Health, Safety and Environment (HSE) in Industrial Installations

Target: 2nd Year Engineering Students

Instructor: Dr. GRINE Wassila

Chapter 2: Occupational Health and Environmental Protection

Description: Protecting Worker Health and Ecosystems in Industrial Operations

Five-Session Roadmap

- **Session 1:** Introduction to Occupational Health & Work-Related Diseases
- **Session 2:** Industrial Hygiene & Environmental Monitoring
- **Session 3:** Environmental Management in Industrial Facilities
- **Session 4:** Industrial Waste Management
- **Session 5: Sustainability & Sustainable Development - Integrated Case Study**

SESSION 5: Sustainability & Sustainable Development - Integrated Case Study

Date: 19/12/2025

19H30-21H00

From concept to application: what is Sustainability really?

Classic Definition (Brundtland Commission, 1987):

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

Three Interconnected Dimensions:

1. **Environmental Dimension** 🌿

- Protecting ecosystems and natural resources
- Combating climate change
- Preserving biodiversity

2. **Social Dimension** 👥

- Justice and equity
- Health and safety for workers and community
- Well-being and human development

3. **Economic Dimension** 💼

- Profitability and growth
- Innovation and productivity
- Job creation

Engineer's Critical Role:

Achieving balance between these dimensions in technical designs and decisions

Life Cycle Assessment (LCA) - The Holistic Lens

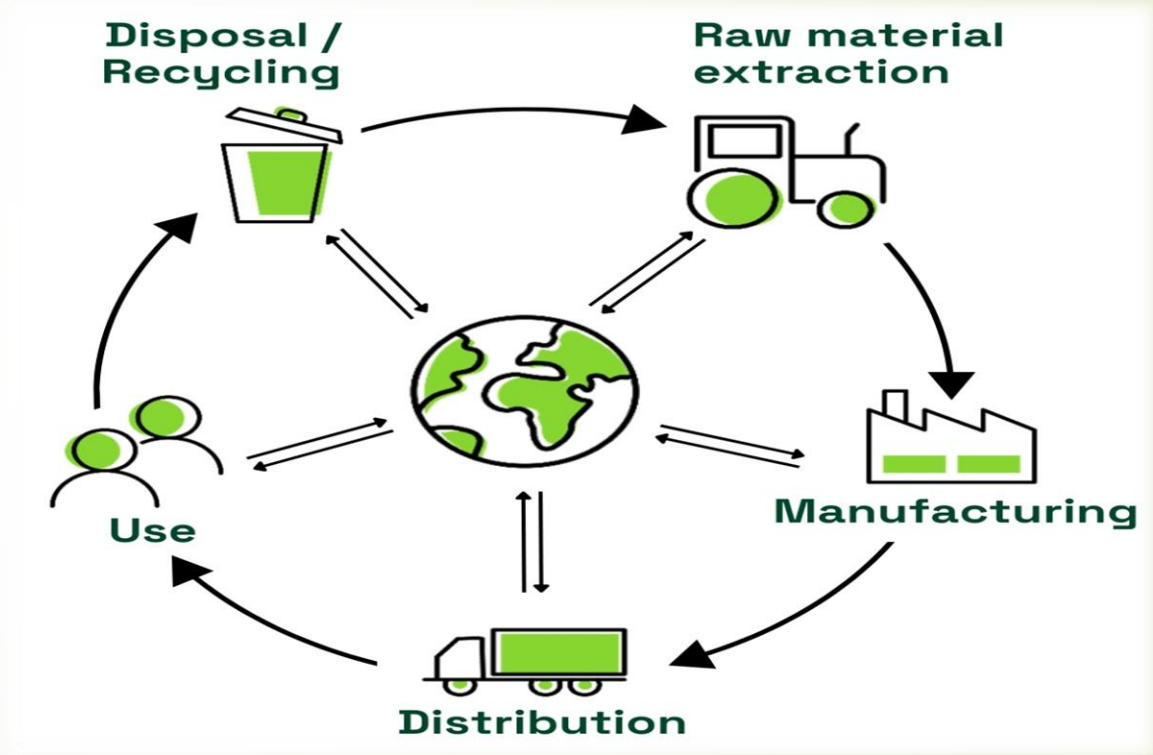
Core Idea:

We don't judge a product only from its use phase, but evaluate its environmental impacts throughout its entire life cycle.

Simply put: "Think about the product's end when you start designing it."

Practical Example:

- **Product:** Electric car
- **Problem:** Lithium batteries
- **Solution:** Design that facilitates recycling from the beginning



Case Study: "Gulf Electroplating Factory"

Current Situation (Traditional Linear Model):

- **Activity:** Electroplating car parts with chromium layer
- **Location:** Industrial area near residential housing
- **Main Problems:**

1. High water and energy consumption
2. Wastewater loaded with hexavalent chromium (toxic)
3. Hazardous sludge waste containing heavy metals
4. Community dissatisfaction due to odors and visual pollution
5. Frequent fines from regulatory authorities

Basic Data:

- Water consumption: 500 m^3/day
- Energy consumption: 8000 kWh/day
- Hazardous waste: 2 tons/month
- Annual fines: 5 million DZD
- Community complaints: 15 complaints/month average

Your Mission (as Engineering Consultants):

Develop a comprehensive transformation plan toward sustainability covering all dimensions

Main Interactive Activity - Sustainability Workshop

Task:

Propose practical solutions to improve factory performance in each of the three sustainability pillars

Group 1: Environmental Dimension Focus 🌿

Guiding Questions:

1. How to reduce the factory's water and carbon footprint?
2. How to address hexavalent chromium in wastewater and sludge?
3. What cleaner production technologies can be applied?
4. How to transform waste from problem to resource?

Group 2: Social Dimension Focus 👥

Guiding Questions:

1. How to protect workers' health and safety from chemical hazards?
2. How to engage with the local community (transparency, reducing nuisance)?
3. What training and development programs are needed?
4. How to build genuine partnership with the community?

Group 3: Economic Dimension Focus 💼

Guiding Questions:

1. How to make these changes profitable or self-sustaining?
2. What new marketing or competitive opportunities exist?
3. How to calculate ROI for sustainable transformation?
4. What new business models are possible?

Support Tools:

- Current operational cost data
- Applicable environmental laws
- Similar global case studies
- List of available technologies

Proposed Integrated Solutions

A) Environmental Solutions

1. **Closed Water System:** 95% water recycling, cost: 200 million DZD, payback: 14 months
2. **Chromium Replacement:** Switch from hexavalent (toxic) to trivalent (safer), cost: 50 million DZD
3. **Solar Energy:** Installation of solar panels, cost: 150 million DZD, payback: 5 years

B) Social Solutions

1. **Health Monitoring:** Regular worker checkups, cost: 5 million DZD/year, reduces absenteeism 30%
2. **Community Transparency:** Open meetings + electronic display boards, cost: 2 million DZD/year
3. **Community Programs:** Garden + training programs, cost: 10 million DZD initial investment

C) Economic Solutions

1. **New Business Models**: Product-as-service, facility sharing, recycled materials trade
2. **Incentive Package**: ISO certification, tax exemptions, green financing with reduced interest
3. **Funding Plan**: 400 million DZD (50% green loan, 30% self investment, 20% government grants)

Expected Results (Year 3)

- **Annual Savings:** 300 million DZD
- **Sales Increase:** 20% due to environmental certification
- **Elimination of Fines**: From 5 million DZD/year to zero

Basic Principle:

Every dinar invested in sustainability returns three: one environmental, one social, one economic

Sustainability In The Algerian Context: Challenges & Opportunities

1. Challenges

2. **Water Scarcity:** 300 m³/person/year (below global poverty line)
3. **Fossil Fuel Dependence:** 98% reliance (unsustainable)
4. **Limited Infrastructure:** For waste and renewable energy
5. **Cultural Resistance:** To change in organizations

2. Golden Opportunities

1. **Solar Energy:** 3000 hours/year (untapped treasure)
2. **Wind Energy:** Long coastline with excellent wind speeds
3. **Supportive Laws:** 04-09 (energy) and 01-19 (waste)
4. **European Demand:** Partners require environmental compliance

3. Algerian Engineer's Role

- **Adapter:** Solutions that fit our resources
- **Innovator:** Using intelligence to compensate for shortages
- **Leader:** Leading transformation in industrial institutions

Message: "Our limitations create our opportunities, and our engineers transform them into reality"

Connecting The Entire Chapter: From Parts To Whole

Intellectual Development Path:

1. **Session 1:** Protecting the Individual (Worker) from disease ← **Precise focus**
2. **Session 2:** Scientific Measurement tools for risks ← **Means**
3. **Session 3:** Systematic Management framework for facility ← **System**
4. **Session 4:** Managing main hazardous Outputs ← **Application**
5. **Session 5:** Holistic vision for Integration ← **Strategy**

Chapter 2 Conclusion

Quick Journey Review:

We moved from protecting the individual worker to protecting the ecosystem and community while ensuring economic activity continuity.

Key Principles Learned:

1. **Proactivity:** Prevention is better than cure (especially with occupational diseases)
2. **Measurement:** What cannot be measured cannot be managed
3. **Integration:** Environment, economy, and society are an inseparable triad
4. **Responsibility:** Not optional but the essence of engineering professionalism
5. **Continuity:** Continuous improvement is not luxury but necessity

«As future engineers, you are not just designers or operators, but guardians of the future. Every technical decision you make, every design you create, has an impact beyond the four walls of your factory.»

Always Remember:

Engineering without sustainability = Temporary solutions to permanent problems

Sustainability without engineering = Beautiful ideas without implementation

Sustainable engineering = Possible future for coming generations

كمهندسين مستقبليين، أنتم لستم مجرد مصممين أو مشغلين، بل أنتم حماة للمستقبل. كل قرار تقني تتخذونه، كل تصميم تبتكرونه، له أثر يتعدى الجدران الأربعة لمصنعكم.

تذكروا دائماً:

- **الهندسة بدون استدامة** = حلول مؤقتة لمشاكل دائمة
- **الاستدامة بدون هندسة** = أفكار جميلة بدون تنفيذ
- **الهندسة المستدامة** = مستقبل ممكن لأجيال قادمة

Thank you all for your attention