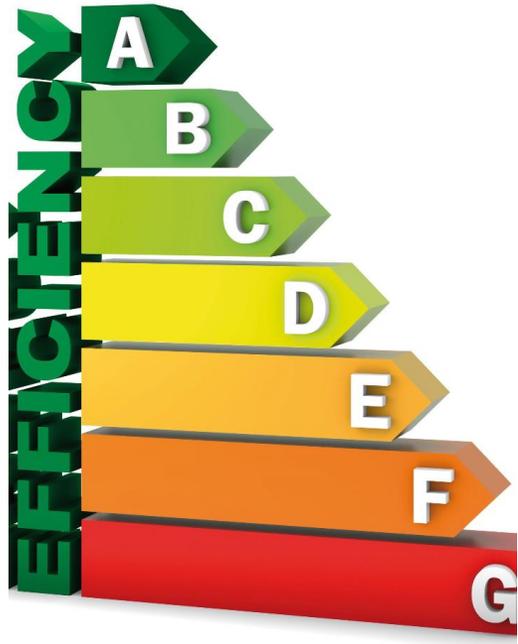


Hidden Knowledge Gap in Academic Education on Energy Efficiency



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Why energy efficiency should be taught at the academic level?

Energy efficiency should be taught at the academic level for several reasons:

- Firstly, it is crucial to address the growing **concerns about climate change and the need to reduce greenhouse gas emissions**. Energy efficiency plays a significant role in mitigating climate change by reducing energy consumption and the associated carbon footprint.
- Secondly, teaching energy efficiency at the academic level can help create a more sustainable future by promoting responsible energy use and conservation. It can **empower students to make informed decisions** regarding energy consumption in their personal and professional lives.
- Lastly, energy efficiency education can also **contribute to economic benefits** by reducing energy costs for individuals, businesses, and governments.

Current state of academic education (on energy efficiency)

Theoretical Focus

Recognizes the dominance of theoretical teachings on energy efficiency in academic curricula

Insufficient Practical Training

Uncover the limited emphasis on hands-on experiences in the realm of energy efficiency education

Industry-University Gap

Address the misalignment between academic teachings and industry requirements in the field of energy efficiency

What is the interdisciplinarity in academic education on energy efficiency?

Interdisciplinarity in academic education on energy efficiency refers to the integration of multiple disciplines and fields of study to address the complex challenges related to energy efficiency. It involves bringing together knowledge, methodologies, and perspectives from various academic disciplines to develop comprehensive solutions.

Barriers to academic education on energy efficiency at the academic level (1)

1. **Lack of comprehensive curriculum:** Many academic institutions do not offer specialized courses or programs specifically focused on energy efficiency. This results in a limited understanding of the principles, technologies, and best practices associated with energy efficiency.
2. **Outdated curriculum:** Rapid advancements in technology and evolving energy policies require regular updates to the curriculum. However, academic institutions may struggle to keep up with the latest developments in energy-efficient technologies, energy management systems, and emerging trends.
3. **Limited interdisciplinary approach:** Energy efficiency is a multidisciplinary field that requires knowledge from various disciplines such as engineering, economics, policy, and environmental science. However, academic education often lacks an interdisciplinary approach, with subject-specific courses failing to integrate energy efficiency concepts effectively.
4. **Limited faculty expertise:** The availability of faculty members with expertise in energy efficiency may be limited. This can hinder the development and delivery of comprehensive academic programs.
5. **Insufficient practical training:** Energy efficiency education often lacks hands-on training, practical experiences, and real-world case studies. This gap limits students' ability to apply theoretical knowledge to real-life scenarios and hinders the development of practical skills necessary for implementing energy efficiency measures.
6. **Limited awareness of behavioural aspects:** Energy efficiency is not solely dependent on technical solutions but also on human behaviour. The academic education on energy efficiency often overlooks the understanding of behavioural aspects, such as consumer behaviour, decision-making processes, and the role of social norms, which are crucial for effective energy conservation.

Barriers to academic education on energy efficiency at the academic level (2)

- 1. Inadequate focus on policy and regulation:** Energy efficiency is heavily influenced by policy and regulatory frameworks. However, academic education may not adequately cover the understanding of energy-related policies, regulations, and their impact on energy efficiency practices. This knowledge gap limits students' ability to navigate policy landscapes and contribute to effective energy efficiency policymaking.
- 2. Insufficient funding:** Lack of financial resources dedicated to energy efficiency education can restrict the development of necessary infrastructure, research opportunities, and teaching materials.
- 3. Limited industry collaboration:** Collaboration between academia and industry is crucial for practical application and real-world experience. Limited partnerships with industry can restrict students' exposure to energy efficiency projects and hinder their ability to apply theoretical knowledge.
- 4. Perception and awareness:** Energy efficiency may not be seen as a priority or may be undervalued in some academic circles. This can result in limited resources and attention being allocated to education in this field.

What skills must an architect have to design energy-efficient buildings?

- 1. Sustainable Design Principles:** Architects should have a strong understanding of sustainable design principles, including passive design strategies, which rely on the building's natural surroundings to regulate temperature and lighting.
- 2. Building Science:** A solid grasp of building science is essential. This includes knowledge of building envelope systems, insulation materials, thermal mass, and the principles of heat transfer.
- 3. Energy Modelling:** Proficiency in energy modelling software is crucial to simulate and analyse the energy performance of a building under various conditions. This helps in making informed decisions about energy-efficient design strategies.
- 4. Renewable Energy Integration:** Architects should understand how to incorporate renewable energy sources like solar panels, wind turbines, and geothermal systems into their designs.
- 5. Building Codes and Regulations:** Staying up-to-date with local building codes and energy efficiency regulations is essential to ensure that designs comply with legal requirements.
- 6. Materials Selection:** Knowledge of sustainable and energy-efficient building materials is vital. Architects should be able to choose materials with high insulation values, low embodied energy, and minimal environmental impact.
- 7. Daylighting Design:** Architects should know how to maximize natural daylight in buildings to reduce the need for artificial lighting, which can significantly affect energy consumption.
- 8. Ventilation and HVAC Systems:** Understanding of efficient heating, ventilation, and air conditioning (HVAC) systems, as well as strategies for natural ventilation, is important for optimizing indoor air quality and energy efficiency.
- 9. Site Analysis:** Architects should be skilled in site analysis to take advantage of natural features like prevailing winds, shading, and local climate conditions.
- 10. Client Education:** Educating clients about the benefits of energy-efficient design and helping them make informed decisions is a crucial skill for architects in this field.
- 11. Life Cycle Assessment:** Being able to perform life cycle assessments to evaluate the environmental impact of a building throughout its entire life cycle, from construction to demolition, is increasingly important.
- 12. Collaboration:** Collaboration with other professionals, such as engineers, sustainability consultants, and contractors, is essential to ensure that energy-efficient strategies are effectively integrated into the project.
- 13. Continuous Learning:** Given the rapidly evolving field of sustainable architecture, architects should be committed to continuous learning and staying updated on the latest technologies and practices.
- 14. Cost-Benefit Analysis:** Architects should be able to perform cost-benefit analyses to demonstrate the long-term financial advantages of energy-efficient design to clients.
- 15. Passion for Sustainability:** Finally, a passion for sustainability and a commitment to reducing the environmental impact of buildings are fundamental for architects in this field.



Skills a professional energy auditor must have

A professional energy auditor must possess a combination of technical knowledge, analytical skills, and communication abilities.

Some of the essential skills for an energy auditor include:

1. **Technical knowledge:** A deep understanding of energy systems, building science, and energy efficiency measures is crucial. This includes knowledge about insulation, HVAC systems, lighting, appliances, and renewable energy technologies.
2. **Data analysis:** Energy auditors need to be proficient in analysing energy consumption data, utility bills, and building performance metrics. They should be able to identify patterns, trends, and anomalies to assess energy usage and efficiency.
3. **Building assessment:** The ability to conduct thorough on-site inspections and assessments of buildings is essential. This involves evaluating insulation, air sealing, windows, doors, HVAC systems, lighting, and other energy-related components.
4. **Energy modelling:** Proficiency in energy modelling software is important to simulate and evaluate the energy performance of buildings. This helps in identifying potential energy-saving opportunities and estimating the impact of different energy efficiency measures.
5. **Problem-solving:** Energy auditors should have strong problem-solving skills to identify energy-related issues, diagnose their causes, and propose effective solutions. This involves considering various factors such as building design, occupant behaviour, and climate conditions.
6. **Communication skills:** Energy auditors need to effectively communicate their findings and recommendations to clients, building owners, and occupants. They should be able to present technical information in a clear and understandable manner, both verbally and in written reports.
7. **Knowledge of codes and standards:** Familiarity with local, national, and international energy codes, standards, and regulations is important. Energy auditors must stay updated with the latest requirements and guidelines to ensure compliance and provide accurate recommendations.
8. **Project management:** Energy auditors often work on multiple projects simultaneously, so strong project management skills are essential. This includes prioritizing tasks, managing timelines, coordinating with stakeholders, and ensuring accurate and timely completion of audits.
9. **Continuous learning:** The field of energy auditing is constantly evolving, with new technologies and best practices emerging. Energy auditors should have a passion for continuous learning, keeping up with industry trends, attending training programs, and staying informed about the latest advancements in energy efficiency.

Topics that should be taught in energy efficiency classes

1. Energy Transformation and Consumption
2. Introduction to Energy Efficiency
3. Energy Auditing and Assessments
4. Building Envelope and Insulation
5. Heating, Ventilation, and Air Conditioning (HVAC) Systems
6. Lighting and Electrical Efficiency
7. Renewable Energy Sources and Technologies
8. Energy-Efficient Appliances and Equipment
8. Energy Management Systems and Controls
9. Behaviourur and Occupant Engagement
10. Sustainable Transportation and Mobility
11. Energy-Efficient Building Design and Construction
12. Energy-Efficient Retrofits and Upgrades
13. Financing and Incentives for Energy Efficiency
14. Policy and Regulations for Energy Efficiency

Why are classes on energy efficiency at the academic level not attractive and exciting?

- 1. Lack of practical relevance:** Students may perceive energy efficiency classes as disconnected from real-world applications and not directly applicable to their future careers.
- 2. Perception of complexity:** Energy efficiency topics might be perceived as complex and technical, making students hesitant to enrol in such classes
- 3. Limited awareness and understanding:** Students may lack awareness and understanding of the importance and benefits of energy efficiency, leading to a lack of interest in related classes
- 4. Perception of dullness:** Energy efficiency topics might be seen as less exciting compared to other subjects, leading to a lower level of interest among students
- 5. Inadequate promotion and marketing:** Lack of effective promotion and marketing strategies for energy efficiency classes might contribute to the perception of unattractiveness

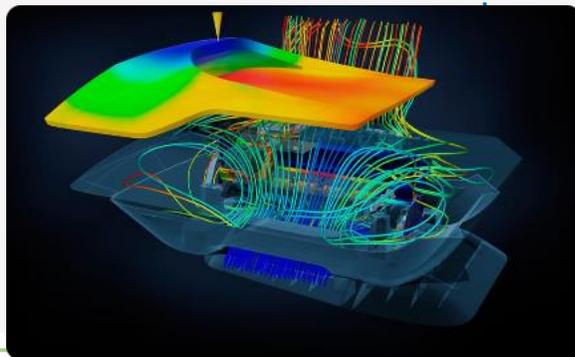
Knowledge on energy efficiency shall be upgraded in the hierarchy of science disciplines

Possible Solutions



Industry Collaboration

Forge partnerships with industry experts to integrate practical experiences into the curriculum.



1

Curriculum Enhancement

Strengthen energy efficiency topics within academic programs through tailored courses and modules.

2

3

Internship Programs

Facilitate hands-on learning by establishing internships with companies focused on energy efficiency.

Energy efficiency teaching must have feedback from industry

Making classes on energy efficiency at the academic level more attractive and interesting

1. **Hands-on experiments and demonstrations:** Incorporate practical activities that allow students to witness energy efficiency principles in action. This can include building and testing energy-efficient models, conducting energy audits, or analysing real-world case studies.
2. **Guest lectures and industry experts:** Invite professionals from the energy industry to share their experiences and insights with students. This can provide a real-world perspective and make the subject matter more relevant and engaging.
3. **Field trips:** Organize visits to energy-efficient buildings, renewable energy installations, or research facilities. This can give students a chance to see energy efficiency measures in practice and understand their impact firsthand.
4. **Gamification and interactive learning:** Use educational games, simulations, and online platforms to engage students in a fun and interactive manner. This can include virtual energy audits, energy-saving competitions, or online quizzes.
5. **Integration of technology:** Utilize tools like data loggers, energy monitoring systems, and smart home devices to collect and analyse real-time energy data. This can help students understand the importance of energy monitoring and management.
6. **Multidisciplinary approach:** Connect energy efficiency with other relevant disciplines such as environmental science, engineering, economics, and policy. This interdisciplinary approach can broaden students' perspectives and make the subject more appealing.
7. **Project-based learning:** Assign students to work on energy efficiency projects, such as designing an energy-efficient building, developing a renewable energy plan, or creating an awareness campaign. This hands-on approach fosters creativity, critical thinking, and teamwork.
8. **Incorporate current events and case studies:** Integrate recent news articles, reports, and case studies related to energy efficiency into the curriculum. This helps students understand the real-world implications and challenges associated with energy efficiency.
9. **Engage with local communities:** Encourage students to participate in energy efficiency initiatives within their communities. This can involve conducting energy audits for local businesses, organizing energy-saving workshops, or collaborating with local organizations working on sustainability projects.
10. **Continuous assessment and feedback:** Provide regular opportunities for students to apply their knowledge through quizzes, assignments, and group discussions. Offer constructive feedback to encourage their progress and improvement.

Policymakers' help to upgrade the role of energy efficiency in education at the academic level

- 1. Develop and implement energy efficiency curriculum:** Policymakers can work with educational institutions to develop and integrate energy efficiency curriculum into various academic disciplines, such as science, engineering, architecture, and environmental studies.
- 2. Provide funding and resources:** Policymakers should allocate adequate funding and resources to support the development of energy efficiency programs, research, and infrastructure at educational institutions.
- 3. Establish partnerships and collaborations:** Policymakers can facilitate partnerships between educational institutions and energy efficiency organizations, government agencies, and industry stakeholders to enhance knowledge sharing, research collaboration, and practical training opportunities.
- 4. Promote teacher training and professional development:** Policymakers can support training programs for teachers to enhance their knowledge and skills in energy efficiency education. This can be done through workshops, seminars, and online courses.
- 5. Incorporate energy efficiency in accreditation standards:** Policymakers can work with accreditation bodies to include energy efficiency as a criterion for evaluating educational institutions. This can incentivize institutions to prioritize energy efficiency in their curriculum and operations.
- 6. Raise awareness and promote behavioural change:** Policymakers can support awareness campaigns and initiatives to educate students, teachers, and the wider community about the importance of energy efficiency. This can help foster a culture of energy conservation and sustainable practices.
- 7. Create incentives and recognition programs:** Policymakers can introduce financial incentives, grants, and awards to encourage educational institutions to excel in energy efficiency initiatives and research.

Future of Energy Efficiency Education

1

Empowered Graduates

Envision a future where academically trained individuals lead the way in implementing energy-efficient practices worldwide

2

Industry Collaboration

Highlight the importance of ongoing collaboration between academia and industry to bridge the knowledge gap

3

Sustainable Transformation

Outline the role of energy efficiency education in achieving a sustainable future for our planet

4

Artificial Intelligence

????

Conclusions

No energy transition without helping hands (and minds)

- Energy efficiency at the academic level is not considered important
- Academic teaching must be supported by suitable policy, legislation, regulations, and awareness
- Knowledge gap is large and does not show tendency to get narrow
- Lecturers must increase their competences, especially in practical skills
- Current pattern of academic teaching on energy efficiency does not reflect the market needs
- Methods of improving are known, however, require coordinated involvement of all stakeholders
- Market demand will decide

Joint Workshop on workforce shortages and upskilling for the clean energy transition

Madrid, 28th-29th September 2023

Disclaimer:

The Joint Workshop on workforce shortages and upskilling for the clean energy transition is an initiative of the three Concerted Actions with the support of DG ENER and CINEA. For further information please visit www.ca-eed.eu, epbd-ca.eu, www.ca-res.eu or contact the CA EED Coordinator at lucinda.maclagan@rvo.nl



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