Course Description

Science and Citizens meet Challenges of Sustainability

Summer semester 2020,
3 March to 2 June 2020

An interdisciplinary course for exploring responsibilities citizens can assume in a knowledge society.

Open to participation by professionals and students from all degree programmes.

ECTS:	6 (Course work & Report)
	4 (Peer group work)
Day & time:	Tuesdays 17.15-20.30
Campus:	Kirchberg
Contact:	Christellle Karleskind
E-mail:	christelle.karleskind@uni.lu
Responsible:	Ariane König
Office hours :	14.00-17.00 (with appointment)

UNIVERSITÉ DU LUXEMBOURG

Course Description

How can 'science' meet challenges of sustainability? What responsibilities can citizens assume in a knowledge society? We think of Science as a social institution, on the analogy of The Law or The Churches or Medicine. We know that it is realised by individuals in particular organisations, each with defined tasks, privileges and ethical responsibilities; these are derived from a variety of 'contracts', some explicit with the State, others informal with various sectors of society and individuals. Traditionally science was mostly conceived as autonomous, detached and objective, creating a 'fountain of facts', the fruits of which are passed on to Society. The responsibility of Society traditionally was to provide room and means for Science to unfold.

This conception is however slowly changing: for example, sustainable development needs recognition of uncertainty, complexity and issues of social and personal ethics. Accordingly, the concept of knowledge production has been fundamentally revised over the last decades. The development of science, technology and social norms, rules and laws, are increasingly conceived as linked or 'co-produced'. Awareness of and the possibility to act in the face of uncertainties from complex intertwinement of science, technology, politics and social practices are desirable, for scientists and citizens alike.

In this new and challenging situation, there is a creative interaction of the roles and responsibilities of science and citizens. Every scientist engaged on sustainability issues must also be a citizen. They have a duty to make their special knowledge available for public debate; but also a special responsibility not to pretend to more certainty and objectivity than is justified. On their part, citizens must evaluate the scientific bases behind competing claims and policies. For this they must respect expertise but decide which experts to trust more than others in that particular context. And they must be aware of their own commitments, perspectives and prejudices.

This course provides tools for better understanding and acting in the face of complexity and interdependencies of the natural and social world. The three dimensions of learning of the first course remain central themes across all units:

1. How we know, why do we accept?
2. How can we better take account of diverging interests and expertise
3. Local and global interconnectedness, interdependencies and inequalities and tensions

Learning concept

We distinguish three levels at which learning occurs: the community (all participants including lecturers), peer-groups of 5-6 students, and individuals.

L*earning at the level of the community*: You will join a diverse learning community, guided by our *interdisciplinary team* of natural and social scientists and practitioners, who are working closely together and cross-question each other. Learning will largely occur through group interaction during sessions, and the development of a joint report on the course. An *alternation* of closed lectures, public lectures and engaged learning activities will offer possibilities to engage with *diverse view points* on each issue. The engagement of *practitioners* will ensure societal salience, and the *open lectures will allow you to connect to public reactions and debates on the issues*. Conceptual tools provided in the *engaged learning activities* highlight challenges and facilitate the drawing together of diverse perspectives and disciplinary approaches where possible.

For *peer-group learning*, each peer-group of 5-6 students will still be assigned to one thematic unit and two lecturers from that unit. There will be two tasks: first, the peer- group is asked to develop a project to improve sustainability on the topic and based on the course material of their assigned thematic unit in a semi-fictitious city. Each peer-group will

present an interim plan for coordination across peer groups, and a final plan in the concluding session of the course. There will be a guidance document for this project work. Secondly, each peer-group is asked to write a report on their thematic unit, identifying four key lessons, and discussing the literature and course material from their jointly developed perspective. They can include a brief discussion of their project work. All five peer group reports will be assembled to a joint report on the course, and the concluding session will serve to brain storm on how to develop a concluding chapter for the learning-communities joint course report. Thus we can develop a learning community synthesis document reflecting our community learning process and priorities.

Individual learning *will rely on t*he combination of keeping a course diary after each session, working on five short assignments, and writing a reflexive essay at the end of the course on the impacts of the course on personal and professional activities and plans.

INTRODUCTION

Tuesday 03.03.2020 17.15-20.30

Session 1. Sustainability challenges in the 21st century: How can we tackle them here in this course?
(Room C15)

17.15-19.15 Setting the scene for the course, course design and objectives
Dr Ariane König, University of Luxembourg

In this first session, we will discuss changing roles of science and citizen's in fostering systemic change for sustainability. In this lecture we will provide an overview on core themes and all the lectures to come in this semester. Science is organised in disciplinary silos, yet the challenges are where humans meet with their environment and with each other. The economy and governments are organised in sectors, yet the real challenges of the 21st century transcend sectors and are often situated at the nexus of several sectors, where there are interdependencies, trade-offs and tough decisions to be made. In this course, we will be looking at the water-food-energy nexus. We will ask: 'Why science and how each and everyone of us produces knowledge part of the problem and the solution?' Why do we need 'sustainability science' and what does it look like? We will also critically discuss the role of measurement regimes to assess societal transformations, and social learning processes to change social practices in the face of serious systemic constraints. Last, but not least, we will explore how science and citizens can meaningfully engage in such change processes.

Break

19.30-20.00 Sustainability– what does is the meaning of this word in the here and now?
Work in break out groups on describing a sustainable society, and what changes are required in Luxembourg.

20.00 Break-out groups presenting back, synthesis and conclusions (30 min)

Readings:

Rockström, J., Steffen, W., Noone, K., Persson, A., Chapin, F.S., Lambin, E., Lenton, T.M., et al. (2009), "A safe operating space for humanity," Nature, 461, September, pp. 472-475.

Jasanoff, S. (2001). Technologies of Humility: Citizen Participation in Governing Science. *Minerva* , (X), 1-28.

 Further readings:

König, A. (2018). Sustainability science as a transformative social learning process. *Sustainability Science*. Routledge. pp. 3-29.

Maggs, D., Robinson, J. Sustainability in the Anthropocene

Miller, T.R., Wiek, A., Sarewitz, D., Robinson, J., Olsson, L., Kriebel, D. & Loorbach, D. (2013). The Future of Sustainability Science: A Solutions-oriented Research Agenda. Sustainability Science 9(2): 239-246. doi: 10.1007/s11625-013-0224-6

Wiek, A., Withycombe, L. & Redman, C.L., 2011. Key competencies in sustainability: a reference framework for academic program development. Sustainability Science, 6(2), pp.203-218. Available at: http://www.springerlink.com/index/10.1007/s11625-011-0132-6 [Accessed March 5, 2012].

Tuesday 10.03.2020 17.15-20.30

Session 2. Contemporary problems of science and their implications for sustainability science and education (Room C15)

Ariane König, University of Luxembourg

17.15 -18.30 What is science and what are its contemporary problems?

In this lecture we will juxta-pose competing conceptions of science, technology, knowledge and their relation to progress to ask -- what is 'quality' in science? What are science's contemporary problems in the information age and in the face of populism? What are challenges of quality control.

19.00 -20.30 Citizen Science : What potential does it have as a tool for good governance in our networked knowledge society ?

How might we leverage the potential of the networked knowledge society for transforming knowledge production and social practice for sustainability? In this interactive session we will explore innovative tools and processes of citizen science. Its founding fathers take an empiricist view of the world, but also try to enrich the web with functions that help building communities across differences to counter the prevalence of individualizing algorithms on the web.

Readings:

Kuhn, T. 1962. The structure of scientific revolutions. Introduction. The University of Chicago Press. Pp. 1-10.
Popper, K. Conjectures and refutations. (Essay on Moodle).

Rorty, R.1999. A philosophy of social hope. Preface & Introduction. Penguin books. Pp. xii – xxxii.

Wals, A.E.J., Brody, M., Dillon, J. & Stevenson, R.B. (2014). Convergence between Science and Environmental Education. Science 344 (6184): 583-584. doi: 10.1126/science.1250515

 Further Readings:

Ravetz, J., 2006. Post-Normal Science and the complexity of transitions towards sustainability ☆. *Ecological Complexity*, 3(4), pp.275-284. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1476945X07000037 [Accessed July 31, 2011].

Mark S. Reed et al., 2010, what is social learning? Ecology and Society

Friday 17.03.2020 17.15-20.30

Session 3. Transformative and social learning for sustainability (Room A16)

17.15 -xx.xx **Theory of knowledge in the International Schools curriculum**
Dorothée Prendergast (4TU)

xx.xx -20.30 **The School Futures project: Learning and transformation for sustainability in practice**
Bo Raber & Joy Mertz

- ***Readings:***

Tuesday 24.03.2020 17.15-18.30

Session 4. Quantity and quality: Indicators to assess impacs and progress on sustainability transitions PART I. (Room A16)

17.15 -18.30 **The ecological footprint - A case study**
Paula Hild, University of Luxembourg

The first systematic attempt to calculate the Ecological Footprint and biocapacity of nations began in 1997 (Wackernagel et al. 1997). Since 2003, the National Footprint Accounts are used to measure one main aspect of sustainability: how much biocapacity humans demand, and how much is available (Borucke et al. 2011). The presentation about the Ecological Footprint will highlight the calculation method behind this highly aggregated indicator, its merits in terms of communication and its limitations towards other sustainability aspects and environmental concerns. Luxembourg's Ecological Footprint will be presented as a case study.

- ***Readings:***

Ravetz, J., Hild, P., Bollati, J., Thunus, O. (2018). Sustainability Indicators: Quality and quantity. In A. König (Ed.), *Sustainability science: Key issues*. (pp. 271-296). Abingdon, UK: Routledge.

Wackernagel, M., Onisto, L., Linares, A.C., Falfán, I.S.L., García, J.M., Guerrero, A.I.S., Guerrero, M.G.S., 1997.*Ecological Footprints of Nations: How Much Nature DoThey Use? How Much Nature Do They Have?* Commissioned by the Earth Council for the Rio+5 Forum. Distributed by the International Council for Local Environmental Initiatives, Toronto.

Further reading:

Borucke, M.; Moore, M.; Cranston, G.; Gracey, K.; Iha, K.; Larson, J.; Lazarus, E.; Morales, J. C.; Wackernagel, M.; Galli, A. (2011).*Accounting for demand and supply of the Biosphere's regenerative capacity: the National Footprint Accounts' underlying methodology and framework*.

Wednesday 25.03.2020 17.30-19.00

Session 4. Quantity and quality: Indicators to assess impacs and progress on sustainability transitions PART II. PUBLIC LECTURE. **Salle Paul Feidert**

Walter Radermacher

Tuesday 31.03.2020 17.15-20.30

Session 5. Cognitive pitfalls in the face of complexity (Room A16)

17.15-18.30 Cognitive pitfalls in face of complexity
Philipp Sonnleitner, University of Luxembourg

When facing problems of sustainability, people inevitably have to deal with a certain amount of complexity. Such problems are often dynamic and in-transparent, encompassing a large number of interconnected elements and various stakeholders following several, partly contradictory goals. However, a large body of research shows that even in simple problem situations human decision-making behavior is flawed by systematic thinking errors, inconsistencies, anchoring- or framing effects, and unconscious preferences, which lead to suboptimal decisions. When dealing with complex problems like the sustainable water supply of a region, these thinking errors become aggravated by the human tendency to focus on narrow sub-problems and the inability to recognize dynamics within a system or to understand exponential growth. A first step to avoiding such thinking errors on the micro- as well as the macro level is being aware of the brain systems which underlie decision making, their way of functioning, and the resulting possible cognitive pitfalls. This lecture therefore focuses on the human cognitive architecture and the ability to deal with complexity in order to raise awareness of cognitive limitations and how to overcome them.

The lecture will be complemented by a preceding hands-on exercise in which participants can engage with a so-called serious, computer-based game they choose from a list of freely available programs. Their experiences during this process will be the starting point of a joint discussion of the role of emotions, limited capacity of the brain, and possible solutions and strategies to overcoming limitations of the human cognitive architecture in order to make sound, rational and--hopefully--sustainable decisions.

Readings:

D. Kahneman, A Perspective on Judgment and Choice, pp. 697-720, Copyright 2003 by the American Psychological Association,

Sonnleitner, P. (2018). Cognitive pitfalls in dealing with sustainability. In A. König (Ed.), *Sustainability science: Key issues*. (p. 82-95). Abingdon, UK: Routledge.

19.00-20.30 Systems thinking and cognition in complex human-environment systems: Considering feedbacks between what we think and see, and how act and do in designing for sustainability
Ariane König, University of Luxembourg

The University of Luxemburg is currently adapting and further developing the collaborative conceptual systems mapping (CCM) method developed by Proust and Newell (2006) in two transdisciplinary research projects. The purpose is to develop the CCM method for its ability to create problem-oriented dialogue and shared priorities for

action among a diverse set of stakeholders in spite of differences in interests, expertise, values and worldviews. The two projects where the CCM method is being further developed are embedded in two different fields of practice – one project is concerned with future-oriented systems thinking in Luxembourg schools, the second project that is conducted in collaboration with two river partnerships is concerned with sustainable engagement with water and land. The lecture will first briefly outline the development of the CCM method and its theoretical underpinnings within the systems literature. Subsequently, some of the key lessons learned from applying the CCM method in different workshops in Luxemburg over the past 12 months will be shared. The main focus will include a critical reflection on the CCM method and its potential for creating problem-oriented dialogue across differences in order to identify leverage points for transformative learning. Of specific interest is whether the CCM method, which draws on practice- and place-based learning and experience, has the potential to direct dialogue and influence between the personal, social, technological and biological spheres in social-ecological-technological systems. Implications for sustainability transformations include suggestions for adapting the CCM method to better enable stakeholders to dialogue, to create collaborative and place-based knowledge and to fuel transformative change in Luxemburg's schools as well as water and land use nexus.

This lecture will provide the background for the practice of the CCM method in the workshop on 11 May 2019.

Readings:

Newell and Proust (2018). Escaping the complexity dilemma. In A. König (Ed.), *Sustainability science: Key issues*. (pp. 96-113). Abingdon, UK: Routledge.

Proust, K., and Newell, B., 2006, Catchment & Community: Towards a management focused dynamical study of the ACT water system, Final Report, Actew Project WF-30038. http://www.water.anu.edu.au/pdf/publications/2006/Proust_Newell06.pdf

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Tuesday 21.04.2020 17.15-20.30

Session 6. Transforming food systems for sustainability

17.15-18.30 Systemic analysis of the sustainability transition in Luxembourg's foodscape. Methodological and theoretical framework.
(Room A12/13)

Rachel Reckinger, Diane Kapgen, Helena Korjonen, University of Luxembourg

Contemporary food systems in developed countries have proven to be largely unsustainable: apart from providing food security and food safety to their national populations, they entail considerable negative environmental and health externalities, fail to address rural poverty throughout the world and create and foster power imbalances in food chains, and social injustice on different levels (De Schutter, 2017). Given these facts, researching the transition processes towards a more sustainable food system and culture from a *systemic approach* by focusing on the involved actors from the four interdependent spheres of governance, production, diffusion and consumption as well as their potential optimisation is primordial.
This lecture discusses how such an approach allows for understanding the opportunities and challenges of processes of a sustainable food transition by sharing preliminary findings from a systemic analysis of Luxembourg's transnational food system. We show how the food system can be envisioned as a dynamic multi-scalar and multi-sited foodscape by drawing from visual tools like infographics, and how these tools can contribute to increase the capacity to grasp and work with food system complexity. We present the methodology and the theory allowing us to analyse the current state of the system (including interrelationships, pressure points, gaps, blockades and opportunities), and to elaborate potential pathways for optimization of different leverage points within the system.

- ***Readings:***

Reckinger, R. (2018). Social Change for Sustainable Localized Food Sovereignty. Convergence between Prosumers and Ethical Entrepreneurs. Sociologia del Lavoro, 152(4).
Reckinger, R. (2019). 'Pas de fraises pour Noël'. Le rôle de la régionalité locavore dans la (re)prise de conscience de la saisonnalité des aliments . In C., Adamiec, M.-P., Julien, & F., Régnier, L'alimentation au fil des saisons. La saisonnalité des pratiques alimentaires. Rennes, France: Presses Universitaires de Rennes.

19.00 - 20.30 PUBLIC LECTURE – How can agro-ecological transitions increase the resilience of rural areas?

Salle Paul Feidert
Nicolas Dendoncker, Unviersité de Namur

Agroecology has been proposed as a promising concept to foster the resilience and sustainability of agroecosystems and rural territories. Agroecological practices are based on optimizing ecosystem services (ES) at the landscape, farm, and parcel scales. In this presentation, we will highlight how the concept of ecosystem services (ES), defined as the contributions of ecosystems to human well-being can help understand agroecological transitions. We will provide examples from salient research comparing agroecological and conventional farms through the lens of ecosystem services. We further argue that ES can be a tool to steer and facilitate agroecological transitions, but other theoretical and methodological approaches, combined by a series of practical tools, need to be mobilized in order for agroecological transitions to increase the resilience of rural areas. We will give examples of transition initiatives in Belgium and France, mixing research and action, that have started using such approaches. Finally, we will reflect on what we believe are necessary next steps for action-research to meet the challenges posed by pressing socio-environmental issues.

- ***Readings:***

Dendoncker, N., Crouzat, E. (2018). Can ecosystem services help the new agricultural transition? In A. König (Ed.), Sustainability science: Key issues. (pp. 169-183). Abingdon, UK: Routledge.

Mazoyer M. & L. A. Roudard, History of World Agriculture: From the Neolithic Age to the Current Crisis

Steel C. 2009, Hungry City - How Food Shapes Our Lives

- ***Further Readings:***

International assessment of agricultural knowledge, science and technology for development (IAASTD) : Executive summary of the synthesis report: a synthesis of the global and sub-global IAASTD reports / edited by Beverly D. McIntyre . . . [et al.]

The Economics of Ecosystems and Biodiversity - TEEB - Synthesis Report http://www.teebweb.org/TEEBSynthesisReport/tabid/29410/Default.aspx

Bawden, Richard (Centre for Systemic Development, U. of W.S.H.) (1997), "Learning to persist: A systemic view of development" in F. Stowell, R. Ison, R. Armson, J. Holloway, S. Jackson, S. McRobb. (Ed.), *Systems for Sustainability* People, Organizations, and Environments**,** Springer US, Boston, pp. 1-5.

Tattersall, P.J. (2010), "What is Community Based Auditing and how does it work?," Futures, Elsevier Ltd, Vol. 42 No. 5, pp. 466-474. doi:10.1016/j.futures.2009.11.031

Tuesday 28.04.2020 17.15-20.30

Session 7. Transforming the water system

17.15 – 20.30 Innovation in water systems: what does the future hold? (Room A12/13)
Paul Schosseler (4TU)

The circular economy is a buzz-word often used in the hope that this new way of organizing the economy holds the key to making our production and consumption more sustainable. This lecture will explore future potential challenges in reconciling economic growth and development plans with regional limitations to water supply in view of the potential the circular economy holds. Three different scenarios that shape different approaches to 'going circular' with different design logics for innovations and different roles for hybrid systems with humans, AI and infrastructures will help to better understand the interplay of the social, technological and environmental spheres in our dynamic and complex social-ecological-technological systems.

- ***Readings:***

Tuesday 05.05.2020 17.15-20.30

Session 8. Energy systems and futures

17.15 - 18.30 "Energy consumption and generation – can we make a difference?" (A16)
Phillip Dale, University of Luxembourg

Can we live in energy balance?

Do you know how much energy you use personally every day? Do you know how many photovoltaic modules or fractions of a windturbine's time is required to cover that use renewably? Does Luxembourg have the resources to go 100% renewable given its current population? It is easy to say we want renewable energy to power our lives, but have we checked if it is physically possible. We will answer these questions during the talk. In order to do so, we will discuss the concepts of energy and power, generation and consumption. To facilitate this discussion and to make it more fun, we need data…and I invite you to carry out an energy audit of your own life. I would be very happy if you would send me this data several days before the talk, and I would present it anonymously next to my own during the talk.
Please could you send to phillip.dale@uni.lu as much of the following information as possible:

- Your electricity use in a given time and how many people this might involve
- Your oil/gas use for heating in a given time and how many people this might involve
- The kilometers that you drive or the amount of money that you spend on fuel per unit of time.
- Other transport, planes, trains, including holidays as well as the distance travelled
- Your eating choices
- Whether you have pets?
- Anything else you can think of in a quantifiable way?

- ***Readings:***

In order to prepare for this discussion it would be extremely useful if you could read at least chapters 1 and 2 of this book, Sustainability without the hot air by David MacKay, which can be downloaded here:
http://www.inference.org.uk/sustainable/book/tex/sewtha.pdf

19.00 - 20.30 **PUBLIC LECTURE – ENERGY SUSTAINABILITY** (Salle Paul Feidert)
Ciaran McGinley, NormannPartners & Oxford Scenarios Programme

We live in a world that is increasingly turbulent, uncertain, innovative and full of ambiguity. How do large institutional and industrial actors in the energy sector successfully plan in such an environment? How do they navigate this complexity? How do they frame sustainability? With so many contextual drivers changing at the same time and with increasing speed, what does success look like in this sector – and for whom?

A way of seeing the world – a model of how things work around here - is a very powerful thing. It empowers you as a manager to act, to steer, to set targets, monitor KPIs and to get things done. But inside every model is a blind spot – a way of not seeing. And that is where scientific discovery and theory starts to get really important. The truth is that one map, one model, is never enough. We all need different models, different maps, different frames to see differently and to get things done – and to get them done well. And, today more than ever, the global energy sector needs different ways of seeing the world to navigate through the transition to a sustainable energy ecosystem.

This lecture will introduce participants to how some of the world's largest energy players are framing this transition. It will introduce participants to exploring some of the main issues in the energy sector through the use of reframing techniques, scenario planning, system thinking, value constellations and dilemma thinking from a practitioner's perspective.

- ***Readings:***

MacKay, David JC, 2009. Sustainable Energy - Without the Hot Air. Cambridge: UIT Cambridge Ltd.

Saturday 09.05.2019 10.00-16:00

Session 9. SATURDAY WORKSHOP (Room A12/13)

10.00 -16.00 **Future-oriented systems thinking to understand challenges at the water-food-energy-nexus**
Ariane König and Kristina Hondrila, University of Luxembourg

This workshop provides the opportunity of a hands on practice of exploring sustainability challenges at the food water energy nexus collaboratively in a future-oriented manner using a set of scenarios fo rhow we engage with water and food in the year 2045. There will be the possibility of developing a concrete project proposal.

- ***Reading:***

Drenth, G., König,A., and Elahi, S. (2018).Chapter 7. Working with scenarios. In A. König (Ed.), Sustainability science: Key issues. (p. 96-113). Abingdon, UK: Routledge

Tuesday 12.05.2020 17.00-21.00

Session 10. **A visit to Centre HOLLENFELLS AND PEER GROUP PRESENTATIONS & DINNER**
Futures for education and peer group presentation
Michel Grevis, Head of Center SNJ Hollenfels, Luxembourg

Castle Hollenfels Luxembourg's fortress for education on sustainable development.

17.00-21.00 **Presentations from peer-groups on key insights drawn in their unit in the context of the course**

Presentation on the future of education as conceived in the Luxembourg SCHOOL FUTURES Project.
Presentation by the peer group.
Wrap-up discussion – All in the learning community

19.00-19.30 Education in Sustainability in Luxembourg at Centre Hollenfells - Michel Grevis, the "Châtelain", Head of SNJ Hollenfels.

Concluding debate on main conclusions to be included in conclusion section of the community course report.

19.30 Dinner in the castle

ILAN CHABAY , IASA Potsdam, Public lecture on Tuesday 2 June 2020 from 18.00-19.30 – Salle Paul Feidert

Biographies of contributors

Phillip Dale spends most of his time researching how to make solar cells more efficient and less expensive. Recently he has become interested in the question of whether we can live in renewable energy balance, and whether there are really physical or technical obstacles, or is it rather a question of economy, education, and politics? He is an Associate Professor at the University of Luxembourg leading a new research programme into advanced, higher efficiency, photovoltaic devices. Besides researching, he also teaches in the Physics bachelor and masters programmes, as well as co-initiated the physics outreach programme of the Scienteens. Some more information about his research group can be found here *physics.uni.lu/research_areas/energy_materials*