



Innovative Green Teaching

Primer on Innovative Teaching Techniques of
Environmental and Energy Topics

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**Chair for Management of Renewable Energies,
Institute for Economy and the Environment,
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The Good Energies Chair at the Institute for Economy and the Environment, University of St. Gallen, focuses on issues related to management of renewable energies, including analysis of investment strategies and policy, as well as research on business models and consumer behavior. The Chair's research has been published in leading academic journals in the field and has informed decision-makers in Switzerland and internationally. The Chair was founded in 2009 and is led by Prof. Dr. Rolf Wüstenhagen.

<http://goodenergies.iwoe.unisg.ch>



**School of Economics and Business Administration,
University of Tartu, Estonia**

The School of Economics and Business Administration is part of the Faculty of Social Sciences, with a history of more than 75 years of teaching business and economics. The School has a leading role in Estonian economic and business education, and it is *alma mater* for most Estonian business and political leaders. In 2016, a group of students and faculty members launched the *Ecoinnovation* club, with a goal of incorporating sustainability-related issues into the teaching of core economics subjects.

www.mtk.ut.ee



**Oleg Balatsky Academic and Research Institute of
Finance, Economics and Management,
Sumy State University, Ukraine**

Faculty of Economics and Management at Sumy State University was founded in 1992. In 2016, the Faculty was reorganized and renamed into Oleg Balatsky Academic and Research Institute of Finance, Economics and Management. The institute focuses on issues related to economics and business administration, finance, management, marketing, and international relations. Other research fields also include environmental economics and management, sustainable development, renewable energy resources, and innovations. The Institute is led by Prof. Sc.D. Tetiana Vasylieva and is a leading institution of e-learning in Ukraine. It was ranked as the best business school in Ukraine according to the Webometrics, 2013.

<http://fem.sumdu.edu.ua>

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Introduction and acknowledgements

This primer is intended to assist teaching faculty at institutions of higher education with the integration of new teaching techniques in their classrooms. The primer offers a list of possible approaches and provides some useful links, which can serve as inspiration and a starting point. After providing a general overview of interactive teaching techniques, we adapt our examples to the field of teaching environmental and energy topics. While this primer should be useful for teaching a wide range of undergraduate and graduate classes, it has a particular focus on environmental and resource economics, energy policy

and economics, entrepreneurship, sustainable business and management.

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New teaching techniques

“Tell me and I forget, teach me and I may remember, involve me and I learn.”

Benjamin Franklin

While frontal lectures still remain the most common form of instruction, research shows that students absorb the least amount of information during lectures (about 10%) compared to more interactive teaching methods (about 90%) (Dale, 1969)¹. As a result, it is not surprising that new teaching techniques are receiving more widespread recognition. Without real-world practical applications, students often fail to comprehend the lessons-learned from study material. In contrast, utilization of active teaching methods can turn the learning process into an engaging and attractive activity for students. Active learning means that the mind is actively engaged: instead of being passive

observers, students assume the role of dynamic participants in their learning, reflecting on and monitoring both the learning processes and its results (Barkley, 2010)². Often these new interactive teaching styles engage the audience by encouraging group work and mutual help, while also allowing students to make individual contributions and promoting healthy competition. Active teaching methods tend to lead to a higher level of understanding of new concepts. Importantly, students learn to apply the newly acquired knowledge in their everyday lives, while having a positive and ‘fun’ experience in the classroom.

1 Dale, E. (1969). *Audiovisual Methods in Teaching* (3rd ed.), New York: Dryden Press

2 Barkley, E.F. (2010). *Student Engagement Techniques: a Handbook for College Faculty*, Wiley/Jossey-Bass, USA

Blended Learning

Blended Learning is a new approach to education that connects classroom learning with digital learning, involving a mixture of face-to-face activities and online learning (Picciano, 2009)³. Typically, students work with a teacher while at school and use online resources at home. In this way, blended learning allows students more flexibility and a personalized study experience, as they can work at their own pace and obtain immediate feedback online.

Blended learning can be applied to a variety of academic courses and disciplines. In-class activities can be supplemented by online quizzes, exercises, and video and audio materials. Simulation games can be also used as an in-class activity. For an enhanced learning experience, they can be videotaped while engaging in exercises and the content

can be critiqued later by peers and the instructor. Detailed analysis of the blended learning technique was provided by Bogden (2014)⁴.

Example:

Apostolou (2017)⁵ describes the use of blended learning in the context of teaching an energy balance course. In addition to traditional lectures, the course included eleven labs, during which students acquired hands-on skills related to chemical equipment, instruments, data acquisition, data analysis, and report writing. Several online modules substituted for face-to-face time. Moreover, online quizzes were used for testing, encouraging students to read through the materials. Thanks to online learning and testing, this left more face-to-face time for active learning in the classroom.



USEFUL LINKS

Short video “What Is Blended Learning?” by The Learning Accelerator:

<http://youtu.be/X4gA-eeJrcc>

Short video “Fundamentals of Blended Learning” by Education Elements:

<http://goo.gl/fLxnBK>

Description of the blended learning models by Christensen Institute:

<http://www.christenseninstitute.org/blended-learning-definitions-and-models/>



³ Picciano, A.G. (2009). Blending with purpose: The multimodal model. *Journal of the Research Center for Educational Technology*, 5(1). Kent, OH: Kent State University.

⁴ Bogden, J.F. (2014). *Blended Learning: Bringing Personalized Education to Scale*. National Association of State Boards of Education. Discussion guide. July 2014. Available online at: http://www.noche.org/media/1/Blended-Learning-Discussion-Guide_7-09-14.pdf

⁵ Apostolou, K. (2017). Effectiveness of blended learning for an energy balance course. *Proceedings of the Canadian Engineering Education Association*, [S.l.]. Available online at: <http://ojs.library.queensu.ca/index.php/PCEEA/article/view/6443>

Flipped Classroom

Flipped classroom is one example of blended learning. In contrast to traditional teaching when the new material is explained in class, the flipped classroom technique allows students to learn lecture material before class, which opens up class time for different activities, problem solving, and other forms of instruction that has traditionally been assigned as homework (Szparagowski, 2014)⁶. Students are expected to complete readings, watch video lectures and familiarize themselves with all lecture materials at home before class. In a familiar setting at home, students can study materials at their individualized pace, having the ability to re-read assignments, rewind videos and get additional help and input to fully understand materials. As supplemental materials, a teacher could assign TEDtalks, videos on Youtube, recorded lectures, or podcasts. In such a way, students will be prepared for active learning in class by joining discussions and debates, applying their knowledge to solve case studies, delivering presentations, preparing posters or playing simulation games. This also re-assigns some responsibility for student's success from the teacher to the student.

Flipping the classroom allows students to take a more active role in their education, while the class instructor acts as a guide, helping if difficulties arise. Flipped classroom technique can be useful in the teaching of sustainability or environmental and energy-related topics. Marks et al., (2014)⁷ offer a description of a flipped classroom while teaching sustainable engineering at the University of Pittsburgh and Pennsylvania State University. The flipped classroom technique was implemented by preparing recorded videos and voice-over PowerPoint slides instead of traditional in-class lectures. These videos were accompanied by quizzes to ensure students studied the lecture material. In class, the students completed active learning exercises. After class, a survey investigating the results of implementing the flipped classroom technique has shown positive student feedback. More than half of the students stated that they frequently were able to put their class knowledge to use during activities in the classroom and that they learned skills that will be useful in their future careers. Some examples of skills mentioned include adaptability, leadership, and communication.

USEFUL LINKS

Additional information on the flipped classroom technology is available online:

Education blog by Jackie Gerstein, Ed.D:

<http://goo.gl/KjvaUj>

Introduction to Ecology course by Andrew Tredennick, Ph.D:

<http://goo.gl/X3a9Tu>



6 Szparagowski, R.(2014). The Effectiveness of the Flipped Classroom. Honors Projects. Paper 127. Bowling Green State University. Available online at: <http://scholarworks.bgsu.edu/honorsprojects/127/>

7 Marks, J., Ketchman, K.J., Riley II D.R., Riley, L., Bilec M.M. (2014). Understanding the Benefits of the Flipped Classroom in the Context of Sustainable Engineering. 121st ASEE Annual Conference & Exposition. Paper ID # 9053. Available online at: <http://goo.gl/519SJA>

Case study

“The case method packs more experience into each hour of learning than any other instructional approach. It stimulates students' thinking and encourages discussion. Not only is it the most relevant and practical way to learn managerial skills, it's exciting and fun.”

Harvard Business Publishing

What is case method teaching?

According to the Case Center, an online resource with over 59,400 cases: ‘The case method has its roots in the ancient techniques of Socratic dialogue or questioning, as well as Aristotelian logic and the method of argument and counter-argument.’ The case method immerses students into real-life business situations, where a protagonist, often a CEO or a business manager, is facing a challenge. Being a recognized teaching method used in business schools around the world, the case method is a powerful teaching tool, as it gives students the chance to wear the hat of a decision-maker. Cases simulate the reality of managerial decisions by including real-life characteristics like incomplete information, time constraints, conflicting goals, or budget limitations. Working alone or in teams, students analyze the pros and cons of various approaches to solving a prob-

lem. As students discuss possible solutions to business situations, they learn to connect theory with practice, while simultaneously developing a wide range of vital skills that are valuable on the job market. These essential skills include negotiating, doing analysis, defending their own and challenging others' viewpoints, working in teams and developing strategies. The cases usually do not have a right or wrong solution, instead they are designed to spur debate and encourage deeper understanding of learning materials. Given the complexity of environmental and sustainability issues facing both business managers and political decision makers, the case study method represents a suitable teaching tool. The case study may be either descriptive in nature, helping students trace a particular issue back in time, or it may be more provocative and forward-looking, requiring decision-making in situations with limited information.



USEFUL LINKS

Case Startup Kit by Harvard Business Publishing:

<http://goo.gl/7X9R1A>

Case studies available for download:

Harvard Business Publishing:

<http://cb.hbsp.harvard.edu/cbmp/pages/content/cases>

oikos international:

<http://oikos-international.org/programmes/cases-program/>

MIT Management Sloan School:

<http://mitsloan.mit.edu/LearningEdge/Pages/Sitemap.aspx>

The Case Center:

<http://www.thecasecentre.org>

Two Case Study Examples

1) Wind in the Sails: Managing Social Acceptance of Large Wind Energy Projects in Switzerland⁸

[catchy title with important keywords]

Abstract *[usually not longer than 300-500 words]*

[Introduction of general context and time frame] Shortly after the Fukushima meltdown of 2011, the Swiss government developed Energy Strategy 2050, aimed at building up renewable energy capacity, improving energy efficiency and phasing out nuclear energy. Yet, growth in the wind sector had been disappointing. This case study examines the factors that took the wind out of the sails of large wind projects in Switzerland, paying special attention to the risks associated with public policy and stakeholder opposition. *[What are the learning aims?]* Though focusing on Switzerland, the lessons learned from the case study are applicable internationally, with multiple examples of large infrastructure projects being halted or severely delayed by public opposition and red tape. *[Introduce the protagonist]* Staged in May 2017, the case centers around Nadine Haller, who has been developing a large wind project for the last five years. *[Most protagonists are male and most case studies take place in the US. So a little diversity is encouraged]* She has just learned the news that Energy Strategy 2050 has been accepted by popular vote and she is contemplating what this result means for her project.

[Data sources, connection to reality] The case study is based on interviews with more than 20 wind project developers and permitting authorities. Several teaching options are included. The storyline can be updated as relevant news develops, creating new challenges for Nadine. The case offers an accompanying cash flow calculation model, teaching students that social acceptance and regulatory compliance come at a significant cost. Another option is a role-play game, where students try wearing hats of differ-

ent project stakeholders: the project developer, the head of municipal government, a local landowner, a journalist, and a member of an environmental NGO, among others. *[Summarize teaching options]*. The case also offers a framework to systematically approach project-related risks and develop risk-mitigating strategies. It should be relevant to graduate students from a variety of backgrounds, including communications, finance, law, and economics. *[Define the most appropriate audience]*

Keywords: renewable energy; stakeholder engagement; public opposition; regulation; project management *[Up to six keywords should cover most important aspects of the case]*

2) Sustainable development of university campus: the case study of the University of Tartu⁹

Sustainable development is usually linked to positive effects on the environment, society and the economy. The current case study investigates an additional aspect of sustainability, financial sustainability, as applied to the redevelopment of the campus of the University of Tartu. The case study argues that the redevelopment of university campuses in Central and Eastern European countries, implemented with the help of the European Union structural funds, has two competing impacts. On the one hand, it improves the quality of the study environment and decreases the CO₂ footprint of the buildings. On the other hand, it puts the universities under a potential financial strain in having to manage the (re)developed buildings. The main question of the case study is: How does the university achieve financial sustainability (avoid potential financing gaps) and maintain appropriate upkeep of the real estate, given the university's limited budget and a major cut of support from the EU structural funds in Estonia?

⁸ Free case from oikos case collection, available online at: <http://oikos-international.org/publications/wind-in-the-sails/>. Teaching Note available upon request.

⁹ Manuscript by Dr. Kaia Kask, kaia.kask@ut.ee

Case Study Teaching Notes

Teaching Note could include the following elements:

1. **Summary of the case study**
2. **Learning objectives**
3. **Target audience:** graduate or undergraduate students, discipline
4. **Recommended literature:** peer-reviewed or not, possibly subdivided by topics
5. **Teaching options by discipline:**

5.1. For all students: evolving case

The case study can be taught as a developing case. The teacher can introduce the following “news”, which are all imaginary future scenarios and are relevant to the project developer, the CEO Nadine Haller. What strategic actions can she take to respond to this news?

The Swiss population voted in favor of Energy Strategy 2050 in May 2017 (true!)

Local media has written a damning report about Nadine’s wind project.

A federal agency is not sure whether an important permit can be granted and requires a new study to reassess the project.

5.2. For all students: analysis of wind project risks and their mitigation strategy.

Task students with identifying different risk categories of a wind project (e.g. financing, management, administrative risks) and discuss risk-minimizing strategies.

5.3. Marketing and communications students: developing an optimal communications strategy.

Task students with development of an optimal communications strategy to win a municipal referendum against the building of wind turbines.

5.4. Finance students: building a discounted cash flow model for a wind park and respond to unexpected changes.

Task students with building a realistic discounted cash flow (DCF) model by providing the most important details and assumptions. In addition to being an exercise in finance, students will learn how unexpected deviations from the ideal cash flow impact the project.

5.5. Law and public policy students: developing ‘investment grade’ policy recommendations.

Law and economics students could focus on policy uncertainty and suggest policy design options. Which ones are optimal from project developer’s perspective? What about societal perspective?

6. Notes on examination and grading case solutions

7. Possible structure for discussions:

Ask several students to sum up the case study, but do not ask for solutions or introduce new information yet. Then, divide students into groups of a maximum of 7 students. Add new information from the “news” above and let the groups discuss Nadine’s strategic responses. Allow at least 10 minutes for group discussion. Encourage students to think about advantages and disadvantages of their solutions and to provide international examples. Ask the first group to present their solutions in a short pitch of a maximum of 2 minutes. Make sure that the speakers from the groups are rotating. Ask another group to present their ideas, without repeating what was already said. Summarize their suggestions (e.g. by noting them on a flipchart) and provide your input with respect to whether students considered the most important aspects of the case and whether there were other possible responses.



Engaging in public debate

Lively discussions do not have to end in the classroom and students can be encouraged to actively engage in public debates. Thanks to digitalization, everyone can contribute their opinion on the most pressing sustainability issues today, such as climate change, environmental degradation or energy innovations. There are multiple teaching options to engage students, mostly aimed at formulating and publicly disclosing their informed opinions.

The aims of these exercises are manifold:

- to familiarize students with the most recent topics of discussion,
- to make students think critically and consider multiple viewpoints,
- to encourage students to publicly express their opinions and enhance their writing skills,
- to teach students about refuting the incorrect statements sometimes found in the media.

Writing an op-ed. An op-ed is a short opinion piece, which summarizes a well-articulated viewpoint of the writer, supported by the facts. The most successful op-eds usually address a topical issue that is discussed in the news, and often represent opinions that are diverging from or complimentary to what has been published before. The Earth Institute at Columbia University¹⁰ provides a handy guideline for writing op-eds.

As a homework assignment, students can be asked to take a stance on a recent article that appeared in an internationally renowned news outlet, such as Science, Nature, National Geographic, the Wall Street Journal, or the Economist. Alternative outlets can have a national, regional or even local reach, depending on the topic at hand. The topics

can be pre-selected by the teacher or self-selected by the students. Many outlets allow any member of the public to submit opinion pieces. If a news outlet accepts a student's op-ed for publication, this is the best compliment to a student. Their opinion piece can reach thousands of readers as a result. Submissions should be encouraged and students should receive generous points towards their final grade if their piece is accepted. Another way to evaluate an op-ed is peer-review by other students.

Writing a blog post. Like op-eds, blog posts are short opinion pieces, but are published online and have to be accepted by a blog moderator, who ensures quality. Some schools have their own blogs or set up course blogs for students. In this case, the course instructor can assume the role of the moderator. Students can also get engaged by writing responses to the posts of influential bloggers. There are a number of exceptional international blogs available with a sustainability focus, e.g. Katharine Hayhoe's blog, NASA Climate blog, PERColator blog, WWF blogs, to name a few.

Engaging with public opinion makers on social media. Students can identify public opinion makers (scientists, businessmen, celebrities) whom they either passionately agree or vehemently disagree with and follow them on the social media. The aim is to discern the reasons for agreeing or disagreeing with these opinions. Students might want to follow some prominent players in sustainability questions, listed alphabetically: Al Gore, Michael Liebreich, Bjorn Lomborg, Bill McKibben, Elon Musk, Richard Toll, Daniel Yergin. Foreign Policy magazine publishes an annual list of the most eminent thought leaders and public intellectuals, who are often engaged in sustainability and energy debates and have a social media presence.

¹⁰ The Earth Institute (2010). Writing and Submitting an Opinion Piece: A Guide, The Earth Institute. Columbia University. Available online at: www.earth.columbia.edu/sitefiles/file/pressroom/media_outreach/OpEdGuide.doc

Debates: Oxford Union style and Karl Popper style

“Debates provide a framework to help students develop more mature ways of thinking as they start to recognize the range of perspectives inherent in complex topics and internalize a view of knowledge that is dialogic, contingent, and ambiguous.”
(Barkley, 2012).

Debate is a formal method of presenting arguments that support or oppose a given issue (British Council, 2011)¹¹. Sustainability issues, as well as broader energy questions, can be discussed by means of debates. First, a statement is chosen, e.g. ‘Nuclear power can easily be substituted with solar energy’. After that, students are divided into groups that act according to assigned roles and are given a strict time limit. One party argues in favor of the statement (the affirmative team), while another competing party provides arguments against that statement (the opposition team). Both teams have equal time to present their arguments. The jury decides which party is more convincing based on the quality of the arguments presented.

There are two main types of debates: Oxford Union style debate and Karl Popper style debate (IDEA, 2004¹²; ECGL, 2005¹³). There are strict rules for both types of debates, with a specific role assigned to each player. There can be two participants in each team in the Oxford Union style debate, and three to four team members in the Karl Popper style debate.

Debates are composed of several parts. Most time is dedicated to speeches, which are uninterrupted presentations by a designated speaker. The remaining time consists of cross-examination – that is, a series of questions and answers involving one speaker from each side. There is a strict time limit for each speech and cross-examination, as well as a specific purpose for every presentation.

- The first affirmative speaker is expected to offer the complete argument *in favor* of the solution. Later, the other affirmative speakers may repeat some points and expand on them.
- The two debaters are expected to face the audience

(opposite to each other). The opposition is expected to ask questions rather than make speeches. The affirmative speaker is expected to answer these questions; he or she should not make speeches or ask questions in return. Every session ends with questioning.

- The opposition speaker is expected to offer a complete argument *against* the affirmative position.
- The affirmative speakers must outline refutations of the opposition’s arguments and must respond to the refutations made by the opposition team. This speech is reactive. During the last rebuttal, the debater presents the refutations that have not been addressed adequately and focuses the attention of judges on the key issues.
- The opposition rebuttal must respond to the refutations made by the affirmative speakers and continues attacking the affirmative team’s arguments. However, the last speaker cannot introduce new arguments, because the affirmative team will not have a chance to respond (the last speech acts more as a summary of prior arguments).

Tips:

- **Karl Popper style debate**

After a debate is finished, the audience can also play an active role. Based on the arguments, the audience members can decide whether they were persuaded by the affirmative or the opposition team. Judges vote according to the quality of the evidence, arguments and performance in the debate, deciding the winner.

- **Oxford Union style debate**

The audience can join the floor debate after the first round of speeches is finished. The floor debate is limited in time and proceeds with the second round of speeches.

11 British Council (2011). Public debating in principle and practice. Available online at: <http://goo.gl/Zw2KJr>

12 International Debate Education Association (2004). Karl Popper Debate. Available online at: <http://goo.gl/ixCSCq>

13 European Corporate Governance Institute (2005). Oxford Union style debate: Sequence & History. Available online at: <http://goo.gl/yHTEJh>

Debates: an illustration

Oxford Union style debate



Karl Popper style debate



USEFUL LINKS

Student debating associations worldwide:

UCL Debating Society: <http://www.debating.org>

Yale Debate Association: <http://www.yaledebate.org>

International Debate Education Association: <http://idebate.org>

Debate Central: <http://debate.uvm.edu>



Pitching competitions

It has become increasingly popular among students to present their ideas in the form of a pitch. This idea has grown out of the so-called 'elevator speech': one has to be ready to explain the core of their idea in a very short period of time – imagine riding in an elevator with a big boss, an important investor or client. Nowadays, elevator pitches and pitching competitions are extremely popular in entrepreneurship and innovation courses, but they can be equally useful for courses in other disciplines. Pitches can be used to present novel ideas for solving important societal challenges, like environmental pollution, climate change, or sustainable development.

Typically, a pitch is limited to 3-5 minutes and is usually followed by a Q&A session that lasts about double as long, between 6 and 10 minutes. Pitches are often developed in teams, but due to a time limit, it is not unusual for only one team member to pitch. Thus, it is advised that the teacher

involves other team members during the Q&A session. As students are increasingly IT-savvy, teachers can assign recording video pitches as homework.

Pitches are usually (but not always) accompanied by a slide show, the so-called 'pitch deck'. Making slides that match limited time and fit the target audience is another critical skill for students to learn. The pitching event usually includes a panel of judges, consisting of angel investors, venture capitalists, successful entrepreneurs, representatives of the university and other public bodies (e.g. a city council) or international organizations. When pitching is part of a course, it can be organized such that some students are given the roles of panelists, since presenters might accept criticism more easily if it comes from their peers, not the teacher. Alternatively, students could exchange roles, offering a variety of different perspectives.

Useful links to some of the largest pitching competitions:

Climate Launchpad: <http://climatelaunchpad.org>

Cleantech Open: <http://cleantechopen.org>

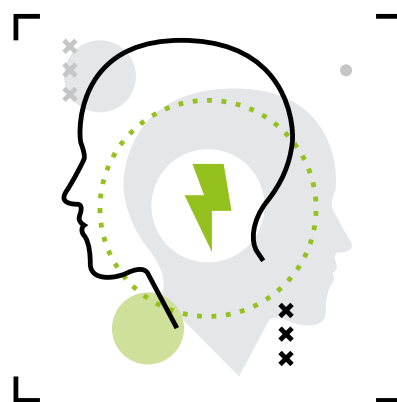
Clean Energy Trust: <http://cleanenergytrust.org/challenge>



Some Winning Ideas of Pitching Competitions

Below are some examples of winning ideas, which can be very different:

- **Eco-House:** a house constructed with energy-saving technologies and materials and serviced by renewable energy sources
- **Bike-mobile:** a bicycle with an electric engine from a motorbike. The student constructed and presented a prototype
- **Ecological tax calculator:** a mobile application that allows input of certain data (e.g. size of a car engine) to estimate ecological taxes, import and other civil taxes
- **Urban garden:** a garden in the city where urban poor can plant vegetables with the help of students
- **Online resource “Single window”:** online resource helping disabled people with documentation on disability, and applications for subsidies, social security etc. without having to leave their house. This resource is especially useful when there are a lot of changes in legislation
- **Water Use Clock:** a clock installed near sinks in bathrooms that shows the usage of water when washing hands or flushing
- **Gleather/Gelatex¹⁴:** a material chemically identical to leather that is made by combining nanotechnology with tanning chemistry
- **Festera¹⁵:** a smart eco-friendly garbage bin
- **POKO¹⁶:** a reusable shopping bag for weighing vegetables in the supermarket



¹⁴ <http://climatelaunchpad.org/finalists/gleather>

¹⁵ <http://www.festera.eu>

¹⁶ <http://www.facebook.com/Pokokott>

Visual thinking: infographics and mind maps

“The mind is more slowly stirred by the ear than the eye.”

Horace

Using infographics is a good way to present data in a visual way. Infographics text should be readable and concise.

Infographics can be used to communicate central messages(s) to a target audience:

- In teaching: develop infographics as a visual representation of a student’s thought process
- In print: include infographics in the executive summary of reports
- At conferences: use infographics in slides and poster presentations
- Other creative ways: add infographics to websites, print on greeting cards, bags, t-shirts, or even as bus stop banners.

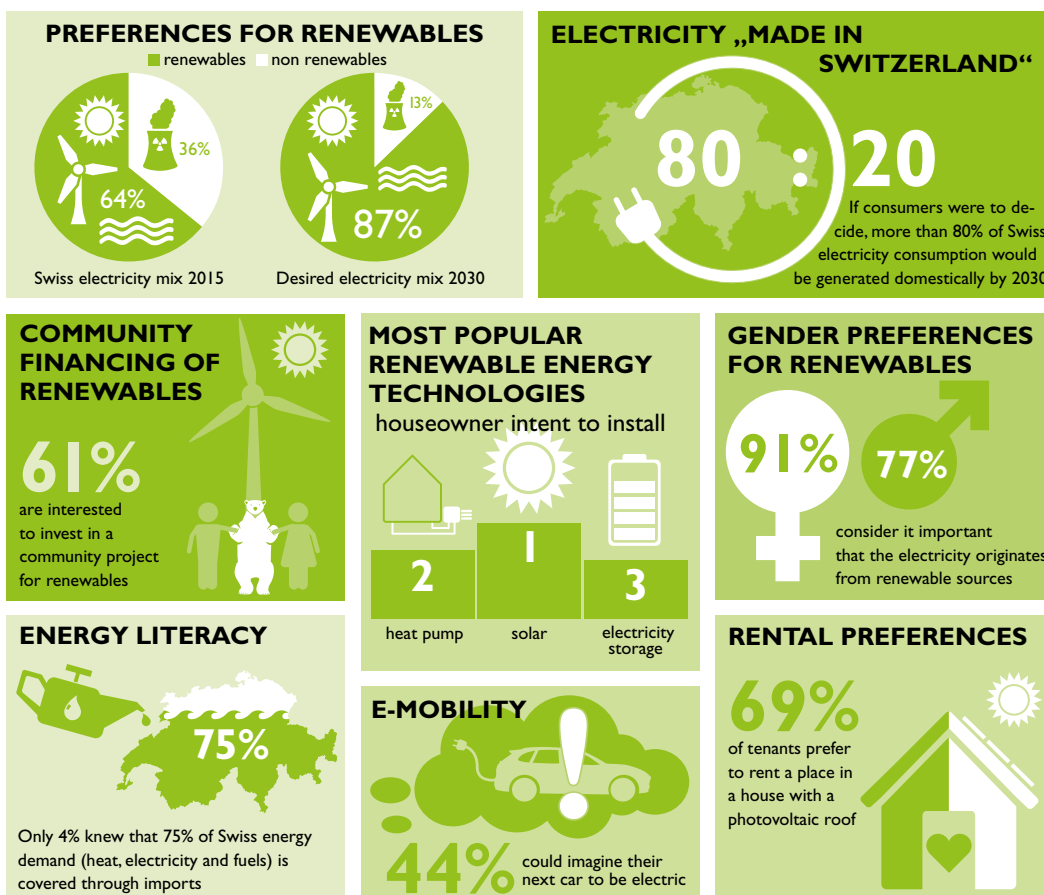
Examples of infographics on energy issues can be found here: <https://iwoe.unisg.ch/kundenbarometer>

A mind map is a visual learning tool to represent ideas, relationships, or concepts, often emerging as a result of brainstorming. Group mind map exercises help visually structure ideas, which facilitate analysis and recall. A mind map can be used to:

- simplify content
- store data in a centralized location
- convert tedious inputs into an attractive visual.

Every mind map has a natural organizational structure that radiates from the center and uses different symbols, numbers and figures. As a result, a highly organized colorful diagram is produced.

Nowadays, mind maps are not only drawn by hand but can be created using software. Examples of different types of mind maps are available online: <http://www.matchware.com/examples>.



Video and audio

Video

A number of students are likely to be ‘visual learners’, meaning that they process information the best when it is presented via images. Videos combine visual and auditory inputs and can be a powerful tool for teaching in and outside of the classroom.

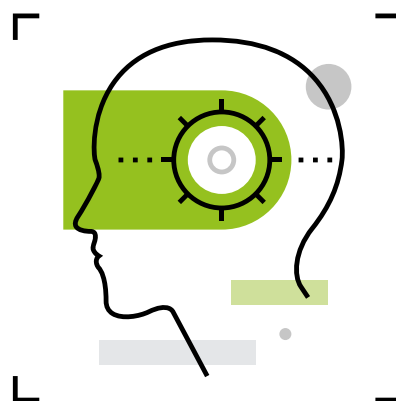
Below we compiled possible assignments that utilize video:

- Discuss prominent Ted talks on energy issues: e.g. presented by Al Gore, Hans Rosling, Alice Bows-Larkin, James Hansen
- Ask students to write a speech to be presented at a mock TedX in class
- Help students to organize a TedX conference on campus
- Task students with making a short Youtube video that communicates an important energy or environmental issue
- Offer movie nights and watch a documentary e.g. Cowspiracy, Chasing Ice, and discuss in class
- Assign viewing of freely available online lectures, called MOOCs (massive open online courses). Some of the most prominent collections of MOOCs can be found on Coursera¹⁶, Khan Academy¹⁷ and edX¹⁸. The body of MOOCs is constantly growing and new courses are added daily.

Audio

Course instructors can use podcasts for teaching purposes. Podcasts are recorded audio programs, freely available online. They can be assigned instead or in addition to required reading. Podcasts are a convenient way of familiarizing students with an issue and can be enjoyed by students while undertaking another activity (commuting, doing sports, engaging in house chores).

There are a number of podcast specifically dedicated to climate change, sustainability and energy issues. The selection of podcasts includes: Climateone²⁰, NPR Climate Cast²¹, America Adapts²² (by Doug Parsons), Climate History²³ (by Dagomar Degroot), Evidence Squared²⁴ on climate communication, The Elephant²⁵ (by Kevin Caners), the Sustainable Futures Report²⁶ (by Anthony Day), Forecast²⁷ (by Michael White). Other podcasts worth exploring can be found on the World Bank²⁸ and BBC²⁹ websites.



17 <https://www.coursera.org>

18 <https://www.khanacademy.org>

19 <https://www.edx.org>

20 <http://climateone.org/watch-and-listen/podcasts>

21 <http://www.npr.org/podcasts/414685982/climate-cast>

22 <http://americaadapts.org>

23 <http://itunes.apple.com/ca/podcast/climate-change-podcast/id1022409974?mt=2>

24 <http://evidencesquared.com>

25 <http://www.elephantpodcast.org>

26 <http://sustainability.libsyn.com>

27 <http://forecastpod.org>

28 <https://olc.worldbank.org/content/climate-change-podcasts>

29 <http://www.bbc.co.uk/programmes/b006r4wn/episodes/downloads>

Model UN and other simulations

Simulation of the work of international organizations is another experiential learning technique. Some more well-known initiatives include Model United Nations (Model UN), Model World Trade Organization (WTO), Model UN Framework Convention on Climate Change (WFCCC), and Model European Parliament, but the same principles can be used for simulating the work of a national parliament or a city council.

Participating students are assigned a specific role (e.g. being an ambassador of a specific country). Students can participate individually or in some cases represent a country as a group. The simulation usually mimics the work of the General Assembly, the Security Council or a similar body, where parties have to bring forward arguments and need to make a decision about a resolution. Typically, the questions put on the table by the teacher cannot have a solution that would satisfy all participants. In addition to being tasked with advocating a particular position, this learning-by-doing experience gives students debating and negotiating skills, as well as enhances their understanding about democratic decision-making. The simulation can become even more interesting if some time is left for lobbying 'out of session', i.e. drafting of resolutions outside of formal UN procedures.

It is recommended that the teacher prepares and distributes some general background information about the simulated 'conflict', allowing students sufficient time (e.g. several weeks) to adapt to their roles. Plenty of time should be allotted for the explanation of 'house rules' on putting forward a motion, voting, delivering speeches, negotiating and writing resolutions, and building of coalitions. This is important so that the first-time delegates understand the process and general rules. Event could span across several days, but usually a minimum of one full day is needed.

List of possible topics for a simulation:

- Simulation of the adoption of the Paris Agreement at COP21
- Debates about climate change at the UNFCCC
- Discussion about South Stream or other gas pipeline projects at the European Parliament
- Debates about appropriate policy support for renewable energy at the European level
- Discussion of increases in gasoline taxation at a national parliament

USEFUL LINKS

Harvard Model United Nations: <http://www.harvardmun.org>

Model European Parliament: <http://mepeurope.eu/>

Model WTO: <http://www.model-wto.org/>

Model United Nations Framework Convention on Climate Change: <http://www.modelunfccc.org>



Educational Business Games

Gamification is the use of gaming principles to help students understand and learn material in an engaging and exciting manner. This technique promotes teamwork and healthy competition. There are several types of educational games: role-playing games, computer games, and board games. Educational business games are business simulations, which allow students to assume the role of businesspeople, obtaining experience and knowledge without associated risks (like losing real money).

There are a number of educational business games available on the MIT Sloan School's website³⁰, which are dedicated to environmental and energy issues: Fishbanks, Eclipsing the Competition: The Solar PV Industry Simulation, World

Energy: A Climate and Energy Policy Negotiation Game, CleanStart: Simulating a Clean Energy Startup, World Climate: Negotiating a Global Climate Change Agreement.

Electro City³¹, an online computer game, lets students and teachers manage their own virtual cities, taking into account energy, sustainability and environmental management issues.

Disaster Detector³² is a computer game that teaches players to analyze data on natural hazards in order to forecast future catastrophic events, as well as to implement tools that mitigate negative effects of those disasters.

USEFUL LINKS

Learning for Sustainability website: <http://learningforsustainability.net/online-games>

Climate Interactive website: <http://goo.gl/rgYBL0>

Zielonegry website: <http://zielonegry.crs.org.pl/category/games>

Forestia game website: <http://www.gameforscience.com/forestia>



³⁰ <https://mitsloan.mit.edu/LearningEdge/simulations/>

³¹ www.electrocity.co.nz/

³² <https://ssec.si.edu/disaster-detector>



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