Industrial Material Flow Management: Strategic Approaches to optimise business potentials and values

Global Experiences from a leading German Non-Profit Research Institut

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UNU - Zero Emission Approach

**Cleaner Production**

- Raw Material → Product → Waste
- Raw Material → Waste

**End-of-Pipe**

- Raw Material → Product → Waste

**Zero Emissions**

- Raw Material → Product → Another Industry
- Zero Emissions by M. Suzuki, UNU
Different System Borders for MFM

- Company-internal processes
- An entire company
- Supplier relationships along a value-added chain (vertical Co-operations or horizontal Co-operations)
- An entire value-added chain (raw materials, manufacturing, distribution, use, disposal)
- A region or Co-operations between regions
General Goals of Enterprises

- Profit Maximization
- Meet the Customers’ Needs
- Company Growth
- Minimization of Costs (e.g. material, energy, waste, assurance)
- Market Expansion (Higher Market Share)
- Development of Quality Goods
- Good Image
- Creating Wealth for Shareholders (and Stakeholders)
- Development of Company Culture
Core elements of Industrial MFM

- Life Cycle Analysis (LCA)
- Eco-Efficiency
- Cleaner Production & PIUS
- Ökoprofit / ECO-Profit
- Environmental Management
Why take a Life Cycle Approach?

- Systemic perspective
- Integration of environment into core business issues
- Enhancement of Efficiency and Innovation
- Engage stakeholders – investors, customers, employees
- Environment is not a cost center for the company, but a business opportunity
  - Look beyond the company’s gate
  - Expose trade-offs and opportunities
  - Expand analysis of products, projects, policies and programs – what is the function, what are the boundaries, what are the impacts, where are the opportunities?
The „Traveling T-Shirt“

- Products can be evaluated through each stage of their life-cycle:
  - Extraction or acquisition of raw materials
  - Manufacturing and processing
  - Distribution and transportation
  - Use and reuse
  - Recycling
  - Disposal

- For each stage, identify inputs of materials and energy received; outputs of useful product and waste emissions
- Find optimal points for improvement – eco-efficiency
Management Steps of LCA

- Determine scope and system boundaries
  - functional unit
  - life-cycle stages
  - define “unit processes”
- Data collection
- Analysis of inputs and outputs
- Assessment of numerous environmental issues
- Interpretation
  - LCA principles and framework are standardized by the Organization for International Standardization’s 14040 series of standards (ISO14040)
PIUS means “production/process/product integrated environmental protection” (considers all stages of the life-cycle of a product).

Cleaner Production – integration of environmental technologies into the production processes of companies

Involves the use of advanced technologies for waste management, air quality control, noise abatement, water protection and energy.

www.cleaner-production.de and www.pius-info.de
What’s ECO-Profit

- the "ECOlogical PROject For Integrated Environmental Technology"
- “The basic idea of ECOPROFIT® is a win-win-model, using integrated environmental technologies to strengthen businesses economically and simultaneously improve the local environment.”
- Eco-Profit was developed by the Environmental Department of the city of Graz in Austria, as a way of fostering sustainable economic development
The BASF sustainability approaches

- BASF developed 2 sustainability tools: *Eco-Efficiency Analysis* and *SEEBALANCE*

- **Eco-Efficiency Analysis**: “provides information about the relationship between the economic benefits of a product and its impact on the environment”. Product’s entire life cycle is analyzed, so consumers (and management) can make informed decisions.

- **SEEBALANCE**: “extension of the Eco-Efficiency Analysis that includes social impact”. Includes employee affairs, training, research and development and ‘economic evaluation parameters such as taxes and subsidies’
Key Elements of Eco-Efficiency

- re-engineer processes
- revalorize by-products
- redesign products
- rethink markets
Re-Engineer Processes

- Companies can re-engineer their processes to reduce the consumption of resources, reduce pollution and avoid risks, while at the same time saving costs.
- Optimize processes and procedures to minimize resources (materials, time etc.)
- Maximize energy, raw material and water savings
- Eliminate hazards material where possible
- Save through systematic risk minimization in production, procurement, sales, R&D, human resources, etc.
Re-Design Products (DfE)

- Products designed to ecological design rules can be cheaper to produce and use. They are smaller and simpler in their design. They include a smaller variety of materials and are easier to disassemble for recycling.
- Consider entire value chain in product design – supply chain through disposal
- Make products upgradeable and recyclable
- Create new and increased functionality with less material and energy consumption
Re-Think Markets

- If it is possible that by providing a service instead of selling the product, the overall material or energy intensity may be reduced, then opportunities for new economic growth and higher profitability can be opened up.

- Know the customer

- Sell functional (rather than material) offerings

- Provide users with comprehensive solutions

- Create new businesses with add-on services

- Improve customers’ eco-efficiency

- Rethink opportunities in light of changing market conditions (new taxes, increased consumer awareness, etc.)
Getting Started in your Company

- Understand the full life-cycle of your products
- Establish eco-efficiency as a prominent target and evaluation screen in your innovation process.
- Test your key technologies and markets against changing trends in societal acceptance.
- Set eco-efficiency measurements and targets for your current operations and products.
- Develop a communication concept including dialogues, partnerships with stakeholders, and others.
- Evaluate which business lines would benefit from planned resource-based economic instruments.
- Explore how you could mitigate negative impacts through product innovation.
Company internal IMFM: easy!
Regional IMFM: the tricky part?!
Example: Regional District Heating Concept

- Stakeholder Management
- MFA – Biomass Potential
- Analysis Heat Energy Demand
- Logistics and Supply Concept
- Technology Concept
Stakeholder Management

- Community Council and Waste Management Service Organisation of the Region
- Ten Enterprises of the Industrial Park
- Potential Investor and Operator of the Biomass Plants
  - Biogas plant operated by local farmers (Energy farmer)
  - Wood Chip Co-Generation done by community forestry department
- Local District and City government
- Federal Ministries
Available Biomass Potentials

- Agricultural & Lifestock breeding potentials
  - 90 ha Maize – 3,900 t
  - 10 ha various energy crops – 250 t
  - 15 ha greenery residues from extensive greening – 500 t
  - 2,600 t Liquide Manure
  - 400 t Solid Manure

  ➤ Energy Potential for 242 kW_el.
  - Transport distances below 2 km
  - Total available cropping area: 160 ha plus options on 100 ha

- Community Greenery Residues (optional)
  - 40 m width street green belt (2 x 2 km; 15 ha)
- Thermal Energy Potential at the proposed Biogas Plant with an installed capacity of 250 kW_{el.}: 1.800 MWh/a netto; Ø 150.000 kWh/Monat netto
Analysis Heat Energy Demand IP

- Average Heat Energy Demand throughout the year above 200,000 kWh/Month
- Total Heat Demand of all the enterprises exceeds the thermal energy supply potential of the biogas plant
- Future increasing heat energy demand by extension of industrial park
- Additional cooling demand at 4 enterprises

Conclusion: Additional biogas unit plus wood chip cogeneration
Plant Logistics

Standort 1:
max. Distance of 2 km;
Max Grid Distance 3,1 km

1=R. Stahl
2=Ziehl-Abegg
3=SWG
4=Wolff+Müller
5=Lidl
6=Würth
7=GSTech
8=HPN
9=Sped. Kübler
10=GEMÜ (geplant)
Technology Concept

Phase 1: Biogas Plant

- **Plant Details:****
  - CHP: 315 kW th. / 250 kW el. - 7.200 VLS
  - **Electricity Production:**
    - Brutto: 1.800.000 kWh/a
    - Netto: 1.700.000 kWh/a (6% self consumption)
  - **Heat Production:**
    - Brutto: 2.300.000 kWh/a
    - Netto: 1.800.000 kWh/a (22% self consumption)
    - [Ø 150.000 kWh/Monat]

- **Economically feasible with existing feed-in tariff**
  - Basis Feed-in Tariff: 10,43 ct
  - Energy Crop Bonus: 6,86 ct
  - CHP Bonus: 2,94 ct
  - Manure Bonus: 2,74 ct

- **Extension possibility to 630 kW th. / 500 kW el.**
Technology Concept

Phase 2: Wood Chip Co-Generation with District Heating

- Coverage of base load with Biogas plant.
- Coverage of mid-load with wood chip Co-Gen
  - Heat production: 6 Mio. kWh (3 Mio. kWh Gas)
  - Electricity: up to 2 Mio. kWh
  - Wood Demand: 6,000 bis 8,000 Srm
- Modular Extension Concept based on available Resources
- Emergency units at Enterprises
- Option: Adsorption Cooling Grid
Business Modell

- Centralised Energy Production by local EIP management unit
- Contracting Modell
- Emergency Units at Enterprise level
Conclusion

- Enhancement of regional/company competitiveness by low/stable energy costs
- Green Marketing opportunities for companies (Image)
- Regional Initial Investment volume of approx. (min.) 2.5 Mio. €
- Regional Added value due to operation and renewable fuel supply
- New jobs and new income diversification for farmers and forestry
- Active contribution towards climate protection
- Cooperation instead of Competition
IMAT®:
Sustainable Education
or Education for Sustainability

Master in International Material Flow Management
IMAT Key Ideas

- Interdisciplinary Education for Sustainable Development
- Sound knowledge in Clean Technologies and Business Planning
- Training in Zero Emission System Design
- Applied Research for Sustainability
- Student are working hands-on
Project based Learning in Small Learning Groups
Classes of 15-30 Students
International Research and Education Networks
Residential Campus: Living, Learning, Working
Industrial Practitioner as Lecturer
Provided Knowledge

- Material Flow Management
- Ecological Economics
- Clean Technologies / Environmental Technologies
- Understanding of Holistic and Complex Material and Ecological Systems
- Project and Change Management
- Intercultural Communication / Networking
- Financing
- Environmental Management
- …..
IMAT Programs

- German-Japanese Dual Degree IMAT Program together with Ritsumeikan Asia Pacific University, Beppu
- German-Turkish Dual Degree IMAT Program together with Akdeniz University, Antalya
- German-Brazilian Dual Degree IMAT Program together with Universidade Positivo, Curitiba (March 2011)
- German IMAT MSc Program
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| Total             | 24 | 30 | 900 | 24 | 30 | 900 | 24 | 30 | 900 | 30 | 900 |
Job Perspectives and Opportunities

- Eco-Entrepreneurship
- Global Consultancy Companies
- (Non-) Governmental Organisations
- Industry (Process Optimisation, Eco-Controlling, Strategy Development, Corporate Governance, etc.)
- Research Institutions
- Policy Making
- .....
Admission Requirements

- Bachelor Degree or Equivalent
- Adequate Knowledge of English Language (e.g. TOEFL with 550 points is recommended)
- Sound Research Proposal
- High Motivation and Interest in MFM and Circular Economy
- One Annual Intake (Fall Semester)

- Scholarships are available! MEXT PGP Application deadline 30.11.2010
Thank you for your time and attention

www.stoffstrom.org
www.imat-master.com