United Nations Open Working group on Sustainable Development Goals
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Introduction.

The United Nations is collecting inputs for the definition of the post-2015 sustainable development agenda, which will include a number of Sustainable Development Goals (SDGs). This contribution is intended to advocate the importance of science for the sustainable development of society, and the need to integrate science into the main decisional processes concerning society, as well as in the SDGs.

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Science and society

As historical evidence shows, science and scientific knowledge have strong impacts on the social and economic growth of society. They allow fundamental knowledge to advance and they improve, via technology and innovation, the welfare of citizens.

Global challenges are social, economic and environmental in nature. To be successful they require **global strategies and global collaboration**, but also effective **local implementation**. Science permeates all aspects of development, at both global and local levels, thus contributing to the social and economic development of society. The benefits it generates are important for all countries, particularly **developing** economies.

Furthermore, science and the free dissemination of scientific knowledge foster dialogue among **cultures** and are instrumental in fostering **peaceful relations** between nations.

Science, education, technology and innovation

The term science is often associated with, or even used synonymously with research and development, R&D, the societal benefits of which are widely recognized. However, there is an important distinction to be made. R&D begins with the fruits of basic science – blue sky research that has the primary objective of increasing the sum of human knowledge – developing technologies that improve the lives of all: without science, R&D would grind to a halt. A more accurate term to employ might well be Science, Research and Development, S, R&D, since these three ingredients are all essential to progress, and they are linked by a **virtuous circle**: from basic science springs applied research and industrial development, which in turn delivers more powerful tools for basic science. This simple concept should become a mantra for anyone setting the science and technology agenda.

Another element, and one that encompasses the entire Science, Research and Development agenda, is **education** in general, but in particular in the areas of science, technology, engineering and mathematics: the so-called STEM subjects. This is the key to ensuring sustainable progress: **no effective research** would be possible without a steady supply of trained, competent researchers.

Investing in science

Basic science and scientific education are societal **long-term investments**: the return, which a glimpse at the historical record shows is usually forthcoming, normally comes on timescales far longer than the political cycle. In some cases, however, scientific advance

generates **disruptive innovation** with rapid and substantial return to society. Examples taken from the world of particle physics research include the **World Wide Web,** invented at CERN to allow scientists to exchange information and made freely available to the world, and **positron emission tomography (PET)**, in which CERN scientists, responding to the needs of the medical community, adapted particle physics technology for use in medical imaging.

Due to their nature, investments in STEM education and basic science - which today typically amount to roughly **one fifth** of the total money invested in R&D by the most virtuous countries - are not appealing for private investors. Like roads and railway lines, such investments should be considered as part of the basic infrastructure that allows an economy to thrive. Accordingly, it is the obligation of governments to assume the heavy responsibility of sustaining these investments over the long-term.

In the great majority of cases **public** money already sustains STEM education and basic scientific research, while **private** capital finances applied research and innovation. In this context governments have another important role to play: ensuring **coordination** and synergy between public and private investments.

Science has no borders, it thrives fully open and transparent collaboration, and sharing of information, but solutions to global problems also require understanding at local levels. In an era of big science, international scientific research is often a must, but it needs to be coordinated at a global level, with strong regional and national contributions. At both international and national levels, **developed and developing economies** should set up and implement policies and strategies aimed at ensuring:

- The availability of **qualified personnel** to carry out research.
- Effective research **infrastructures.**
- Good **governance** as well as a cultural research approach based on **sharing** and **Open Access** principles.

Governmental objectives and commitments for investments in R&D, typically fixed as a given **percentage of the GDP**, vary considerably from country to country and targets are frequently not met, even in rich countries. The return on investment depends on many factors, some of which are very local and related to the internal situation of the country and to its capability to interact and compete with the rest of the world. However, the notion that return is linked to investment is supported by evidence that countries with **high investment** in basic science and STEM education on the one hand, and applied research and development on the other, rank highly in innovation and competitiveness indices, and offer the **highest level of welfare** to their citizens.

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Messages to the Open Working Group and the United Nations

The definition of the UN post-2015 sustainable development agenda and related SDGs is a difficult and complex exercise necessitating a deep level of understanding among decision-makers covering a wide and heterogeneous field of subject matter, and coupled with the ability to bring many strands together to arrive at the right conclusions. This contribution is intended to provide some elements for reflection on the vital importance of science for society, and to propose possible concrete goals. In conclusion:

- **Science is vital for sustainable social and economic growth of society**. Science improves the welfare of people, builds capacity in developing economies, and fosters peaceful international co-operation between nations and cultures.

- STEM education, basic and applied research, and innovation are intimately linked and **must be treated together**. They constitute a virtuous circle that fuels the sustainable development of society.

- Effort is required from **all countries**, developed and developing, to invest in STEM education as well as Science, Research and Development in a culture of openness and transparency.

- STEM education and basic scientific research, essential for long-term development, need adequate **regular** investment from the **public purse**. Policies and strategies for the post-2015 agenda must account for this.

The various inputs collected by the UN during the present consultation phase will have to be condensed soon into a coherent sustainable development strategy. The Open Working Group and the United Nations might want to consider the following suggestions when deciding the UN Sustainable Development Goals:

- Regardless of how science is integrated into the UN sustainable development strategy, the SDGs should **explicitly** indicate a **minimum target** - expressed as a percentage of the GDP - for each nation's **global investment in science, research and development, and STEM education**. This would include all **public and private** investments.

- To ensure continuity and long-term development, the SDGs should also **explicitly** indicate a **specific target** – within the global target - for each nation's investment in **STEM education and basic science,** guaranteed from the **public purse**. This is particularly important in times of economic downturn, when private funding naturally concentrates on short-term returns.

  Now – more than ever – basic research is needed to chart the course forward.

CERN, the European organization for Nuclear Research

CERN (www.cern.ch) is an intergovernmental Organization with seat in Geneva, Switzerland, and premises that sit astride the Swiss-French border near Geneva. It was founded 60 years ago by twelve European Countries. Today it counts twenty Member States, which will soon increase with the planned adhesion of some European and non-European countries. The yearly budget amount to ~ 1.1 bn US$.

CERN personnel consists of about 2300 staff and 1000 other collaborators (students, researchers on temporary contracts) paid by CERN, as well as of more than 11000 researchers, representing about 100 different nationalities, on the payroll of national institutions from approximately 75 countries.

The Convention of CERN explicitly prohibits any activity concerned with "… work for military requirements", and prescribes that the results of any theoretical or experimental work carried out at CERN be published or made generally available to the scientific community and to the general public. CERN is very active in promoting Open Access.

*During its 60 years of life CERN carried out a number of scientific programmes with fundamental breakthroughs in particle physics. The most recent major CERN achievement is the discovery in 2012 of the **Higgs boson** at its Large Hadron Collider (LHC), a 27 km-circumference proton-proton superconducting ring that is the most powerful particle accelerator in the world.*

*To accomplish its scientific programmes, the Organization is intensely involved in **technology and innovation**, as well as in **education**. Every year it receives and trains hundreds of students, both theoretically and "on the job", as well as more than one thousand high-school teachers from both Member and non-Member States.*

*CERN is a concrete example of international co-operation with strong links to national research institutions/agencies. It contributes to accelerating **knowledge,** but also to make the society profit of the innovation deriving from its activities, including for non-Member States. Its way to develop science without borders allows creating **bridges between cultures**, and fostering **peaceful co-operation** among people and countries.*