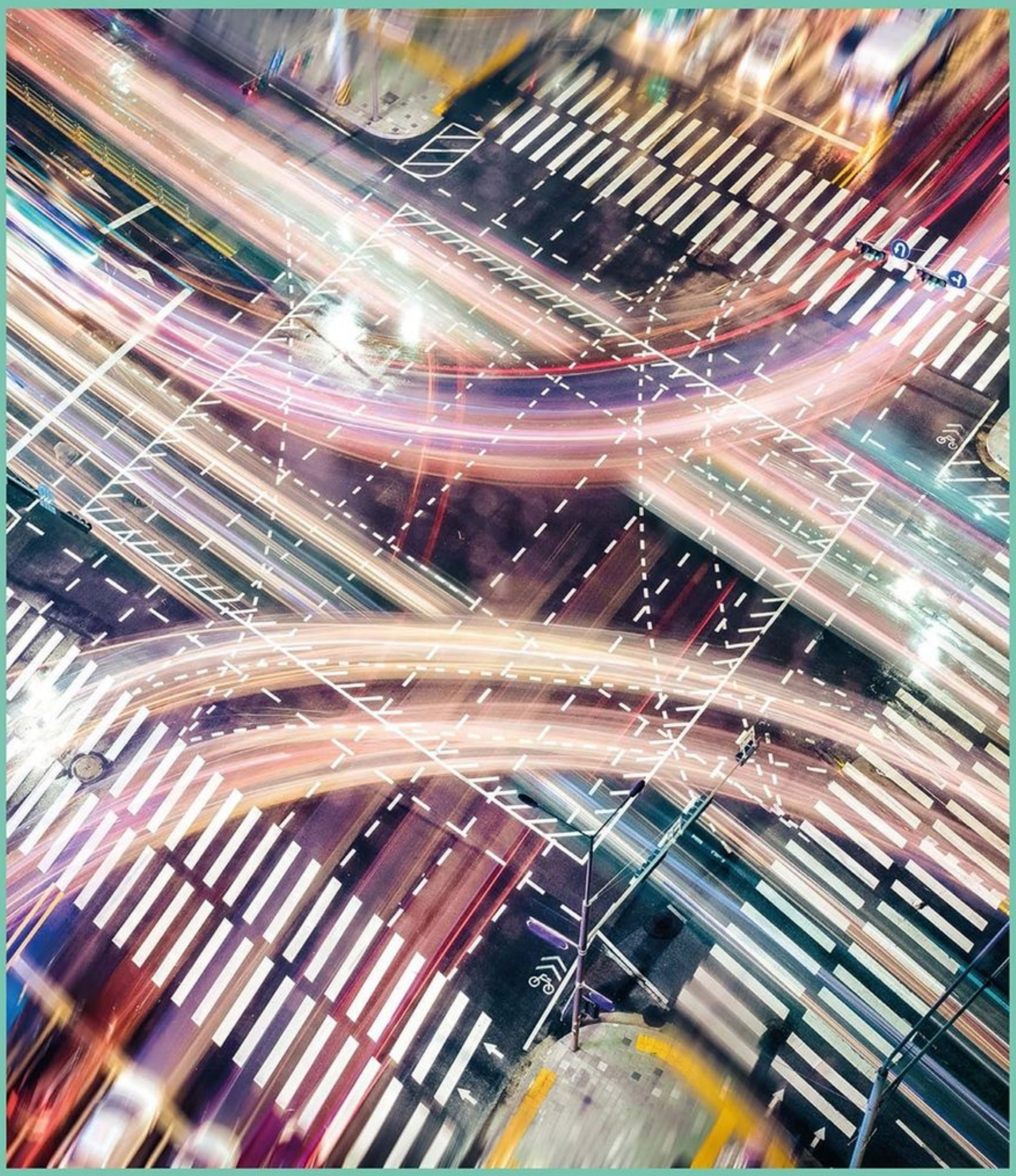
Materials World

The member magazine of the Institute of Materials, Minerals and Mining



January 2021

Volume 29, Number 1

The Transport Issue

Up and away

Blue sky thinking for urban air mobility

All roads lead to circular

Closing the loop on transport via land, sea and sky

Go west

Ambitious plans for mining in South West England

On the move

Above: Datwyler's manufacturing facilities in Switzerland

Identifying and specifying the correct components can boost sustainability in the automotive sector. **Andreas Minatti, Dr Jakub Kadlcak** and **Rolf Figi** at Datwyler explain more.

Global consulting firm Capgemini's March 2020 report – *The Automotive Industry in the Era of Sustainability* – stated: "With growing concerns of climate change and environmental degradation, sustainability has become a strategic priority for automotive organisations." As a result, to maintain valuable partner status, suppliers must incorporate sustainable practices into every possible element of an operation – from production processes at the factory level, to the design, material use and functionality of the products produced.

Original equipment manufacturers (OEMs) are increasingly particular about supplier selection. In the case of component suppliers, in addition to internal processes and procedures, it is also possible to make a tangible impact in terms of the systems within which those components are incorporated. The electrification of vehicles is a prime example. A key driver for increased sustainability within the industry and for global emissions reduction, it also delivers components for emission control and emission reduction systems, enabling existing internal combustion engines (ICE) to operate at far cleaner levels.

Plugged in

Pure electric vehicles (EVs) are projected to account for 19% of the market by 2030 – with full and plug-in hybrids accounting for 11% and ICE only and mild hybrid vehicles for the remaining 70%, according to a report from vehicle engineering firm FEV. From a sustainability viewpoint, it states that, "based on the grid which charges EVs, in the 27 EU countries and the UK, for example, the shift to electric vehicles would cut the overall lifetime greenhouse gas (GHG) footprint by approximately 37% for passenger vehicles while reducing the operating footprint by 75%, when powered by renewable sources [assuming a total lifetime distance of 150,000 km]."

Small components such as seals that incorporate sensor technology will be prevalent in electric vehicles due to their natural affinity with the power source, and could contribute to this reduction of GHGs. By using smart sealing solutions with sensors embedded, for example, not only ensures the integrity of the seal, but to monitor a wide range of activities can be monitored within the vehicle. An integrated sensor could monitor or track functionality, for instance, or other elements such as temperature, humidity or leakage – delivering data to the vehicle itself or to the manufacturer or driver that could aid more efficient operation.

Predictive maintenance and predictive analytics will also be possible, as the sensors will be able to detect whether parts are wearing or close to failure, ensuring their replacement can be planned before unscheduled

downtime events or even potential safety issues occur. This active data will be critical to realising the full potential of sensor technology and its impact on sustainability.

Additionally, advances in braking technology can impact on the efficiency of EVs. The move from the vacuum booster to electrohydraulic technology, for example, means the kinetic energy from braking forces can be recuperated and used to charge the battery while the vehicle is in operation. Electrohydraulic systems are also lighter by nature, meaning further energy efficiencies can be realised through weight reduction.

As an example, TÜV, a firm that provides vehicular inspection and product certification services, has confirmed that Continental's MK C1 electrohydraulic brake-by-wire brake system reduces the amount of CO_2 emitted in the Worldwide Light Vehicles Test Procedure (WLTP), when installed in a standard plug-in hybrid vehicle from D-segment cars (large cars). In a certified test, around 5g/km less CO_2 was emitted on average compared with a conventional non-brake-by-wire hybrid brake system.

Strict regulations

Due to rapidly increasing traffic and stricter regulations, experts predict a worldwide growing demand for exhaust gas treatment products, especially in emerging markets. Nitrogen oxide (NOx) limits in the WLTP and even stricter Super Ultra-Low Emission Vehicle (SULEV) limits for California, USA, for example, are continuously posing a major challenge to vehicle manufacturers.

The already introduced Real Driving Emission (RDE) tests examine exhaust gas emissions under realistic driving conditions, meaning that low-emission values under laboratory conditions will no longer be sufficient. These stricter regulations require more than optimised diesel engines, making additional exhaust gas treatment necessary.

Key technologies for the reduction of NOx are selective catalytic reduction (SCR) systems – considered to be the most efficient and reliable method to reduce more than 90% of NOx emissions of diesel engines and to comply with Euro 6d standards and above.

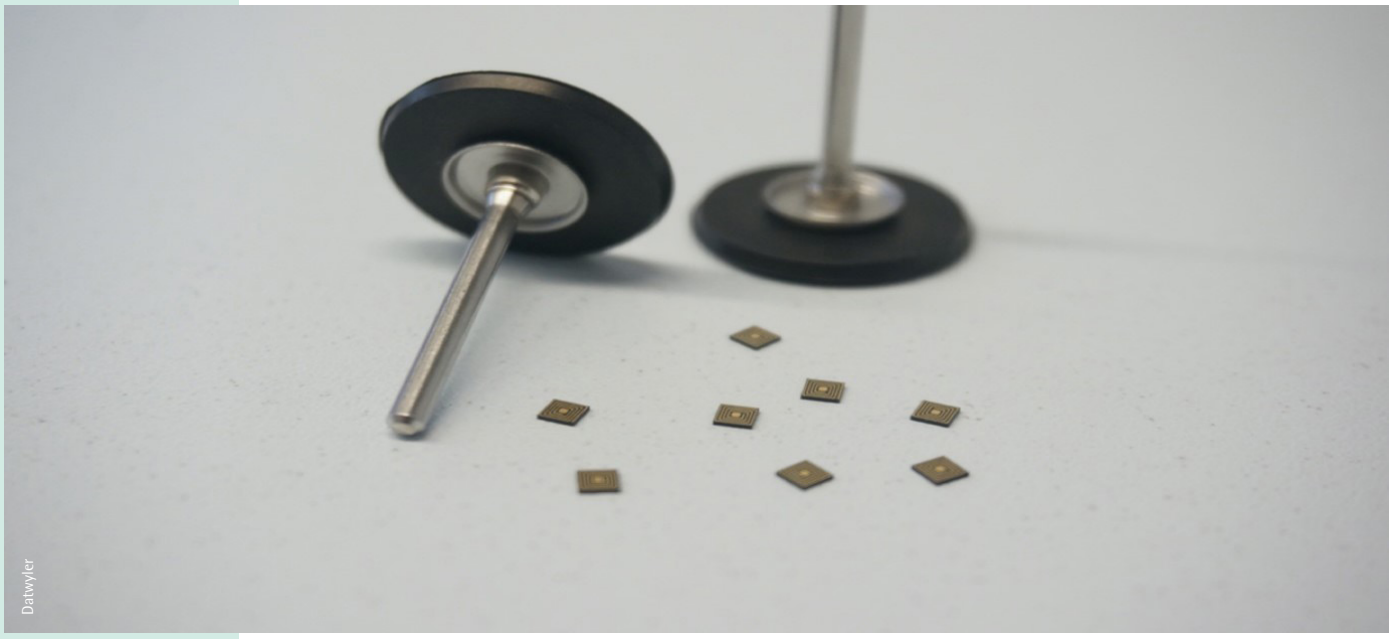
Chemical regulations in Europe, the USA and Asia are tightening. Each region has different chemical requirements, and it is necessary for component suppliers to proactively align with these regulations with regard to compounds. Restrictions on specific ingredients that are not allowed, or could be restricted in the future, should be closely monitored.

At a certain level, this approach can feed into sustainability as these compounds may be environmentally unfriendly or, in some instances, harmful to workers. The ideal is to have an internal team of experts to help identify any ingredients that are under even the slightest threat of being restricted or removed in the future.

Should a compound be identified as a potential disruptor, the first step is to contact the supplier and to scan the market with relevant regulatory experts. Then it is necessary to look for an alternative, to hold production trials internally and, once confident an appropriate replacement has been developed, to then communicate to the customer. The whole supply chain needs to be involved if positive changes are to be made in terms of chemical compounds, and this collaborative approach ensures a timely reaction.

Exhaust systems

SCR systems use water-based urea solutions – AdBlue or Diesel Exhaust Fluid (DEF) as it is known in the USA – as an ammonia source to neutralise NOx in exhaust emissions of diesel engines. Ammonia (NH_3) reacts selectively with nitrogen oxides, resulting in harmless nitrogen and water. To guarantee the safe transport of these chemicals



Datwyler

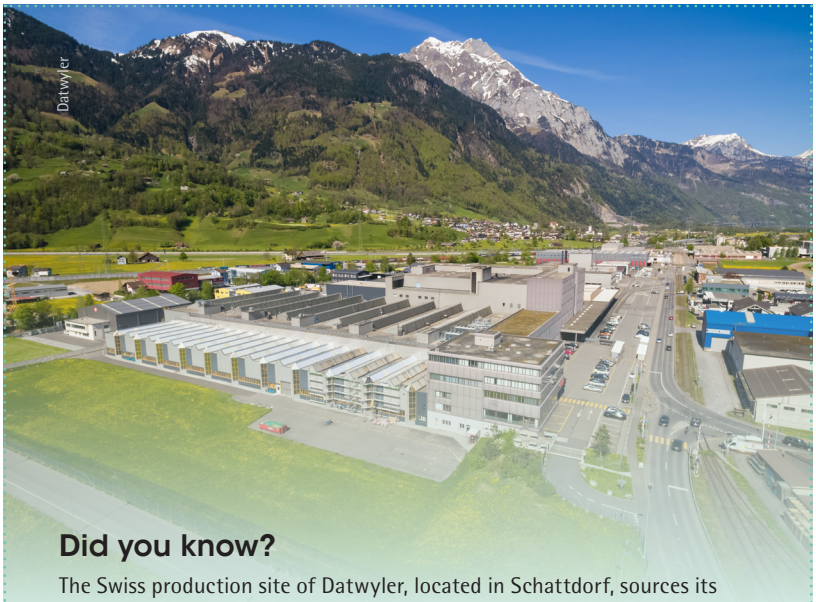
Below: Embedded electronics in elastomer components

from their storage tank to the exhaust system, the SCR technology requires parts that are based on specifically designed elastomer materials. These materials are exposed to and attacked by AdBlue.

Choosing suitable elastomer materials that withstand the aggressive urea solution poses a considerable technical challenge. This applies equally to the elastomer-to-substrate bonding that is often required for AdBlue or DEF applications. SCR systems use complex components with elastomer and elastomer-to-metal/plastic-bonded parts, tight tolerances and sophisticated geometries. Elastomer materials are available in different, tailored compositions, covering specific requirements, for example, temperature flexibility, internal lubricant, fibre reinforcements or diesel resistance. They must be successfully tested in extreme environments at peak temperatures of between 120°C and 150°C to ensure maximum resilience and long lifetime.

The demand and complexity of SCR technology will substantially increase in the coming years due to the following:

- The spray rate of AdBlue will increase, which will have an impact on durability, the performance of pumps and dosing modules.
- Fluid measurement will be added to the system features, to ensure correct media and its concentration.
- Production volumes of SCR systems will increase due to stronger legislation.
- Due to increasing requirements and additional system features, the number of elastomer components will further grow in the coming years.



Did you know?

The Swiss production site of Datwyler, located in Schattdorf, sources its electricity entirely from hydropower from power plants with 'nature made basic' certification belonging to the local electricity provider. The company says the resulting reduction in CO_2 emissions amounts to around 2,300t per year. Since 2008, heating comes from a nearby wood-fired plant, saving around 500,000 litres of heating oil a year and reducing annual CO_2 emissions by another 1,300t or so per year. A new closed cooling circuit for the mobility production facility delivers further reductions in water resources consumed. Datwyler has recently announced that it is setting carbon neutrality as a long-term target for the entire group, including more than 20 production sites on four continents.

Worth the Payne

Materials that are either renewable or from natural sources is a significant trend now. Recycled and reused materials or materials based on renewable sources can be used to create a compound in conjunction with other ingredients, and any proportion of a so-called 'green' material is a step forward where sustainability is concerned. Research is ongoing into using polymers synthesised from sugar cane and fillers based on rice skin, cellulose, or already recycled materials such as carbon black – a filler that gives a compound certain performance properties.

Usually produced with heavy mineral oils, the alternative in elastomer development is to reuse old tyres. They are burnt in a controlled environment, such as pyrolysis, so there are no harmful side products of the process, and then the remaining ash is used.

First, the carbon black that was originally in the tyre can be recovered. Second, the rubber is transformed into carbon black. These can either be used as they are or treated and used as a filler to a compound.

In the mobility sector, everything is standards driven, so variability needs to be minimal and the standard deviation in the processing and properties of the compounds must be very low, which means a high level of testing. To measure the effectiveness of using carbon black as a compound filler, the Payne effect is used to analyse the stress-strain behaviour of the compound and is a measure of filler networking originating from filler-filler and filler-polymer interactions and, as such, can provide information about the quality of the mixing process.

In addition to carbon black, if we take ethylene propylene diene monomer (EPDM) as an example, there are other avenues to explore to make this commonly used polymer more sustainable going forward. Studies are being undertaken to determine whether ethanol from renewable sources such as sugar cane, sugar beet, wheat grain etc. are viable, which would be dehydrated to make ethylene – the raw material used to make polyethylene to make EPDM.

Many more initiatives are ongoing across the industry. Even the smallest components can be more friendly to the environment and everything possible is being put into place to ensure that this is the case. It has never been more important to look at the bigger picture in terms of a sustainable future for the mobility sector, and by working in a collaborative manner the vehicles of the present and the future can contribute to tangible change at a global level.