CGT exemption (Re-Investment Relief) @28%	(7,000)	(3,500)
Net cost of investment (after IT/CGT relief)	£ 5,500	£9,000

3. CGT Disposal Relief

Where an investor has received SEIS income tax relief (which has not subsequently been withdrawn) on the cost of the qualifying Shares, and the SEIS qualifying Shares are disposed of after the minimum period any capital gains are free from CGT. If no claim to income tax relief is made, then any subsequent disposal of the shares will not qualify for exemption from CGT.

Disposal after three years	£50,000 (example only)
Original cost	(25,000)
Tax-exempt capital gain	£25,000

4. Share Loss Relief

Capital losses realised on the ultimate disposal of SEIS qualifying Shares (net of income tax relief attributable to the investment) may qualify for share loss relief. The amount of the net loss may be set off against capital gains in the tax-year of disposal or carried forward for relief against future capital gains. Alternatively, an investor may elect to set off the net loss against income arising in the tax-year of the disposal or the previous tax-year.

In the case where no proceeds are received on disposal of the SEIS qualifying Shares, the maximum net loss (after the income tax credit of 50%) on an investment of £25,000 would be £12,500; however, this is reduced to £6,875 on a post-tax basis (based upon share loss relief at a future 45% income tax rate).

By making a claim for both income tax relief (50%) and full CGT re-investment exemption (28%), an investor can reduce the initial cost of their investment to 22p for £1 subscribed. When full share loss relief is factored in (effective relief up to 22.5%) the potential net cost of an investment in the Fund is nil, as tax relief will have exceeded the initial cash outlay. Where there is partial CGT exemption, the comparative net cost in the situation when a total capital loss occurs is 13.5p per £1 invested.

5. Inheritance Tax Relief

On the basis that the investment will be in an SEIS qualifying company, this should mean that SEIS Qualifying Shares will constitute "relevant business property" as defined in Inheritance Tax Act (IHTA). Provided the SEIS qualifying Shares are held for a period of not less than two years they should qualify for 100% business property relief, which would reduce any IHT liability arising on transfer of the SEIS qualifying Shares to nil.

If the investor dies within the two-year period and his or her spouse inherits the SEIS qualifying Shares, the holding period of both the investor and the spouse are combined in order to determine whether the 2-year holding period condition has been satisfied on death of the spouse.

SEIS Rules

There are a number of conditions to be met. These, fall into two categories – those which must be met throughout the minimum period commencing with the issue of the shares, and those which must be met at the time the SEIS shares are issued.

Minimum Period Conditions

The Company must, throughout the minimum period:

- Not be under the control of another company or control another company other than a qualifying subsidiary (nor can there be arrangements for the Investee company to be under the control of another company or control another company other than a qualifying subsidiary)
- Either be a company which exists wholly for the purpose of carrying on a new qualifying trade (being a qualifying trade which commenced less than two years before the issue of the SEIS shares) or a parent company of a group which does not consist wholly or as to a substantial part in the carrying on of non-qualifying activities
- Carry on the new qualifying trade, prepare to carry on that trade or carry out research and development activities from which a new qualifying trade will be derived or from which a new qualifying trade will benefit either itself or through a 90% subsidiary
- Have a permanent establishment in the UK.

Issuing Conditions:

- The Company must be unquoted and there must be no arrangements in place for it to cease to be unquoted
- The Company may not have gross assets of more than £200,000 immediately before it receives a subscription for eligible shares. If the company is a parent company, the value of the group's gross assets must not exceed £200,000 immediately before it receives the subscription for eligible shares
- The maximum amount that a company may receive from SEIS investors is £150,000 in any three-year period ending with the investment then being made. Neither the investee company nor any subsidiary may have previously received any EIS or VCT investments

- The Company must have fewer than 25 full-time employees at the date of issue of shares to SEIS investors
- The Investee Company must not be in financial difficulty.

Claiming SEIS Relief

An investor cannot claim income tax relief until the Company has submitted an SEIS1 form and HMRC has issued a compliance certificate to confirm that it is SEIS qualifying. An application will be made to HMRC once the Company has been trading for four months, or if earlier, when more than 70% of the SEIS monies have been spent on the qualifying activity. It anticipated that the Company would distribute claims forms to investors within 8 months after the closing Date.

Relief must be claimed within five years after 31 January following the year of assessment in which the investment was made. Investors are strongly recommended to seek professional tax advice on making claims for SEIS relief as personal circumstances may differ.

Exit Strategy and Potential Returns to Subscribers

The Directors plan an Initial Public Offering of the shares in the company between 2020 and 2022 or at such time as the Directors believe a significant multiple on initial investment may be achieved for subscribers.

No guaranteed forecast can be given of the likely or potential returns to Subscribers upon the successful delivery of the project. Therefore, given current market uncertainties, allowances have been made for a broad spectrum of returns, on the basis of Market Research carried out by VN-KERB-TS.

In the licencing scenario outlined on page 22 of the IM VN-KERB-TS is budgeting for royalty income in 2020. The company's fixed annual operating costs are budgeted at £250K in 2020 rising to £500K in 2022.

Licence sales will follow the automotive 'channel supplier' and OEM route with potential partners identified and marketed to, whilst the initial PR campaign commences. VN-KERB-TS will completely outsource the manufacturer of new turbo devices to third party specialist service providers, retaining only the scientific development, product technology design, supply chain audit, management, certification and licence sales and marketing elements of the business.

Penetration into the licenced 'rights of use' automotive marketplace is restricted by the number of prototype designs VN-KERB-TS can produce annually, and by the number of different engines adopting the technology.

Example market penetrations are:

1. 0.5% penetration of projected new vehicles fitted with turbo drives in 2020
2. 1% penetration of projected new vehicles fitted with turbo drives in 2020
3. 2% penetration of projected new vehicles fitted with turbo drives in 2020
4. 5% penetration of projected new vehicles fitted with turbo drives in 2020
5. 10% penetration of projected new vehicles fitted with turbo drives in 2020

Note* The following charts assume:

1. The projected industry number of 49 million vehicles using turbo drives in 2020.
2. An average turbo drive sale prce of £100
3. A 10% of sale price royalty income
4. No income recorded for up-front design charges or one-off royalty payments.

Round 1 SEIS @ £1000 per Share

Table 1

Minimum Investment			£20,000 = 20 Shares		
Rights of use licence royalties £10 each - Turbo devices sold at £100 per unit			Potential Return on Investment		
Year	EBITDA	Sales Projections	P/E	P/E	P/E
			7	10	12
2020	£2,450,000	Scenario 1	£214,375	£306,250	£367,500
2020	£4,900,000	Scenario 2	£428,750	£612,500	£735,000
2020	£9,600,000	Scenario 3	£840,000	£1,200,000	£1,440,000
2020	£24,500,000	Scenario 4	£2,143,750	£3,062,500	£3,675,000
2020	£49,000,000	Scenario 5	£4,287,500	£6,125,000	£7,350,000

Directors & Their Track Records

Directors:

Alasdair Cairns (Technical & Automotive)

Mark Gilmore (Sales & Operations)

David Newman (Commercial and Managing)

Alasdair Cairns is Head of Department in Automotive Propulsion at Nottingham University, with a background in low carbon powertrain research and development within both academia and industry. He is the designer and initiator of the VN-KERB-TS technology and has the role of Technical Director within the company.

Career History:

2017 - Head of Automotive Propulsion, Nottingham University
2014 - 2016 Director of Teaching and Learning
2013 - 2016 Professor, Brunel University London
2010 – 2013 Senior Lecturer, Brunel University London
2006 – 2009 Principal Research & Development Engineer, Mahler Powertrain Ltd.
2003 – 2006 Senior Research & Development Engineer, Cosworth Technology Ltd.
2000 – 2002 Development Engineer, Cosworth Technology Ltd.

Research area(s)

- Spark Ignition Engine Combustion
- Advanced Exhaust Gas Recirculation Systems
- Alternative Fuels (including biofuels)
- Advanced Turbocharging Systems
- Diesel Engine Combustion
- Optical Engine Diagnostics
- CAI / HCCI Engine Combustion
- Hybrid Vehicle Propulsion (including mechanical and hydraulic systems)

Research & Research interests

Low carbon automotive powertrain technologies, with prior and on-going projects in the following research areas:

- Spark Ignition Engine Combustion
- Advanced Exhaust Gas Recirculation Systems
- Alternative Fuels (including biofuels)
- Advanced Turbocharging Systems
- Diesel Engine Combustion
- Optical Engine Diagnostics
- CAI / HCCI Engine Combustion
- Hybrid Vehicle Propulsion (including mechanical and hydraulic systems)

Research project(s) and grant(s)

- 2015-2018: Ultra Efficient Engines & Fuels. EPSRC funded project with JLR, BP, Delphi & Ricardo. CI. £2.9m
- 2015-2017: Innovative Low Carbon Power Generation Technology. Innovate UK (EPSRC) funded project with 2020 Powergen, Integral Powertrain Ltd & Lontra. PI. £230k
- 2015-2016: Pre-Mixed Micropilot Combustion in Future Heavy Duty Dual Fuel Engines. KTP follow-on project with Clean Air Power Ltd. PI. £86k
- 2012-2015: Advanced HD Dual Fuel Operation. KTP project with Clean Air Power Ltd. PI. £180k
- 2012-2013: Novel Hydraulically-Assisted Boosting System for Future Military Land Vehicles. CDE funded project with GE Precision Engineering Ltd. PI. £50k.
- 2010-2014: Lubricant Induced Pre-Ignition in Future Downsized Spark Ignition Engines. Direct funded PhD studentship with BP. PI.
- 2010-2015: Particulate Emissions Reduction in Future Advanced SI Engines Operating with Gasoline/Ethanol Blends. Direct funded PhD with MAHLE Powertrain LLC. PI.
- 2011-2012: The Effects of Multiple Spark Discharges and Future Fuels during Hybrid SI-CAI Combustion. EPSRC funded project with BP. PI. £99k.

Mark Gilmore is a founding Director of Viridis Navitas Capital Partners Ltd (the sponsor of VN-KERB Turbo Solutions) and a serial entrepreneur who has successfully managed to blend a career of high level professional corporate roles, and an enviable track-record in start-ups. Mark brings more than 20 years successful operating experience at senior and executive level sales and operational management to VN-KERB-TS.

Mark's most recent corporate role was managing COLT Managed Services strategic markets region (6 countries and 27 employees). In his last year, he delivered over £30m in revenues (118% against target) and nearly £13m of new business bookings (122% against target). This achievement was coupled with the process of transitioning the pre-sales technical architects, with corporate incentive structures to technical consultants holding personal incentive schemes.

Prior to this Mark held a number of senior Business Development roles including; Dimension Data for over 4 years, significantly exceeding revenue, bookings and margin targets in each of the 4 years he was there; GTS Carrier Services; and TGNS S.A. In between these roles, Mark started Big Picture Interactive, a brand new digital multimedia and interactive web company and took the company from start-up to over £1m turnover in the first year, and prior to that converted an antique shop into a pub and restaurant and ran it for 2 years before exiting.

David Newman is also a founding Director of Viridis Navitas Capital Partners Ltd (the sponsor of VN-KERB Turbo Solutions) and another highly commercial, innovative and success driven individual. He is also an entrepreneur with a strong electronic, electro-mechanical, automotive and heavy engineering background.

Following 10 years of military service operating throughout the world, David spent the next 10 learning the commercial realities of international business by apprenticing himself to the most successful business owners and companies he could find.
During this time, he was tasked across a broad range of industries including, leisure, entertainment, automotive, telecoms, advertising and IT.

His corporate roles have included: Project Management, New Business Procurement, Financial Restructuring, Technical Creation and Support, IT Solution Creation & Delivery, Training Program Creation & Delivery and Change Management.

In 1999 he formed his own Telecoms consultancy and later that year created Trans Global Network Services, the world's first global fibre optic leasing operator.

After successfully exiting TGNS in 2002 with annual revenues of $27m, David accepted the role of Commercial advisor to the then Maltese Minster of Finance, The Right Hon Mr John Dalli.

There he formed part of a 3-man team charged with redesigning the Countries FDI programme, agencies and Industrial Estate Management. Successful completion of this project delivered a 'step change' in Government attitude toward FDI procurement, Business Promotion and even its own work force, pre-the Country's accession to Europe.

In 2004 David continued his career by taking on international consultancy roles within the restructuring IT and telecoms sector and later within the emerging renewable energy industry.
He returned to the commercial 'start-up' market place in 2008, designing and building an "outsourced" Debt Management and Cash Collection business for top 50 London accountancy practice, Simmons Gainsford LLP. SG Debt Management was initially created to assist SG client's post-recession but today has exceeded that brief. The business currently manages annual cash collections in excess of £16m and continues to quietly attract new clients by user recommendation only.

In mid-2009, David was invited to lead the design team in building an 'algae to fuel' Photo Bio Reactor for a US project. In mid-2010 working with the same US affiliates, he went on to manage the design and build of an innovative 'oleophilic membrane' crude oil recovery rig. With support from the US Department of Energy, the machine was deployed in the Gulf of Mexico and trialled as part of the Deep-Water Horizon clean-up operation.

In September 2010 David joined forces with Mark and formed Viridis Navitas Capital Partners Ltd (VN-CP) specifically to target the renewable energy start-up funding gap experienced by inventors, engineers and scientists alike.

The above-mentioned experiences have allowed David to build up a broad network of contacts throughout Governments and industries alike that he leverages to the benefit any company he works with. Understanding the financial risk versus reward balance for investors, as a 'real' investor himself, he brings an unusual but extremely useful skill set to the company.

Management - Engineering - Science Partners & Their Track Records

Management:

VN Capital Partners (VN-CP)

VN-CP has since inception, delivered 7 successful funding rounds for platform technology application spinouts raising in excess of £2M via HMRC Advanced Assured Seed Enterprise Investment Schemes & Enterprise Investment Schemes. Investors in VN Advanced Assured SEIS and EIS projects have seen very significant increases in share value, with increases of between 500% and 2400% in some projects so far.

Engineering Providers:

Allenfield Precision Engineering:

Allenfield Precision Engineering is a specialist provider of highly technical precision manufactured engineering solutions. They have been involved with the VN Automotive project for over 5 and a half years, and the manufacturing of all UK EHG variants and their evolution since the technologies migration from Russia to the UK. The quality, professionalism and timeliness delivered by them has ensured that the area of manufacturing is one less area for concern in the project.

Design Consultants:

Fordfleet Ltd

Fordfleet are Electro/Mechanical Design Specialist Engineers with over 20 years' extensive experience within the Power Generation and Process industries providing design services for Plant upgrades and special-to-type Test Equipment for major projects particularly associated with emissions control and plant performance assessment. Possessing a comprehensive knowledge in all aspects of Design for Manufacture and a working knowledge of Control and Instrumentation Systems design and implementation together with production of Plant Layout and Control System drawings for both Safe and Hazardous areas.

Current projects include: Electro/Mech. Design – Mechanical Handling Equipment within a Nuclear environment - C & I Design – Pneumatic Systems design – design and integration of handling equipment for security cleared environment -Test Systems Design and Development – Test Rigs – Control Panel Layout. Plant layout for purpose built Nuclear-handling facility. Civil and Mechanical Handling Interfaces. AWE MENSA Project with SC Clearance.

Previous experience has been gained delivering: Electro/Mech. Design – C & I Design - Control Systems for Combustion, Generation and Process Plant – Test Systems Design and Development – Fuel Transport Systems – Test Rigs – Control Panel Layout - Mechanical Handling Equipment - Plant Safety – QA.

Related Automotive Renewable Project Success

VN Automotive Ltd. – The team at VN KERB TS Ltd. is common to a number of leading edge renewable technology start-ups where Government legislation and incentives are driving the adoption of CO_2 reduction solutions across industries worldwide. They are recognised by the UKTI as a professional management team working with projects of exceptional global potential. As a platform technology, this is the second project in the development of an Electro Hydrogen Generator for the Diesel Generator and Heavy Truck markets. Here the team generated significant success using the same set of basic principles of business operation now being used in VN KERB TS, i.e. clear and transparent principles of operation, and 'sweat equity' incentives meaning very low costs of technology development, as described on page 5.

The team has raised over £1.1m in VN Automotive Ltd., delivering the scientific and engineering proofs used in the development of an embryonic Electro Hydrogen Generator (EHG) solution to prove the following:

1. The most efficient Hydrogen production technology in development – in testing over 95% efficient
2. The most flexible method of production using waste energy streams from generator and truck exhaust gases
3. Proof of potential scalability for global diesel generator and truck markets

The solution will, at the next stage, move to the production of an EHG integrated into a diesel generator. Replacing 10% of the diesel fuel with hydrogen to demonstrate the reduction in CO_2, particulates and NOx. This will demonstrate the effectiveness of the solution and potentially enable the company to licence the technology to the diesel generator manufacturer and operator markets with full commercialisation targeted for 2019/20. The target investor exit multiples projected of between 5 and 120 times initial investment is looking increasingly likely.

Schedule 1 – HMRC Advanced Assurance

Fax 03000 582 456

Email enterprise.centre@hmrc.gsi.gov.uk

Web www.hmrc.gov.uk

Date 06 December 2016
Our ref WMBC/MSB/S0970/81933 00971/SCEC
Your ref

Dear Sir/Madam,

VN KERB Turbo Solutions Ltd – Seed Enterprise Investment Scheme – Advance Assurance

Thank you for your application dated 11 November 2016. I am pleased to confirm that, on the basis of the information you have supplied, I would be able to authorise the company to issue certificates under Section 257EC(1) ITA 2007 in respect of Ordinary Shares issued to individuals following receipt of a properly completed form SEIS1.

Please note that:

- Responsibility for the accuracy of the information supplied and considered by me rests wholly with the company.
- This provisional assurance is based solely on the information supplied in and with the clearance application and will not apply in circumstances that vary from those described. You are advised to forward particulars of any proposed changes, or the draft of any shareholders subscription, investment or similar agreement, for further clearance before the issue of shares.
- This clearance does not guarantee the availability of any form of relief under the Seed Enterprise Investment Scheme to any particular subscriber.
- This assurance is given on the basis of the legislation as enacted at the date of this letter. In the event of any changes to the legislation which take effect on or before the date of any share issue, the assurances given may not continue to apply.

Yours faithfully

Miss L M Phillips
H M Inspector of Taxes

Information is available in large print, audio and Braille formats.
Text Relay service prefix number – 18001

Assistant Director: Tim Bowes

Schedule 2 – Emissions Limits and Timescale

By 2021, phased in from 2020, the fleet average to be achieved by all new cars is 95 grams of CO_2 per kilometre. This means a fuel consumption of around 4.1 l/100 km of petrol or 3.6 l/100 km of diesel.

The 2015 and 2021 targets represent reductions of 18% and 40% respectively compared with the 2007 fleet average of 158.7g/km.

Limit value curve

Emission limits are set according to the mass of vehicle, using a limit value curve. The curve is set in such a way that the targets set for new cars fleet average emissions are achieved. The limit value curve means that heavier cars are allowed higher emissions than lighter cars. Only the fleet average is regulated, so manufacturers are still able to make vehicles with emissions above the curve provided these are balanced by vehicles below the curve.

Phase-in of requirements

The target of 130g/km was phased in between 2012 and 2015. From 2015 onwards, all newly registered cars must comply with the limit value curve. A shorter phase-in period will apply to the target of 95g/km. 95% of each manufacturer's new cars will have to comply with the limit value curve in 2020, increasing to 100% in 2021.

Penalty payments for excess emissions

If the average CO_2 emissions of a manufacturer's fleet exceed its limit value in any year from 2012, the manufacturer has to pay an excess emissions premium for each car registered. This premium amounts to:
€5 for the first g/km of exceedance
€15 for the second g/km
€25 for the third g/km
€95 for each subsequent g/km.
From 2019, the cost will be €95 from the first gram of exceedance onwards.

Eco-innovations

Innovative technologies can help cut emissions, but in some cases, it is not possible to demonstrate the CO_2-reducing effects of a new technology during the test procedure used for vehicle type approval.
To encourage eco-innovation, manufacturers can be granted emission credits equivalent to a maximum emission saving of 7g/km per year for their fleet if they equip vehicles with innovative technologies, based on independently verified data. These eco-innovation credits will be maintained for the 2021 target.

Super credits

The cars Regulation gives manufacturers additional incentives to produce vehicles with extremely low emissions (below 50g/km).
Each low-emitting car is counted as:
(i) 3.5 vehicles in 2012 and 2013
(ii) 2.5 in 2014
(iii) 1.5 in 2015
(iv) 1 from 2016 to 2019.

Super-credits will also apply in the second stage of emission reductions, from 2020 to 2023.
Each low-emitting car will be counted as:
2 vehicles in 2020
1.67 in 2021
1.33 in 2022
1 from 2023.
(Source http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm)

FAQ's for VN KERB Turbo Solutions Ltd.

What is the minimum investment?

£25,000.

What are the fees?

There are no fees payable by investors in addition to their initial investment. The Company provides for external distribution and intermediary charges of up to 6% of the funds raised. There are no annual 'fund management' fees, neither are there any success fees. The management team does not draw salaries either, until the company is revenue-generating and profitable. The management team members are incentivised by their respective equity stakes in the company, and therefore their goal is completely aligned to that of any investor, i.e. a profitable exit upon refinance or sale.

What are the projected returns on my investment?

The company is targeted to finish development of the technology suitable for use in the automotive industry in 2020. Based on the projections described in the IM, the potential gain for investors in this fundraising Stage is estimated at between 10 and 300 times their initial investment.
See page 25 of the IM.

How will the company make money?

The Company intends to licence the developed technology to major: commercial vehicle (trucks, buses & coaches), and automotive manufacturers. This will take the form of up-front payments, development fees and licence fee per device /vehicle, manufactured.
See pages 13 to 15 and page 24 of the IM for more detail.

Why will manufacturers of commercial vehicles and cars buy a technology licence from VN KERB TS?

Legislation is forcing manufacturers to reduce $C0_2$, NO_X and particulate emissions in all of their engines, diesel and petrol, and today they do not have a solution. Failure to do so will result in significant fines, as has been seen with Volkswagen, Hyundai & Kia in the US.
See pages 24 to 25 of the IM.

Do large automotive manufacturers have R&D departments and budgets that they spend on delivering new technologies and engines that will be able to meet the target legislation?

Most manufacturers do have large R&D departments and budgets. However, manufacturers are now using external third-parties to help in developing the new technologies required to hit the legislated targets. They recognise that they are not flexible enough, they are not quick enough, and they are not entrepreneurial enough to deliver the solutions required within the timescales allowed by the legislation and its requirements. One example is Ford using Ricardo to assist in the development of the new generation of HyBoost and Eco Boost engines.

When will the company make money?

Once the KERB TS technology has been successfully developed and tested with the proposed on-engine static test rig to the required TRL6, the Company will have the potential for a sale to an interested OEM or similar company. Notwithstanding this potential opportunity, the company has the target of 2020 for the first licence sales.
See pages 20 to 21 and pages 24 to 25 of the IM for more detail.

What is the exit strategy?

The Directors plan an Initial Public Offering (IPO) of shares in the Company between 2020 and 2022. A trade sale may be considered, as the Directors target will be to derive the maximum possible gain for investors. A third option now available is the use of Asset Match, (see www.assetmatch.com).

Why does the market opportunity exist?

Legislation has been put in place by Governments' around the world in order to reduce $C0_2$, NO_X and particulate emissions created by Internal Combustion Engines, (ICEs). Both diesel and petrol ICEs are targeted, in particular in the commercial vehicle and automotive markets. Failure to meet the targets will result in significant fines for manufacturers, as has been seen with Volkswagen, Hyundai & Kia in the USA.

What is the competition?

The VN KERB TS technology is complementary to the 'Hybrid' as, assuming the technology can be made cost effective enough, it has the potential to be fitted to a 'Hybrid' engine, making a 'Hybrid' even more efficient and reducing emissions even further. The only competition today is the Volvo PowerPulse, although it requires a more complex engine design and infrastructure, as well as more weight. See page 20 of the IM.

What is unique about this opportunity?

Today, VN KERB TS has the only technology solution that is able to take kinetic energy from braking events on a car and use this energy to spin-up a turbo charger to reduce turbo-lag and to potentially increase fuel efficiency, and reduce the emissions. See page 16 to 17 of the IM.

There are also a number of operating principles embedded in VN projects that make VN KERB TS completely different from the competition, namely:

1. No salaried management team, and no success fees. The team is incentivised on equity position and therefore focused on making the technology as efficient and profitable as possible for the IPO or sale to enable a profitable investor exit
2. No money management fees, VN-KERB-TS is not a fund neither do the management team act or charge as one
3. The management team includes individuals with experience of creating, developing and managing small, medium and large companies through to exit
4. Complete financial transparency on the project, development Opex etc. and on equity distribution and gains at exit.

How proven is the technology?

A novel hydraulic-based, kinetic energy recovery boosting system has been designed, analysed and tested. The basic results obtained indicate the promise of the system for future passenger cars. The results indicate the potential to help initially spin-up a turbocharger, with shaft speeds similar to those found in turbos in cars today, and similar to typical conditions encountered in real-world conditions.

What are the main risks in this company and how will VN KERB TS mitigate them?

1. An investment in the Company is speculative because, although it has access to a substantial amount of research and data which has been compiled regarding the VN-KERB-TS project and has a full IP exploitation licence granted by the IP owner, the VN-KERB-TS has not been proven.

Mitigation - The Company's Technical Director and major shareholder is Professor Al Cairns, formerly of Brunel University, and who is now Head of Automotive Propulsion at Nottingham University. The company will be utilising him and the facilities at Nottingham University for research and development, where everything required for the testing and development to TRL5/6 enabling Stage 2 of the project, is onsite.

2. Whilst the engineering principles and theories being utilised to enable the VN-KERBS-TS solution to be technically successful in an ICE or Hybrid engine, it is not proven in this environment.

Mitigation - The R&D work performed thus far involved theoretical and experimental studies of the hydraulically assisted turbocharger system for future automotive applications. The system is based upon use of relatively lightweight parts, where kinetic energy is recovered during vehicle braking, stored in a hydraulic accumulator and used later on to rapidly accelerate the engine's turbocharger. The turbocharger is fitted with a replacement housing including a small impulse turbine, powered by a jet of hydraulic fluid. The overall aim of the work was to improve fundamental understanding of the operation and capabilities of such a system for future passenger cars. Fundamental hydraulic system calculations were undertaken and a simple rig was produced including a miniaturised Pelton wheel, a disc (of inertia equal to the target turbocharger), mounting shaft and hydraulic supply circuit. The system was capable of generating shaft speeds of ~80000rpm within less than 1 second and the peak oil pressure and flow rate were ~200bar and ~9.5 l/min respectively. This underpins the theory with evidence that the technology has the potential to deliver in the real-world, and subsequently a pre-prototype has been designed and built ready for testing on a static rig to be built in this first phase of testing and development.

3. The market uptake for this type of technology is unproven. Whilst this project is driven by legislation forcing the Automotive Industry by 2020 to reduce emissions by 30% more, and increase fuel efficiency by another 20% from where it is today, there is no guarantee that the VN KERB TS will become one of the industry's 'preferred solutions'.

Mitigation - Developing an independently third-party tested solution using the Automotive Industry's Technology Readiness Level framework, gives VN KERB TS the best chance of success by aligning the requirements of the industry to the deliverables of the project.

4. Estimates of potential value and costs may not be reliable. The potential licence income values are illustrations only, based on available comparable industry information. These illustrations are subject to market input variables that cannot be determined until the unit is developed and ready for market.

Mitigation - The Directors of VN KERB TS have used extremely conservative, industry reference-able figures in the projections and estimations of market penetration and uptake. Furthermore, the Directors have used industry recognised metrics and multiples for valuations and shown how these estimates and projections are put together.

5. The illustrations of potential income value in this Information Memorandum may, accordingly, not be reliable despite the Directors best efforts to judge them accurately.

Mitigation - The Directors of VN KERB TS have used extremely conservative, industry reference-able figures in the projections of income and estimations of market penetration and uptake.

What if I have other questions about the opportunity, what should I do?

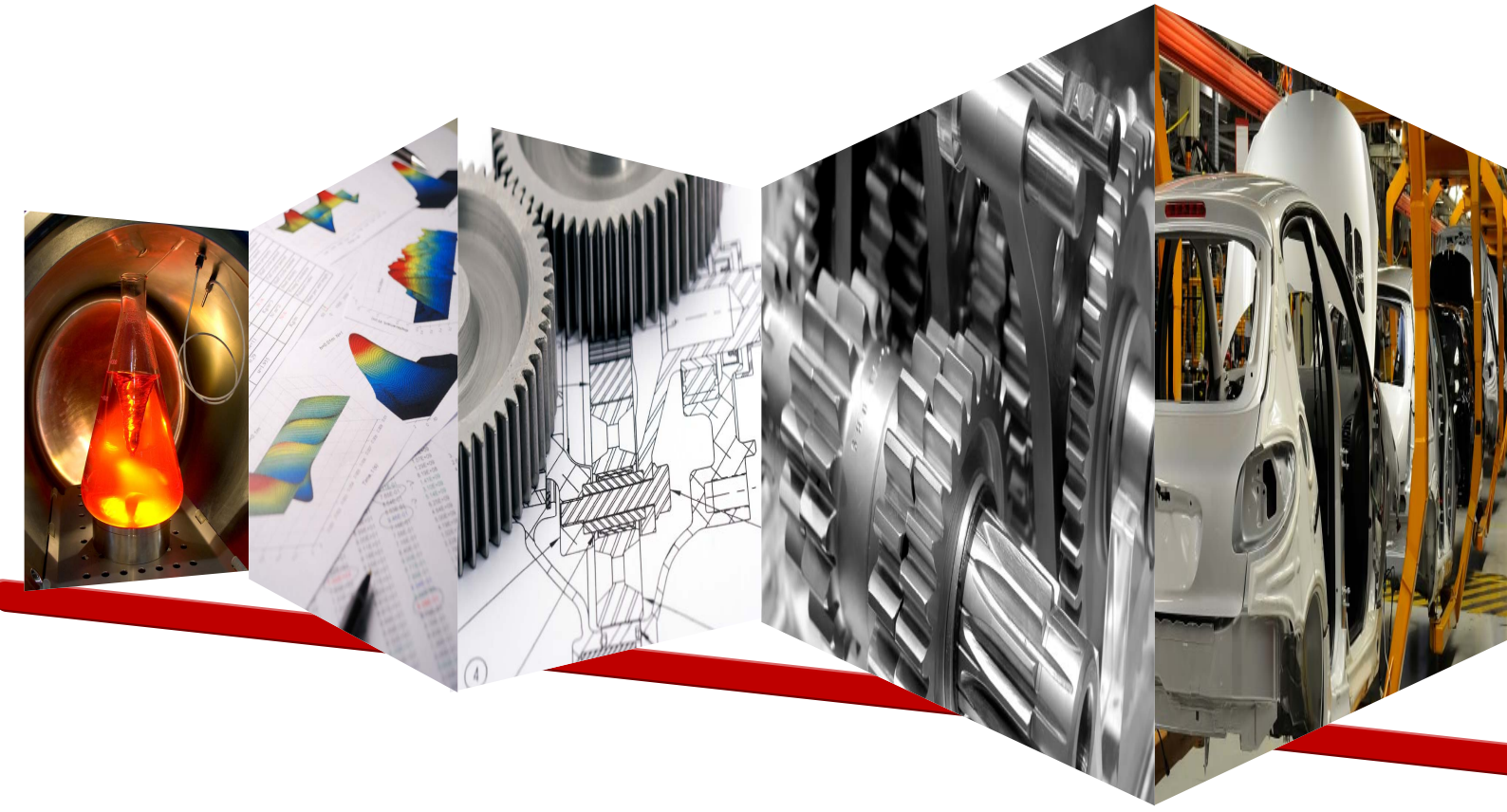
Either put your questions in an email, or request a call from one of the management team to discus your requirements in more detail.

How do I invest?

Download the High Net Worth self-certification form and the VN-KERB-TS investor application form, fill them in with your investment amount and personal details, sign at the bottom and then either scan and email them to investors@vn-cp.co.uk, or take photocopies and then send them along with your cheque to VN Capital Partners, 7/10 Chandos Street, London W1G 9DQ.

Automotive Technology and Manufacturing Readiness Levels

A guide to recognised stages of development within the Automotive Industry



automotive council UK

BIS Department for Business Innovation & Skills

LowCVP low carbon vehicle partnership

SMMT DRIVING THE MOTOR INDUSTRY

Technology Strategy Board Driving Innovation

Foreword

Good, clear communication firms the ground for exploring new ventures, common areas of interest and establishing new relationships. Within engineering sectors, communication is paramount to achieving high quality products and using resources most efficiently and effectively.

There is an ongoing need for greater cooperation, joint exploration of new designs and acquisition of evolutionary and revolutionary products in order to rebuild the strengths of the UK's Automotive Sector. This set of 'readiness' levels assists the sector by providing specific, identifiable stages of maturity, from early stages of research through to supply chain entry.

I hope you will join others in implementing this framework for technology development, using it as a basis for further planning and communication, and gaining further benefit from its use.

Professor Richard Parry-Jones CBE
Co-Chairman of the Automotive Council

Acknowledgements
The authors of these readiness levels Roy Williamson (LowCVP) and Jon Beasley (GKN) wish to thank and acknowledge the support contributed by the UK automotive sector in developing this guide under the auspices of the Automotive Council. These levels draw upon established practices for defining technology development and acquisition in use within the defence and aerospace supply chains.

This guide has been created by the Low Carbon Vehicle Partnership in association with the Automotive Council.
January 2011

automotive council UK
BIS Department for Business Innovation & Skills
LowCVP low carbon vehicle partnership
SMMT DRIVING THE MOTOR INDUSTRY
Technology Strategy Board Driving Innovation

Introduction to Technology and Manufacturing Readiness Levels (TRLs and MRLs)

A recurring issue to developers and adopters of new technologies is how to successfully communicate their accomplished or expected stages of technology development and readiness for manufacture. This set of Automotive TRLs and MRLs aims to help facilitate this dialogue and in doing so help with technology commercialisation, development work with new partners, planning supplier engagement and bringing new capabilities to market, through common understanding. Readiness levels provide common terms to define technology from concept to commercial production and through to disposal, and have a proven effectiveness from the aerospace and defence sectors. Independently, readiness levels can also assist with self-assessment, monitoring progress and planning goals and actions.

Benefits

- Emergent supply chain companies have a framework through which they can better understand the engagement needs of TIer1s/VMs.
- VMs, Tier1s and funding agencies are presented with clear definitions for present and targeting levels of development status.
- A framework can be used to provide clearer direction regarding engagement of the most appropriate public sector support.
- Angels/VC investor interenst can be strategically aligned to product requirements.
- Self assessment provides guidance on next steps (trials, certification etc) relevant to Level and signposts sources of support.
- Sector-wide assessments and initiatives have a common framework to build upon.

These are a few of the benefits that are realised through common understanding.

Application to Integrated Assemblies and Roadmaps

When components are brought together and integrated, their individual TRL and MRL contribute to the readiness of the overall assembly. Integrated systems may contain components with different levels of readiness, influencing the status of the assembly overall. The use of readiness levels in such cases can highlight areas for focus and prioritisation in order to make best progress.

When considered with a timeframe in mind, readiness levels help depict the development path or time to implement next generation technologies or derivatives with respect to established products, similar to technology roadmaps and highlighting strengths and weaknesses in proposed or emerging systems.

Readiness levels also offer the ability to assess complete systems at a high level, the electrification of transport for example, and to focus in on contributing components, such as battery technologies or infrastructure integration.

Relationship between Technology Readiness and Manufacturing Readiness Level

The table which follows details ten stages of maturity for a product to:

- deliver its function (Technology Readiness)
- be produced (Manufacturing Readiness)

These levels are staggered in the table since advancing technological capability logically progresses ahead of manufacture. For each Technology Readiness Level the corresponding Manufacturing Readiness Level is that which is usual. It should be noted however that some technologies can deviate from these levels.

Automotive Technology and Manufacturing Readiness Levels

TRL	Technology Readiness	MRL	Manufacturing Readiness
1	• Basic Principles have been observed and reported. • Scientific research undertaken. • Scientific research is beginning to be translated into applied research and development. • Paper studies and scientific experiments have taken place. • Performance has been predicted.		
2	• Speculative applications have been identified. • Exploration into key principles is ongoing. • Application specific simulations or experiments have been undertaken. • Performance predictions have been refined.		• A high level assessment of manufacturing opportunities has been made.
3	• Analytical and experimental assessments have identified critical functionality and/or characteristics. • Analytical and laboratory studies have physically validated predictions of separate elements of the technology or components that are not yet integrated or representative. • Performance investigation using analytical experimentation and/or simulations is underway.	1	• Basic Manufacturing Implications have been identified. • Materials for manufacturing have been characterised and assessed.
4	• The technology component and/or basic subsystem have been validated in the laboratory or test house environment. • The basic concept has been observed in other industry sectors (e.g. Space, Aerospace). • Requirements and interactions with relevant vehicle systems have been determined.	2	• Manufacturing concepts and feasibility have been determined and processes have been identified. • Producibility assessments are underway and include advanced design for manufacturing considerations.
5	• The technology component and/or basic subsystem have been validated in relevant environment, potentially through a mule or adapted current production vehicle. • Basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested with equipment that can simulate and validate all system specifications within a laboratory, test house or test track setting with integrated components • Design rules have been established. • Performance results demonstrate the viability of the technology and confidence to select it for new vehicle programme consideration.	3	• A manufacturing proof-of-concept has been developed • Analytical or laboratory experiments validate paper studies. • Experimental hardware or processes have been created, but are not yet integrated or representative. • Materials and/or processes have been characterised for manufacturability and availability. • Initial manufacturing cost projections have been made. • Supply chain requirements have been determined.

6	• A model or prototype of the technology system or subsystem has been demonstrated as part of a vehicle that can simulate and validate all system specifications within a test house, test track or similar operational environment. • Performance results validate the technology's viability for a specific vehicle class.	**4**	• Capability exists to produce the technology in a laboratory or prototype environment. • Series production requirements, such as in manufacturing technology development, have been identified. • Processes to ensure manufacturability, producibility and quality are in place and are sufficient to produce demonstrators. • Manufacturing risks have been identified for prototype build. • Cost drivers have been confirmed. • Design concepts have been optimised for production. • APQP processes have been scoped and are initiated.
7	• Multiple prototypes have been demonstrated in an operational, on-vehicle environment. • The technology performs as required. • Limit testing and ultimate performance characteristics are now determined. • The technology is suitable to be incorporated into specific vehicle platform development programmes.	**5**	• Capability exists to produce prototype components in a production relevant environment. • Critical technologies and components have been identified. • Prototype materials, tooling and test equipment, as well as personnel skills have been demonstrated with components in a production relevant environment. • FMEA and DFMA have been initiated.
8	• Test and demonstration phases have been completed to customer's satisfaction. • The technology has been proven to work in its final form and under expected conditions. • Performance has been validated, and confirmed.	**6**	• Capability exists to produce integrated system or subsystem in a production relevant environment. • The majority of manufacturing processes have been defined and characterised. • Preliminary design of critical components has been completed. • Prototype materials, tooling and test equipment, as well as personnel skills have been demonstrated on subsystems/ systems in a production relevant environment. • Detailed cost analyses include design trades. • Cost targets are allocated and approved as viable. • Producibility considerations are shaping system development plans. • Long lead and key supply chain elements have been identified.
9	• The actual technology system has been qualified through operational experience. • The technology has been applied in its final form and under real-world conditions. • Real-world performance of the technology is a success. • The vehicle or product has been launched into the market place. • Scaled up/down technology is in development for other classes of vehicle.	**7**	• Capability exists to produce systems, subsystems or components in a production representative environment. • Material specifications are approved. • Materials are available to meet planned pilot line build schedule. • Pilot line capability has been demonstrated including run at rate capability. • Unit cost reduction efforts are underway. • Supply chain and supplier Quality Assurances have been assessed. • Long lead procurement plans are in place. • Production tooling and test equipment design & development has been initiated • FMEA and DFMA have been completed.

		8	• Initial production is underway • Manufacturing and quality processes and procedures have been proven in production environment. • An early supply chain is established and stable. • Manufacturing processes have been validated.
		9	• Full/volume rate production capability has been demonstrated. • Major system design features are stable and proven in test and evaluation. • Materials are available to meet planned rate production schedules. • Manufacturing processes and procedures are established and controlled to three-sigma or some other appropriate quality level to meet design characteristic tolerances in a low rate production environment. • Manufacturing control processes are validated. • Actual cost model has been developed for full rate production.
10	• The technology is successfully in service in multiple application forms, vehicle platforms and geographic regions. In-service and life-time warranty data is available, confirming actual market life, time performance and reliability	**10**	• Full Rate Production is demonstrated • Lean production practices are in place and continuous process improvements are on-going. • Engineering/design changes are limited to quality and cost improvements. • System, components or other items are in rate production and meet all engineering, performance, quality and reliability requirements. • All materials, manufacturing processes and procedures, inspection and test equipment are in production and controlled to six-sigma or some other appropriate quality level. • Unit costs are at target levels and are applicable to multiple markets. • The manufacturing capability is globally deployable.

Examples

Below are two examples of levels applied to automotive technologies.

Composite Structures for mass market automotive applications

TRL	Technology Readiness	MRL	Manufacturing Readiness
8	• Test and demonstration phases have been completed to customer's satisfaction. • The technology has been proven to work in its final form and under expected conditions. • Performance has been validated, and confirmed.	**4**	• Capability exists to produce the technology in a laboratory or prototype environment. • Series production requirements, such as in manufacturing technology development, have been identified. • Processes to ensure manufacturability, producibility and quality are in place and are sufficient to produce demonstrators. • Manufacturing risks have been identified for prototype build. • Cost drivers have been confirmed. • Design concepts have been optimised for production. • APQP processes have been scoped and are initiated.

ABS for multiple vehicle class, automotive applications

TRL	Technology Readiness	MRL	Manufacturing Readiness
10	• The technology is successfully in service in multiple application forms, vehicle platforms and geographic regions. In-service and life-time warranty data is available, confirming actual market life, time performance and reliability	**10**	• Full Rate Production is demonstrated • Lean production practices are in place and continuous process improvements are on-going. • Engineering/design changes are limited to quality and cost improvements. • System, components or other items are in rate production and meet all engineering, performance, quality and reliability requirements. • All materials, manufacturing processes and procedures, inspection and test equipment are in production and controlled to six-sigma or some other appropriate quality level. • Unit costs are at target levels and are applicable to multiple markets. • The manufacturing capability is globally deployable.