

Green ILC and the UN Sustainable Development Goals

Towards implementing the United Nations Sustainable Development Goals in the planning of new accelerators for high energy physics

**SUSTAINABLE
DEVELOPMENT GOALS**

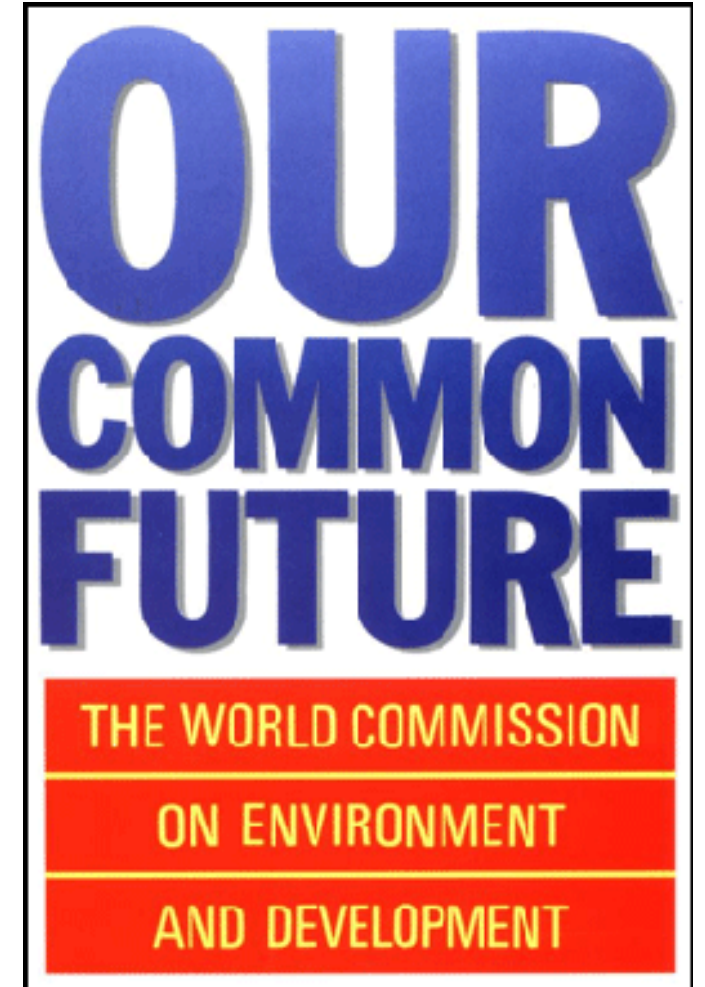
Sustainability: Definition

Development that meets the needs of current generations without compromising the ability of future generations to meet their needs and aspirations.
(WCED, 1987)

WCED (World Commission for Environment and Development)
(1987) *Our Common Future*, Oxford University Press, Oxford.



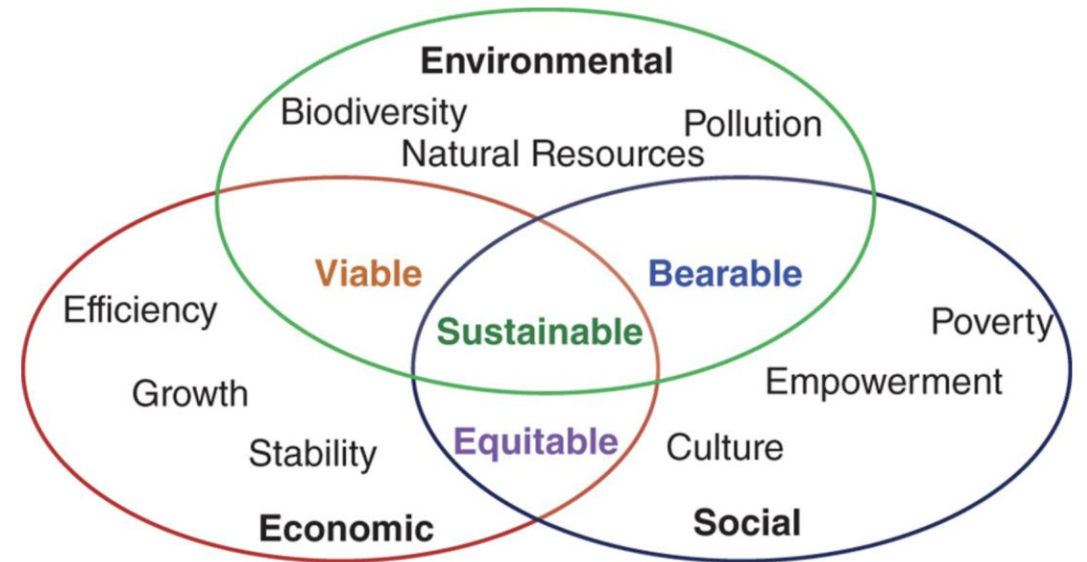
Gro Harlem Brundtland at WEF 1989
© WEF, CC-BY-SA-2.0



Cover of the "Brundtland Report" 1987

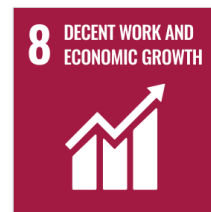
The Three Pillars of Sustainability

- Sustainability encompasses
 - Environment
 - Economy
 - Society
- Note: Lifecycle Assessment (LCA) explicitly addresses only environment



R.Y. Surampalli et al. (eds), Sustainability. Wiley 2020.

SUSTAINABLE DEVELOPMENT GOALS



1 No Poverty

1 NO
POVERTY



UN SDG 1: End poverty in all its forms everywhere

- Target 1.2: By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions

- Most difficult SDG goal for us to contribute

2 Zero Hunger

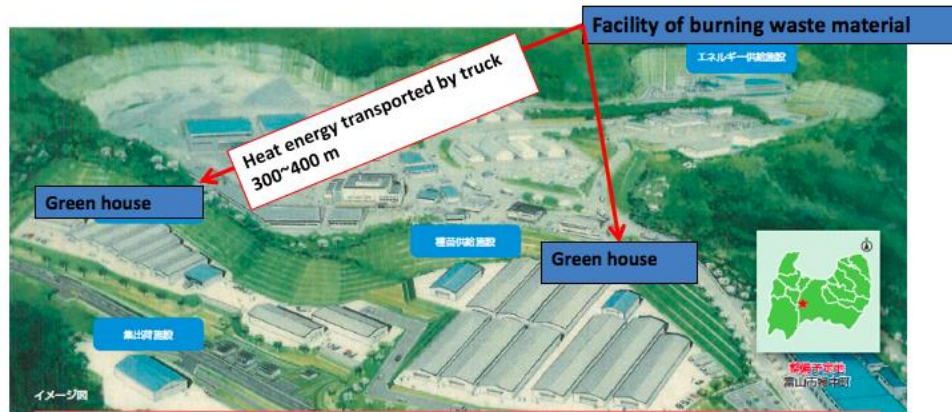
2 ZERO HUNGER



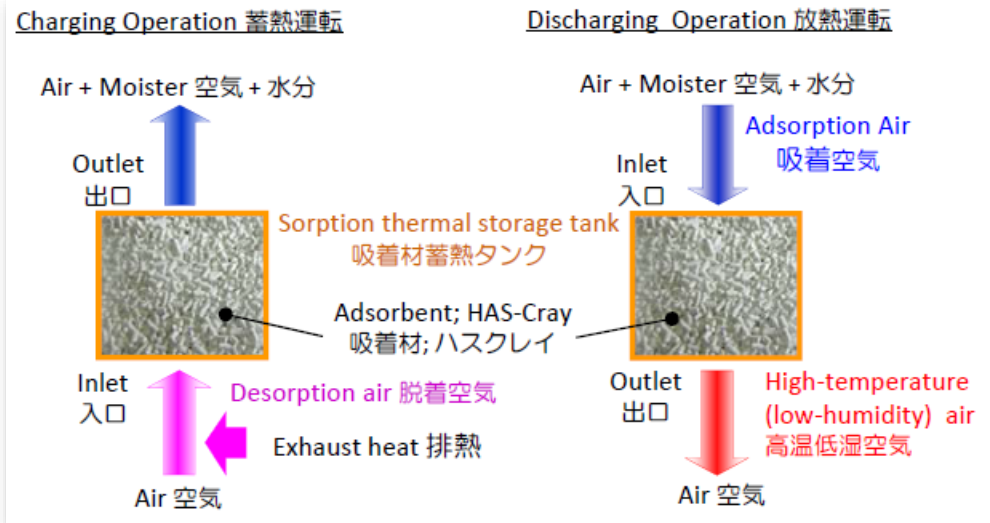
UN SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture

- **Target 2.3:** By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment
 - **Target 2.4:** By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality
- Collaborate with local farmers, forestry and fisheries to utilize waste heat for improved productivity
 - Example: HASClay®: Transport „heat“ by means of special clay
 - Proposal: Set up a dedicated project / collaboration with local agriculture bodies for agricultural use of process heat
-> could also affect/balance CO2 emissions

Reminder: HASClay[®]



- Use low-grade heat to dry clay
- Transport clay
- Generate warm, dry air by adding moisture
- Candidate to transport and store(!) low grade process heat for agricultural applications



See

https://doi.org/10.5571/syntheng.9.3_155

And presentation J. Sawai at LCWS2016 (Morioka)

<https://agenda.linearcollider.org/event/7371/contributions/38064>

3 Good Health and Well-Being

3 GOOD HEALTH
AND WELL-BEING



UN SDG 3: Ensure healthy lives and promote well-being for all at all ages

- **Target 3.9:** By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination

- **Proposals:**
 - Establish rigorous measures to reduce use of toxic chemicals
 - Establish LCA methods with respect to eco toxicity etc
 - Develop procurement guidelines that demand sustainable production of goods acquired, including raw material certificates

4 Quality Education

4 QUALITY
EDUCATION



UN SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

- **Target 4.7:** By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development
- **Target 4.b:** By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries

• Proposed Measures:

- Build a global community at the ILC Laboratory
- Bring together foreign guest and local population
- Build international nurseries, schools where international and local people mix
- Provide exchange programs, fellowship programs etc
- Invite people from developing countries

5 Gender Equality

5 GENDER
EQUALITY



UN SDG 5: Achieve gender equality and empower all women and girls

- **Target 5.5:** Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life

- Proposed Measures (ILC Lab):
 - Have affirmative action hiring policies for ILC lab
 - Implement special programs to attract female students and scientists

6 Clean Water and Sanitation

6 CLEAN WATER
AND SANITATION

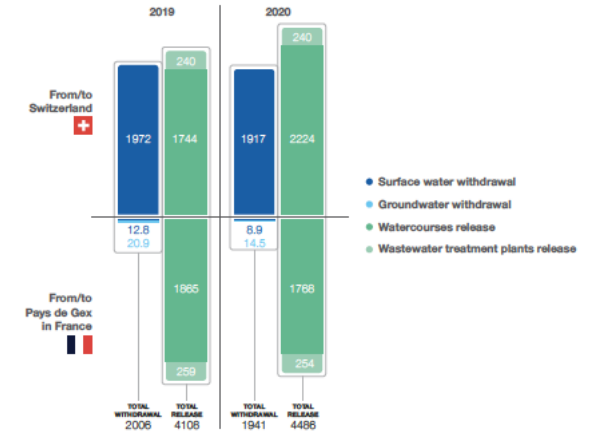


UN SDG 6: Ensure availability and sustainable management of water and sanitation for all

- **Target 6.3:** By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
 - **Target 6.4:** By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
- CERN: Monitors water withdrawal and consumption
 - Proposed Measures:
 - ILC: Manage tunnel water, use it carefully (cooling, irrigation, ...)
 - Introduce rigorous limits on pollution

CERN water management

- Water use reported in environment report



WATER MEASUREMENTS IN THE ALLONDON.

7 Affordable and Clean Energy

7 AFFORDABLE AND
CLEAN ENERGY



UD SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all

- **Target 7.2:** By 2030, increase substantially the share of renewable energy in the global energy mix
- **Target 7.3:** By 2030, double the global rate of improvement in energy efficiency

- Proposed Measures:
 - Cooperate with power companies to build renewable energy sources
 - Make all buildings / civil engineering facilities energy efficient
 - Use geothermal energy from tunnels
 - At ILC: Can we extract hydro power from tunnel water?

8 Decent work and economic growth

8 DECENT WORK AND
ECONOMIC GROWTH



UN SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

- **Target 8.2:** Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors

- Proposed Measures:
 - Foster Cooperation with local industry
 - Establish technology transfer center
 - Create business parks

9 Industry Innovation and Infrastructure

9 INDUSTRY, INNOVATION
AND INFRASTRUCTURE



UN SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

- Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all
- Target 9.2: Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries
- Target 9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities
- Target 9.5: Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending

- Proposed Measures:
 - Create model living quarters for int'l guest scientists, free shuttles / transport systems
 - Install procurement guidelines to encourage sustainable sourcing
 - Cooperate with industry to increase sustainability in the production chain
 - Invite / encourage participation from developing countries

10 Reduced Inequalities

10 REDUCED
INEQUALITIES



UN SDG 10: Reduce inequality within and among countries

- **Target 10.2:** By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status
 - **Target 10.4:** Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality
 - **Target 10.6:** Ensure enhanced representation and voice for developing countries in decision-making in global international economic and financial institutions in order to deliver more effective, credible, accountable and legitimate institutions
- **Proposed Measures:**
 - Have affirmative action hiring policies for ILC lab
 - Implement special programs to attract students and scientists from developing countries
 - Liaise with UN bodies in Geneva
 - Use spare cryo modules to create XFEL as science outpost in developing country (a la SESAME)

11 Sustainable Cities and Communities

11 SUSTAINABLE CITIES
AND COMMUNITIES



UN SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable

- Target 11.2: By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons
- Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries
- Target 11.4: Strengthen efforts to protect and safeguard the world's cultural and natural heritage
- Target 11.a: Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning

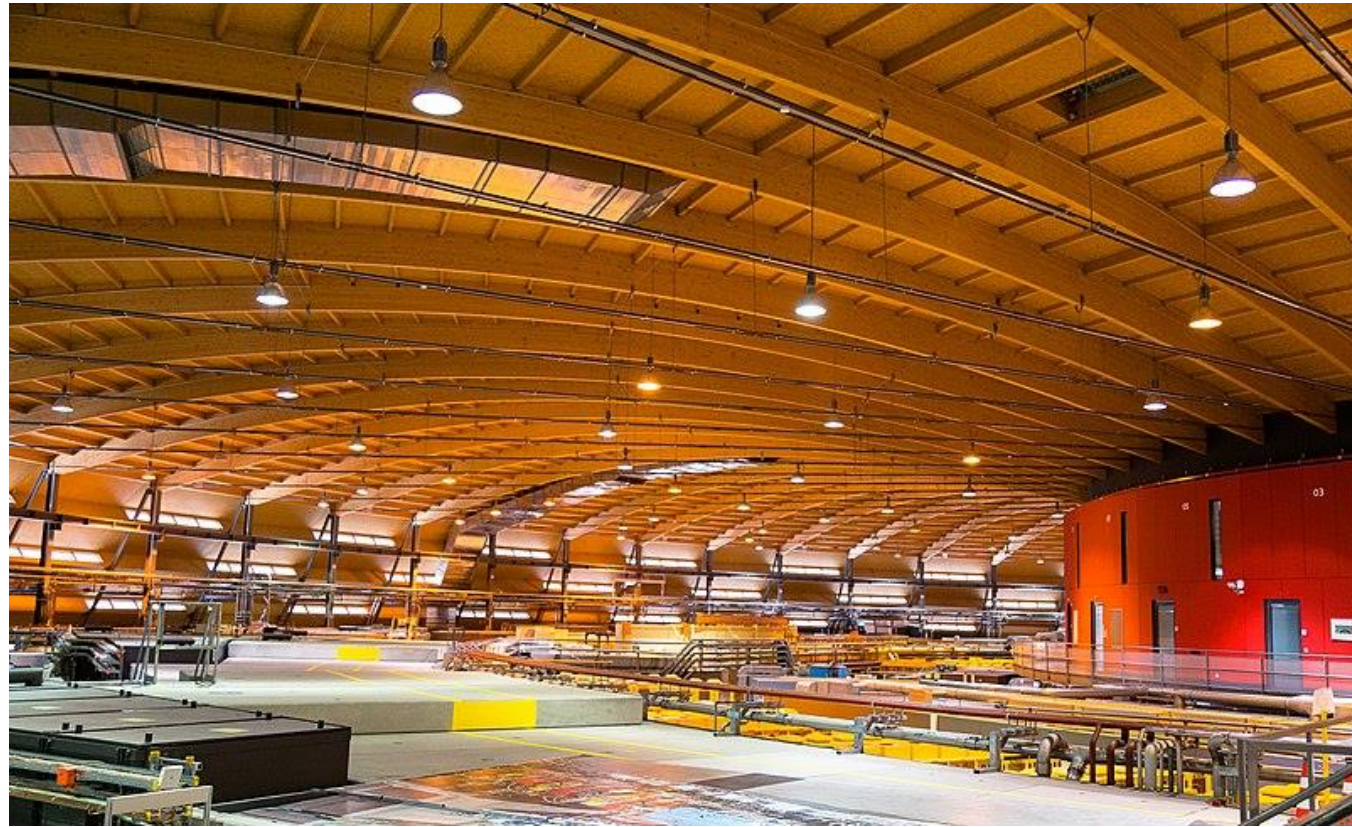
- Proposed Measures:
 - Create model living quarters for int'l guest scientists, free shuttles / transport systems
 - Japan: Ensure accelerator buildings integrate with nature, do not disturb sight from temples etc
 - Use wooden structures for buildings

Example: SLS Wooden Roof

Swiss Light Source uses wooden roof with
50m wide wooden beams



PSI,
https://commons.wikimedia.org/wiki/File:Luftbild_PSI_Mai_2016.jpg



CC-BY-3.0 Ryan Bodenstern,
https://commons.wikimedia.org/wiki/File:Sls_At_Psi_Wooden_Roof_%28248229497%29.jpeg

12 Responsible Consumption and Production

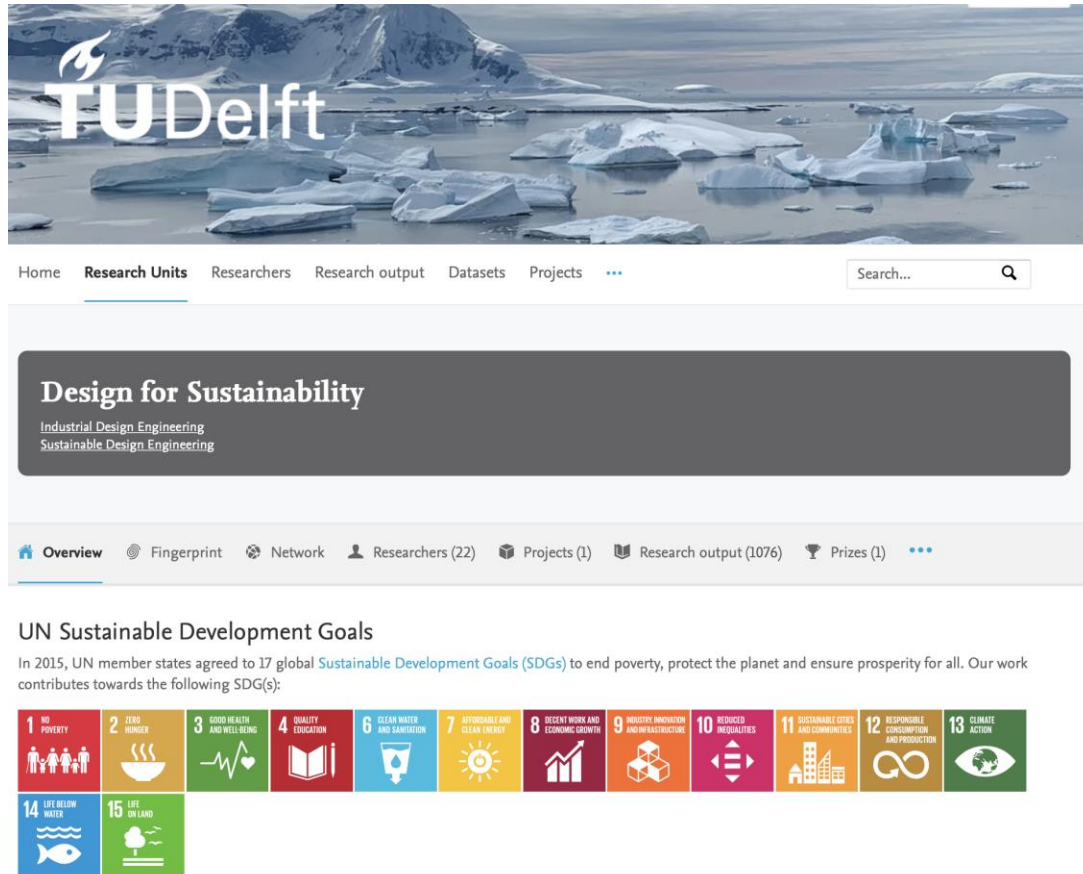


UN SDG 12: Ensure sustainable consumption and production patterns

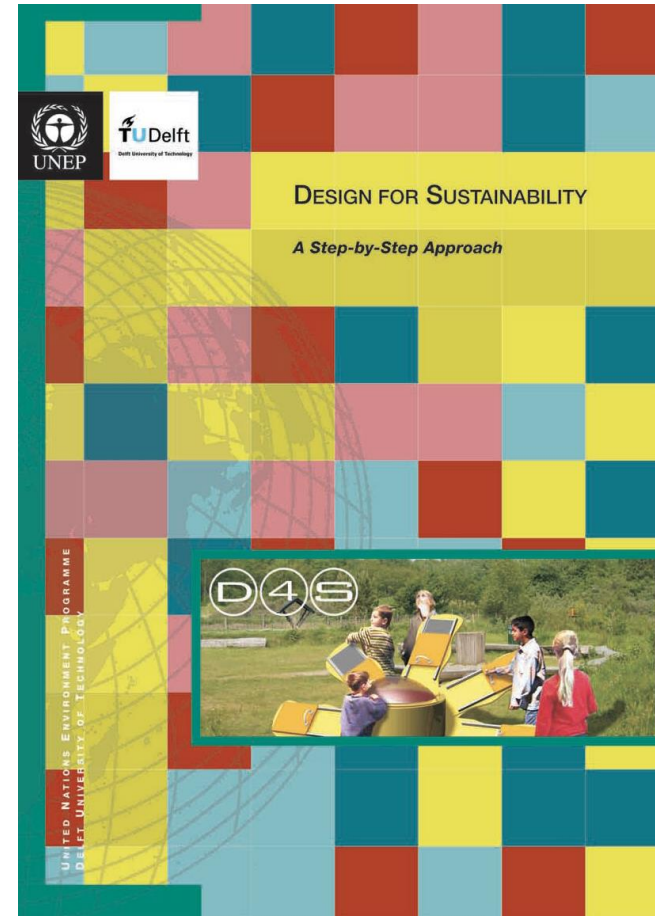
- Target 12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment
- Target 12.5: By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse
- Target 12.6: Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle
- Target 12.7: Promote public procurement practices that are sustainable, in accordance with national policies and priorities
- Target 12.8: By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature

- Proposed measures:
 - Again: Procurement policy
 - Set up sustainability awareness programs in the labs, educate engineers and physicists: design for sustainability

D4S: Design for Sustainability



The screenshot shows the TU Delft website for the Design for Sustainability research unit. The header features the TU Delft logo and navigation links: Home, Research Units, Researchers, Research output, Datasets, and Projects. A search bar is located on the right. Below the navigation is a dark grey banner with the text "Design for Sustainability" and sub-categories "Industrial Design Engineering" and "Sustainable Design Engineering". A secondary navigation bar includes "Overview", "Fingerprint", "Network", "Researchers (22)", "Projects (1)", "Research output (1076)", and "Prizes (1)". The main content area is titled "UN Sustainable Development Goals" and includes a paragraph: "In 2015, UN member states agreed to 17 global Sustainable Development Goals (SDGs) to end poverty, protect the planet and ensure prosperity for all. Our work contributes towards the following SDG(s):". Below this text is a grid of 17 SDG icons, with the first two (No Poverty and Zero Hunger) highlighted in a darker shade.



The image shows the cover of the book "Design for Sustainability: A Step-by-Step Approach". The cover features a colorful grid pattern in shades of teal, yellow, and red. In the top left corner, there are logos for UNEP and TU Delft. The title "DESIGN FOR SUSTAINABILITY" is prominently displayed in the center, with the subtitle "A Step-by-Step Approach" below it. At the bottom, there is a photograph of a group of people gathered around a large, colorful, spherical object, possibly a piece of art or a design model. The D4S logo is overlaid on the photograph. On the left side of the cover, there is vertical text: "UNITED NATIONS ENVIRONMENT PROGRAMME" and "DELFT UNIVERSITY OF TECHNOLOGY".

<https://research.tudelft.nl/en/organisations/design-for-sustainability>

13 Climate Action

13 CLIMATE ACTION



UN SDG 13: Take urgent action to combat climate change and its impacts

- Target 13.2: Integrate climate change measures into national policies, strategies and planning
 - Indicator 13.2.2: Total greenhouse gas emissions per year

- Proposed Goal:
- Make Operation of ILC / CLIC CO2 neutral!
 - Use power exclusively from regenerative energy sources
- Further Proposed Measures:
 - Minimize GHG emissions over whole lifecycle of project:
 - Make LCA of project, key components, civil structures etc

14 Life Below Water



UN SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

- Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
 - Indicator 14.1.1: (a) Index of coastal eutrophication; and (b) plastic debris density
- Target 14.4: By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics

- Proposed Measures:
 - Waste water management
 - Japan: collaborate with fish industry to use excess heat for fresh water aquatic fish production

15 Life On Land

15 LIFE ON LAND



UN SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

- Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements
 - Indicator 15.1.1: Forest area as a proportion of total land area
 - Indicator 15.1.2: Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type
- Target 15.2: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally
- Target 15.3: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world

- Target 15.4: By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development
- Target 15.5: Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species
- Target 15.9: By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts

• Proposed Measures:

- Collaborate with forest industry
- Collaborate with freshwater aquatic fish industry
- Use land surrounding access shafts etc for biotopes

16 Peace, Justice and Strong Institutions



UN SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

- Target 16.8: Broaden and strengthen the participation of developing countries in the institutions of global governance

• Proposed Measures

- Liaise with UN bodies in Geneva
- Invite / encourage participation of student and scientists from developing countries

17 Partnerships for the Goals

17 PARTNERSHIPS
FOR THE GOALS



UN SDG 17: Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

- Target 17.6: Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism
- Target 17.7: Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed
- Target 17.10: Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the World Trade Organization, including through the conclusion of negotiations under its Doha Development Agenda
- Target 17.11: Significantly increase the exports of developing countries, in particular with a view to doubling the least developed countries' share of global exports by 2020
- Target 17.16: Enhance the Global Partnership for Sustainable Development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the Sustainable Development Goals in all countries, in particular developing countries
- Target 17.17: Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships