EARLY-STAGE INVESTMENT FOR

# TACKLING AIR POLLUTION

*LEARNINGS REPORT & DIGITAL EVENT HIGHLIGHTS*

JUNE 2020

BGV / Bethnal Green Ventures

GUY'S & ST THOMAS' CHARITY

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# EXECUTIVE SUMMARY

## *Investment opportunity in early-stage tech ventures tackling air pollution to improve the health of urban population in Lambeth, Southwark and beyond*

Air pollution outdoors and inside our homes claims about seven million lives each year. According to data from the World Health Organization, London is 10% over the safe level and more than 20,000 deaths from air pollution are reported every year[1]. With 68% of the world's population predicted to be urban by 2050, up 55% from today according to the UN, the importance of building more sustainable, healthier cities has never been greater to ensure healthy lives for future generations.

The scope of companies addressing air pollution is vast, yet given the nascent nature of the sector, many are early-stage i.e. they have not yet raised beyond Series A investment rounds. Through our initial research it was apparent that there was divergence between the companies who were treating the effects of the problem and those who are addressing the root causes. We continued to investigate this theme to understand the various opportunities and risks associated with each approach and to assess venture capital (VC) appetite for high-risk, high-return, and high-impact investments.

In this report, we examine how different technologies are addressing air pollution at varying stages of growth with a focus on early-stage ventures.

Through research, interviews with founders and investors and our virtual workshop, we examine:

- Existing gaps and opportunities within the startup landscape
- Investment trends and new market challenges and drivers
- What investors can do to support founders beyond capital
- How policy and regulation act as a catalyst for particular areas of innovation and a barrier for others

The COVID-19 crisis has brought to light the importance of improving London's air quality and the need for systems which protect residents, particularly those who are most vulnerable and underserved.

This report provides an argument for the opportunities that exist by investing in ventures tackling air pollution and the need for a more supportive ecosystem to fuel promising startups and unlock new ways of addressing the health effects of air pollution in Lambeth, Southwark and beyond.



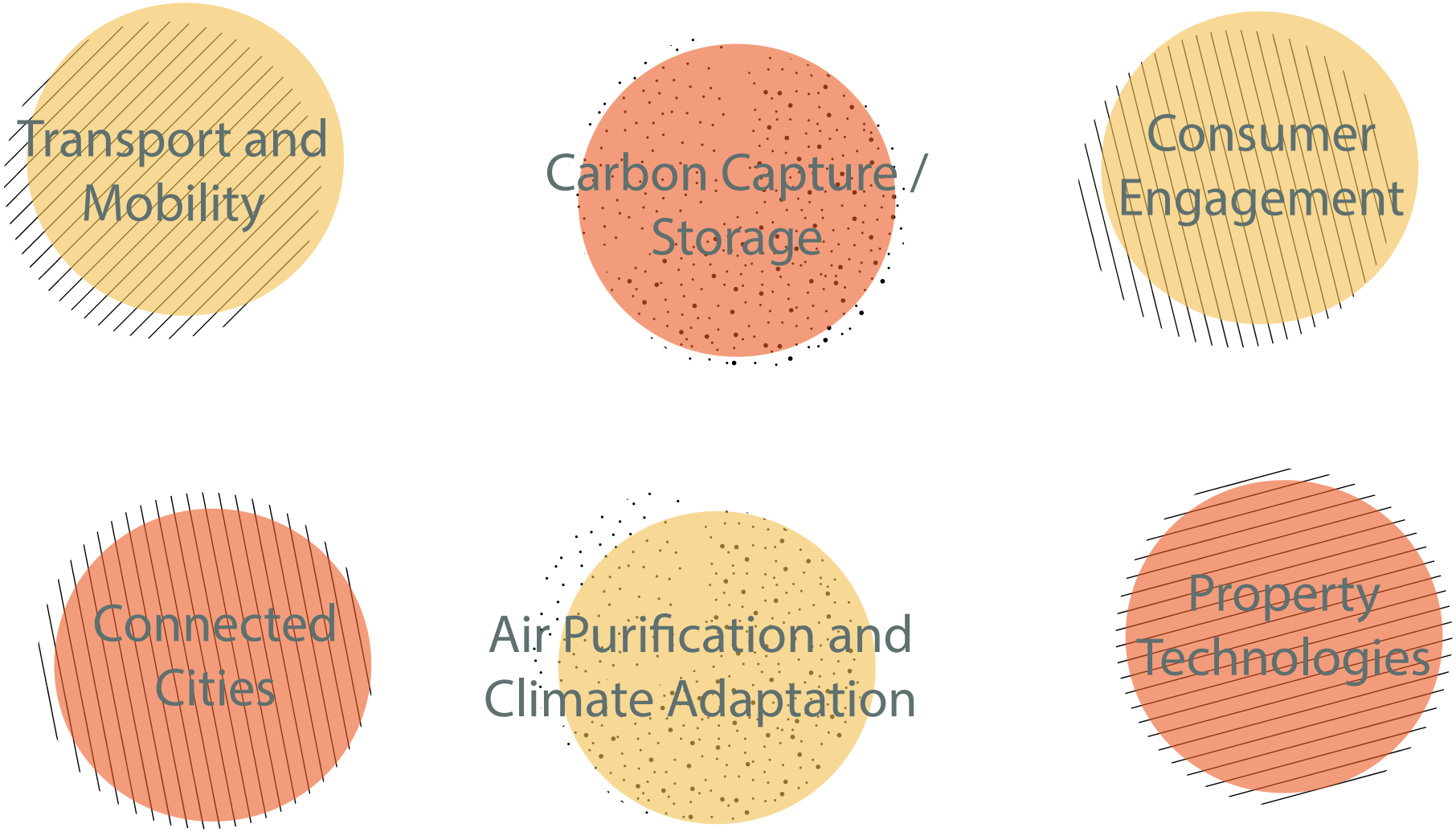
1. **BreatheLife 2030 (2019)** *The Air Pollution in London, UK*

# TECHNOLOGY INNOVATION OVERVIEW

1.0

# 1.1 KEY TECHNOLOGY AREAS

Our early research focused on the six verticals below:



# 1.1 KEY TECHNOLOGY AREAS

## Transport and Mobility

Alternative transportation vehicles, energy sources, advanced resourcing of existing options, micro mobility, greener infrastructure.

## Carbon Capture / Storage

Carbon removal via engineered solutions like enhanced weathering, direct air capture, carbon capture and use (e.g. construction materials, fuels, chemicals, plastics, protein, carbon fiber, and nanomaterials). Carbon removal via natural and hybrid solutions like carbon farming, biochar, and the restoration of carbondense natural ecosystems — other potential solutions, such as phytoplankton stimulation and bioenergy with carbon capture and storage, still need to demonstrate system sustainability[3].

## Consumer Engagement

Product and services that do not tackle root causes but are important in raising awareness and behaviour change and in many cases seek to include traditionally underserved communities. These include carbon tracking/offsetting platforms, digital health and shared-mobility apps as well as personal and family-use hardware products.

## Connected Cities

Solutions that improve urban efficiency to enable energy and water infrastructure, advanced recycling, circular economy systems, local food production and community management[2]. Digital urban planning tools for improved air quality such as data management, and advanced simulations.

## Air Purification & Climate Adaptation

Air quality data providers, localized data sources, sensors and filters.

## Property Technologies

Advanced energy management, sustainable materials, digitising and streamlining construction processes, commercial and residential building management. Retrofitting existing buildings with new technologies.

2. **Good Tech Labs (2020)** *The Frontiers of Impact Tech*
*3*. **ibid**

# 1.2 PRIMARY RISKS AND CHALLENGES

### Lack of Appropriate Funding Mechanisms

High-risk, early-stage companies require working capital in order to first get their product or service market ready and then to scale. Sources of such funding typically come from government grants, academia or private investment in exchange for equity (such as individual angel investors or institutional funds). However, within the context of air pollution startups, governments have been slow to allocate sufficient funding. When they do, they offer limited commercial support in parallel (e.g. to secure community-level pilots) so often funding doesn't match up to the startups' requirements.

There is also a variance of risk appetite amongst these funding sources, in which certain ventures are "not innovative enough" for venture capital yet too risky for a local authority to support or procure without any prior traction.

### Disconnect between Academia and Commercial Enterprise

Conversations with university incubators and academics confirm our understanding that limited funding options exist for founders who are developing R&D-heavy solutions that rely on very particular pilot partners for testing. A common risk for investors is that the company IP is still tied to the university and they may also hold a significant amount of equity. This might make it harder for them to raise funds from other investors. In many cases, startups with this profile may take years of research and testing before even getting to market-readiness.

While university challenger funds could provide some patient capital for alumni/faculty spin-outs, this is problematic for VC funds that operate on roughly ten year cycles and expect returns within particular timeframes.

Equally, scientists and academics may not have the entrepreneurial drive or know-how to bring their solution from 'great idea' to 'great business'. There are currently a few VCs in the UK trying to fill this gap, such as Oxford Sciences Innovation, who have formed partnerships with universities in order to match commercial expertise with scientific innovation. IP Group, who acquired Parkwalk in 2016, are also a growth fund focussed on university spin-outs. It is worthwhile to note technology transfer offices' work to accelerate the commercialisation of academic research.

# 1.2 PRIMARY RISKS AND CHALLENGES

### Lack of Regulation and Enforced Policies

There is a lack of approved methodologies and regulations that are consistent with emission-reduction objectives. Additionally, property rights and related liability can often be unclear, which could particularly become an issue with public entity/private corporation partnerships.

### Measuring Impact

Despite impact investment becoming more mainstream and global frameworks such as IRIS+ or Impact Management Project gaining more traction, measuring and communicating impact as an investor is still more art than science. Here, we regard the concept of **'additionality'** as key. In impact investing, additionality suggests the financial intervention i.e. the investment could claim to have positive impact only if it has made a change to the baseline i.e. pre-invesment status. In other words, did your investment achieve something that would not have happened without that particular cash injection? Our experience in early-stage investment shows that it is easier to draw a causality line between positive societal impact and backing young startups which would not have started operating without that initial support.

On a startup level, it can be hard to ascertain whether that particular product/service will achieve the desired impact. Also, to consider potential unintended consequences that might occur as a byproduct.

### Large Capital Requirements

Certain technologies, especially those with hardware components, require a bigger amount of funding than software businesses from the outset. This is a deterrent for some investors who don't have the funds under management required to invest and/or follow-on meaningfully; and/or lack the sector expertise to have conviction in making big bets.

# STARTUP OVERVIEW

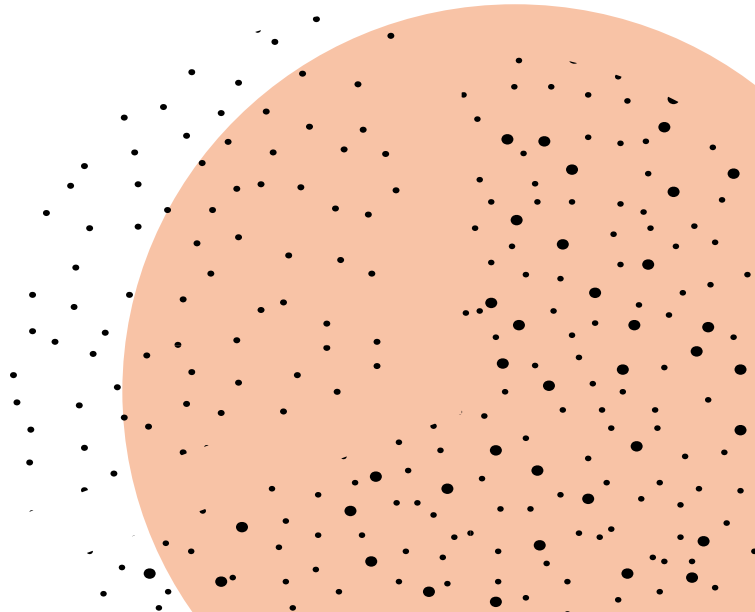
2.0

# 2.1 STARTUP OVERVIEW

There are already some areas related to air quality that are well funded. In our market research, we found that Carbon Capture / Storage, Advanced Materials, Climate Adaptation and Medical Devices have garnered large funding rounds of >£ 4 million at seed stage. According to Pitchbook data, the median deal size in 2019 in "Carbon Capture and Removal" was £ 3M (US), and trending up 50% Year-on-Year[4].

However, for the purposes of this report, we have focused on verticals where we think small(er) capital injections could make a big difference to the startups' trajectory and potential for impact. We think this will encourage a wider range of purpose-driven entrepreneurs to build products and services to help tackle the negative effects of air pollution.* Early-stage investment is a useful tool for this market building exercise.

We focused our efforts on **Property Technologies, Connected Cities, Transport and Mobility, Consumer Engagement** and **Air Purification** ventures - largely looking at **software-enabled businesses**.



4. **Pitchbook (2019)** *Carbon Capture Removal Emerging Space*

*It's important to note that there is a wide spectrum of Cleantech usually intersecting with relatively more established sustainability and green energy verticals, not all of which targets a diverse end beneficiary audience. In other words, cleantech investing does not by nature address the socioeconomic imbalances associated with environmental issues such as climate change. Many startups tackling air pollution, including some discussed in this report, could fall into the clean-tech category. Equally, not all of these companies are necessarily geared towards impacting underserved communities.

# 2.2 PROPERTY TECHNOLOGIES: OPPORTUNITIES

Considering people spend nearly 87% of their time indoors, the importance of high air quality within the built environment should be a top priority for property owners and residents. However, it has only been in recent years that information around indoor pollution has become more widely distributed. The real estate sector is typically very slow to adopt change, but with proptech becoming a fast-growing strand of venture capital in the UK, we are seeing a greater shift towards innovation. Notable funds including PiLabs, Surplus Invest and Round Hill Ventures are not shying away sustainability-focused investments. According to a PwC survey, almost half of European real estate investors say climate change has become a greater risk within their portfolio, and 73% expect that risk to increase over the next five years[5].

The opportunity for impact in the built environment is vast. There are an increasing number of new market entrants addressing air purification, monitoring and resident & employee wellbeing.

**Decarbonization:** This sector represents a £60 billion market globally, yet out of date policies and the fragmented nature of different offerings between corporates and startups has resulted in complex procurement cycles and slow adoption of new technologies[6]. Recommendations to Parliament from the Committee on Climate Change in 2020 include setting standards on all public buildings decarbonisation by accelerating plans to halve direct emissions in the public estate by 2032 at the latest[7].

Now, with heightened awareness around respiratory health and air quality, we expect the demand for change within indoors spaces to increase. We anticipate changing standards to be put in place by corporations and governments around **indoor air quality** and as a result, more emphasis on adoption of newer technologies.

*"Work with BEIS on the Buildings and Heat Strategy, and a strategy for netzero manufacturing to ensure that relative prices favour a shift to low-carbon technologies that sufficient funding is available and to consider the role of tax incentives... ensure that local authorities are properly funded to enforce buildings standards." (CCC, June 2020, Reducing UK Emissions Progress Report to Parliament)*

**New digital tools for better construction:** The construction industry is worth over £8 trillion globally, and despite being responsible for 11% of total CO2 emissions[8], there has been "little incentive for self-disruption."[9] However, COVID-19 might act as a catalyst that will encourage rapid innovation in the construction sector. For example, the use case is much larger for companies like ATLAS, who are digitising the future of healthcare construction through its platform. This new wave of technologies means that many companies are still in the Seed to Series A range, which presents a great opportunity for new-entrant investors.

**Redefining how we build, operate and renovate commercial buildings:** The current practices for commercial construction and management are out of date, slow and environmentally destructive. Recent speculation around how buildings will need to be designed or adapted to adopt social distancing measures brings the need for improved sustainable building practices to the forefront. Leadership from the private sector will be necessary, combined with a holistic approach to creating healthier indoor environments. Taking into account energy efficiency, air quality, facility management and ease of movement will be vital to raising industry-wide standards.

5. **PwC (2019)** *Emerging Trends in Real Estate: Europe 2020*
6. **CleanTech Group (2019)**, *Smart Buildings Innovation in Space Utilisation*
7. **CCC (2020)** *p.24, Reducing UK Emissions Progress Report to Parliament*



8. **UN Environment (2017)** *Global Status Report 2017*
9. **Talis Capital (2020)** *Building the foundations: mapping the construction sector's journey to innovation*

# 2.2 PROPERTY TECHNOLOGIES: CHALLENGES

BGV's conversations with other investors signal that tackling air pollution by creating healthier built environments is an increasing area of interest. However, certain barriers are preventing more investments from being made into this space, such as:

- **Long time frames for investment realisation** (+10-12 years)
- **Lengthy and arduous sales cycles** into commercial contractors and/or public entities (meaning more capital many be required to ensure sufficient runway).
- **Heavily regulated industry,** with variance across different geographies.
- **Difficult to identify suitable investment opportunities**, lack of in-house expertise to perform technical due diligence, increasing the level of risk taken by the investor.

Equally, many barriers exist for startups to access funding, including:

- **Difficulty securing commercial contracts** (and therefore revenue) beyond small pilots.
- **Typical customer profiles** that often include public authorities can be a deterrent to investors.
- Hardware and materials-based business models are **highly capital intensive** and attract fewer, mostly specialist investors.

The disconnect between industry, public sector, startups and investors has left gaps within the startup lifecycle, particularly at the early-stage, therefore reducing chances of success. More on this in the 'Event Explorations' section.

*The CCC Report echoes these challenges, and in respect of building targets and standards, advises the government to "Publish long-awaited policies to deliver Clean Growth Strategy ambitions on retrofit... the 20% business efficiency target and the public sector targets. This must include a package for able-to-pay home-owners, a delivery mechanism for the social housing minimum standards and support for SMEs." (CCC, June 2020, Reducing UK Emissions Progress Report to Parliament)*

# MARKET SNAPSHOT*: PROPTECH

| Startup Name | Location | Stage | Business Model | Technology | Investors |
|---|---|---|---|---|---|
| Ambify | Ambify is a preventative health platform focused on protecting health and wellbeing from the negative impacts of environmental pollution. They are an end-to-end IoT enabled platform that provides customers with real-time, continuous monitoring to known environmental health risk factors. | | | | |
| ambify | London | Seed | B2B, B2B2C | Hardware, Machine Learning web/mobile interface | Entrepreneur First, Grants |
| Foobot | Foobot SAB optimizes HVAC systems in buildings with artificial intelligence and smart sensors, no retrofitting required. | | | | |
| foobot | EU | Seed | B2B | Hardware, AI-powered software platform | Hardware.co, The Factory, Grants |
| DTE Materials | Sustainable, high-performing building insulation material without any toxic chemicals to breathe in. The engineered material is uniquely introduced as a complete prefabricated system to support tight budgets within typical to the construction industry. DTE's closed-looped process also allows them to extract valuable byproducts from its 'waste stream'. | | | | |
| DTE MATERIALS | USA | Seed | B2B, B2C | Physical materials | LA CLeanTech Incubator, CalSeed, Grants |
| Physee | The future-proof glass facade for next-generation sustainable buildings. SmartSkin can autonomously power, sense and regulate a building's climate. It intelligently adjusts to personal use and creates a comfortable indoor environment. | | | | |
| PHYSEE | Europe | Series A | B2B | Physical materials | Angels, Grants |
| Carbon Cure | Creates, develops, and licenses solutions that consume waste CO2 to make better concrete. It is a green concrete alternative as it enables concrete manufacturers to convert waste CO2 into solid minerals. | | | | |
| CARBON CURE. | Canada | Series B | B2B | Physical materials | Pangaea Ventures, NEO Ventures, Breakthrough Energy |

***All Market Snapshots based on publicly available data.***

Investment in Property Technologies companies globally hit £11 billion in the first half of 2019, a 309% increase from the first half of 2018.[10]

Indoor air pollution can be 5 times worse than outdoors.[11]

Unissu, a PropTech procurement platform, lists 3,219 PropTech companies located in Europe, 803 of which are located in the UK.[12]

23 of the UK's leading commercial property owners — managing 300bn of assets signed the "Better Buildings Partnership Climate Change Commitment."[13]



10. **CRETech (2019)** *End of Year Report*
11. **EPA (2018)**, *Report on Indoor Air Pollution*
12. **Said Business School (2020)** *Protech 2020*
13. **PiLabs (2020)** *Sustainability in the Built Environment*

# STARTUP CASE STUDY: AIREX

Airex helps to reduce heat demand in the home whilst managing indoor air quality via automatically controlling airflow through an innovative air brick system. Their technology improves residents' thermal comfort and protects residents' health, while lowering their energy bills. Airex helps tackle fuel poverty despite being non-intrusive, and estimates a payback period of 2-3 years.

AIREX

STAGE: Seed

LOCATION: London, UK

INVESTOR: Green Angel Syndicate

## Use Case:

Airex helps to reduce maintenance costs for Social Landlords through providing real time property diagnostics - enabling preventative maintenance, rather than expensive repair work (e.g. flagging up indicators of damp).

Through smart control of airflow, the system can mitigate the risk of poor indoor air quality, therefore reducing the risk of respiratory illnesses. Covid-19 is resulting in more residents spending time at home and experiencing longer exposure to poor indoor air quality. With a greater understanding of the risks associated with airborne viruses and pollution, residents will increasingly prioritise having a 'healthy home.' Airex can also be installed 90% externally, allowing for essentially contactless onboarding.

## Key Risks:

Typical customers are local authority social housing associations which means potentially long sales cycles and barriers to quick growth.
Technology in this sector is developing very quickly - other solutions may overtake theirs in terms of efficiency and cost-effectiveness.

## Ideal Outcome:

Improved indoor air quality for lower-income households
reduced long-term spending on energy consumption
reduced spread of airborne viruses through smart control of airflow

# 2.3 CONNECTED CITIES: OPPORTUNITIES

'Connected' or 'Smart' Cities is an increasingly attractive space for investment - sitting at the intersection of mobility, private and public property and resident engagement. A connected city "uses an integrated approach to coordinate all essential services."[14] With **two thirds of the global population expected to live in urban areas over this generation**, making cities more efficient and sustainable is a top priority.

*"The ability to connect private property to broader smart city infrastructure will be critical in determining whether urban planners can meet sustainability goals." (PiLabs, 2020, Sustianability in the Built Environment)*

In London, the government recently announced the £ 40 million Clean Growth Fund, which could reach 100 million by next year, and will supercharge the development of "next generation clean, low-carbon technologies." They will invest at early-stage, Seed or Series A rounds. Tech Nation also announced their Net Zero programme to support the growth of UK startups from different verticals to help reach the ambitious goals set by the government.

Some exciting opportunities in this vertical to tackle air pollution:

**Helping property owners make improvements to get to net zero emissions:** Two thirds of the buildings that exist today will still exist in 2050, meaning that property owners will face significant challenges to comply with changing emission reduction regulations. Small business owners in large part don't have the money or know-how to finance or procure the necessary upgrades to comply with mandates. Streamlining this process, as estimated by Lawrence Berkley National Labs, is an estimated multi-trillion dollar opportunity by 2040.[15]

**Hyperlocal, real-time data**: Sudden and often unpredictable changes to urban communities resulting from the pandemic have been difficult for traditional information sources like Google Maps to keep up with. Citiesense, for example, is helping to create accurate maps of real-time conditions around neighborhoods, including changes to services like curbside pickup options. The company's cloud platform is able to provide a measurement of the pandemic's impact on the community, and help urban planners develop strategies for the reduction of traffic and health risks.

**Energy-Efficiency-as-a-Service platforms**: Business models in this segment combine funding, technology, implementation and active energy saving management to reduce the barrier to market entry for SMEs. Other investors are signaling interest in this concept. Sustainable Ventures, for example, recently launched their 'Net Zero' home programme with Schneider Electric to fund startups through 'proof of concept' to explore the potential of their technology in helping make the Net Zero home a reality.[16]

**Grid Modernization**: Essential for smart city development as it serves as the foundation for IoT, AI and electric vehicles.

**14. Smart Cities Dive(2020)** *5 Focal Points Needed to Develop a Smart City*
**15.UrbanX (2019)**, *Unerty: Fighting Climate Change with Financing*
**16. Sustainable Ventures (2020)** *The Net Zero Home Programme*

# 2.3 CONNECTED CITIES: CHALLENGES

A major hurdle for smart city adoption is **defining who owns and is responsible for the data collected**. Issues can occur in public/private partnerships and many cities lack government structures to integrate technology within urban infrastructure. This can cause privacy and data sharing conflicts.

**Risks of cyber intrusion** increase as digital practices are adopted by cities. Connected sensors, for example, have an inherent risk due to how they collect and share data which can track individuals and activities.[17]

As Good Tech Lab pointed out in their recent report, there is a clear **urban tech divide**: "The benefits from technological innovation and urban growth are not yet reaching all of those in greatest need (...) While vulnerable populations, and children in particular, stand to gain the most from access to emerging tech (...) these require constant connectivity, and are not designed for, or with, the urban poor." —UNICEF and Arm.

**Local Resistance**: Safety, impact on community and public transport are just a few incumbents to adoption of new services and technologies within urban environments. Clear communication, leadership and incentives are essential in order to align innovation with citizen well-being.

**Lack of transparency for startups around procurement opportunities and processes:** Public and private sectors have shared goals surrounding improved urban environments yet lack co-creation. Coming together will be essential as citizen behaviour continues to change so rapidly. Founders often recount an arduous road to securing trials and even more so to scale. This will need to change in order to allow for innovation. We discuss this in more detail in 'Event Explorations.'

17. **Smart Cities Dive**(**2020**) *Securing Critical Infrastructure in the Smart City*

# MARKET SNAPSHOT: CONNECTED CITIES

| Startup Name | Location | Stage | Business Model | Technology | Investors |
|---|---|---|---|---|---|
| Bettair | Bettair is a Platform as a Service (PaaS) that allows cities to map air pollution at a large scale, based on a large deployment of accurate sensors by using an advanced post-processing algorithm. | | | | |
| bettair Mapping Air Quality | Europe | Seed | B2B | Software platform, customer App, hardware | Grants, angel investors |
| Near Spacce Labs | Provides real-time, ultra high resolution imagery. They provide an API to access an archive of historic and current imagery. This supports citizens, businesses and municipalities in mobility, leisure and urban planning decisions, by providing access to fresh and actionable geospatial data at a competitive cost. | | | | |
| NEAR SPACE LABS | USA | Seed | B2B | API, real-time imagery | Draper Associates, UrbanX |
| Emsol | EMSOL has developed a tracking and attribution technology to identify in real time the cause of the air pollution breach. | | | | |
| EMSOL | UK | Seed | B2B | 'Emissions as a service' software platform, hardware | Grants, SIRIUS Program |
| AirLabs | AirLabs is a global developer and supplier of air cleaning and air quality measuring, monitoring solutions that p rovide valuable insight, enable action & clean the air to make it safe for people to breathe | | | | |
| airlabs breathe easy | UK, Europe | Series A | B2B, B2B2C, consul-tancy | Hardware, software platform, data services | Undisclosed VC, matched government funding |
| Cloud & Heat | Develops, builds and operates energy-efficient, scalable and secure data centers that meet the requirements of the future cloud. Cloud&Heat's innovative hot water direct cooling enables the re-use of the waste heat; water at a constant temperature of 60 degrees connects directly to building or district heating systems. | | | | |
| CLOUD & HEAT | UK, Europe | Series B | B2B, B2B2C | Hardware, monitoring cloud-based platform | ETF Partners, Sicav, Seedmatch, Inven Capital |

Global Smart Cities market is expected to reach £252.56 billion by the end of 2025.[18]

By 2050, 75% of the world's population will live in urban areas.[19]

Large industrial companies, including ABB, Siemens, Bosch, Philips, Volvo and GE, have all invested in young innovative smart city technology companies.[20]

18. **Bloomberg Business (2019)** *Global Smart Cities Market*
19. **UKTI (2019)** *Smart Cities Pitchbook*
20. **Osborne Clarke (2015)** *Financing the Commercialisation of Smart City Technology*

# STARTUP CASE STUDY: ZENCITY

AI-driven platform to help local government make better decisions, based on insights from their local community. Zencity gathers and analyses resident generated data and then delivers actionable insights that help local entities prioritise resources, track performance and connect with citizens.


STAGE: Series A

LOCATION: Tel-Aviv, USA

INVESTORS: Vertex Ventures, Canaan Partners, M12 Ventures

## Use Case:

Real-time resident feedback to understand how they are responding to specific city initiatives, projects, policies etc.

Live alerts of trending topics for quick crisis management. Hyper-local data to see an even more nuanced visualisation of where certain needs and preferences sit within the community. Recently have launched a product to specifically address the needs out of crisis management related to COVID-19, in order to identify and correct misinformation, prioritise health services, and use geolocation data to pinpoint specific areas requiring additional support.

## Key Risks:

Is data being collected in such a way that eliminates bias and reaches vulnerable groups? Expansion into other countries requires more consideration - different government structures with various procurement processes.

## Ideal Outcome:

More cohesion between resident needs and government decision-making to establish healthier, safer cities.

# 2.4 TRANSPORT AND MOBILITY: OPPORTUNITIES

In the past 5 years, venture capital investment within the mobility sector in Europe has risen from £ 316m in 2014 to £ 2.25bn in 2019 (+48% CAGR vs. +29% CAGR for worldwide mobility investments). It's the second largest VC-backed consumer segment in Europe. [21]

**Transport emissions represent the biggest source of air pollution in the UK**, posing a huge public health risk. Transport represents 51% of PM10* (49% industry & commercial, domestic, road surface and other pollutants) and 62% of NOx** (38% industry & commercial, domestic pollution).
In the UK, emissions have fallen by about 28% (2008-2018) yet most progress has come from the power sector, while buildings and transport have seen little change.[22] Predictions from mobility investors we spoke to during our research around exciting areas of interest include:

**COVID restrictions around movement**: Changes in user behaviour brought about by Covid-19 and the resulting restrictions around movement are still very much unknown.

***Pitchbook's Q2 2020 report on Shared Mobility predicts[23];***

- The shared mobility industry could see a long-term market expansion as public transport ridership declines in urban areas.
- Micromobility may play an important role in continuing social distancing while also reducing existing congestion and emission issues. Cities closing streets from car traffic to allow for more pedestrian space would enable consumers and city planners to adopt micro mobility at a larger volume.
- There is an opportunity for investors to source attractive deals in a more competitive investment landscape with discounted valuations.

'**Active' travel:** Research linking air pollution to higher coronavirus death rates, in addition to citizen risk aversion to taking public transport, has instigated more government initiatives encouraging 'active' transport options, such as cycling. An estimated 11,000 premature deaths were avoided in Europe in April due to lower air pollutant exposure.[24] To accommodate new infrastructure and associated behavioural change will require innovative technology.

**Last-mile logistics:** Designing for pedestrian streets, adoption alternative, electric options. For example, ONO, a pedal-assisted transporter for city streets, or Lime, an electric bike sharing scheme. In London, the Mayor's ambition to get to zero carbon by 2050 sets out that by 2041, 80% of all trips are to be made on foot, by cycle or public transport.[25] Zero Emission Zones will continue to expand, creating more opportunity for services that offer alternative & more efficient transport/delivery options. Xero-e from BGV portfolio is one example for zero-emission last mile delivery platforms Worldwide, Zero Emission Zones are growing in popularity as an imperative transition to achieve emission reduction goals. Another, newer subsector to this wave is **last-mile health-care delivery,** such as Carbon Health in the US.[26]

**Software-enabled businesses:** Platform, marketplace, IoT, SaaS, network effect and some AI/Machine Learning business models often require less capital compared to hardware and big cleantech companies, yet if successful can generate high return on investment. Wundermobility, for example, provides software, vehicles and a full range of services to cities and companies, helping them launch and scale new mobility services.

* Particles of any substances that are less than 10 or 2.5 micrometres diameter. Particles in this size range make up a large proportion of dust that can be drawn deep into the lungs.

** Nitrogen dioxide is an irritant gas, which at high concentrations causes inflammation of the airways.

21. **Idinvest (2019)** *European Consumer Startup Map*
22. **CCC (2020)** *Reducing UK Emissions Progress Report to Parliament*
23. **Pitchbook (2020)** *Report on Shared Mobility*



24. **WeForum (2020)** *Could the pandemic usher in a golden age of cycling?*
25. **Transport for London (2019)** *Guidance for Zero Emission Zones*
26. **Kauffman Fellows (2020)** *Carbon Health CEO Eren Bali on Covid-19*

# 2.6 TRANSPORT AND MOBILITY: CHALLENGES

The strain on current city transport systems is deepening as a result of increased populations seeking urban living. Addressing these challenges is a priority for city governments, yet innovation of any kind is often hindered or delayed due to long procurement cycles and public approval.

Challenges identified by mobility investors and startups:

OEM (Original Equipment Manufacturer) **sales cycles are extremely long:** limited traction achievable by startups, often not compelling enough to investors. Trajectory from pre-seed to Series A is very difficult as revenues are not always consistent and there can be disconnect between the goals of the OEM and those of the entrepreneurs. Retrofitting solutions for existing automobile applications is extremely cost-intensive and time consuming as it disrupts existing supply chains, product development processes and often increases unit costs for OEMS. "Many EV models in their base version, and potentially even including options, still may have low contribution margins, especially compared with current internal-combustion-engine (ICE) levels."[27]

In the UK specifically, "OEMs faced intense financial pressure because of declining sales, higher R&D costs, and increased tariffs. Globally, OEM profit margins had decreased from 6 percent in 2018 to 3 percent in early 2020."[28]

**Technology may not always be 'VC fundable'*:** Bets are often big, meaning a lot of capital required. Can be challenging for investors to decide which 'horse to back' when technology innovation is changing rapidly.

**Often have a hardware component which increases risk and capital requirements.** Technology in this space is moving at a rapid pace which means that founders need to maintain a high level of agility to keep up with the latest innovations. Commitment from investors can often come down to how confident they are in the founding team.

*Electric Vehicle (EV) use is undoubtedly increasing worldwide; The International Energy Agency's EV30@30 scenario expects EV sales to make up 30% of all vehicle sales by 2030. However, the biggest barrier to adoption remains a lack of accessible charging stations. "EVs could also represent a strong opportunity for OEMs…Because of COVID-19, European sales of EVs could be well above the 14 percent in 2022, as estimated by the McKinsey Centre for Future Mobility."

In terms of VC investment activity, some EV megadeals that fall under the wider Transport and Mobility sector also cover the cost of developing the underlying technology such as batteries that could be transferable across other sectors.

"What will help EVs gain market share is that OEMs have reached ranges with their EVs that allow them to focus on reducing price points, for example, by increasing design efficiency or reducing manufacturing cost in order to become affordable to more customer segments." (Mckinsey (2018) What a teardown of the latest electric vehicle reveals about the future of mass-market EVs)



27. **Mckinsey (2018)** *What a teardown of the latest electric vehicle reveals about the future of mass-market EVs*
28. **Mckinsey (2020)** *Moving forward:How COVID-19 will affect mobility in the United Kingdom*

# MARKET SNAPSHOT: TRANSPORT AND MOBILITY

| Startup Name | Location | Stage | Business Model | Technology | Investors |
|---|---|---|---|---|---|
| The Tyre Collective | A patent-pending technology that captures harmful tyre wear PM2.5 and PM10 particles right at the wheel of the vehicle, preventing them from entering our environment. | | | | |
| The Tyre Collective | London | Pre-Seed | B2B | Hardware, data | Grants |
| ev.energy | A cloud-based software platform that enables electric vehicle owners to save on the cost of EV charging, access a green motoring experience delivered from renewable electricity sources and automatic control and integration with charging hardware, at home and on the go. | | | | |
| ev.energy | UK | Seed | B2B, B2C | Software platform, customer App | Grants (InnovateUK, Climate KIC) |
| ChargeLabs | A hardware-agnostic platform that runs on the world's most popular EV chargers. Once connected, their software makes any EV charger smarter and easier to use. | | | | |
| | USA, Canada | Seed | B2B, B2B2C | Hardware, software platform, customer App | Government of Canada, UrbanX, Urban Us, Notation Capital |
| Ubiq | Ubiq transform raw urban data into actionable insights and valuable services to enable better mobility decisions. Their service provides demand prediction, demand fulfillment, predictive charging, policy compliance. | | | | |
| Ubiq | Europe | Seed | B2B | AI- driven software platform, API | SpeedInvest, angel investors, Impact Accelerator |
| Urbantz | Urbantz is a delivery management platform to optimize and control first and last mile operations, from the initial order to the final recipient. | | | | |
| | UK | Series A | B2B | Cloud-based SaaS platform | ETF Partners, Korys |

Smart mobility has attached investment of £ 88billion since 2010 , KPMG estimates a £7.1 trillion potential global market for mobility and related services.[29]

UK government planning to phase out the sale of petrol and diesel cars, vans and motorbikes by 2032.[30]

Road transport accounted for 24% of UK emissions in 2019, making it the highest emitting sector.[31]

29. **KPMG (2019)** *Mobility 2030 analysis*
30. **CCC (2020)** *Reducing UK Emissions Progress Report to Parliament*
31. **Ibid**

# STARTUP CASE STUDY: SIGNOL

Signol uses behavioural economics to transform employee behaviour into a competitive advantage. They empower independent transport operators with their own data to help them understand their behavioural patterns and save fuel, time, or effort. The platform allows businesses to understand where waste comes from and how it can be managed without expensive hardware and further training.

signol

STAGE: Seed/Pre-Series A

LOCATION: London, UK

INVESTORS: Elemental (grant), Centrica, Hangar 51, Founders Factory

## Use Case:

Improves driver/pilot productivity,
Delivers fuel cost-savings
Creates happier and more motivated employees
Reduces greenhouse gas emissions

## Key Risks:

Product is a 'nice to have' for corporate customers but does not affect systemic change. Unproven if changes in employee behaviour will lead to changing company policies/standards.

## Ideal Outcome:

Individual employees will make contributed efforts to change behaviours, resulting in cumulative reduction of emissions.
Data will help large corporations to make high-level changes to regulations and standards.
Employee education around making better decisions will overflow into their personal life and overall, will contribute to more sustainable lifestyles.

# 2.5 CONSUMER ENGAGEMENT: OPPORTUNITIES

There has been a shift in recent years of people wanting to take more control over their own health. The success of UK companies like Babylon Health and Second Nature (a BGV portfolio company) indicate that digital delivery increases levels of self-ownership. Transparency between the healthcare system, the patient and their data in addition to ease-of-use prove to be invaluable catalysts to higher, more long-lasting rates of engagement and as a result, a more preventative approach can be taken with citizens.

We anticipate a similar change in consumer behaviour to occur as the correlation between clean air and improved health outcomes becomes more widely understood. More products and services are being made available for consumers to take control of their own environment and make more sustainably-minded choices. Post-COVID-19, personal exposure to airborne viruses will be top of mind, leaving a big opportunity for SMEs who are able to match impact with convenience.

Consumers will have **increased control over household functions and appliances**: Verv Energy, for example, provides appliance manufacturers with predictive maintenance technology to alert them and end-consumers to impending issues. This remote diagnosis reduces the need for repairs, improves customer experience and extends the life of appliances.

Consumers will be looking for more ways than ever before to **keep energy costs down** and maintain reliability.
Post-COVID-19, consumers will be more **proactive about checking on and maintaining their respiratory health**. We have seen more people walking, exercising and anticipate this shift to continue when it comes to commuting to work. A Harvard Study directly links long-term exposure to PM2.5, an atmospheric fine particulate matter, to an 8% increase in the COVID-19 death rate in the US.[32]

**Local Activism:** Local community engagement may rise, creating more opportunity for platforms like Inhabit and Yayzy.

**Employers will be held accountable by their workforce** to be more sustainable. For example;

- Retrofitting existing offices for improved air flow & quality
- Engaging with green incentives, such as bike-to-work schemes and allowing for more flexible work hours in an effort to reduce congestion and exposure to harmful pollutants

32. **Harvard University (2020)** *A national study on long-term exposure to air pollution and COVID-19 mortality in the United States*

# 2.5 CONSUMER ENGAGEMENT: CHALLENGES

Bottom-up approach which **does not address root problems** in many cases. In other words, there is a risk of creating 'nice to haves' rather than adding significant long-term value.

Consumer engagement is **hard to label for investors**. Startups could be deemed too 'impact' for traditional investors but not 'deep-tech' enough for impact or cleantech VCs.

Adoption of products and services demands **behavioural change,** which is an uphill battle. There is a big educational piece required in order to inform consumers about the realities of air pollution. In other words, the need for the product is not always obvious to consumers.

Engagement and initiatives are **not always accessible to all income levels**. This is especially important as it relates to the Charity's beneficiaries and the work to be done in boroughs of Lambeth and Southwark.

# MARKET SNAPSHOT: CONSUMER ENGAGEMENT

| Startup Name | Location | Stage | Business Model | Technology | Investors |
|---|---|---|---|---|---|
| Inhabit | An employee benefit that engages the workforce with the climate crisis - tackling the issue first through offsetting and then giving consumers tools to action via a web platform. | | | | |
| inhabit. | UK | Pre-Seed | B2B, B2B2C | SaaS platform | BGV |
| Ao Air | Ao Air's facewear uses advanced nano-fiber technology to clean and filter air, protecting the user 50x more than the ordinary face mask (self-tested.) | | | | |
| AO AIR | USA | Seed | B2C | Hardware | SOSV, UrbanX |
| CompAct | CompAct provides an interactive and motivational toolkit for companies, institutions and schools to help people form sustainable habits. | | | | |
| CompAct | UK | Pre-Seed | B2B, B2B2C | SaaS platform, chatbot | Climate KIC, grants/ accelerators |
| uHoo | uHoo is an indoor air sensor that tracks air quality and provides data insights and tips to create a healthier, safer and more energy efficient office and building. uHoo have also released their Virus Index - world first, patent-pending, real-time assessment of COVID-19 survival in an indoor space using air quality data. | | | | |
| | Hong Kong | Seed/Pre-Series A | B2C | Hardware, consumer App | Wavemaker Partners, East Ventures |
| Molekule | Molekule's proprietary technology, Photo Electrochemical Oxidation (PECO), works at the molecular level to destroy pollutants. Developed over two decades by research scientists, PECO is an innovative technology that utilizes free radicals – the same radicals used to destroy cancer cells – to break down pollutants at a molecular level, including VOCs, bacteria, mold, viruses, and allergens. | | | | |
| MO | USA | Series C | B2C | Hardware, consumer App | Uncork Capital, RPS Ventures, Foundry Group, Crosslink Capital |

81% of urban dwellers are concerned about air pollution.[33]

65% of consumers said they want to buy purpose-driven brands that advocate sustainability, yet only about 26% actually do so.[34]

23% of healthcare consumers say reliable and secure digital tools that help them to understand their health habits would motivate them to take a more active role in managing their health.[35]

33. **Tranquil City** (2019) *Market Research*
34. **Harvard Business Review** (2019) *The Elusive Green Consumer*
35. **Accenture** (2020) *Digital Health Consumer Survey*

# STARTUP CASE STUDY: TRANQUIL CITY

Tranquil City is an API that provides empowering and actionable environmental quality information to apps so users can lead a healthier life by taking alternative, less congested routes. Currently environmental data is complex and inaccessible, yet 81% of city dwellers say they are worried about urban pollution. Tranquil City offers curated, high-resolution data to organisations of all sizes.

Tranquil City

STAGE: Pre-Seed

LOCATION: London, UK

INVESTOR: BGV

## Use Case:

Location-based apps/services benefit by providing users environmental data and curated routes.

## Key Risks:

Business has to reach massive levels of growth to be commercially viable, possible changes in individual movement patterns/commuting in cities as a result of COVID-19 could reduce the need for alternative routes.

## Ideal Outcome:

Reduced congestion in cities to decrease carbon emissions. Improved overall resident health, including mental health, by reducing stress around transport/ commuting and cultivating a better & safer environment for green mobility options (such as biking and walking).

# 2.6 AIR PURIFICATION: OPPORTUNITIES

Air Purification is an intersecting subsector to others discussed in this report and in our research, has been the area with the most amount of hardware-dependant ventures and as a result, larger capital requirements. We have therefore lessened our focus here however, it's important to consider these as there are many companies leading the way on air pollution research and market testing, which cultivates an improved overall ecosystem and enables progress across other subsectors.

**Some are built on frontier technologies** which could address the root causes of air pollution, while others seek to **address airborne viruses** (such as COVID-19), which has become a heightened focus for governments and citizens, who are vying for immediate action. Unsurprisingly, investors are most excited by proprietary technologies.

# CHALLENGES

**Limited regulation and standards** could enable market entrants with unproven technology. This concern effects investor conviction and might discourage them from investing in novel technologies. Many are university spin-outs from academic incubators or PhD programs and might struggle to get external funding if the **university has IP ownership**.

**Product development timeframes are long:** Molekule, for example, are one of the largest companies in the air purification market and have recently raised a £ 46M Series C round, bringing total funding to £ 76.7M. According to the co-founder, Jaya Rao, "While the Molekule air purifiers have only been on the market for a couple years, the company has essentially been in the works for two decades…"[36]
Many of the consumer-based air purification **devices for at-home use have a high cost barrier** and therefore are reserved for wealthier socio-economic groups. Molekule air purifier, for example, costs $799 (£634) and a "mini" model costs $399 (£316).[37]

**36. Crunchbase** (2020) *Molekule raises $58M Series C*
**37. Molekule** (2020) *Products*

# MARKET SNAPSHOT: AIR PURIFICATION

| Startup Name | Location | Stage | Business Model | Technology | Investors |
|---|---|---|---|---|---|
| AirThinx | Airthinx measures 9 air pollutants in real-time using an innovative, cost-effective, cloud-based sensor technology. The solution identifies dangerous levels of particles in the air and offers continuous and long-term monitoring of Indoor Air Quality (IAQ) in any built environment. | | | | |
| airthinx | US | Seed | B2B, B2C | Hardware, cloud-based web platform | Not disclosed |
| Vortex IoT | IoT devices that offer hyperlocal air quality monitoring and pollution detection, specifically designed for harsh environments. | | | | |
| VORTEX | UK | Seed | B2B | Hardware, software web platform | Startup Funding Club, Grants |
| Novaerus | Novaerus builds portable air disinfection units using patented ultra-low energy plasma technology to reduce airborne viruses, bacteria, particulate, mould spores, VOCs, allergens and odours. | | | | |
| NOVAER | UK | Series A | B2B | Hardware | Eight Roads, F-Prime |
| Airly | Airly provides an AI-driven air pollution forecast with over 95% accuracy, presented for the next 24-hour period, hour by hour.Their API gives access to real-time and historical air quality data from their database - it enables integration with applications and provides raw data for research and scientific papers on air pollution. | | | | |
| | Europe, UK | Series A | B2C | Hardware (IoT devices), software platform, API | Grants, angels |
| Sensio | Sensio is an intuitive interface where users can track their daily allergy symptoms, monitor potential allergens and receive pollen and air pollution alerts in their local area. Advice from experts then helps users learn how to combat and eliminate the sources of their symptoms and, through smart algorithms, better understand their triggers. | | | | |
| S | UK | Series A | B2B, B2C, B2B2C | Hardware, consumer App, API | Cedar Mundi Ventures |

Before COVID-19, air purifiers were already expected to grow at a double digit pace by 2027, the market itself is already worth some £16 billion worldwide.[38]

New market drivers around COVID-19; implied link between air pollution and severity of COVID-19 means higher duty of care is required by employers and property owners and stronger demand for risk mitigation technologies.

38. **Grandview Research** (2020) *Global Air Purifier Market*

# CASE STUDY: METALMARK

Metalmark is a patent-pending air purification system tackling small-particle pollution such as viruses, chemicals and ultra-fine particulate matter. Their initial target market is the automotive industry but their underlying technology can apply to a variety of indoor settings.

STAGE: Pre-Seed

LOCATION: Boston, USA

GRANT FUNDERS: UrbanX, National Science Foundation, Massachusetts Clean Energy Center, Harvard President's Innovation Challenge

## Use Case:

The COVID-19 pandemic has shone a spotlight on the dangers of indoor air. Current technologies are either ineffective or very limited in their ability to tackle particles at the scale of viruses and viral aerosols (0.2 micron or smaller). Similarly, they miss other pollutants such as volatile organic compounds (VOCs) like formaldehyde and acetaldehyde, or ultra-fine particulate matter that cause cancer, heart attacks, asthma, and even dementia and Alzheimer's Disease. Metalmark has created a platform technology to design materials at the nano- and micro-scale to destroy these small air pollutants, enabling a high-performance, cost-effective, and durable solution to making our indoor spaces safer, healthier, and more livable.

## Key Risks:

OEMs are notoriously hard to sell into.
Potentially very capital intensive.
Highly competitive space with many new-market entrants.

## Ideal Outcome:

Improved health outcomes for firstly automobile operators (e.g. truck drivers) who spend significant amounts of time in vehicles. Secondly, technology to be embedded in all transport indoor spaces, both public and private, to reduce exposure to airborne viruses and micro-pollutants for the public.

# THE INVESTMENT OPPORTUNITY

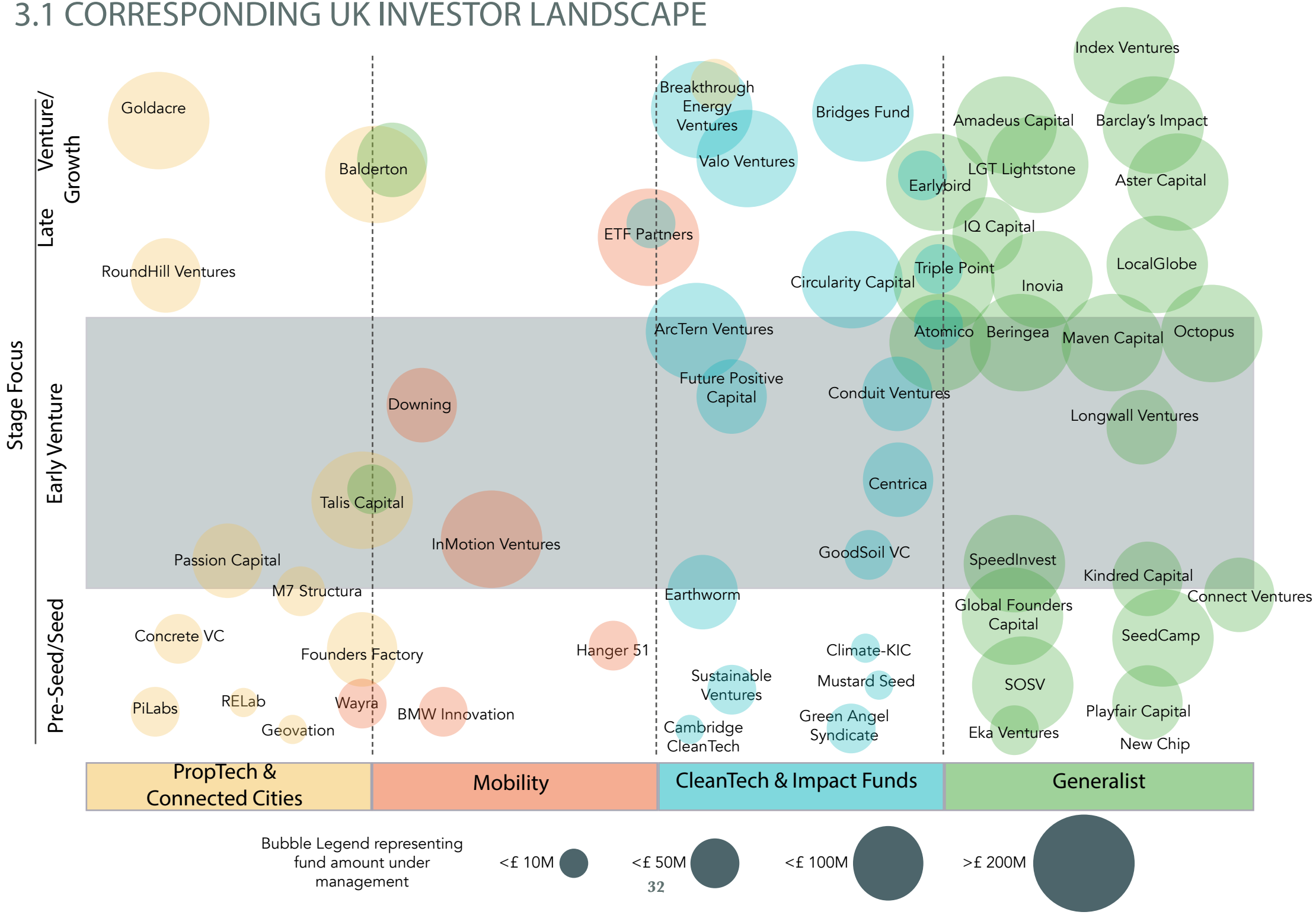
3.0

# 3.0 THE INVESTMENT OPPORTUNITY

The biggest issues facing the global community such as the climate crisis, rapid urbanisation, and an ageing population, are all areas of complex human need which require **various layers of intervention in collaboration** with a wide range of stakeholders.

As **Europe's leading early-stage tech for good VC**, BGV believes these areas of human need are coupled with large, high growth commercial markets and relatively low exploitation of digital technology and therefore represent a meaningful impact investment opportunity.

# 3.1 CORRESPONDING UK INVESTOR LANDSCAPE



# 3.2 EARLY STAGE INVESTMENT: GAP AND CONSIDERATIONS

To understand an early-stage investor's mindset and motivations; let's take a look at a typical seed-stage fund profile. Most seed funds that we spoke to who have looked into the air pollution space are **<£100M in AUM** and tend to **invest c. £250K-2M** for c. 15-20% equity stake. The typical VC model predicts a **3x+ return on the fund over 10-12 years**. VCs will invest in **high-risk, high-potential** startups who could yield 10x+ return on investment (ROI). VCs will expect the majority of their portfolio to either fold or generate lower returns, with the overperforming ones making up for those who fail.

From our conversations with entrepreneurs and funds, we observe that while there is interest in the anti-air pollution space, only a few funds choose to commit while quite a few are still **in information gathering mode.**
This reflects another characteristic of the VC space; investment opportunities in novel technologies areas are **accelerated by strong co-investor appetite**. In other words, most VCs would like to see some market signalling and de-risk their decisions by following early movers in the space and co-invest alongside them.

For air pollution startups, data suggests that **seed-stage funding is harder to obtain** than their counterparts in different verticals. Looking at the stages of development of CleanTech companies (a proxy/umbrella vertical for air pollution startups), only 45% of funded companies were at seed stage as opposed to the overall industry average of 53%.[39]

Given the certain 'novelty' risks associated with early-stage air pollution tech, we may experience a shift that has been occuring in other verticals;

**Later-stage investors are making small seed investments** to give themselves better 'options' for investments at Series A.

Kauffman Fellows surveyed 15 VCs across Europe and the US[40] who have begun making such smaller seed investments and their motivations reflect the barriers to investment that we have heard from investors during our research. Making smaller investments, initially;

- **reduces investor risk** if tech is unproven
- puts investor in a position for greater **equity ownership at Series A**
- allows the fund to **dip their toes in new sectors** before making big bets

This may provide more **cohesion between Seed to Series A** - a notoriously challenging inflection point for founders (only 19% of seed companies successfully raise Series A).[41] Also, the signaled interest from later-stage investors joining seed rounds into companies tackling air pollution could incentivise further sector focus from seed-specific funds.

**39**. **Grandview Research** (**2020**) *Global Air Purifier Market*
**40. Kauffman Fellows** (**2014**) *Disrupting the Traditional VC Model: VC Adaptations for Seed Investments*
**41.Pitchbook** (**2019**) *The Journey to Series A in Europe: 2018 Report*

# 3.2 EARLY STAGE INVESTMENT: GAP AND CONSIDERATIONS

We have identified some **key themes for considering investment opportunities** in the air pollution space:

**Hyper-localized insights and actions:** A key hurdle for startups is long sales cycles when selling into government bodies and local authorities. One Series A impact fund we spoke to based in San Francisco, believes possible solutions could be achieved through lower buy-in cost levels with potential to upsell from there. In their experience, companies who have been successful go after smaller communities rather than larger regions and are able to offer hyper-localised insights and actions.

**Hardware enabled solutions can be particularily difficult:** Sensors providing data insights are a very crowded space and few have viable commercial traction. There seems to be a larger group of investors who, therefore, come in post 'product-market-fit' or Series A, leaving a **funding gap for those between pilot phase and commercial launch.**

**Additional revenue streams:** When thinking about an investment framework, it's worthwhile to consider various differentiation points which counter balance the risks associated with innovative yet less proven business models. For example, some startups we spoke to generate a certain amount of revenue through consulting work around air pollution, allowing them to spend more in R&D towards their main product and bigger vision. It could also be argued this acts as a business development, customer research and/or market education activity for them.

**Capital intensive R&D:** A common theme from investors is that many have looked at **alternative materials** opportunities, but due to their capital intensive nature, investors who are not specialized tend to steer away from them.

**Changing regulation:** What are the catalysts to ensuring governments continue spending money on improved air quality? This deeply impacts the relevance and timing of particular startups, affecting their market entry timelines and impacting their ability to secure government tenders and contracts.

# 3.2 EARLY STAGE INVESTMENT: GAP AND CONSIDERATIONS

Additional considerations were drawn from BGV's portfolio data as well as ***The Journey to Series A in Europe: 2018 Report by Dealroom/Atomico/ LocalGlobe***, which looks at 8,800 funding rounds and 6,500 companies:

Angel investors and equity-free support such as grants are vital in the early stages of a company's lifecycle.

Unlike hardware/materials companies, software-enabled business models are less capital-intensive with lower valuations, and fall more in line with VC ROI timescales. That being said, it's been our experience that patient capital is still required. For example, one impact and alternative materials-focused fund that has been around for c. 20 years reported that they have looked at hundreds of companies in the carbon capture/ storage/reduction space, however, most of those are not at scale or even reached commercialisation yet. This speaks to the large size of investment required and the need for extremely patient capital, which is not an option for many funds.

We usually refer to a baseline scenario whereby a typical seed investor, with a £100M fund, would make a £2M investment at an £8M valuation for 20% equity stake, which implies that the investor has to believe that the company will reach >£300M valuation at exit in order to invest. Underperforming companies tend to manifest themselves close to the initial investment, which explains the dramatic drop in success rates between Startup to Series A.

The Pitchbook report highlighted a number of other relevant factors that can affect a company's fundraising trajectory. We've summarised some of the most relevant below, supporting our analysis that seed-stage cash injection is key to unlocking more innovative technologies in the space.

- **Companies who raise pre-seed convert at higher rates to Series A // 21% conversion rate (by 24 months) vs 15% without pre-seed**
- **Series A sizes are going up due to the emergence of the 'new Series A' // New Series A' is $7-15M (£5.5M-12M)**
- **The conversion rate from Seed to Series A is 19% within 36 months of seed // Median time is 18 months**
- **The proportion of US firms taking part in European deals is growing rapidly //reaching 20.9% in 2018, above the past decade's range of 11-14%**
- **Companies that raise £2-3M in total pre-series A**
- **funding have the highest conversion rate(26%) to Series A // Raising too little may impact the chances of converting to Series A: companies raising < £1.2M convert at lower levels**

# 3.3 INVESTOR VALUE-ADD BEYOND CAPITAL

Given the nascent nature of many of the subsectors addressed in this report, it's important to note that **support from investors beyond financial backing is essential** to give startups the best chance at success. Founders we spoke to highlighted the below as key things they look for in an investor profile:

- **Impact-focused:** Founders are mission-driven and want to ensure their vision for success is aligned with that of their investor.
- **Well-connected:** Ideal for the VC to have commercial networks to help secure faster procurement or piloting processes and more sales opportunities, both with corporates and local authorities/government departments.
- **Strong co-investor network:** Being able to meaningfully facilitate introductions to investors for future fundraising rounds becomes hugely valuable to founders as it can take up to twelve months to build relationships with funds before they're ready to commit at growth stage.
- **Expertise in building and scaling a team:** Most of these startups are built by first-time founders, to whom running a team does not always come naturally. In certain phases, founders may be tasked with hiring 10s or 100s of people at once and making difficult executive-level decisions can become overwhelming. This is where an experienced investor who can offer guidance through these periods of expansion is so valuable.
- **Diverse investment team:** In the same way investors need to prioritise diverse founding teams, entrepreneurs are looking for funds with a diversity of ethnicity, gender, background and experience.

# DIGITAL EVENT EXPLORATIONS

4.0

# 4.1 EVENT SUMMARY AND STARTUP SELECTION

As Europe's leading early-stage tech for good VC, we were interested to understand how venture capital can be best leveraged to support impactful innovation in the anti-air pollution space. Given the inflection point the investment landscape is at right now in light of COVID-19, as well as the correlation with air quality and overall management of health, **could we collectively identify barriers to investing in startups tackling air pollution and anticipate some key challenges and opportunities that will exist in a post COVID-19 society?** As investors, we come across hundreds of businesses, how might macro trends affect their ability to grow and scale?

As part of our research, we identified 80+ early-stage air pollution companies across the UK and Europe, North America and Asia through our existing networks and desktop research. We interviewed 22 of them and invited 15 to join us for the event.

After speaking to entrepreneurs and investors on an individual basis, we brought everyone together on June 9th for a virtual event to discuss how tech for good and early-stage investment can help tackle air pollution. **In this section, we will present key highlights and learnings to take forward as we begin planning for next steps.** We are also sharing our learnings with the wider tech for good community in a three-part series on the BGV blog.

# 4.2 INVESTMENT PLANNING POST-COVID

## Session 1 Learnings

We spoke to 37 funds and were joined by a group of 25 investors from Europe and North America, all interested or actively investing in anti-air pollution startups, working across different stages and verticals such as mobility and transportation, smart cities, internet of things and hardware, enterprise and software as a service, consumer goods and e-commerce.

**We imagined four futures, from 2020-2025,** each one projecting contrasting changes to air pollution regulation (e.g. looser versus stricter regulation) and contrasting developments of the global economy (e.g. fast/slow to recover post COVID-19). Main themes that emerged corresponded with our initial research and will reinforce some of the points explored in previous sections.

### Anti-air pollution as a service

Anti-air pollution is a value-add for both direct customers and businesses in a number of different industries: real estate, enterprise solutions, travel and logistics, to name a few.

Regardless of industry, there is board-level pressure to be at least carbon neutral and this is unlikely to go away. Lifting of COVID-19 restrictions is likely to further sustainability concerns as most countries vigorously 'restart'.

Businesses' ability to invest in measures to lower their own contribution to air pollution is unsurprisingly directly related to the economic trend. If the correlation and causation between poor air quality, poor health and poor productivity is better measured and communicated, this might go higher in their agendas.

### Investing in tech for good

In terms of investment, it is necessary to recognise tackling air pollution as a multi-layered opportunity and think about infrastructure investments in adjacent industries like health and construction. Poor regulation would probably result in lower valuations as startups struggle to gain more traction while better regulations might suggest more attractive exits. Regardless, there is benefit to having a long-term, patient capital view with a focus on intersecting verticals rather than purely air quality itself.

If the economic outlook ahead is bleak, would governments ease up their procurement processes to become a stable customer for more SMEs? Worthwhile to note that the BGV portfolio companies that are servicing the public sector proved more resilient so far during this crisis. Would the government give more subsidies for fuelling growth? Or even set up more mechanisms for becoming LPs in venture capital funds?

# 4.2 INVESTMENT PLANNING POST-COVID

## Session 1 Learnings continued

### Regulation as an innovation enabler

When we talk about regulation, it is important to distinguish between local level and national level. There is an opportunity for local authorities should they want to become innovation hubs around air quality - the better the regulation the higher chance for innovation to flourish and develop responsibly.

Equally, there is an opportunity for startups focusing on hyperlocal, real-time data, particularly as people's movement patterns change to adopt social distancing measures.

### Awareness and appetite for self-protection and cleaner consumption

In light of COVID-19, consumer awareness for their environment, air quality and appetite for tech for good and self-protection is growing, regardless of regulation. China, for example, saw an estimated 25% drop in carbon dioxide emissions nationwide in the two weeks following the Chinese New Year, versus the same two-week period in 2019.[42] Could we be looking at a scenario where we are checking air pollution levels like we do with the weather, embedded in various systems?

Hardware innovation could see a boost through government grants around R&D and potentially accelerated commoditisation of sophisticated sensors and other internet of things devices.

There is a risk that the higher demand for hardware might exacerbate income equalities within a society where personal/household devices become quasi-luxury items available only to a small part of the population.



42.**Carbon Brief** (**2020**) *Coronavirus has temporarily reduced China's Co2 by a quarter*

# 4.3 ROUTE TO COMMERCIALISATION

## Session 2 Learnings

We selected three founders and CEOs to help lead this session, each at different stages (from pre-seed to Series A) and from different geographies (Europe, UK and USA). This was intentional to ensure there were perspectives from across the startup lifecycle and to see whether we could identify key overlapping themes. Sissi Liu from MetalMark, inventing new materials for indoors air purification; Marc Ottolini from Airlabs, a monitoring solution for smart cities and mobility; and Dan White from Signol, using behaviour change for sustainability in aviation and shipping industries led the conversation. Below are the key takeaways from the discussion and Q&A:

Products need to be **affordable,** particularly when selling to local authorities. Startups need to provide **a complete solution** - customers are interested in actionable insights/interventions, so data without purpose will not get very far.

Regulations can be problematic as they vary so much from one geography to another so it's not advisable to build a **regulatory-dependent product/business model.** However, regulations in place can help to create market demand and enact standards compliance.

Within the air quality monitoring and purification space, product quality varies widely which is dangerous as it allows for **'air-pollution -washing'** e.g. most indoor sensors and monitors targeted at consumers. Up to this point, there have been standards but with limited or no regulation - will COVID-19 accelerate adoption of industry standards and qualifications? On this note, investors have to take a more active role in understanding what technologies are 'real' vs 'fake'.

**Different standards** for different types of exposure and environments are necessary. For example, countries like China are leading in terms of air pollution standards, however, the pollutants and environment there are different to what we face in the UK.

Tech can't always be customer-driven because commercial customers could be unaware of potential applications **(think cars versus faster horses)**.

# 4.4 LEVERAGING REGULATION

## Session 3 Learnings

For the last session, we wanted to feature another stakeholder organisation to draw attention to different perspectives and opportunities for cross-industry collaboration and co-creation. Alex Perez, Venture Manager at Nitrous City, who works with the public sector, corporates and scaleups to get viable technologies integrated faster for smart cities led the session and brought a corporate innovation lens.

Alex was joined by Freddie Talberg, Founder and CEO of EMSOL - a seed-stage SaaS platform which fuses air quality monitoring data with asset location data to analyse and deliver insights to all stakeholders, resulting in targeted actions. Freddie previously founded Pie Mapping, a transport data and mapping SaaS venture which was acquired by DPD UK. It was important to have two vantage points candidly represented, both the entrepreneur and the corporate perspective. Some highlights of the discussion and Q&A below:

**Startups and public procurement:** Public procurement is regulation-led. Entrepreneurs cannot always afford to wait for regulation and need to be confident that it will catch up with the innovation they are creating. There needs to be a certain level of self-motivation to help improve standards and **showing causation between innovation and positive societal impact** could put pressure on authorities to expedite new, adaptive regulation. Startups need to know their customer and invest in compliance for public sector procurement e.g. acquire certain certifications, have reliable and repeatable processes. The first contract won is a validation signal and usually opens doors for more to come.

More often than not, traditional infrastructure is not compatible with new tech so companies need to find **retrofit solutions** which might mean spending more resources and ending up building bigger end-to-end solutions as opposed to contributing with your own specific piece of the solution.

**Aligning VC objectives with those of the governments**': Model of innovation is shifting. Previously, the governments spearheaded big tech initiatives but now, tech is evolving at a much faster rate and the government is consistently trying to catch up. This has placed more pressure on the governments to work closer with agile, innovative companies - the UK government spent £661M across 394 contracts since 2015 on digital transformation, much of which went towards smart city initiatives. By legislation, **33% of public sector spending needs to go to SMEs.**[43] The opportunity here is clear and air pollution startups could make a case around reliable cash flow while fundraising from VCs.

VCs, particularly at seed stage, need to take more initiative to educate themselves around public sector processes in order to ensure their portfolio companies are properly placed for public procurement. This could have an effect on **typical exit scenarios** - is ten years meaningful in this context? More collaboration needs to happen amongst seed, Series A and growth stage investors to better align risk assessment at each stage and develop cohesion between expectations of commercial traction, as well as societal impact.

**Slow-growth myth - commercial opportunity can co-exist with societal impact**: In the investment community, there is a clear trend towards making more purpose-driven investments. In BGV's experience, we can observe that through our portfolio's fundraising rounds, with investors like Beringea, Triple Point and Longwall joining.

In the air pollution context, it is essential that founders present the wide-spread, global opportunity of their technology and explain how it can be transferable between different geographies while talking about their projected growth. These large markets present great potential for expansion but it is important to ensure that products and services and can be **meaningfully localised.** A UK originated technology may not tackle the issues more pertinent to cities in certain Asian markets due to environmental differences and therefore, a difference in air pollutants.

There is opportunity for all investors to reduce their risk and learn from one another in collaboration. In fact, if we want to tackle the global crises we are all facing, generalist investors, impact investors, commercial entities and founders **cannot afford to work in silos.**

While reflecting on the event, Matt Towner, Portfolio Manager from the Charity drew our attention to the Childhood Obesity Programme and Good Food Fund in collaboration with Big Society Capital (one of our LPs at BGV), Ascension Ventures and Mission Ventures as a relevant example of how **wider sector engagement** is demonstrating the role that capital and specialist expertise can play in solving related challenges in South London and beyond.



43. As of July 2018, the government had approved over £80 billion to spend on 41 major transformation programmes across 10 departments and one public body. At least 19 of these, costing almost £38 billion, are digital transformation programmes p.5, Institute for Government (2018) **The hidden obstacles to government digital transformation**

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