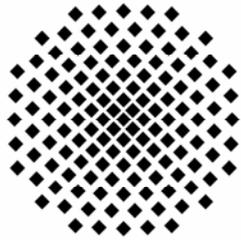


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# Steeluniversity.org: A new Internet E-Learning Resource on Sustainability

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## **Julia Pflieger**

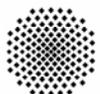
Life Cycle Engineering Dept, LBP, Stuttgart University, Germany

## **Ruth Hambleton**

Project Manager, steeluniversity.org, International Iron and Steel Institute, Brussels, Belgium

3rd International Conference on Sustainable Development  
Indicators in the Minerals Industry (SDIMI 2007)

Milos, June 17-20, 2007



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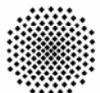


# A new Internet E-Learning Resource on Sustainability

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## Overview

- 1 Motivation for steeluniversity.org
- 2 Aims, Objectives and Target Audiences
- 3 Structure of the E-Learning Resource – The Modules
- 4 The module “Sustainability”
- 5 Conclusion



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Basis for [steeluniversity.org](http://steeluniversity.org)

## Need:

Comprehensive tool for knowledge transfer  
combined with the challenge and fun of a game and realistic  
simulation of industrial processes

## Form:

Freely-available web-based e-learning tool



[www.steeluniversity.org](http://www.steeluniversity.org)

initiated and developed by IISI

*steelmaking*

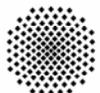
*steel products*

*steel applications*

*underlying scientific principles*

*associated sustainability issues*

*environmental issues*



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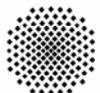
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# Motivation for an E-Learning Resource on Sustainability

## Aims, Objectives & Target Audiences

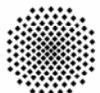
- ✓ Recruitment of high calibre graduates into the steel industry
- ✓ Sustainability of ferrous metallurgy knowledge in academia / industry
  
- ✓ Excite students/teachers about steel; enhance image of steel industry
- ✓ Reduce in-company training costs
- ✓ Enhance knowledge transfer and collaboration between academia and industry
  
- ✓ Undergraduate students, their professors and lecturers
- ✓ Steel company employees, recent graduate recruits
- ✓ Researchers and technical experts in academia and steel industry supply chain



## The Modules

- Secondary Steelmaking
- Continuous Casting
- Materials Selection for Car Door Panels
- Steels in Construction
- **Sustainability**

...



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In this module there are four sections that deal with:

- Sustainability, Steel and the Environment;
- Principles of Life Cycle Thinking;
- Introduction to Life Cycle Assessment, and
- Applications of Life Cycle Assessment.

U.S. Green Building Council

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REFERENCES:  
[Full details here...](#)

NEWS & EVENTS:  
[Clean Technologies in the Steel Industry, Hungary](#)  
[5th European Continuous Casting Conference, Nice, France](#)

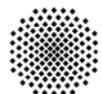
[Send Feedback to steeluniversity.org](#)

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# steeluniversity.org: The module “Sustainability”

## Sustainability, Steel and the Environment

### What is Sustainability?

What is Sustainability? - Microsoft Internet Explorer

1 Satisfying shareholder and stakeholders  
2 Recycling and re-using materials and products  
3 Protecting wildlife habitat and endangered species  
4 Preventing crime  
5 Using renewable energy sources  
6 Defending against flooding  
7 Reducing emissions of greenhouse gases  
8 Relieving poverty  
9 Avoiding pollution of earth, air and water  
10 Increasing life expectancy  
11 Trading fairly  
12 Providing healthcare  
13 Reducing waste and avoiding landfilling of waste  
14 Making a profit  
15 Providing education and training  
16 Reducing fuel consumption  
17 Respecting human rights  
18 Developing energy-efficient processes & products  
19 Working safely  
20 Reducing Third World debt  
21 Building on 'brown field' sites  
22 Providing clean water for drinking  
23 Using public transport  
24 Providing equal opportunities  
25 Investing in research and development  
26 Sourcing materials and products locally

Tolerances:  
Miss  
Near  
Hit

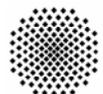
Environmental Equity  
Social Equity  
Economic Prosperity

**Instructions**  
Drag the numbered circles to their appropriate positions on the triangle. Think carefully about the relative importance to environmental, social and economic factors.

**Scoring**  
You can check your progress at any time by clicking the 'Current score' button below. Labels in the appropriate position will be marked green, those close to the appropriate position will be marked orange, and those incorrectly placed (including those still in their original positions) will be marked red. Each time you click the button, the 'number of attempts' is increased. The aim is to successfully complete the diagram in the lowest number of attempts.

Number of Attempts: 1

Instructions Current score



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## Sustainability, Steel and the Environment

What are the main environmental impacts?

Explore the different environmental impacts by moving the mouse across the diagram. Click on the highlighted areas you find to learn more

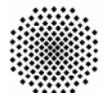
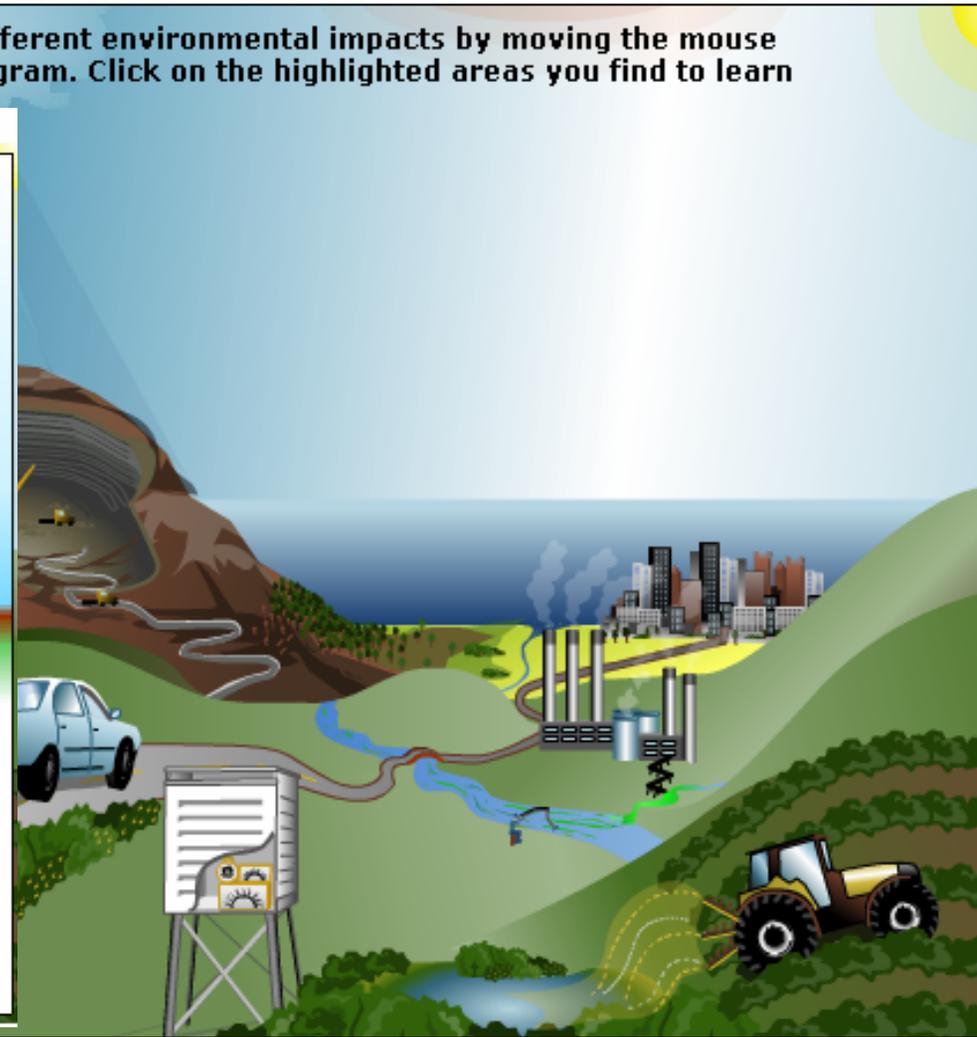
**Global Warming Potential (GWP)**

The diagram illustrates the greenhouse effect. On the left, a sun emits UV-radiation (black arrows) towards the Earth's surface. The Earth's surface reflects some of this radiation (red arrow labeled 'Reflection') and absorbs the rest (red arrow labeled 'Absorption'). The absorbed radiation is re-emitted as infrared radiation (red arrows). Greenhouse gases in the atmosphere (CH<sub>4</sub>, CFCs, CO<sub>2</sub>) absorb this infrared radiation and re-emit it, trapping heat and warming the planet. A city skyline is shown on the ground, and a 'Close' button is in the bottom right corner.

The greenhouse potential is calculated in carbon dioxide equivalents, CO<sub>2</sub>-Eq.

Since the length of stay of a gas in the atmosphere must be included in the calculation, the time horizon under observation must always be given. This is usually given in relation to a 100 years.

In evaluating the greenhouse effect, it should be taken into consideration that the effects are global and of a long duration.



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## Sustainability, Steel and the Environment

### IISI Sustainability Indicators

steeluniversity.org > Steel Processing > Sustainability > Sustainability, Steel and the Environment

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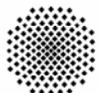
Section Contents...

### Indicators of Sustainability

The International Iron and Steel Institute (IISI) has identified 11 indicators of sustainability and is using these to measure the contribution of the steel industry to sustainable development. These are:

- Investment in new processes and products (% turnover)
- Operating income (% turnover)
- Return on Capital Employed (% capital employed)
- Value Added (% total revenue)
- Greenhouse Gas emissions (tonnes CO<sub>2</sub> / tonne of crude steel produced)
- Material Efficiency (%)
- Energy Intensity (GJ / tonne crude steel)
- Steel Recycling(% crude steel produced)
- Environmental Management Systems (% total employees / contractors working in Registered Production Facilities)
- Employee Training (Training Days / employee)
- Lost Time Injury Frequency Rate (Frequency / 1,000,000 hours worked)

The latest report from IISI on "The Measure of Our Sustainability - Report of the World Steel Industry 2004" can be found at <http://www.worldsteel.org/sustainability.php?page=report>



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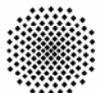
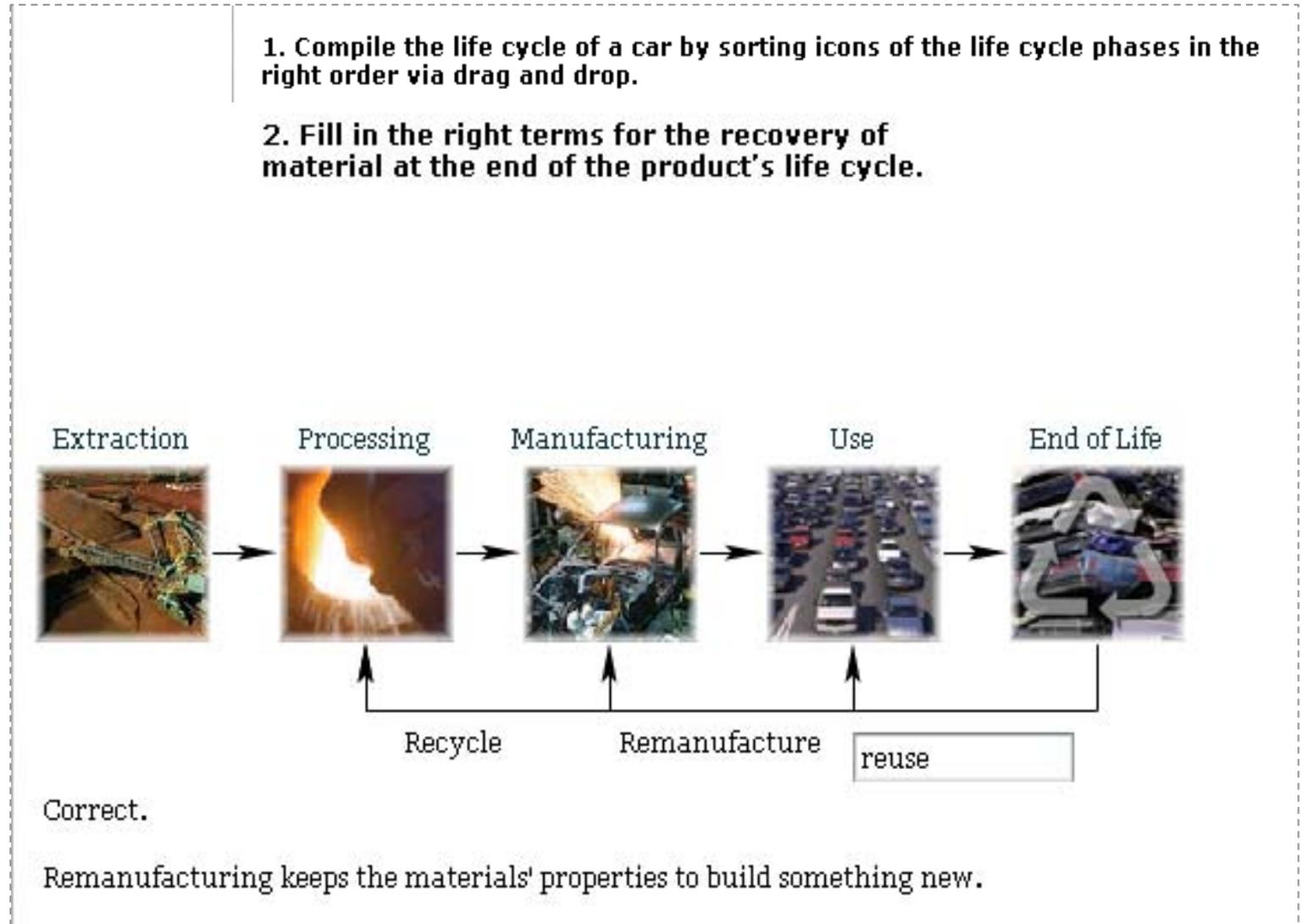
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## Principles of Life Cycle Thinking

The module about the life cycle of steel products contains:

- ✓ Interactive exercises
- ✓ Lessons
- ✓ Queries
- ✓ Tests



### Lessons on methodology of Life Cycle Assessment:

- ✓ Goal & Scope
- ✓ Functional Unit
- ✓ System Boundaries
- ✓ Life Cycle Inventory Analysis
- ✓ Impact Assessment
- ✓ Interpretation of results

3. The **Impact Assessment** evaluates these inputs and outputs from an environmental point of view.

In the graphic click on the elements of an LCA to find out more about the procedure and the individual steps of an environmental Life

| Assessment  | Impacts | Effects  | Inventory table        |
|---|---------|--|------------------------|
| Introduction  |         | Characterization   | Calculation of impacts |
| Concerns  |         | Indicator Result   |                        |
| <b>3. Life Cycle Impact Assessment</b>  |         |  |                        |
| <b>Characterisation of environmental impacts</b>  |         |  |                        |
| <p>The classification of elementary flows simply means to group flows with the same qualitative environmental impact.</p> <p>For global warming it means that all emissions contributing to this environmental effect are grouped, e.g. carbon dioxide, methane, laughing gas (nitrogen(I) oxide), etc.</p> <p>The <b>characterization</b> step within the impact assessment involves the quantification of the emission's possible impacts. This is done in order to achieve one indicator for one impact category (e.g. Global Warming Potential, GWP) by summing the total potential impact.</p> |         |  |                        |
| <b>Enter the answers for:</b>   |         |  |                        |
| 1. What is the GWP characterisation factor for N <sub>2</sub> O?  |         | <input type="text"/>   |                        |
| 2. What is the EP characterisation factor for ammonia?  |         | <input type="text"/>   |                        |
| 3. What is the POCP characterisation factor for CH <sub>4</sub> ?   |         | <input type="text"/>   |                        |
| <input type="button" value="Check score"/>  |         |  |                        |
| <b>Resources:</b><br>....   |         | <b>Inventory Results</b>   |                        |
| <b>Emissions to air:</b><br>CO <sub>2</sub><br>CF <sub>4</sub><br>CH <sub>4</sub><br>N <sub>2</sub> O<br>NO <sub>x</sub><br>SO <sub>2</sub><br>HCl<br>HF<br>Chloromethane<br>Trichloroethane<br>...   |         | <b>Characterization Factors</b><br>GWP 100 (kg CO <sub>2</sub> Equiv.) |                        |
| <b>Emissions to water:</b><br>Phosphate<br>NH <sub>3</sub><br>NH <sub>4</sub><br>...  |         | AP (kg SO <sub>2</sub> Equiv.)   |                        |
| Phosphate<br>NH <sub>3</sub><br>NH <sub>4</sub><br>...  |         | EP (kg Phosphate Equiv.)   |                        |
| ...   |         | ODP (kg CFC11 Equiv.)  |                        |
| ...   |         | POCP (kg Ethene Equiv.)  |                        |
|   |         | Methane 166,67<br>Alkane 2,5<br>NO <sub>x</sub> 35,7<br>Ethene 1       |                        |
|   |         | Σ GWP <sub>i</sub> * Emission <sub>i</sub> [kg]                        |                        |
|   |         | Σ AP <sub>i</sub> * Emission <sub>i</sub> [kg]                         |                        |
|   |         | Σ EP <sub>i</sub> * Emission <sub>i</sub> [kg]                         |                        |
|   |         | Σ ODP <sub>i</sub> * Emission <sub>i</sub> [kg]                        |                        |
|   |         | Σ POCP <sub>i</sub> * Emission <sub>i</sub> [kg]                       |                        |
|   |         | Σ GWP  |                        |
|   |         | Σ AP   |                        |
|   |         | Σ EP   |                        |
|   |         | Σ ODP  |                        |
|   |         | Σ POCP   |                        |



# steeluniversity.org: The module “Sustainability”

## Applications of Life Cycle Assessment

### of a Car: Consequences of Material Selection Decisions

and example of how effective changing the material can be in reducing the environmental impact of a car is the use of higher strength steel to reduce the weight of a car, thereby reduce fuel consumption and hence emission of green house gases and the conservation of the resources of oil.

has conducted an in-depth study (ULSAB AVC - Ultra Light Steel AutoBody Vehicle Concept) to show that the use of high strength steels and advanced automotive manufacturing techniques, including hydroforming and laser welding, in a lightweight vehicle is capable of providing significant weight reduction, improved economy, a high level of safety and passenger comfort, at low cost – see [www.worldautosteel.org](http://www.worldautosteel.org)

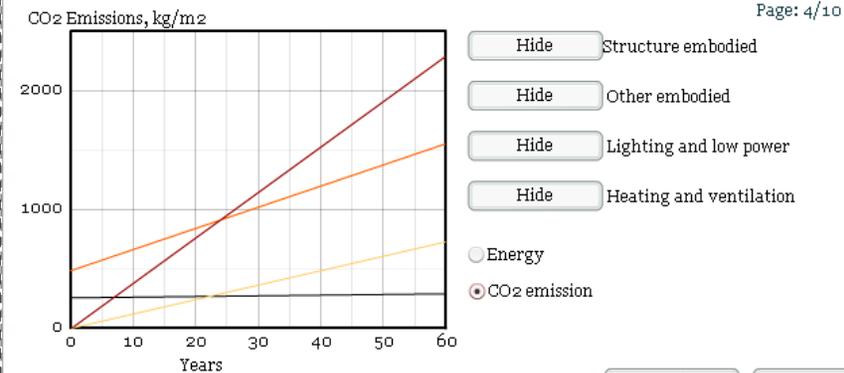


materials used and the performance characteristics of each car are:

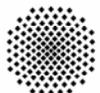
| Materials /kg                     | Conventional | ULSAB AVC |
|-----------------------------------|--------------|-----------|
|                                   | 91.34        | 40.75     |
|                                   | 840.00       | 594.33    |
| Iron                              | 154.13       | 47.83     |
| Ferrous Metals                    | 127.52       | 64.77     |
| Aluminum                          | 150.02       | 126.55    |
| Other Materials                   | 180.68       | 123.37    |
| Weight                            | 1553.69      | 997.60    |
| Life Cycle Vehicle, km            | 193,000      | 193,000   |
|                                   | Petrol       | Petrol    |
| Fuel Consumption                  |              |           |
| /100 km                           | 10.3         | 4.5       |
| (US)                              | 22.8         | 52.4      |
| Doors                             | 4            | 4         |
| Passengers                        | 6            | 5         |
| Acceleration time to 100km/h /sec | 10.7         | 13.9      |

Examples from and exercises on steel, automotive and construction

### LCA of a Building - Phase 2: Life Cycle Inventory



| Years                   | Energy, GJ m <sup>-2</sup> |           |             |             |             |             | CO <sub>2</sub> Emissions, kg m <sup>-2</sup> |            |             |             |             |             |             |             |
|-------------------------|----------------------------|-----------|-------------|-------------|-------------|-------------|---|------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                         | 0                          | 10        | 20          | 30          | 40          | 50          | 60  | 0          | 10          | 20          | 30          | 40          | 50          | 60          |
| <b>Slim-floor</b>       |                            |           |             |             |             |             |   |            |             |             |             |             |             |             |
| Structure Embodied      | 2.6                        | 2.6       | 2.7         | 2.7         | 2.8         | 2.8         | 2.8   | 251        | 255         | 260         | 264         | 268         | 272         | 276         |
| Other Embodied          | 6.2                        | 8.6       | 11          | 13.4        | 15.8        | 18.1        | 20.5  | 474        | 652         | 830         | 1007        | 1185        | 1262        | 1540        |
| Lighting and low power  | 0                          | 5.6       | 11.2        | 16.8        | 22.4        | 28          | 33.6  | 0          | 383         | 765         | 1148        | 1530        | 1913        | 2295        |
| Heating and Ventilation | 0                          | 2.2       | 4.3         | 6.5         | 8.6         | 10.8        | 13  | 0          | 123         | 246         | 369         | 492         | 615         | 738         |
| <b>Total</b>            | <b>8.8</b>                 | <b>19</b> | <b>29.2</b> | <b>39.4</b> | <b>49.6</b> | <b>59.7</b> | <b>69.9</b>                                   | <b>725</b> | <b>1413</b> | <b>2101</b> | <b>2788</b> | <b>3475</b> | <b>4062</b> | <b>4849</b> |



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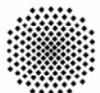
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## Conclusions

steeluniversity.org is intended to...

- ✓ Inform and inspire students, teachers and steel industry employees to better understand the issues around sustainability
- ✓ Encourage them to conduct Life Cycle Assessments
- ✓ Provide information on relevant environmental effects and impacts causing these impacts in general
- ✓ Provide valuable in-service training and life-long learning for employees in the steel industry supply chain at reduced cost
- ✓ Facilitate research partnerships between academic and steel industry experts
- ✓ Demonstrate the commitment and contribution of the steel industry to a sustainable world and to the knowledge economy



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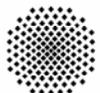


## Awards



Switzerland,  
September 25-27th 2004

*“Innovative and Excellent Graphical Simulations, Open-Ended Problems and Integrated Educational Approach”*



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## Contact

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Chair of physics

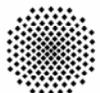
Department Life Cycle Engineering

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<http://www.lbpgabi.uni-stuttgart.de>



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