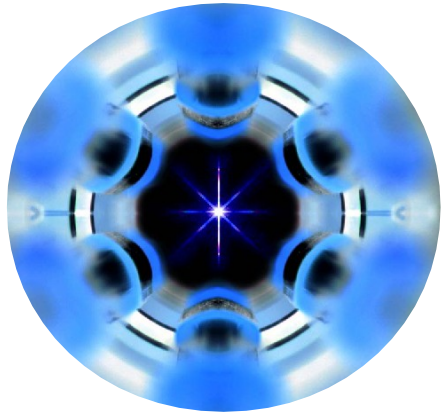
Justification for an AfLS CDR

11th October 2021

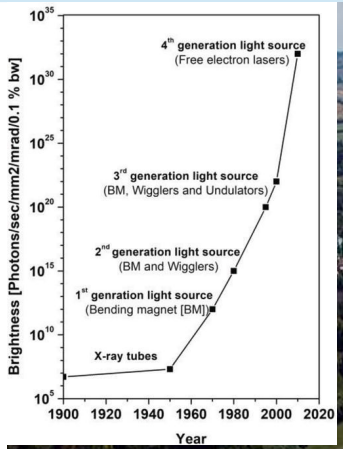
Dr Marcus C. Newton

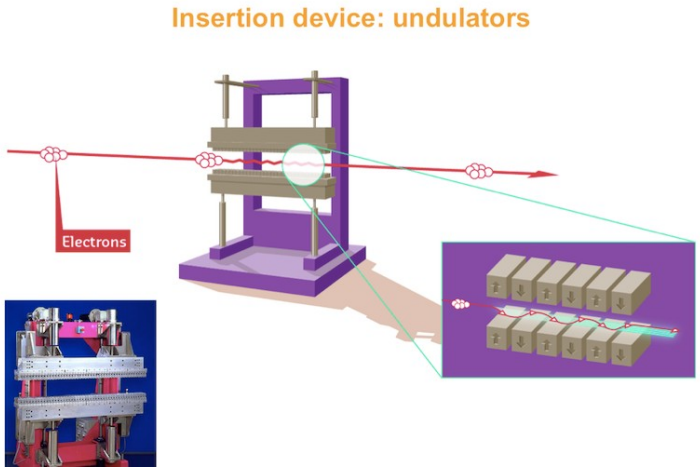
UNIVERSITY OF Southampton

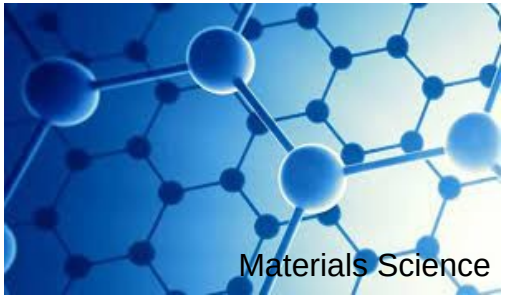
- Justification for an AfLS.
- Justification for a CDR.

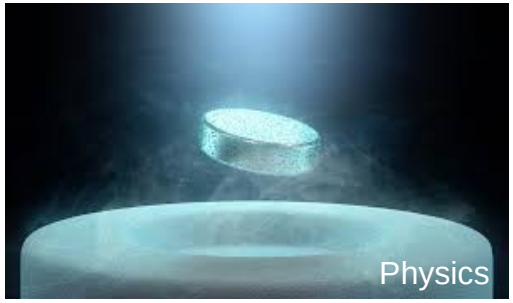


- Powerful source of X-rays.
- Accelerated and stored electrons used to produce synchrotron radiation.
- IDs distributed at multiple beam lines for experiments.





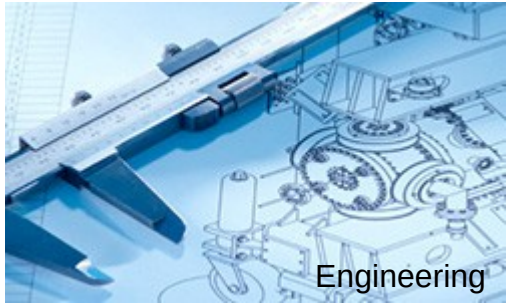

Materials Science


Physics


Chemistry

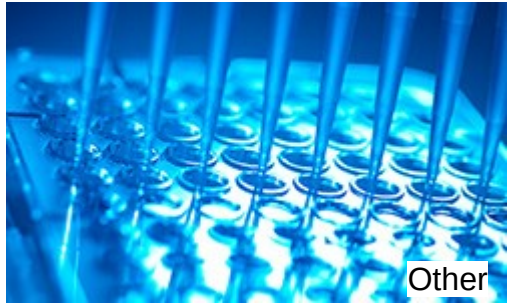

Environmental Science


Life Sciences


Engineering


Cultural Heritage

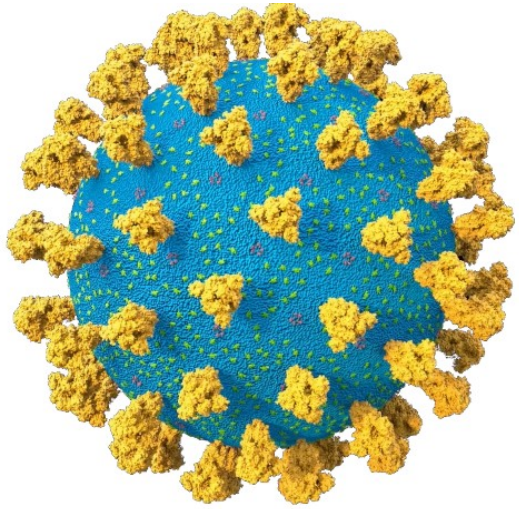

Earth Science


Other

- Structural information helps to elucidate function, the mechanisms of enzymes; inspires the design of new drugs.

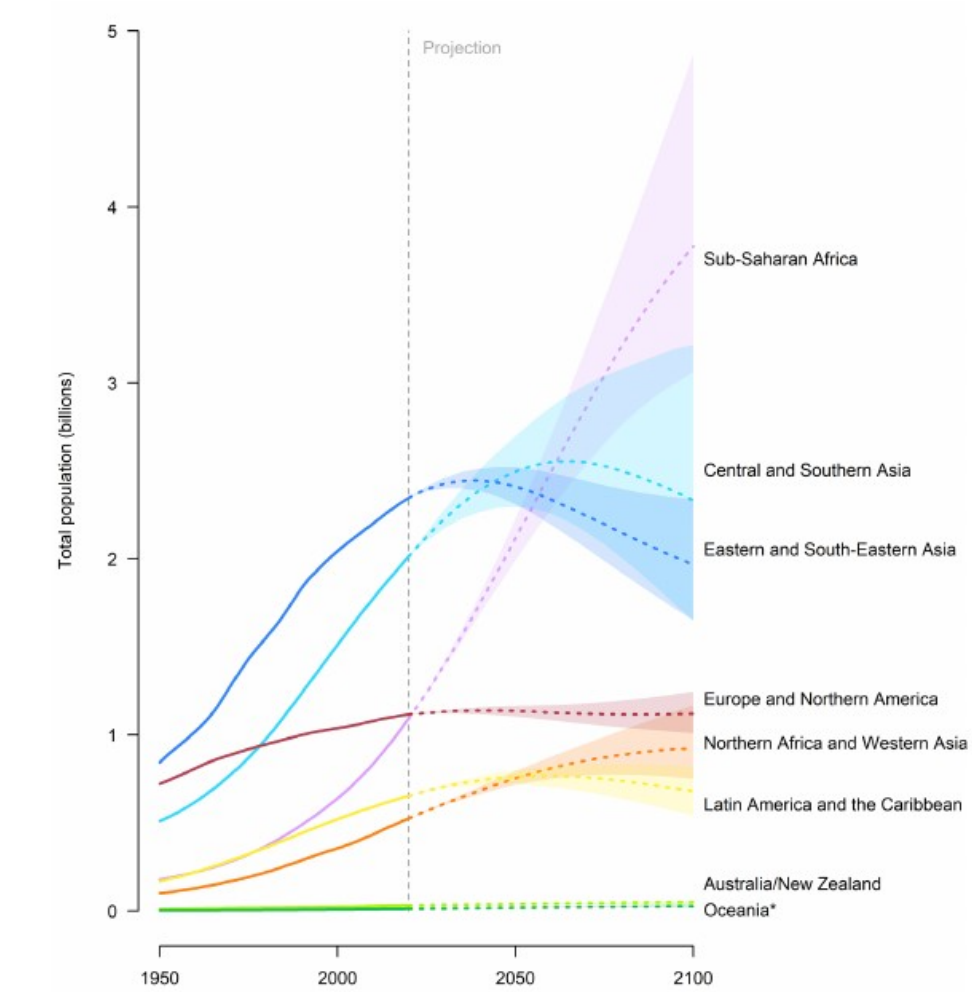
- An African Synchrotron will enable Africa to take ownership in developing cures for diseases of particular relevance.

- Synchrotrons are indispensable for imaging of viruses and bio-molecules:
  - Development of COVID-19 vaccine [Jin 2020].
  - Development of 210 new drugs that depended on protein structural information [Westbrook et al. 2019].
  - Development of drugs for treating HIV-AIDS, [Wlodawer et al. 1998].
  - Development of new treatments for tuberculosis [Blundell 2017a].
  - Interplay between academia and industry [Blundell 2017b].



Where can we find synchrotron facilities?

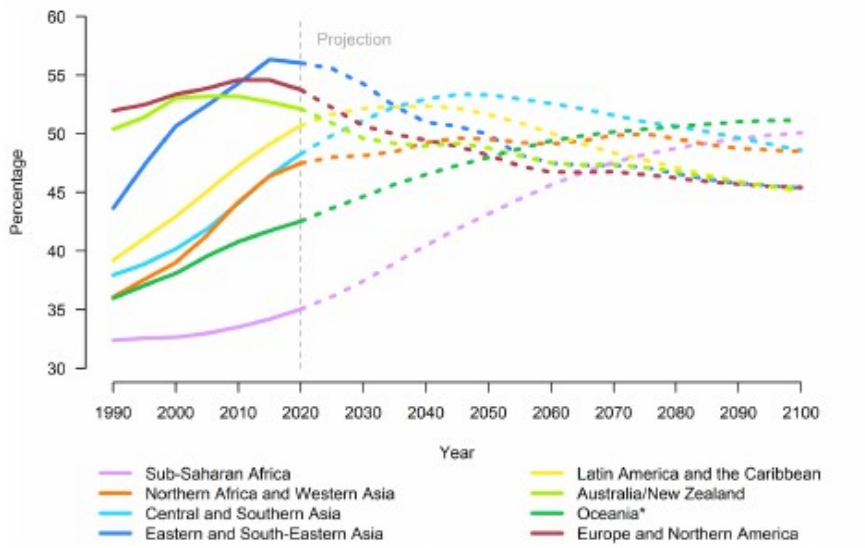
ALBA
ALS ADVANCED LIGHT SOURCE
Argonne NATIONAL LABORATORY
Australian Synchrotron
HZB Helmholtz Zentrum Berlin
Canadian Light Source
CHESS CORNELL HIGH ENERGY SYNCHROTRON SOURCE
diamond
Elettra Sincrotrone Trieste
ESRF The European Synchrotron
LNLS
MAX IV
BROOKHAVEN NATIONAL LABORATORY
NSRRC
PAL POHANG ACCELERATOR LABORATORY
DESY.
HZDR HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF
SOLARIS NATIONAL SYNCHROTRON RADIATION CENTRE
SLAC NATIONAL ACCELERATOR LABORATORY
SESAME
SYNCHROTRON THAILAND CENTRAL LAB
PF Photon Factory
Institute of Materials Structure Science
High Energy Accelerator Research Organization,KEK
PAUL SCHERRER INSTITUT PSI



Data source: United Nations, Department of Economic and Social Affairs, Population Division (2019).

Figure 11. Estimated and projected percentage of population aged 25-64 years by SDG region, 1990-2100, according to the medium-variant projection

An increasing proportion of population in the working ages is presenting an opportunity for a demographic dividend in some parts of the world

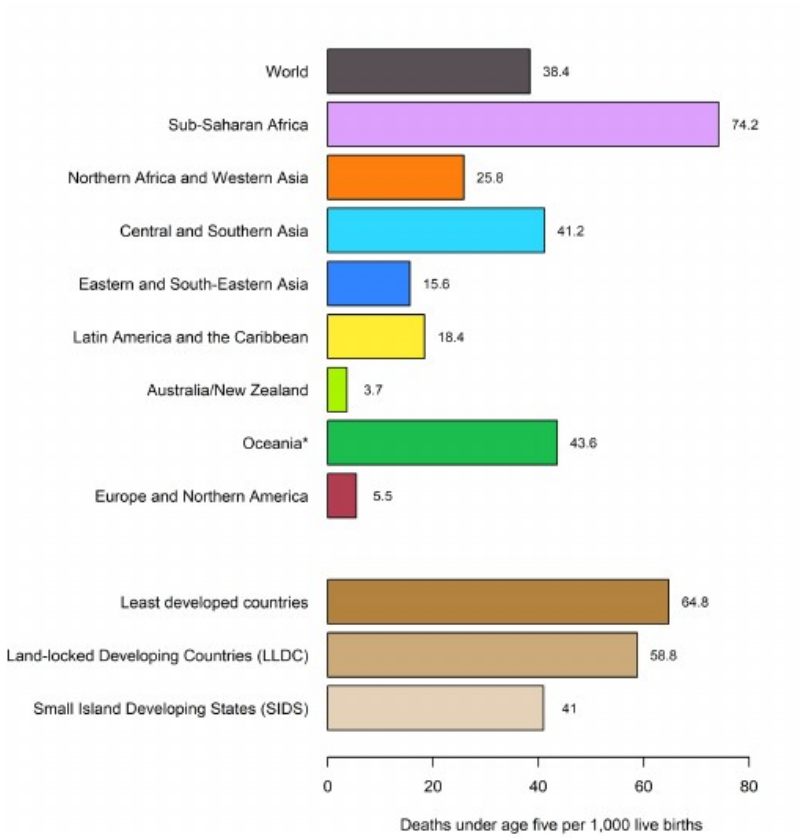


More than half of global population growth by 2050 will happen in Africa.

Urgent need for human capacity building.

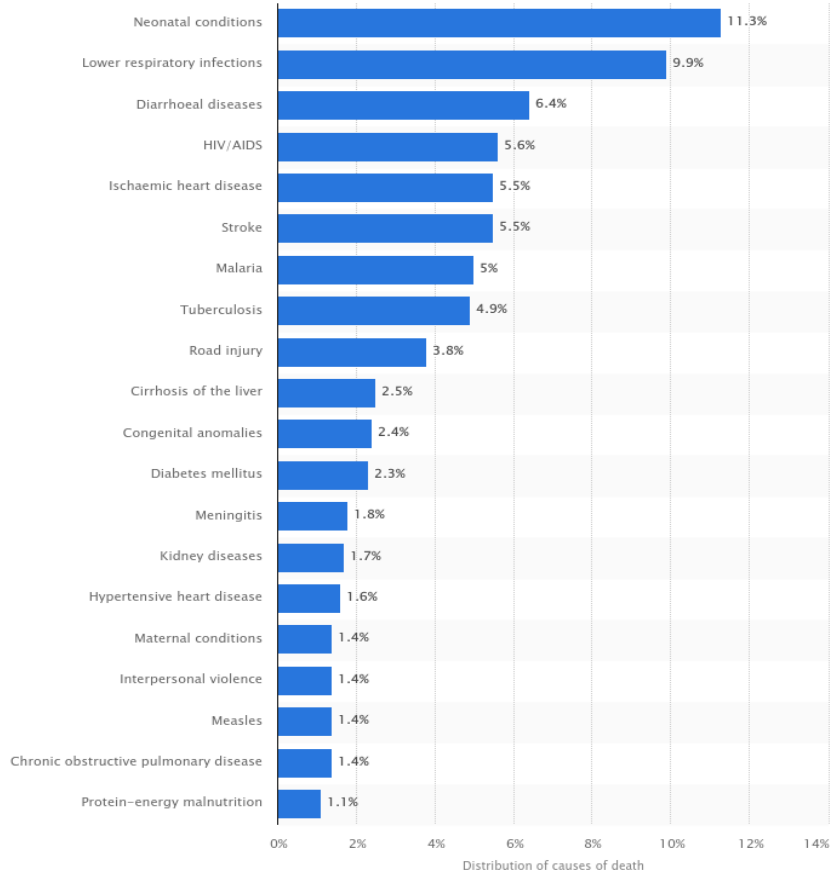
Figure 21. Under-five mortality rate for the world, SDG regions and selected group of countries, 2019

A child born in sub-Saharan Africa is 20 times as likely to die before his or her fifth birthday as a child born in Australia/New Zealand

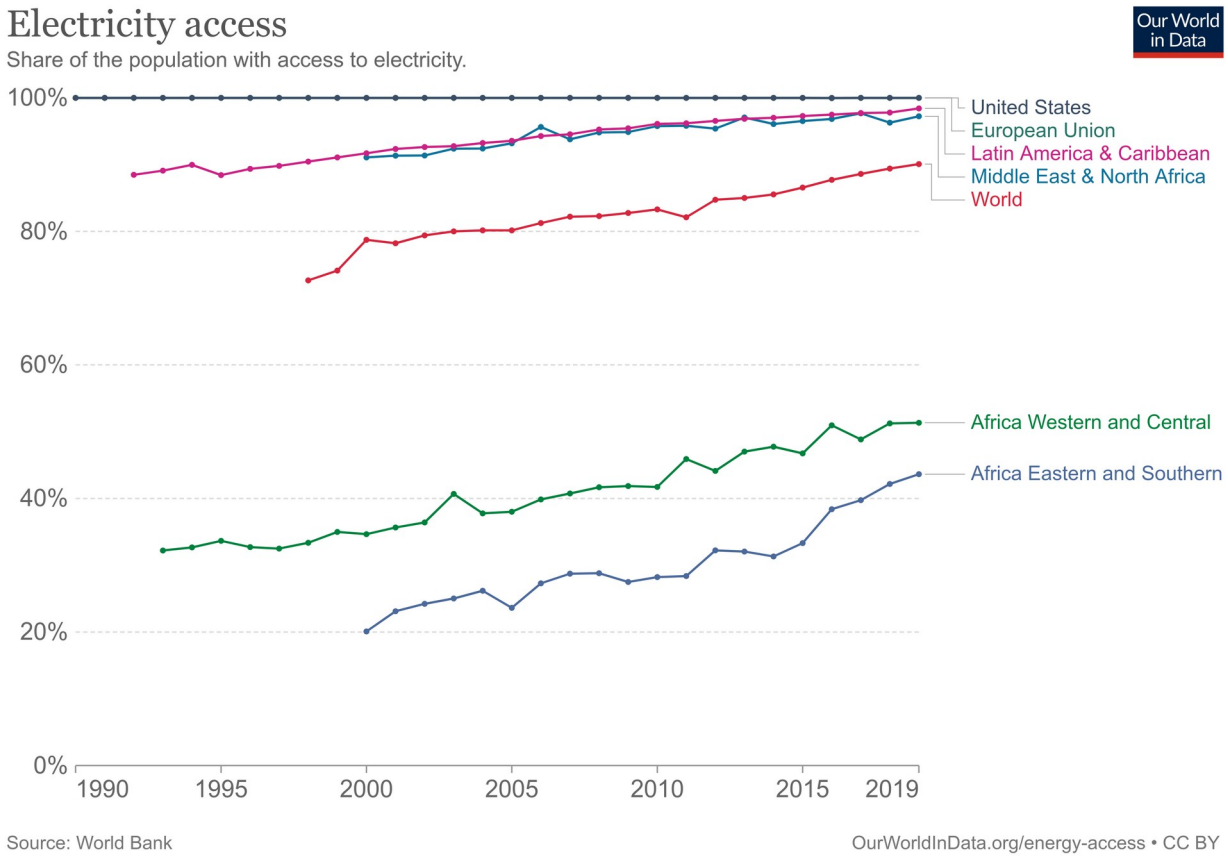


Data source: United Nations, Department of Economic and Social Affairs, Population Division (2019). *World Population Prospects 2019.*
* excluding Australia and New Zealand

Distribution of the leading causes of death in Africa in 2019



Data source: United Nations, Department of Economic and Social Affairs, Population Division (2019).



"Electricity is crucial for poverty alleviation, economic growth and improved living standards."

https://www.un.org/sustainabledevelopment/energy/
https://ourworldindata.org/energy-access

- Autonomy in Tackling such as disease & water/food security:
  e.g.: COVID-19, Malaria, TB, Aids, Ebola, …
  e.g.: Okra, Baobab, Fonio (Digitaria genus), ...
  Decode COVID-19 enable vaccine development.
  Accelerate research into super plants to address food crisis.

- Science for Peace:
  Encourages cooperation between all African countries through common interests and goals.

- Skills development through training:
  Doctoral training centres, beamline operators, software development, data processing, conferences, teacher training, open day visits from public.

- Return of the African Science Diaspora:
  Reverse the brain drain with new opportunities for scientists, engineers, … Attract foreign involvement.

- Boost economic growth:
  ”For every £1 invested, £2.5 is generated”,
  Prof Andrew Harrison, CEO Diamond Light Source.

- Engagement with industry:
  - Access for existing SMEs.
  - Growth of existing and development new SMEs / industries.
  - Catalyst for Pan-African pharma’ industry, high tech industry, etc...

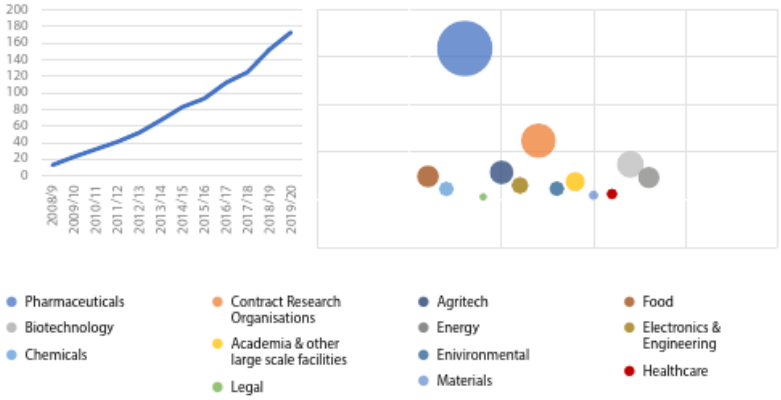


Figure 6-2: (left) Number of industrial organisations using Diamond via the industrial proprietary access route. (right) Graphical representation of the customer base using the industrial services at Diamond. Diamond Light Source Industrial Liaison Office.

- Investment & Job creation:
  Attract international investment.
  Uptick in skilled working force.

- Boost African Scientific Research:
  - Uplift in research capacity; African Science Renaissance.
  - Increased exposure to/collaboration with global research community.
  - Unique African research opportunities attracting international collaboration: Energy opportunities, African Environment, Cradle of Humankind, Cradle of Culture, Mineral beneficiation, Agriculture.

- Further skills development in Synchrotron and related sciences.

- Wealth of publications and patents:
  - Improve the international standing of African scientists. Uptick in Accolades, e.g. Nobel prizes.
  - Equitable Pan-African patent system crucial also for stable economic growth and innovation.

- SESAME Synchrotron facility:
  - Just like CERN, SESAME has was founded on the vision to increase international cooperation between scientists in a conflict-affected region.
  - Vision first promoted by Nobel Prize winner Abdus Salam.
- Phases of Development:
  - Identification Phase (1980s-1999): General promotion of vision and search for support)
  - Institutionalisation Phase (1999-2008): Inauguration of the Council of SESAME; UNESCO research status; Construction.
  - Maturity Phase (2008-2017): Commissioning; First light (2009); Further investment;
- Ongoing activities (beyond beamtime):
  - Training in accelerator physics, beamlines, scientific applications, ...

SESAME

The current Members of SESAME are Cyprus, Egypt, Iran (Islamic Republic of), Israel, Jordan, Pakistan, Palestine, and Turkey.

www.sesame.org.jo

- Blueprint for a African Synchrotron facility. Criteria for site selection.
- Enable Africa to speak with one voice on:
  - What is needed; when it is needed; where it is needed and why.
  - The design(s) of a Pan-African synchrotron facility.
- Science Case to outline:
  Scientific, Socio-Economic, Educational and Political Benefits.
- Receive input from African scientists of all relevant disciplines, industry, African policy makers and International scientists.
- Enable constructive dialogue with its intended audience, including:
  - Policy makers, politicians, academics, engineers, technicians, business persons, industrialists, financiers, strategic thinkers, all possible stakeholders and stakeholder organisations
  - The general public.