



CML: Institute of Environmental Sciences



Universiteit
Leiden
The Netherlands



Discover the world at Leiden University.



Welcome

The Institute of Environmental Sciences (CML) is one of the leading global institutes in environmental sustainability. We are pleased to present the highlights of our work over the past year in this annual report. We hope you will enjoy it.

In 2015, we published over 70 papers, contributed to the United Nations conference on climate change in Paris, won awards and advised the Dutch government on the safe use of pesticides. We awarded 11 PhDs and taught students from all over the world how to contribute to sustainability. We wish you a pleasant read.

CML staff, researchers and students

CML aims to contribute to the sustainable governance of biodiversity and natural resources worldwide

Research

CML has two separate research programmes: Conservation Biology and Industrial Ecology.

Our Conservation Biology programme studies the effects of human activities on the entire biological chain, while the Industrial Ecology programme develops tools for decision-making on sustainable production and consumption.

Our research is a balanced mix of fundamental and applied science for national and European science foundations, and contract research for clients such as the Dutch government and the private sector.

Education

CML's courses link science to societal issues and prepare students for a role in managing the world's natural resources and biodiversity. We offer a Masters in Industrial Ecology, a Minor in Sustainable Development, a Master specialization in Conservation Biology, a popular open online course (MOOC) on the Circular Economy and a PhD programme. During their time at CML, students work together in multidisciplinary groups using interactive learning methods.

Industrial Ecology

Resources:
Economic capital



1978

CML was founded as part of Leiden University

2

Research programmes:
Conservation Biology and
Industrial Ecology

5

Teaching programmes

11

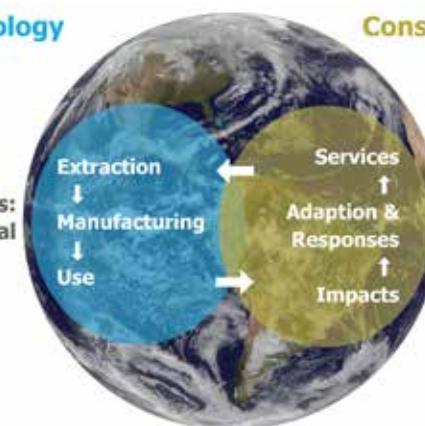
PhDs awarded in 2015

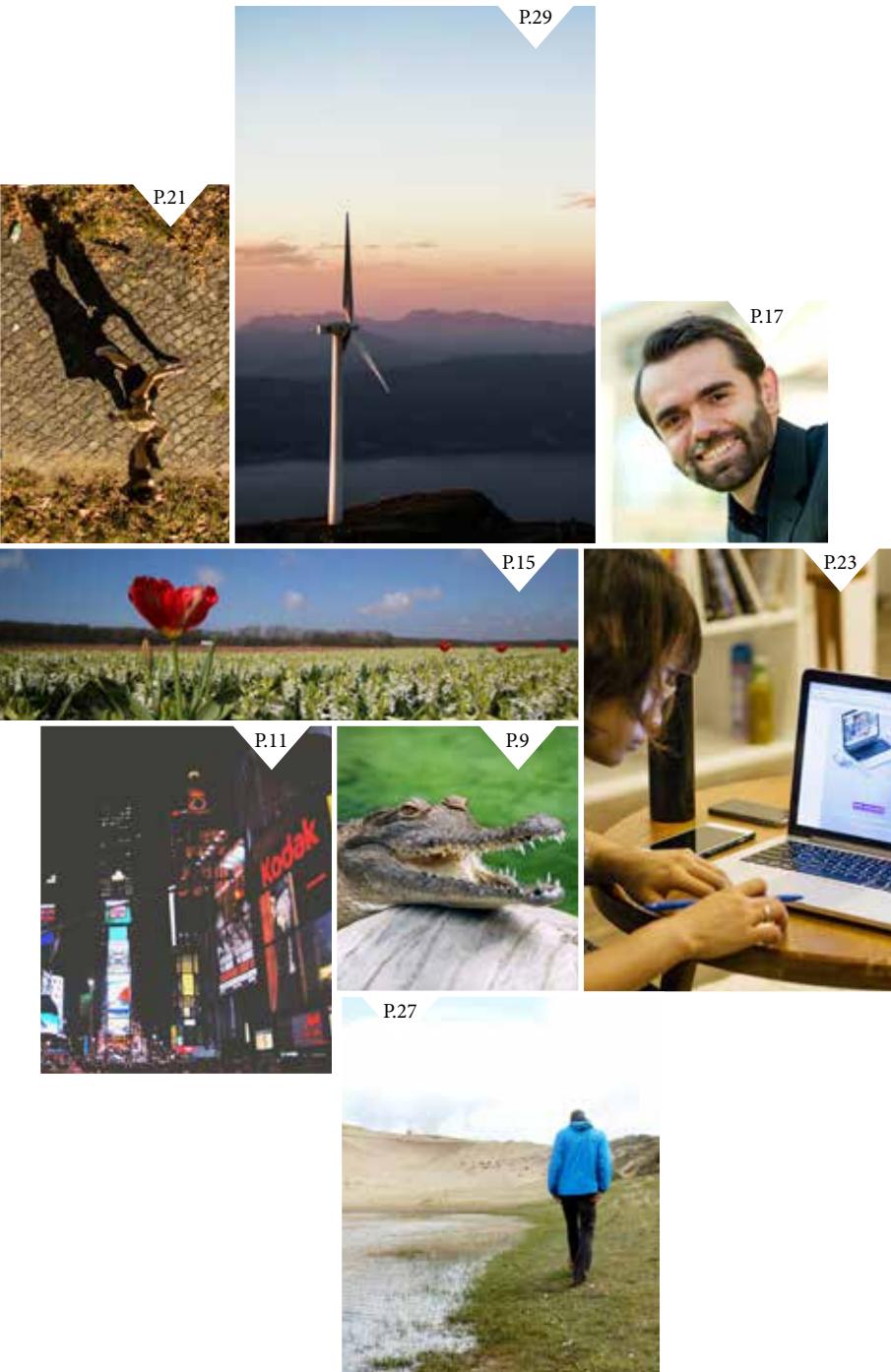
77

Publications in 2015

Conservation Biology

Biodiversity:
Natural capital





Contents

Society

Saving the Philippine Crocodile
CML researcher Merlijn van Weerd receives the Parker/Gentry Award

Quantifying consumption emissions
CML's director presents the Carbon-CAP Project at the Paris Climate Change Conference

Research

CML researches insecticide concentrations
Study for the Dutch government receives media attention

Industrial Ecology PhD researcher wins the Graedel Prize
Combining Life Cycle Analysis with the IPAT Equation

Education

Leiden University & Sustainability
Industrial Ecology students advise Leiden University on how to become more sustainable

Over 7000 students join online course on Circular Economy
CML's Ester van der Voet and Arnold Tukker are instructors

Organisation

Interactions between biodiversity and mankind
Inaugural lecture by Peter van Bodegom

Experts impressed by Industrial Ecology's biodiversity
Successful reaccreditation of CML's Industrial Ecology Masters

Society 2015

René Kleijn wins prize for societal impact

Geert de Snoo in Dutch newspaper Trouw: "Opportunities for godwit and skylark"

January

February

March

April

May

June

CML Director Arnold Tukker talks about resource-efficiency indicators to the Committee of Environment, Public Health and Food Safety at the European Parliament

René Kleijn interviewed on the radio about metal scarcity

CML researcher Merlijn van Weerd wins the 2015 Parker/Gentry Award

Interview in Nieuwe Oogst with CML researcher Martina Vijver about the Dutch policy on pesticides and the possible effects on surface and groundwater

CML researchers Hans de Iongh and Laura Bertola talk on the radio about the declining number of lions in Africa

July

August

September

October

November

December

René Kleijn in a radio Interview discussing the Millennium Goals

Joint publication by CML and Naturalis Biodiversity Center: Analysis of Biodiversity at Dutch Railway Stations

Interview with René Kleijn about urban mining and the circular economy in *Intermediair*

CML's Arnold Tukker and colleagues present the Carbon CAP Project at the Climate Conference in Paris

Various newspaper articles on the life story of CML PhD student J.H. Tuqa



Saving the Philippine Crocodile

CML researcher Merlijn van Weerd receives the Parker/Gentry Award

The Philippine crocodile is one of the most endangered species in the world. Over the past 16 years, Merlijn van Weerd has been working to protect these crocodiles on Luzon Island, in one of only two remaining wild sub-populations. As a result, the number of crocodiles on Luzon increased from 17 in 2001 to over 100 in 2014. In 2015, van Weerd was presented with the Parker/Gentry Award for his work.

Van Weerd began working as a wildlife biologist in the Philippines in 1999 and he and his team soon discovered a small population of Philippine crocodiles. This species was once abundant but had nearly become extinct as a result of hunting. The crocodiles were killed for their skins and meat, as a sport, for revenge and/or out of fear. However the biggest threat to the Philippine crocodile today is the disappearance of its habitat.

To preserve this native reptile, van Weerd and his colleagues set up the Mabuwaya Foundation (the

Filipino words Mabuhay and Buwaya mean “long live the crocodile”). It has adopted a unique people-centred approach to crocodile conservation and generates public support through communication campaigns and by involving local communities in crocodile conservation planning. Crocodiles have thus become more accepted in the area and this, combined with the raising of crocodiles in a safe environment for later release into the wild, has led to an increase in their numbers.

The foundation has broadened its scope to conserve all endemic biodiversity of northern Luzon, including giant fruit bats, the Isabela oriole, the Philippine eagle and the frugivorous monitor lizard *Varanus bitatawa*, which was co-discovered by van Weerd and his team in 2010.

Parker/Gentry Award

The annual Parker/Gentry award is the most prestigious international award in the field of conservation biology and nature research. Van Weerd is the first Dutch scientist to receive the award.

Read more about the Mabuwaya Foundation:
www.mabuwaya.org

“Merlijn’s dedicated work serves as a model for what can be achieved in difficult circumstances with tenacity, dedication and adaptability”

Grahame Webb, Chair of the IUCN-SSC Crocodile Specialist Group



Quantifying consumption emissions

CML's director presents the Carbon-CAP Project at the Paris Climate Change Conference

Human consumption is a key driver of emissions, but this is not always taken into account when climate-change policies are being developed. CML's director Arnold Tukker and other colleagues presented an alternative emission accounting approach, the Carbon-CAP Project, at a side event at the Climate Change Conference in Paris (COP21).

Tukker highlighted how current climate-change accounting, target setting and policymaking methodologies are based entirely on territorial emissions. This means that they account for resource extraction and emissions within country borders. This neglects upstream emissions and resources used in imports. He stressed that this is a "core issue" because carbon embodied in global trade is rising more quickly than total carbon emissions. Around 20% of global carbon emissions are currently directly related to trade.

Structural economic change may help countries to reduce their territorial emissions, while their consumption-related emissions may still be rising. For instance, if countries move carbon-intensive industries abroad, this will result in a reduction in their own territorial emissions. However, their consumption-related emissions will in fact remain the same. This loophole is addressed by consumption-based accounting.

The Carbon-CAP project assesses the amount of carbon embedded in international trade. The COP21 session was the first in a series of events that aim to determine how to frame the Carbon-CAP project within policymaking circles.

The Carbon-CAP Project

The goal of the Carbon-CAP project is to stimulate innovative European and international climate policies and services by improving the shared knowledge base on consumption emissions.

Learn more about the Carbon-CAP Project:
www.carboncap.eu

"CML's research as part of the European Carbon-CAP project shows that the measures countries agreed to take are offsetting each other or causing a rebound effect."

Arnold Tukker, CML's director and Professor of Industrial Ecology

Research 2015

Prizes:

- Stans prize for Best MSc Thesis:

Kevin Groen

- Stans award for Best Scientific Publications:

Patrick J.G. Henriksson

Laura Bertola

CML's Wouter de Groot helps organise the international conference entitled "Motivations and Arguments to Act for Biodiversity. Alternative Ways to Inspire Innovative Policy Making"

PhD awarded to Nynke Osinga for "Comparative Biology of Common and Grey Seals along the Dutch Coast"

PhD awarded to Laura Bertola for "Genetic Diversity in the Lion (*Panthera leo* (Linnaeus 1758)): Unravelling the Past and Prospects for the Future"

11 PhDs awarded

77 publications*

Martina Vijver receives €24,860 from the Gratama Stichting to conduct research on microplastics

PhD awarded to Oleksandra Ieromina for "Effects of Pesticides on Aquatic Macrofauna in the Field"

CML researcher Alexander van Oudenoven appointed as lead author of IPBES's Europe/Central Asia assessment, joining Alexandra Marques (CML), who was the other lead author

*For a complete list of all publications: www.cml.leiden.edu/publications

PhD awarded to Lan Song for "Towards Understanding the Toxicity of Copper Nanoparticles in Aquatic Ecosystems"

2014 Graedel Prize for best paper published by a junior author in the Journal of Industrial Ecology won by PhD researcher David Font Vivanco

PhD awarded to Yang Liu for "Quantifying the Toxicity of Mixtures of Metals and Metal-Based Nanoparticles to Higher Plants"

July

August

September

October

November

December

PhD awarded to Edi Wiloso for "Development of Life Cycle Assessment for Residue-Based Bioenergy"

PhD awarded to Patrik Henriksson for "Evaluating European Imports of Asian Aquaculture Products Using Statistically Supported Life Cycle Assessments"

PhD awarded to Tuqa Jirmo Huqa for "The Impact of Climate Variability on the Ecology of a Lion (*Panthera leo* (Linnaeus 1758)) Population and Lion-Livestock Conflicts in the Amboseli Ecosystem in Kenya"

PhD awarded to Jing Hua for "Determining the Most Appropriate Dose Metrics for Evaluating Dose-Response Relationships of Metal-Based Nanoparticles to Zebrafish Embryos"

CML report published on pesticides in Dutch surface water for the Dutch Ministry of Economic Affairs

PhD awarded to Kai Fang for "Environmental Footprints: Assessing Anthropogenic Effects on the Planet's Environment"

PhD awarded to Roland Ziébé for "Fisheries in the Waza Logone Floodplain : an Analysis of the Status of the Fisheries Sector and Mitigation of Conflicts within the Sector in North Cameroon"



CML researches insecticide concentrations

Study for the Dutch government receives media attention

Agricultural chemicals pose a threat to ecosystems and human health. That is why the Dutch Ministry of Infrastructure and the Environment commissioned CML researchers Wil Tamis, Maarten van 't Zelfde and Martina Vijver to study imidacloprid concentrations in surface water. They concluded that surface water concentrations of this insecticide strongly exceeded environmental quality criteria.

Growers use imidacloprid to protect crops from insects. It prohibits the nicotine neuronal pathway of insects, which results in them becoming paralysed and die. Recent research has suggested that the widespread agricultural use of imidacloprid may be contributing to the honey bee colony collapse disorder. As a result, several countries have restricted the use of imidacloprid and other neonicotinoids. The Dutch government has implemented policy measures to reduce imidacloprid use too. For example, it has been illegal since 2014 to use the substance

in greenhouses that do not have a water-purification system. CML's research is being used to assess the effectiveness of these measures.

CML studied imidacloprid concentrations in five regions: two with greenhouses and three where trees and bulbs are cultivated. The two regions with greenhouses had the highest concentrations and the amount of imidacloprid being used had barely decreased in these areas since the new measures had been implemented. Concentrations in the tree and bulb-growing areas were much lower, and had even decreased in recent years.

Pesticide Atlas

The researchers used their Pesticide Atlas – a free online tool developed to offer insight into pesticide levels in surface water – to analyse imidacloprid concentrations. Data were collected by various water boards that have been monitoring the quality of surface water in the Netherlands for years.

Read the report here:
tinyurl.com/pesticeresearch
Visit the Pesticide Atlas:
www.pesticidesatlas.nl

"This kind of research is important because it can help policymakers to make informed decisions."

Martina Vijver, Associate Professor of Ecotoxicology



Industrial Ecology PhD researcher wins the Graedel Prize

Combining Life Cycle Analysis with the IPAT
Equation

David Font Vivanco received the Graedel Prize for Best Paper by a Junior Author. He wrote his paper jointly with Ester van der Voet (CML), Reinout Heijungs (CML) and René Kemp (Maastricht University). They analysed the contribution of technological innovation to environmental pressures.

It is generally believed that technological innovation is key to solving many of the environmental challenges we face today. However, even though products are becoming more energy efficient, their overall impact on the environment is still increasing. In their article, the authors present the IPAT-LCA model that they used to scale up the environmental profiles of products by considering aspects of demand at the macro level. They combined LCA with the IPAT equation: Impact (I) = Population (P) * Affluence (A) * Technology (T). This allows them to explain more profoundly the correlation between technical innovation and environmental challenges.

A case study illustrates their approach. They analysed carbon dioxide (CO_2) and nitrogen oxide (NO_x) emissions from diesel cars in Europe between 1990 and 2005. Empirical analysis of these cars highlighted the discrepancies between micro (LCA) and macro (IPAT-LCA) approaches. While diesel engines have a better environmental product profile than their gasoline counterparts, total CO_2 and NO_x emissions would have increased in any case. This is mainly driven by the increase in consumption of other goods caused by the induced direct price rebound effect from fuel savings and fuel price differences. This counterintuitive result shows the need for models such as IPAT-LCA.

The Graedel Prize

The Graedel Prize is awarded annually to the best two papers published in the Journal of Industrial Ecology (JIE) by a senior and a junior author. Font Vivanco won the award for a paper written by a junior author.

Read the prize winning article here:
tinyurl.com/PaperFontVivanco

"CML provided me with an exceptional environment to develop both personally and professionally. I especially value its human capital, and treasure the inspiring interaction with the staff and other PhD students."

David Font Vivanco, Postdoc at Yale School of Forestry & Environmental Studies

Education 2015

Presentations by Minor students:

“Wheels of Metals: A Circular Economy
for Metals”

Industrial Ecology students advise
Leiden University on how to be more
sustainable

January	February	March	April	May	June
MSc in Industrial Ecology MIND programme in Industrial Ecology					
Masters Track in 'Evolution, Biodiversity and Conservation'					
Teaching at Leiden University College					
Minor in Sustainable Development					

Guest lecture by Ernst Worrell entitled
“Material Matter: Connecting Energy
and Material Efficiency”

Industrial Ecology Network Event

July	August	September	October	November	December

Marianne Thieme, parliamentary leader
of the Party for the Animals, gives
introductory lecture to the Sustainable
Development Minor 2015-2016

Over thirty alumni attended the first
Industrial Ecology Alumni Event



Leiden University & Sustainability

Industrial Ecology students advise Leiden University on how to become more sustainable

Leiden University is responsible for its actions, its community and its environment, both now and in the future. Being internationally oriented and research based, it has the potential to play an influential role in tackling global challenges. Five of CML's Industrial Ecology students considered what the University could do to become more sustainable. Their aim was to make Leiden University the leading Dutch University in sustainability by 2050.

The students found that Leiden University was already doing well in certain areas: it offers sustainability education in its Minor and Masters programmes and sustainability-related research was identified in nearly every faculty. Certification schemes have also been adopted, for instance for the new science building. Sustainability was taken into account in energy procurement and 100% of the energy used by Leiden University comes from renewable sources. In addition, waste streams have been declining steadily at an average of 3% annually.

"I hope our report has increased the ambitions of the university to not just be 'good enough' but to become more proactive and ambitious in approaching sustainability issues."

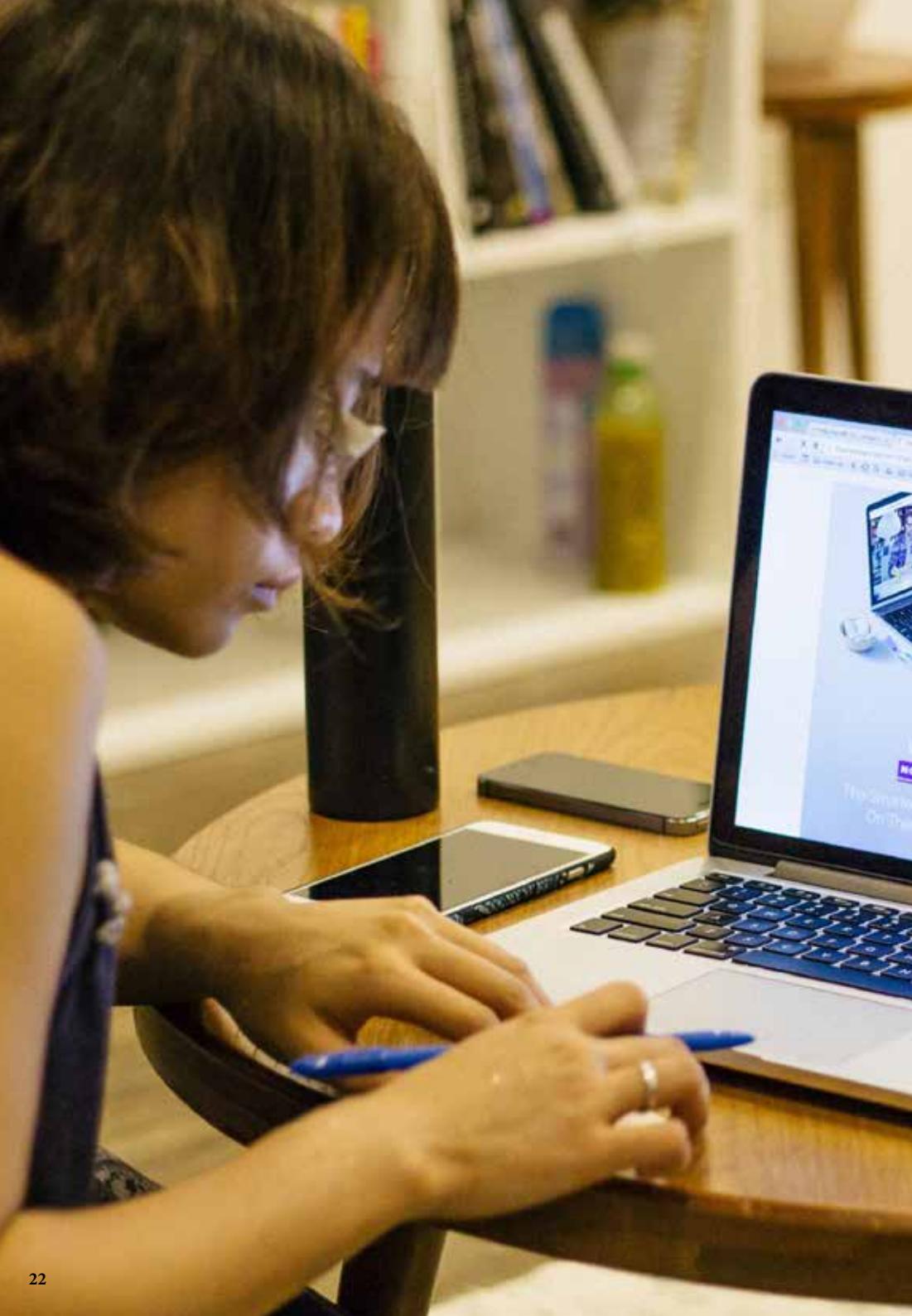
Miranda Verboon, Graduate Student Industrial Ecology

The students also identified areas that could be improved and concluded that sustainability performance and initiatives could be communicated more effectively. They therefore advised Leiden University to establish a student-led, staff-supported Green Office to coordinate sustainability-related issues. This would be similar to those already operating at Maastricht University, Utrecht University, Groningen University and VU Amsterdam. The student researchers presented their findings to Leiden University's executive board and also at the sustainability congress organized by Green Keys (Leiden University's student sustainability group).

Interdisciplinary project groups

The project was part of the Industrial Ecology "Interdisciplinary Project Groups" course. Problem-oriented education allows second-year students to cooperate across various disciplines and come up with practical solutions. Groups were formed based on their preferences for project topics in deliberation with staff members from the universities involved and external parties, discipline (background) and nationality.

Read the report here:
tinyurl.com/MasterKeyReport



Over 7000 students join online course on Circular Economy

CML's Ester van der Voet and Arnold Tukker
are instructors

In a circular economy, we reuse, remanufacture and recycle our products and the take-make-waste way of doing things is coming to an end. This Massive Open Online Course (MOOC) on the circular economy encourages students to take the first steps towards an alternative economic model. CML staff members Ester van der Voet and Arnold Tukker are among the instructors.

Van der Voet offers a fresh perspective on metals in a circular economy in the course and states that urban mines, which are above-ground stocks of metals, are the mines of a circular economy, as opposed to underground stocks of metal.

Why are urban mines the mines of a circular economy? First of all, if one accesses urban mines instead of geological mines, supply is spread and the world will no longer be dependent on only a few mines. This reduces supply risk. Secondly, urban mines are much less energy-intensive compared to

conventional mines and are the only way to reduce energy requirements for metal production.

In another part of the course, Tukker describes how companies can move from a “sell more, sell faster” model to a business model that emphasises selling services instead of products. Describing the most important challenges regarding this shift, Tukker says “Changing culture is very hard and that is what you have to do”.

MOOC on the Circular Economy

Over 7000 people from 155 countries followed this MOOC and because it is now a free, self-paced, online learning tool, students can continue to enrol in it. The course consists of seven chapters, each of which takes 4-6 hours to complete. It is led by TU Delft and was set up jointly with the Ellen MacArthur Foundation and the Leiden-Delft-Erasmus Centre for Sustainability.

This is CML's second MOOC, in 2014 it released the popular Wheels of Metals course.

Follow the Circular Economy online course at:
tinyurl.com/CourseCircularEconomy

“This course has opened my eyes to the power of the economy and how it changes the world hopefully in a good way towards a circular economy. A circular economy is the only way to go if we want to preserve our planet. Thanks a lot!”

Participant of Circular Economy MOOC

Organisation 2015





Interactions between biodiversity and mankind

Inaugural lecture by Peter van Bodegom

"The world around us is changing, and that change is probably going faster than ever before". This was how Peter van Bodegom began his inaugural address on the way mankind and nature continuously influence each other. He hopes to solve societal and scientific questions by understanding and quantifying interactions.

Humans change the environment by, for instance, developing cities, cutting down forests or abandoning agricultural land. Nature reacts and adapts to these changes and this, in turn, affects humankind. For example, forests capture the carbon dioxide that humans emit through industrial processes. There are many ways in which ecosystems and biodiversity react to human actions, and this subsequently influences humankind. It is a two-way process.

Van Bodegom aims to find 'unifying concepts' through biodiversity research. One possible way of realising a general quantitative approach is by

looking into the traits of organisms. It is impossible to predict how every individual plant species will react to and influence people, but every species has a set of traits through which reaction and influence are expressed. For example, nearly every plant relies on roots to absorb nutrients and moisture, on a stem for support, storage and transportation, and on leaves to absorb carbon dioxide. By understanding the circumstances under which traits are favoured and the influence this has on the functioning of the ecosystem they are part of, we can potentially predict how ecosystems will react to changes.

Van Bodegom has been working on such a concept for the past ten years with fellow scientists. They have developed TRICYCLE, a model in which a selection of plant traits can be described by a set of environmental factors.

Peter van Bodegom

Prof. van Bodegom is Professor of Environmental Biology and head of CML's Department of Conservation Biology. He works at the interface of environmental sciences, ecology, microbiology and biogeography.

"I sincerely hope that increasing the understanding between the relationship between man, nature and ecosystem services and the dissemination of that knowledge will lead to a more responsible use of our planet by man"

Peter van Bodegom, Professor of Environmental Biology



Experts impressed by Industrial Ecology's biodiversity

Successful reaccreditation of CML's Industrial Ecology Masters

Talented students from around the world are now coming to Europe in large numbers to obtain their Masters in Industrial Ecology. And while they are at CML, they gain expertise in working on real-world sustainability challenges. This Masters programme was successfully reaccredited in 2015 by an international panel of experts.

The panel recognised that Industrial Ecology is a relatively new programme. Although the programme is still developing, students and alumni were able to identify the essence of Industrial Ecology. The panel saw the programme's strong systemic, solution-oriented approach as its most important element, combined with its pragmatic focus on applications.

The panel was impressed by the 'biodiversity' of the students in terms of academic background, nationality and culture. In 2014, 41% of students had a background in engineering, 20% in the natural sciences and 39% in the social sciences. Students

from 57 different nationalities participated in CML's Industrial Ecology Masters between 2004 and 2014. The panel spoke to students, who said they experience a tough study load. This is caused partly because of their diverse background, every student has to master the basics of one or two new areas. To deal with this, students organize forms of 'remedial teaching'. For instance, natural science students teach math to social science students. In turn, they help with social science oriented skills and knowledge, such as writing a paper.

The Future of Industrial Ecology

The growing interest in the Industrial Ecology Masters can be seen in its enrolment figures, with student numbers growing fourfold between 2004 and 2014. The curriculum is constantly being reviewed to cater to the larger group of students and closer cooperation with the Rotterdam School of Management is strengthening the business part of the course. These developments will allow Industrial Ecology graduates to play a greater role in facilitating a smooth transition to a world that will hopefully ensure "the good life" for 9 billion people by 2050.

"The programme has provided a list showing the jobs of graduates. Of these, 28% work in research and 69% in 'industry' (including consultancy, government). Only 3% are unemployed. Industrial Ecology graduates are clearly in demand."

International panel for reaccreditation



See you next year?

We trust this annual report has given you an idea of our institute's activities and successes in 2015. For additional information, please visit our website: cml.leiden.edu or contact us on +31 (0)71 5277461 or by email at secretariaat@cml.leidenuniv.nl. We look forward to hearing from you.

We are proud of what we achieved last year and are excited about what the future will bring!
CML staff, researchers and students

Colofon

Compiled by Merel Segers – Sustainability Analysis & Communication.

Editorial team

Concept design and content: Merel Segers
Graphic design: Marta Suanzes
Language editing: Ann Reeves

Our thanks go to all the CML staff, researchers and students who contributed to this report:

Paul de Hoog, Maarten van 't Zelfde, David Font Vivanco, Merlijn van Weerd, Martina Vijver, Mart Lubben, Natalia Uribe, Miranda Verboon, Peter van Bodegom, Arnold Tukker, Alexander van Oudenhooven, Geert de Snoo, Marloes van Kuppevelt, Nadia Soudzilovskaja and Ellen Cieraad.



Universiteit
Leiden
The Netherlands



CML

Institute of Environmental Sciences