Contribution to the stakeholder consultation held as part of the "Study for the review of the list of restricted substances and to assess a new exemption request under Directive 2011/65/EU (RoHS 2) – Pack 15".

Response to questions in
'ROHS Annex II Dossier for Indium phosphide. Restriction proposal for substances in electrical and electronic equipment under RoHS'

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About Lumentum

Lumentum (NASDAQ: LITE) is a market-leading manufacturer of innovative optical and photonic products enabling optical networking and commercial laser customers worldwide. Lumentum's optical components and subsystems are part of virtually every type of telecom, enterprise, and data center network. Lumentum's commercial lasers enable advanced manufacturing techniques and diverse applications including next-generation 3D sensing capabilities. Lumentum is headquartered in San Jose, California with R&D, manufacturing, and sales offices worldwide. For more information, visit www.lumentum.com.

Lumentum acquired Oclaro in December 2018 therefore, this response also includes contribution from the former Oclaro business.

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Questions for stakeholders participating in the stakeholder consultation:

2.3 Quantities of the substance used

Questions for stakeholders participating in the stakeholder consultation:
Though it can be understood that InP QD technology is expected to develop so as to enable "on chip" configurations in the future, the time frame for such developments and how this will influence InP QD to be placed on the EU market in the future is not clear:
1. Please provide estimations as to when InP QD "on-chip" configurations can be expected to become market ripe.
2. Please estimate the development of volumes of use of InP in display applications over the next 10 years. In this respect, please explain how this relates to the development of the distribution of displays to different configurations ("on layer", "on edge" and "on-chip") and to different display types (televisions, monitor, tablet, smartphone, etc.). If additional data shall not be received in relation to the future volumes of use of InP in QD display applications, it shall be assumed that:
1. The current growth rate of InP QD technology with a doubling of sold units every three years will continue over the next 10 years;
2. As further assumption, the specific amount of InP required per display will not decrease;
3. Resulting in approx. 600 kg (= 60 kg * 210/3) of InP used in display applications per year in Europe in 2028.

Questions for stakeholders participating in the stakeholder consultation:
Though it can be understood that InP QD technology in LED lighting products is expected to develop in the future, the prevalence of these products on the EU market is not clear. Therefore, stakeholders are requested to provide information or concrete figures on the following issues:
1. Please estimate the development of volumes of use of InP in lighting applications over the next 10 years. In this respect, please explain how this relates to the development of the distribution of lighting equipment to different configurations ("on layer", "on edge" and "on chip");
2. Please provide data on the specific amount of InP needed for lighting applications as compared to CdSe.
If additional data shall not be received in relation to the future volumes of use of InP in QD lighting applications, it shall be assumed that:
4. The market share of cadmium-based QDs in lighting applications, which was estimated with 5% in 2015 and causes a CdSe consumption of 8 kg, will be taken as a starting point;
5. As further assumption, the specific amount of InP is double the amount of CdSe; 6. By 2028, the market share for cadmium-based QDs in all lighting applications will be estimated to reach 80%, resulting in approx. ***256 kg*** *(= 8 kg * 2 * 80/5) of InP used in lighting applications per year in Europe.*

Photovoltaic applications

Questions for Stakeholders participating in the stakeholder consultation:

Though it can be understood that InP technology in photovoltaic applications is expected to develop in the future, the prevalence of these products on the EU market is not clear. Therefore, stakeholders are requested to provide information or concrete figures on the following issues:

1. Please estimate the development of volumes of use of InP in photovoltaic applications over the next 10 years. In this respect, please explain how this relates to the development of GaAs;

2. Please provide data on the specific amount of InP needed for photovoltaic applications.

Answer: Lumentum does not currently plan to use indium phosphide QD technology, nor photovoltaic applications of indium phosphide.

2.4. Potential for impacts of the substance on the environment and on health during the use of EEE

'(…) MMTA points out that the InP applied in optical communication devices is being managed by professional users in large facilities, e.g. data-centres. Therefore, MMTA considers any risks during use to be managed proficiently. MMTA is confident that only negligible amounts would come into contact with consumers. If glass fibre in residential applications would become more widespread, domestic premises might contain miniscule amounts (approximately 1 mg) of InP, but the telecommunications box would remain the property of the provider and would, therefore, be managed by them.'

Questions for Stakeholders participating in the stakeholder consultation:
Against this background, stakeholders are requested to provide contributions on possible emissions, their quantities as well as their hazard profile.

Answer: Lumentum concurs with the cited contributions, including that from MMTA regarding InP use in optical communication and has no further information to add.

5.3. Waste treatment processes relevant for assessment under RoHS

(Question is relevant to quantum dot technology waste treatment assumptions)

Questions for stakeholders participating in the stakeholder consultation:
Stakeholders are requested to comment on this assumption and to provide information if necessary.

Answer: Lumentum concurs with the cited contributions and assumptions and has no further information to add.

8.3. Data basis for alternatives and uncertainties

'Also alternative technologies (e.g. gas lasers / solid state lasers in optoelectronics (…)) can be considered, but are characterised to suffer significantly from reduced performance data, as well as higher energy consumption.'

Questions for stakeholders participating in the stakeholder consultation:
Further information as to additional substitutes for InP, their potential hazardousness and their applicability as substitutes in the wide array of InP-based application is sought.

Answer:

There really is no alternative to InP for the light wavelengths of 1.55µm and 1.3µm used in optical fibre communication systems.

It is the only known material suited for the wavelengths required in optical fibre communications. All non-semiconductor alternatives are totally impractical in terms of size, power dissipation and cost, and additionally they cannot be modulated at anywhere near the necessary Gb/s data rates. The use of gas or solid state lasers is totally impractical in terms of size, power dissipation and cost. On these factors they may be anything from 100 to 1000 times bigger than that of an InP laser.

Silicon photonics is complementary to InP, as it does not generate light. It is only suited for some applications and then only for modulation and detection. Silicon photonics still includes InP.

9. DESCRIPTION OF SOCIO-ECONOMIC IMPACTS

Questions for stakeholders participating in the stakeholder consultation:
In order to understand the socio-economic impacts of a potential restriction of indium phosphide in the various fields of applications as descried in section 2 (of the draft dossier), stakeholders are requested to provide information on the costs and benefits that can be associated with such a restriction of this substance in electrical and electronic substances under RoHS. Within this context, please make available quantitative data wherever possible. However, also qualitative information is considered to be helpful for the assessment of the socio-economic impacts.
The following table gives a structure for the requested contributions according to the different fields of applications as well as for the perspective of costs and benefits. Concerning the impacts, information should be distinguished and specified according to the following scheme as far as possible:

· *impact on EEE producers*
· *impact on EEE users*
Field of application Costs Benefits
Optoelectronics

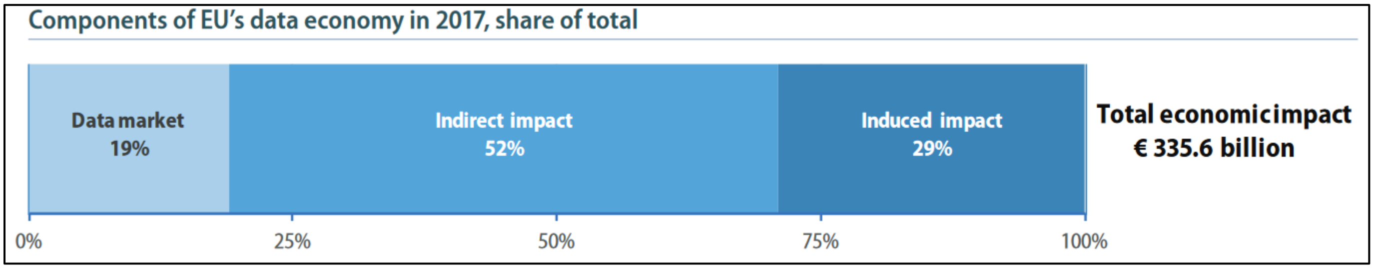
Answer:

Impact on EEE producers
Lumentum concurs with previous contributions on socio-economic impacts in the first consultation related to optoelectronics EEE producers (including Lumentum and the former Oclaro responses).

Impact on EEE users
The modern world is extremely reliant on optical fibre communications for data transfers. The value of the e-commerce and data economies is several trillion of USD. Examples can be seen in the valuations of the largest data firms compiled in UN publication in 2019 [1].
The fast near-instantaneous transfer of huge amounts of data is used by all industries, even those not in the data economy, the governments and research centres. Businesses use it to share data across multiple world-wide teams; banks use it for instantaneous financial transactions, etc.
Data-centres including those of the big data firms shift huge volumes of data within the data-centre and across the world. Both inside and outside the data-centre, data transfers rely on optical fibre communications and InP components.
Domestic users are also now heavily reliant on optical fibre communications (therefore InP) infra-structure to connect to the data centres - for shopping, for entertainment such as TV/video streaming, and electronic gaming, etc. The general industry consensus is that total data volumes per year have continually risen by ~30% each year, for several years, and are forecast to continue to do so.
In summary, the modern world is too reliant on InP technology and the optical fibre communication it enables. The world could not return to a pre-optical fibre communications state.

According to UN the total impact of the data market on the European Union's economy in 2017 was 335.6 billion euros, or 2.4 per cent of total GDP [1], as presented in the diagram below.

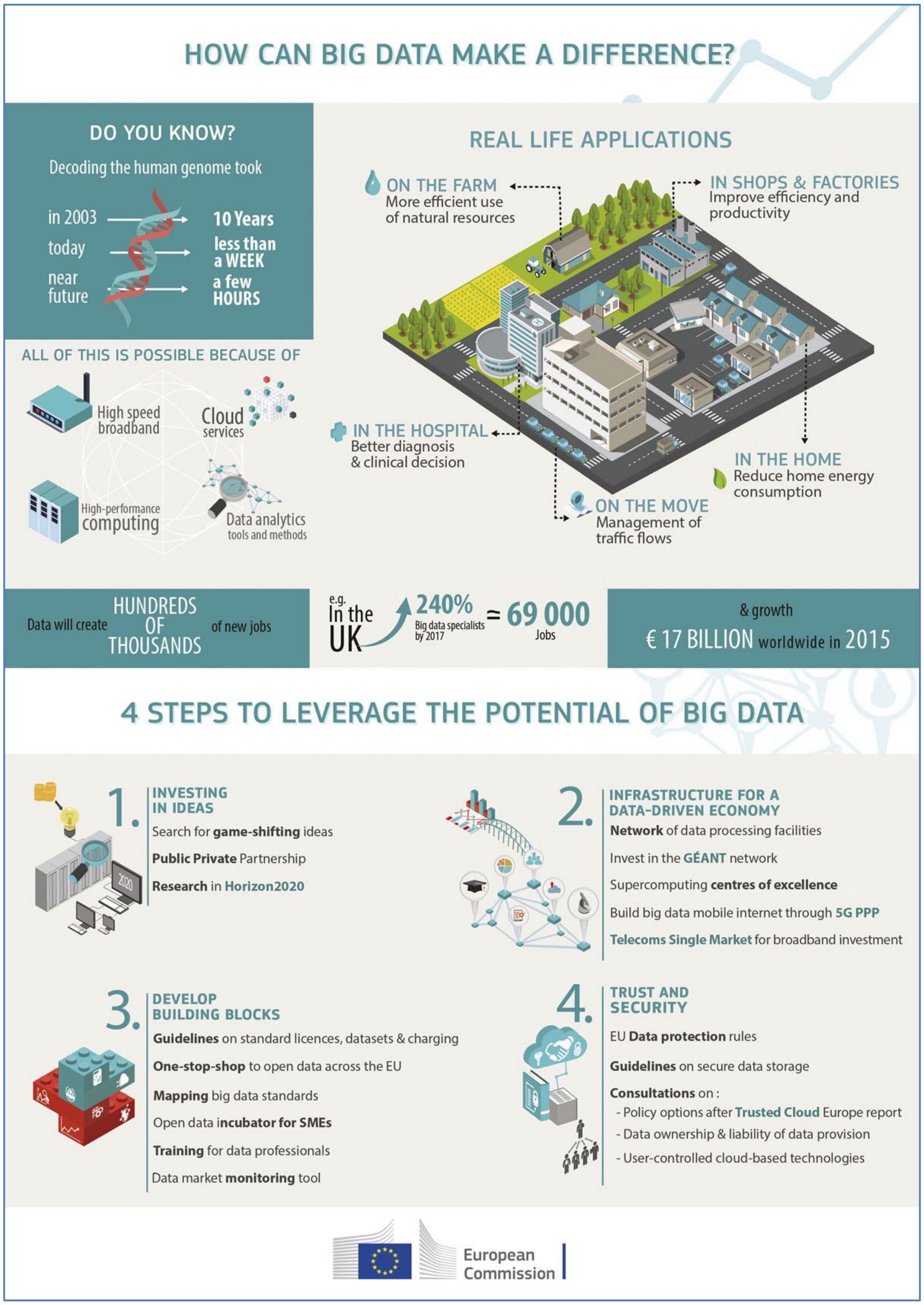
Figure 1: Components of EU’s data economy in 2017 [1]



Other European data market study [2] outlines figures for three scenarios of data market trends in the EU (baseline, high growth or challenge) which in turn illustrates potential for socio-economic loss by preventing the digital economy from growing, if InP use was banned. Depending on the scenario, without optical communication, the data market would not reach 27 to 107 billion Euro in the EU27 by 2025.

The European Commission’s infographic on socio-economic impact of big data, for which the supporting optical communication technology relies on InP based components, illustrates in the figure on the next page the potential for socio-economic loss by preventing the digital economy from functioning.

Figure 2: How Can Big Data Make A Difference? [3]



The EU appreciates the importance of optical fibre communications and has invested in extensive research and policy making to promote these technologies, which completely rely on InP components.

Abbreviations and Definitions

µm	Micrometer, in this context used a measurement of light wavelength.
Gb/s	Gigabit per second, a unit of data transfer rate.

References

[1] The United Nations ”Frontier Technology Quarterly”, January 2019 edition, p. 3, (2019, January). Retrieved from https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/FTQ_1_Jan_2019.pdf

[2] Giorgio Micheletti, Cristina Pepato (IDC), “D2.6 Second Interim Report. The European Data Market Monitoring Tool: Key Facts & Figures, First Policy Conclusions, Data Landscape and Quantified Stories. Update of the European Data Market Study SMART 2016/0063.” Prepared for the European Commission – DG CONNECT, pp. 10-12 (2019, June 28th). Retrieved from http://datalandscape.eu/sites/default/files/report/D2.6_EDM_Second_Interim_Report_28.06.2019.pdf

[3] European Commission, Digital Single Market, Policy: ‘Big data’, diagram: ‘How Can Big Data Make A Difference?’ (2018, April 25th). Retrieved from https://ec.europa.eu/digital-single-market/en/policies/big-data