

# Water Resources Engineering and Management

(CIVIL-466, A.Y. 2024-2025)

5 ETCS, Master course

Marcelo Leite Ribeiro  
**gruner** >



Lecture L9.3 - Water Management: ESG &  
Sustainable Development

**Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.**

Brundtland Report, Our Common Future (1987).



- It is a **framework** used by investors, companies, and other stakeholders to evaluate the **sustainability** and **ethical impact** of an organization's operations and practices.
- The concept of **ESG** (Environmental, Social, and Governance) has been around for several decades, but the term itself was first coined in a 2005 report by the United Nations-backed Principles for Responsible Investment (PRI).
- The report introduced the concept of "**responsible investment**," which includes taking ESG factors into account in investment decisions.
- Since then, ESG has gained increasing attention as a framework for evaluating the **sustainability and ethical impact of business practices**.
- It is now widely used by investors, companies, lenders, and other stakeholders to assess the **long-term financial performance** and **risk management of organizations**, as well as their impact on the **environment, society, and governance**.

# Environmental, Social and Governance



How does the environment get treated?



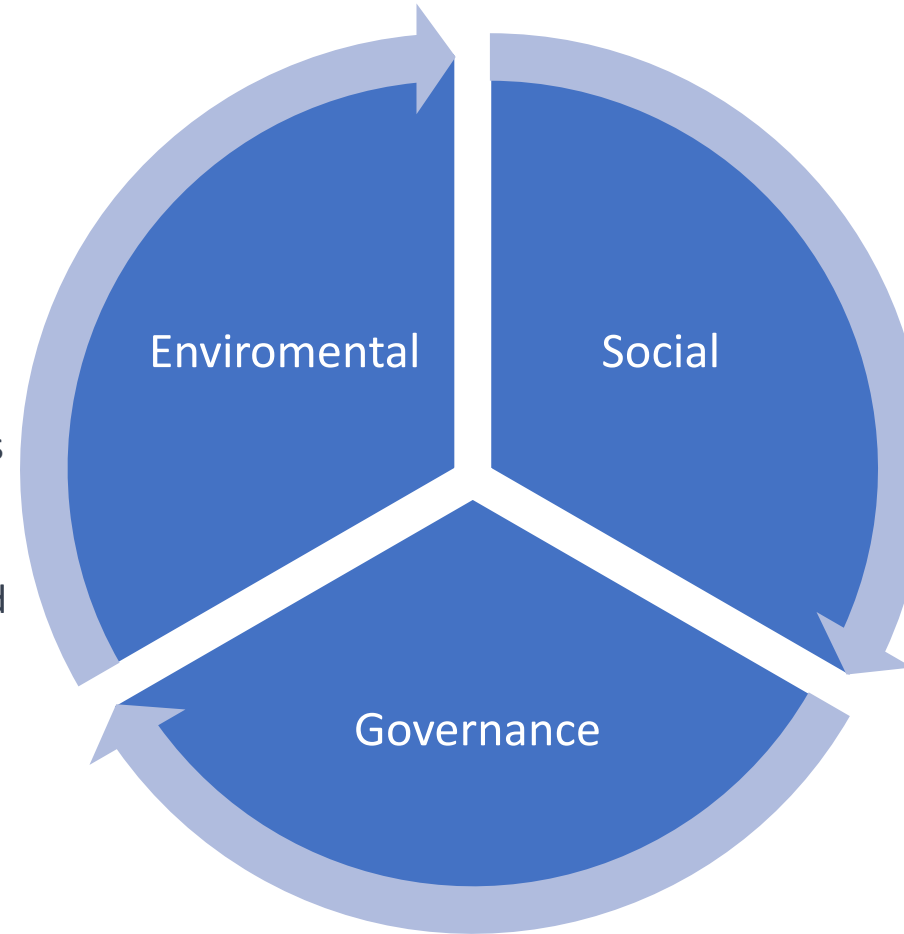
How do the employees, consumers, and the community get treated?



How is the company/project being run?

# ESG on Water Resources Management

- Impact on aquatic ecosystems and biodiversity
- Alteration of river flows and water quality due to changes in sediment levels, water temperature, and chemical pollutants.
- Risk of natural disasters, such as floods and landslides, and the potential for these events to cause damage to infrastructure, disrupt ecosystems, and affect local communities.
- ...



- Impacts on local communities, including displacement, loss of livelihoods, and changes in cultural practices and beliefs.
- Access to water resources and potential conflicts over water allocation and management.
- Public health impacts due to changes in water quality or exposure to chemical pollutants, as well as potential risks to workers on the project.
- ...

- Transparency and accountability in decision-making and project governance.
- Consult with and involve affected stakeholders, including local communities, indigenous peoples, and environmental organizations.
- Compliance with national or international regulations and standards, including those related to environmental protection, human rights, and labor rights.



# 17 UN Sustainable Development Goals (SDG)

Figure 7.2

Water connecting across the SDGs



pted from PBL Netherlands  
mental Assessment Agency  
(2018, p. 13).

- Established by the United Nations in 2015 as a universal **call to action** to end poverty and protect the planet.
- The SDGs aim to create a better future for all people and the planet by 2030.
- Achieving the SDGs requires the cooperation and action of governments, civil society, the private sector, and individuals at all levels.
- Financing the implementation of the SDGs requires a mix of public and private sector investment, as well as innovative financing mechanisms such as social impact bonds and green bonds.

# 17 UN Sustainable Development Goals (SDG)

**Figure 7.2**  
Water connecting  
across the SDGs



pted from PBL Netherlands  
mental Assessment Agency  
(2018, p. 13).

Facts and figures	Goal 6 targets	Links
	<p><b>6.1</b> By 2030, achieve universal and equitable access to safe and affordable drinking water for all</p> <p><b>6.2</b> By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations</p> <p><b>6.3</b> 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</p> <p><b>6.4</b> 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</p> <p><b>6.5</b> By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate</p> <p><b>6.6</b> By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes</p> <p><b>6.A</b> By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies</p> <p><b>6.B</b> Support and strengthen the participation of local communities in improving water and sanitation management</p>	

# 17 UN Sustainable Development Goals (SDG)

Figure 7.2

Water connecting across the SDGs



Adapted from PBL Netherlands  
 Environmental Assessment Agency  
 (2018, p. 13).

## Facts and figures

## Goal 14 targets

## Links

**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

**14.2** By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans

**14.3** Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels

**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

**14.5** By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information

**14.6** By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation

**14.7** By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism

**14.A** Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries

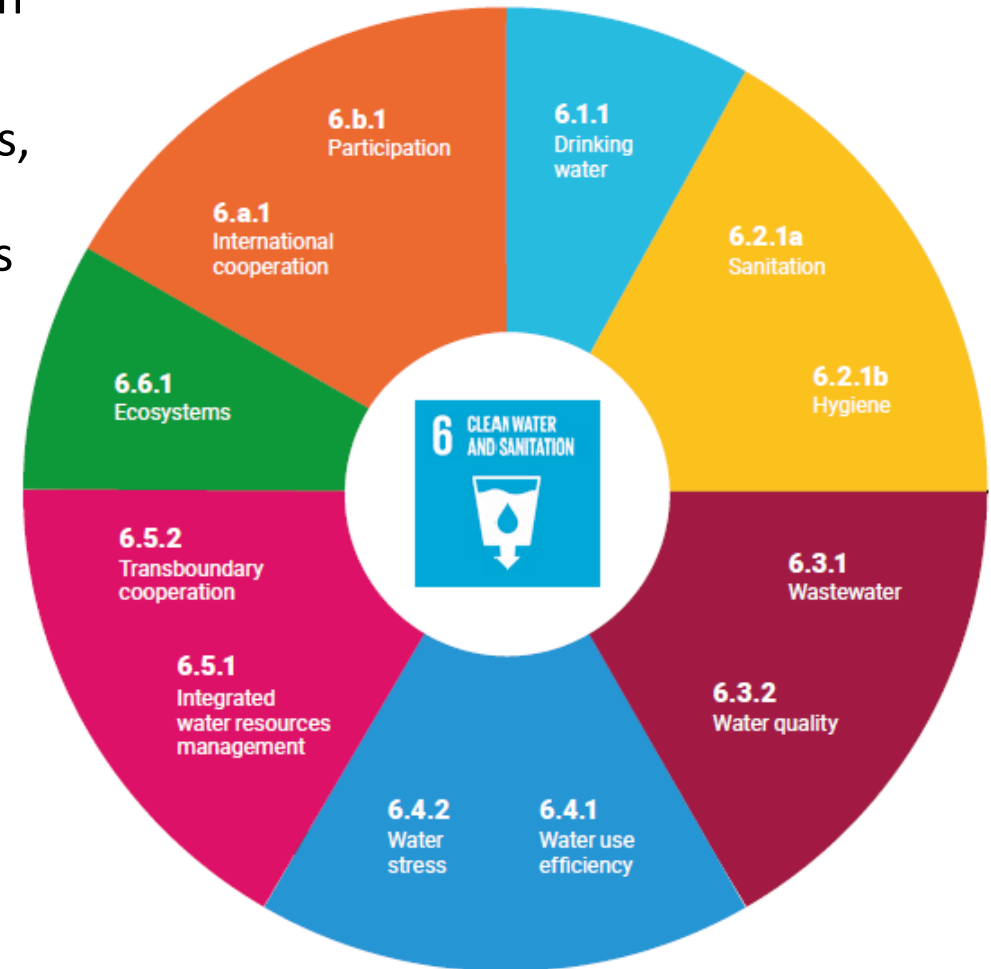
**14.B** Provide access for small-scale artisanal fishers to marine resources and markets

**14.C** Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want



# 17 UN Sustainable Development Goals (SDG)

- None of the SDG 6 targets appear to be on track
- **SDG 6.5.1:** The global average for the IWRM implementation was 54% in 2020 (UNEP, 2021b).
- **SDG 6.5.2** Out of 153 countries sharing transboundary rivers, lakes and aquifers, only 32 have 90% or more of their transboundary waters covered by operational arrangements UNECE/UNESCO, 2018).



# Sustainable development

- Sustainability frameworks guide construction projects by integrating ESG principles, tailored to different contexts.
- Some examples:
  - SNBS (Switzerland)
  - LEED (US)
  - BREEAM (UK, Europe)
  - Envision (Global)



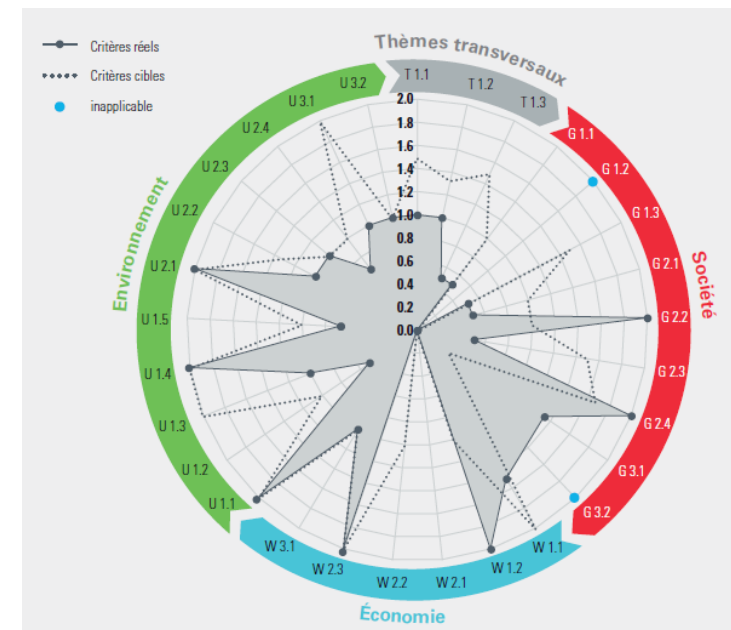
# Sustainable development

## ➤ SNBS (Swiss Sustainable Building Standard)

VERSION 01.07.2020 | © 2020, NNBS












Grease: Indicateurs de base

Thèmes transversaux	Domaine	Objet	Critère	Indicateur									
T1.3 Conflits d'objectifs et synergies T1.3.1 Conflits d'objectifs T1.3.2 Synergies	Société		Développement territorial et zone d'habitat	G 1.1	Aménagement du territoire, paysages, sites construits et espace culturel	G 1.1.1	Aménagement du territoire	G 1.1.2	Paysages, sites construits et espace culturel				
				G 1.2	Qualité d'habitat et cohabitation	G 1.2.1	Effet de morcellement	G 1.2.2	Espace public, espaces ouverts et espaces de détente	G 1.2.3	Vue et panorama		
				G 1.3	Accès à l'infrastructure et qualité de séjour	G 1.3.1	Accès sans obstacles	G 1.3.2	Signalétique	G 1.3.3	Qualité du séjour aux abords de l'infrastructure		
			Communauté	G 2.1	Communication et participation	G 2.1.1	Parties prenantes et participation	G 2.1.2	Communication et réclamations				
				G 2.2	Comportement socialement acceptable	G 2.2.1	Comportement socialement acceptable						
				G 2.3	Sécurité juridique	G 2.3.1	Conditions cadres juridiques et normatives	G 2.3.2	Procédures et autorisations spéciales				
				G 2.4	Solidarité, équité, effet de répartition	G 2.4.1	Services de base et sobriété	G 2.4.2	Équité sociale et intergénérationnelle	G 2.4.3	Équité au sein du projet	G 2.4.4	Achats responsables
			Santé et sécurité	G 3.1	Sécurité au travail, prévention des accidents, sauvetage et santé	G 3.1.1	Gestion des risques et de la sécurité	G 3.1.2	Résilience et fiabilité	G 3.1.3	Scénarios d'urgence		
				G 3.2	Protection contre les agressions et la criminalité	G 3.2.1	Capacité de résistance des installations/infrastructures	G 3.2.2	Sentiment de sécurité				
	T1.2 Détermination des objectifs et délimitation du système T1.2.1 Objectifs du projet T1.2.2 Objectifs de l'évaluation SNBS T1.2.3 Délimitation du système	Économie		Économie d'exploitation	W 1.1	Rapport coûts-avantages sur le plan de l'économie d'exploitation	W 1.1.1	Coûts du cycle de vie	W 1.1.2	Surveillance et entretien	W 1.1.3	Analyse des risques en fonction des coûts	
W 1.2					Flexibilité d'utilisation, capacité d'adaptation et déconstruction	W 1.2.1	Flexibilité d'utilisation et capacité d'adaptation	W 1.2.2	Conservation et déconstruction facilitées				
			Économie publique	W 2.1	Rapport coûts-avantages sur le plan de l'économie publique	W 2.1.1	Analyse coûts-avantages sur le plan de l'économie publique	W 2.1.2	Concept de monitoring	W 2.1.3	Effets de synergie		
				W 2.2	Effets économiques régionaux	W 2.2.1	Matières premières disponibles au niveau régional	W 2.2.2	Compétences et ressources en personnel régionales	W 2.2.3	Amélioration de l'attractivité de la région	W 2.2.4	Réduction des restrictions d'accès
			Financement	W 2.3	Utilisation économique d'infrastructures existantes	W 2.3.1	Infrastructures existantes	W 2.3.2	Utilisation multifonctionnelle ou commune des infrastructures				
				W 3.1	Financement adapté	W 3.1.1	Financement à long terme	W 3.1.2	Taux de couverture des coûts après la réalisation	W 3.1.3	Financement des risques		
T1.1 Évaluation de la durabilité T1.1.1 Contrôle de l'applicabilité T1.1.2 Évaluation de la durabilité T1.1.3 Organisation du projet		Environnement		Matières premières, énergie et sol	U 1.1	Consommation d'énergie	U 1.1.1	Minimisation de la consommation d'énergie	U 1.1.2	Énergies renouvelables	U 1.1.3	Monitoring de la consommation d'énergie	
	U 1.2				Utilisation et recyclage des surfaces, protection du sol	U 1.2.1	Utilisation efficace des surfaces	U 1.2.2	Gestion respectueuse du sol				
	U 1.3				Sites pollués	U 1.3.1	Investigation des sites inscrits au cadastre des sites pollués	U 1.3.2	Intervention sur un site inscrit au cadastre des sites pollués				
	U 1.4				Réutilisation de matériaux de déblais et d'excavation, de démolition et de déconstruction non pollués et pollués (déchets)	U 1.4.1	Déchets non pollués	U 1.4.2	Déchets pollués				
	U 1.5				Utilisation de matériaux et de ressources respectueux de l'environnement	U 1.5.1	Utilisation efficace des ressources	U 1.5.2	Exploitation et entretien écologiquement responsables	U 1.5.3	Potential de déconstruction		
			Nature et environnement	U 2.1	Atteintes au climat	U 2.1.1	Émissions	U 2.1.2	Compensation des émissions de gaz à effet de serre	U 2.1.3	Effet d'îlot de chaleur		
				U 2.2	Atteintes environnementales	U 2.2.1	Polluants atmosphériques et odeurs	U 2.2.2	Bruit et vibrations	U 2.2.3	Rayonnement non ionisant	U 2.2.4	Chaleur et lumière
				U 2.3	Eaux superficielles et nappe phréatique	U 2.3.1	Répercussions qualitatives et chimiques sur les eaux superficielles et la nappe phréatique	U 2.3.2	Volume de rétention, espace réservé aux eaux, débit et cycle hydrologique	U 2.3.3	Consommation d'eau et approvisionnement en eau		
				U 2.4	Nature et paysage	U 2.4.1	Maintien et valorisation des éléments naturels et paysagers	U 2.4.2	Corridors de liaison	U 2.4.3	Espèces envahissantes et néophytes		
			Prévention des risques	U 3.1	Dangers naturels	U 3.1.1	Risques liés aux dangers naturels	U 3.1.2	Influence des changements climatiques				
				U 3.2	Accidents majeurs	U 3.2.1	Accidents majeurs et marchandises dangereuses						



# Sustainable development

- SNBS applied to the Heightneting of the Moyri dam, in Switzerland

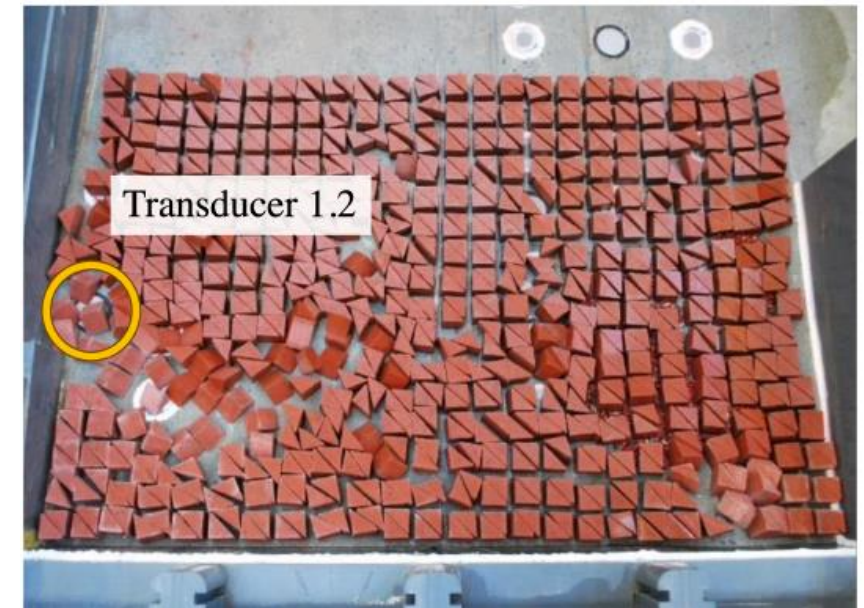
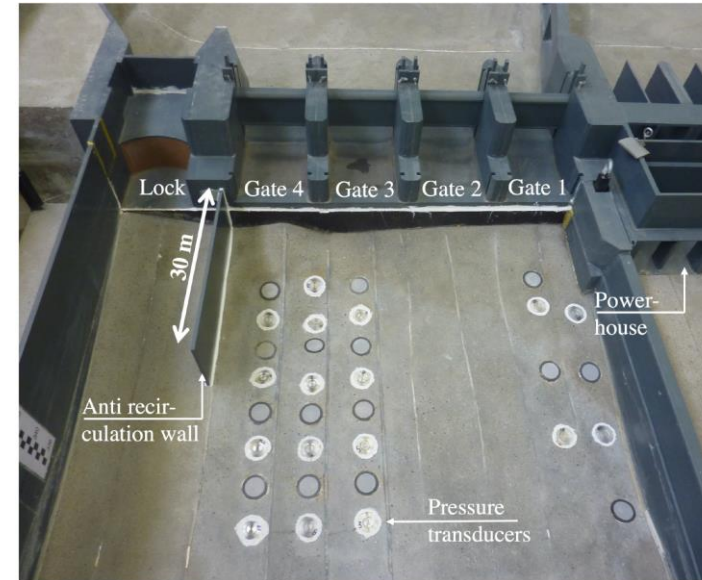
Indicateur SNBS Infrastructures / Objectif	OUVRAGE			PHASE SIA						Références Critère SIA 112/2
	Barrage et ouvrages annexes	Centrale hydroélectrique de Lona	Tunnel d'accès	31 Validation AYP	32 Projet d'ouvrage 33 Mis à l'enquête	41 Appel d'offres	5 Réalisation	6 Exploitation		
 Forte influence de la phase de réalisation sur le résultat de l'indicateur (concerne les entrepreneurs).										
 Aspect déjà défini dans des phases de projet antérieures										
Mesures										
THÈMES TRANSVERSAUX										
T1.3 Conflits d'objectifs et synergies									Ue 1.2	
SOCIÉTÉ										
G 2.1 Communication et participation									G 2.1	
G 3.1 Sécurité au travail, prévention des accidents									G 31.&3.2	
ECONOME										
W 1.1 Rapport coûts-avantages pour l'économie d'exploitation									W 1.1	
W 1.2 Flexibilité d'utilisation, capacité d'adaptation									W 1.2	
W 2.2 Effets économiques régionaux									W 2.2	
W 2.3 Utilisation économique d'infrastructures existantes									W 2.3	
ENVIRONNEMENT										
U 1.1 Consommation d'énergie									U 1.1	
U 1.4 Réutilisation de matériaux de déblais et d'excavation									U 1.3	
U 1.5 Utilisation de matériaux respectueux de l'environnement									U 3.1 & 3.2	
U 2.1 Atteintes au climat									U 2.3	
U 2.3 Eaux superficielles et nappe phréatique									U 2.4	
U 2.4 Nature et paysage									U 2.5	
U 3.1 Dangers naturels									U 4.1	





# Sustainable development

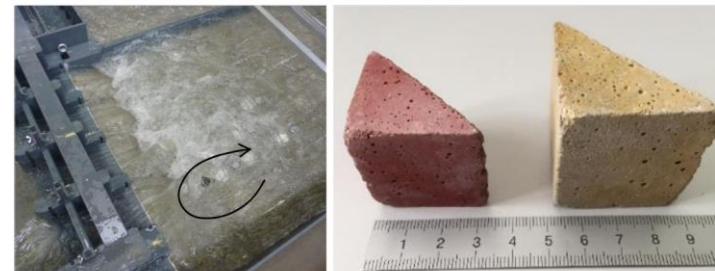
- Chancy-Pougny dam, Switzerland / France (1920)
- Study combining numerical and physical modeling to design scour protection
- Solution of paving the scour with concrete blocs is analysed
- Life Cycle Assessment (LCA) compared construction techniques and materials for environmental impact



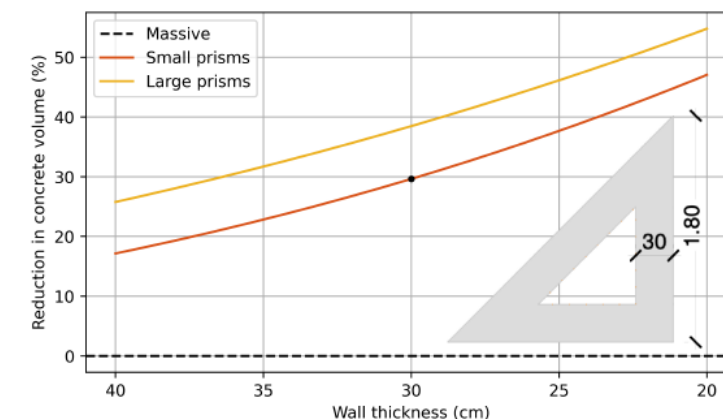
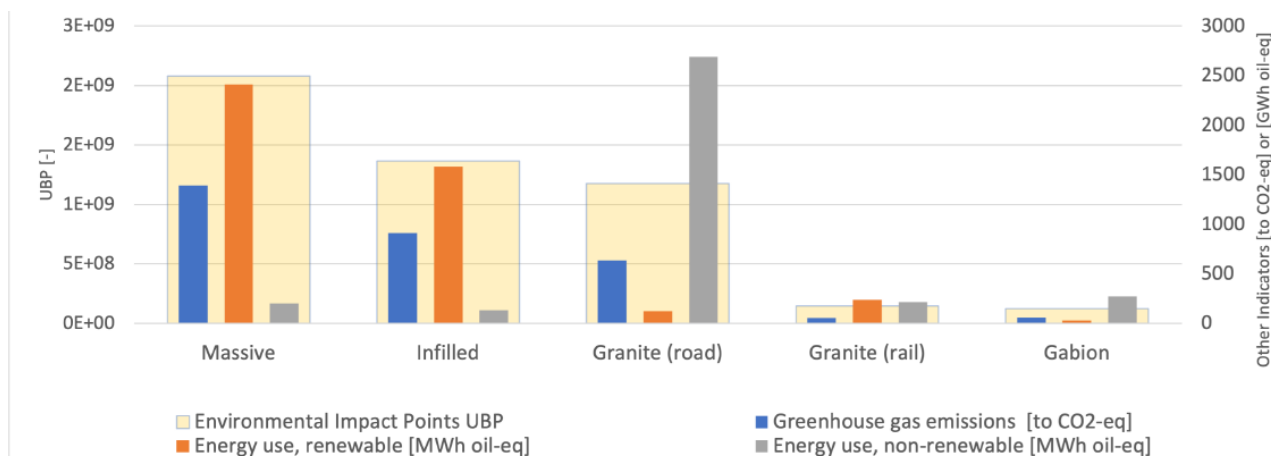


# Sustainable development

- LCA assessment goals
  - Minimize total concrete volume needed.
  - Reduce cement share in the concrete mixture.
  - Use cement with low ecological impact (ecocement).

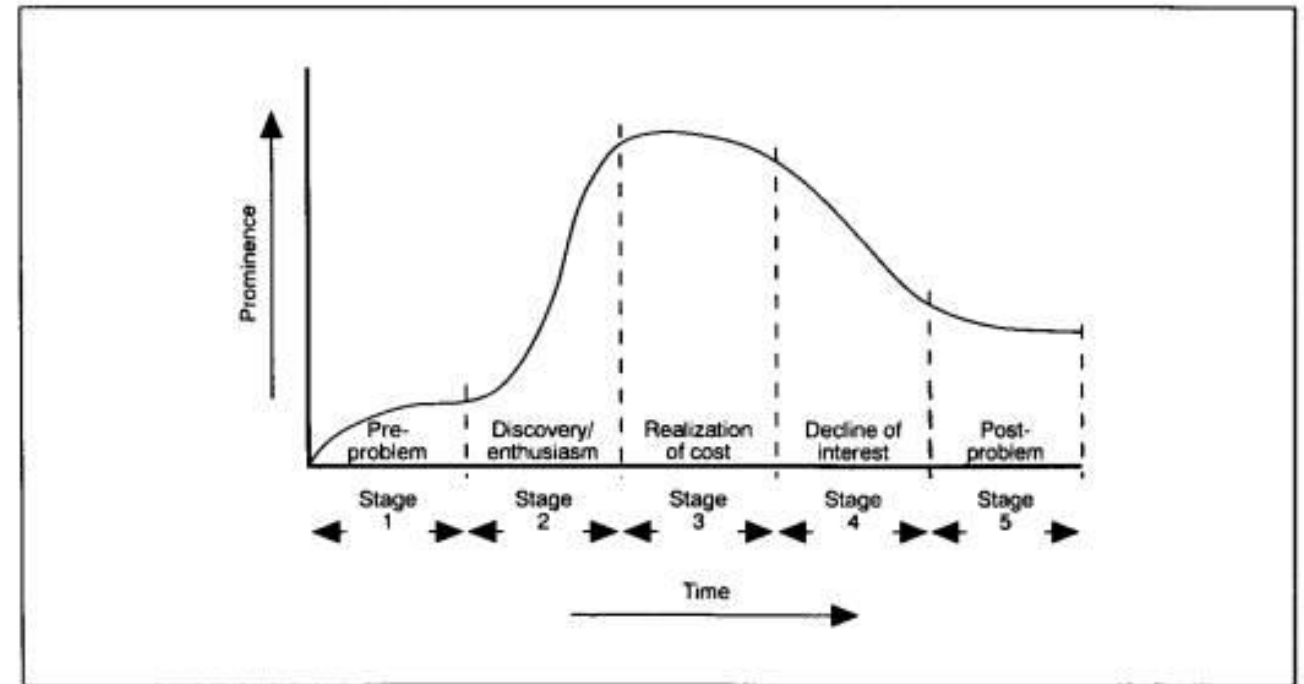
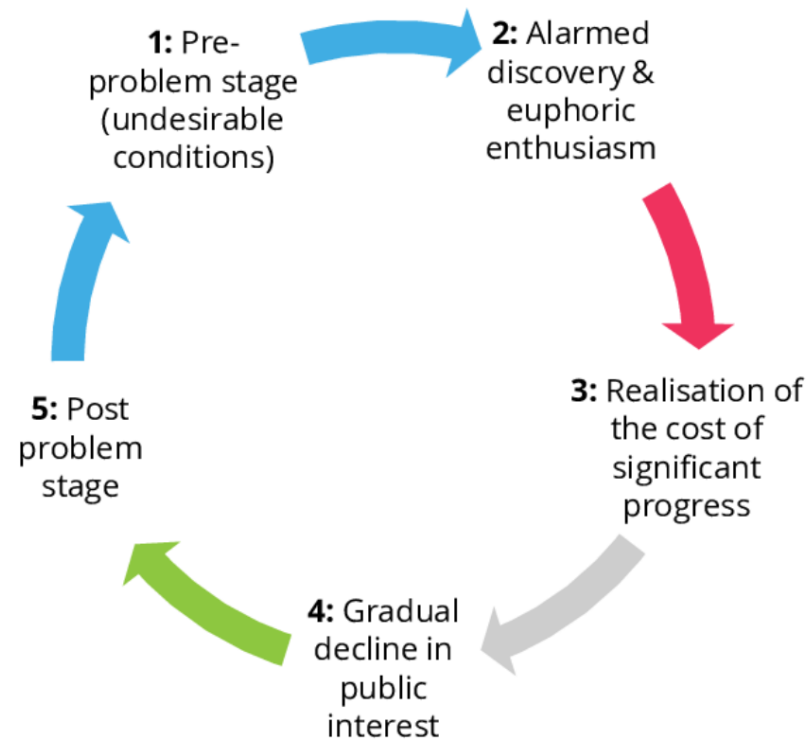


- Alternatives
  - Infilled prisms
  - Natural blocks
  - Gabions
  - Armour units



# Challenges in the public interest

## ➤ The Issue Attention Cycles



Downs (1972)

# Key take aways

- ESG & Sustainable development related to Water Resources Management
  - Environment: Sustainable water resource management prioritizes the conservation and protection of natural water sources, preservation of aquatic biodiversity, reduction of water pollution, and efficient water use practices.
  - Social: Ensuring equitable access to clean water for all individuals and communities, promoting water security, investing in water infrastructure, and preventing conflicts related to water access
  - Governance: Effective water governance requires involvement from multiple stakeholders, transparency and accountability, clear policies and regulations, and innovation and investment in new technologies for water management