Education and Training for Capacity Building in the Energy Sector, IEA Working Party

The Importance of Education for Innovation in the Energy Sector

Torsten Fransson
KIC InnoEnergy

Key questions posed

- **How do we measure effectiveness of capacity and training?**
- **How can we monitor progress and improve the training that we deliver?**
- **How can we scale up capacity building (through finance, different communication channels and delivery mechanissma, ..) at the level of the energy efficiency potential that we need to tap for our below 2C trajectory?**

My main four starting points:

- **We're still too focused on teaching and not enough on learning**
- **And treating innovation & entrepreneurship separately**
- **Modern distribution media not used enough**
- **Lifo-Long Learning; Combine general public, vocational, academic, …**

<u>Of course:</u>
Care must be taken so that general culture does not disappear in the prospect of "on-demand training"

The Future of Higher Education: KIC InnoEnergy

Key messages:

- **Kids of the future will expect a different education from today**
- **Universities need to change**
- ***EIT KIC InnoEnergy is a game changer towards human resources in innovation, entrepreneurship, business creation, as well as in higher education***

Outline

Is there a need for change in (energy) education?

KIC InnoEnergy Philosophy on Education for the Future Energy "Game Changers"

KIC InnoEnergy platform for pedagogical methodology

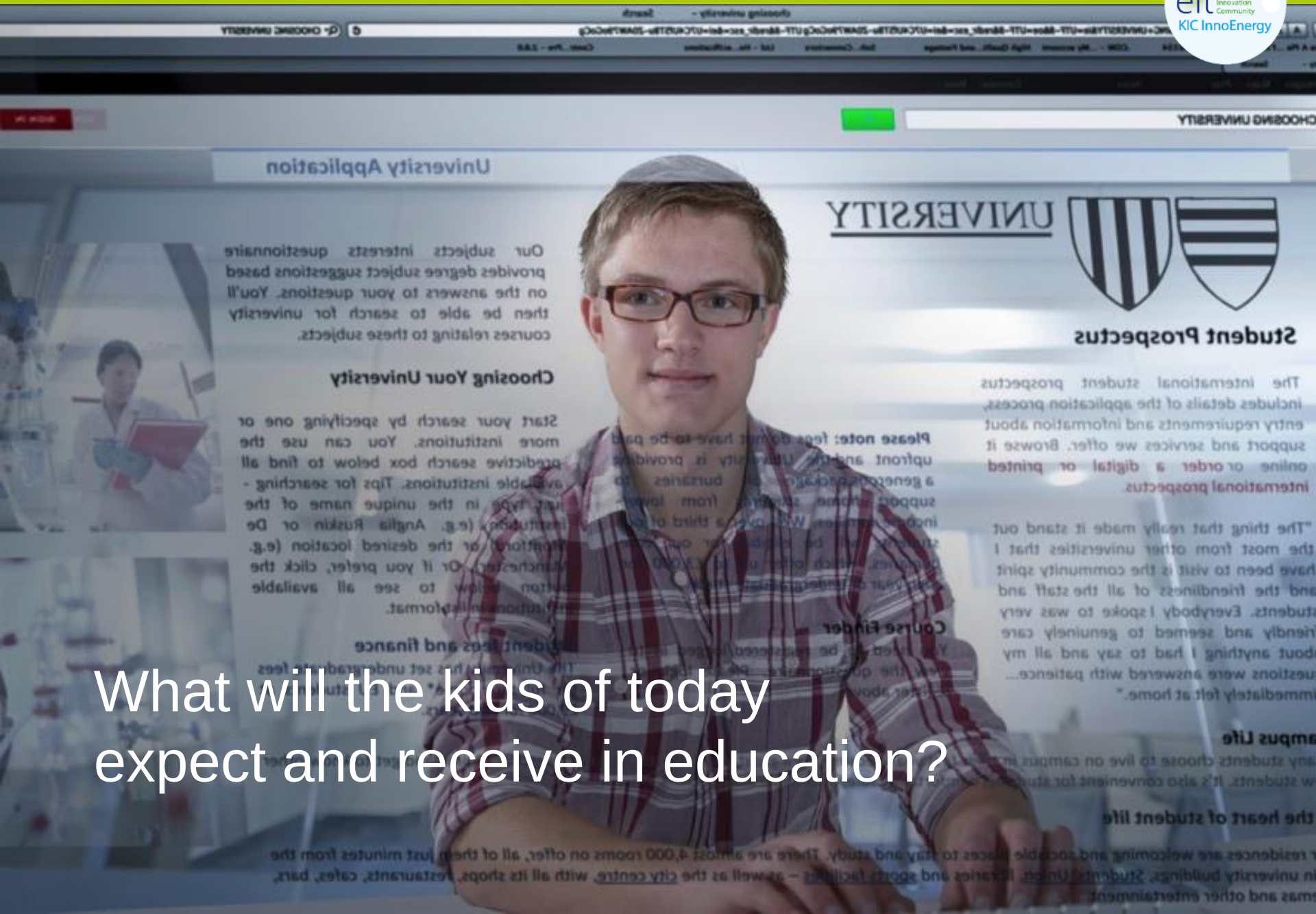
Outline

Is there a need for change in (energy) education?

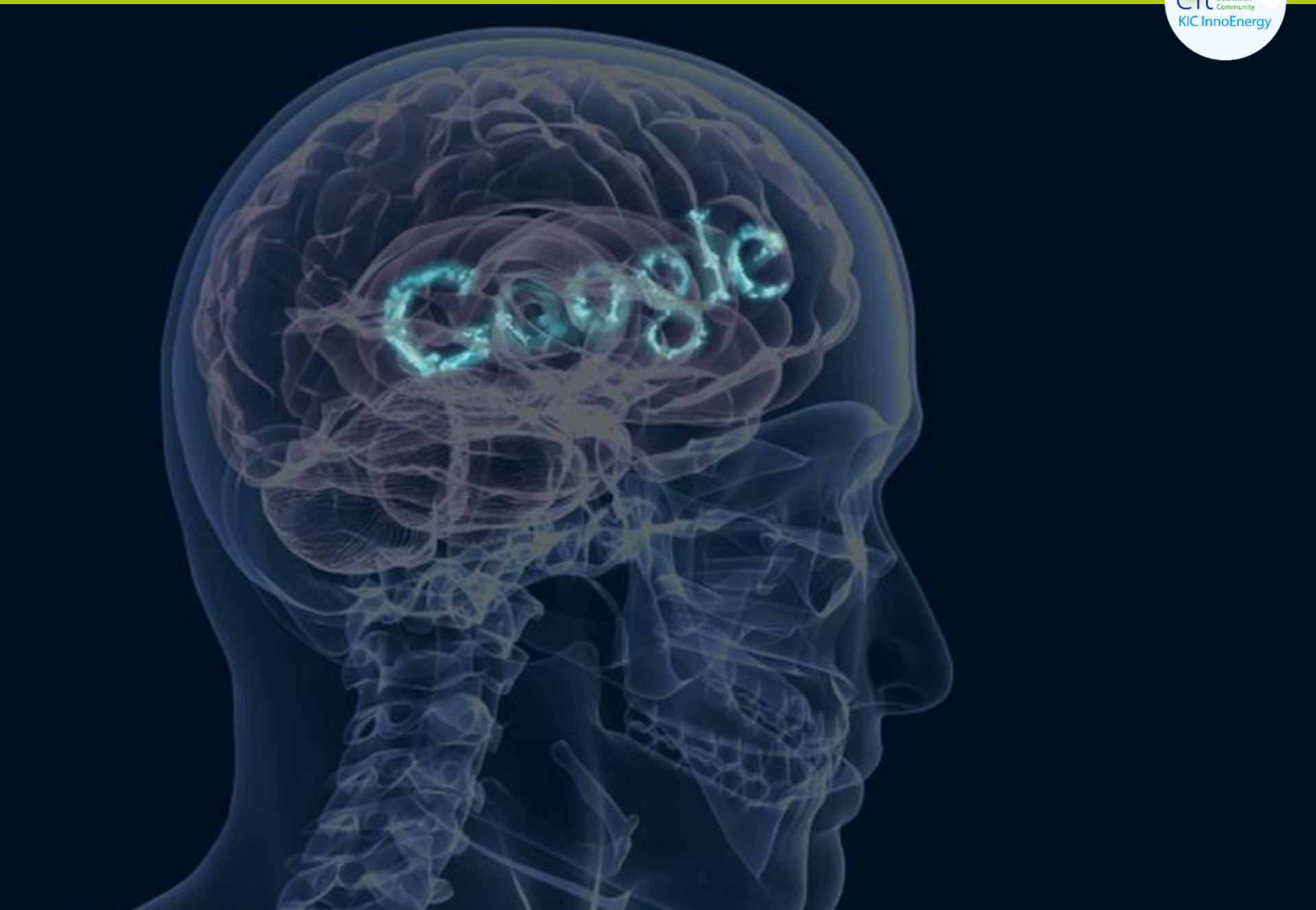
KIC InnoEnergy Philosophy on Education for the Future Energy "Game Changers"

KIC InnoEnergy platform for pedagogical methodology


Future generations stands
in front of global challenges


What will the kids of today
expect and receive in education?

What technology will exist to facilitate education?


Google

Do we *need* energy engineers in the 21st Century?

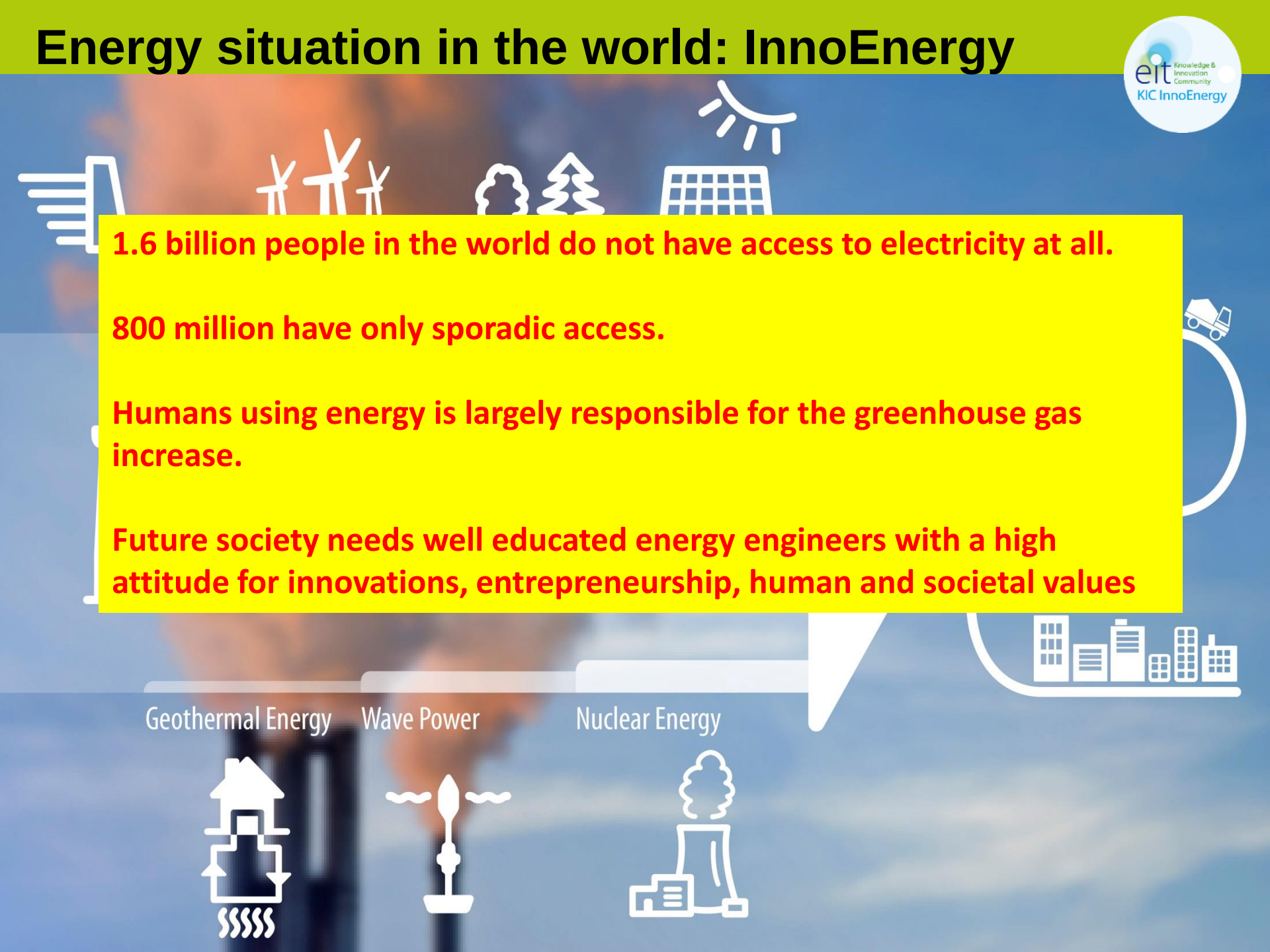
Energy situation in the world: InnoEnergy

1.6 billion people in the world do not have access to electricity at all.

800 million have only sporadic access.

Humans using energy is largely responsible for the greenhouse gas increase.

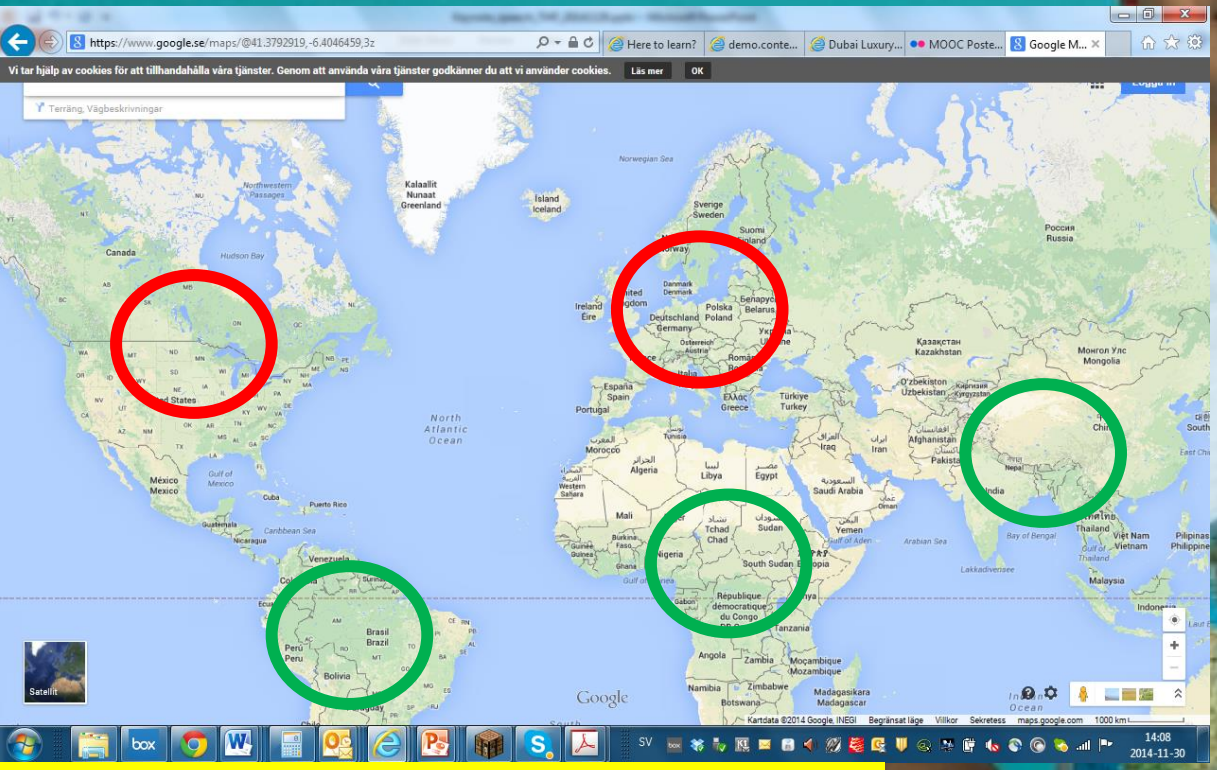
Future society needs well educated energy engineers with a high attitude for innovations, entrepreneurship, human and societal values



Where do we need these future energy engineers?

Everywhere!

And how do we match teachers and learners?



Most "research-based" teachers

Most future students

Do we today efficiently match the world-wide knowledge providers with the global learners?

Is this efficient in today's global world?

Or this?

Are we in the same situation as 700 years ago?

Teaching today

- Teaching is very traditional
- Not much collaboration between teachers
- Research results make their way into general teaching much too slowly

What will the future of education look like?

How is the energy education performed today?

In the traditional on-campus way!

- **Many teachers still "turn their back to the learners"**
- **And repeat the same messages year by year**
- **And write the same old classical equations year by year**
- **Very good "comfort zone"**

➢ **Thousands of general online courses exist**

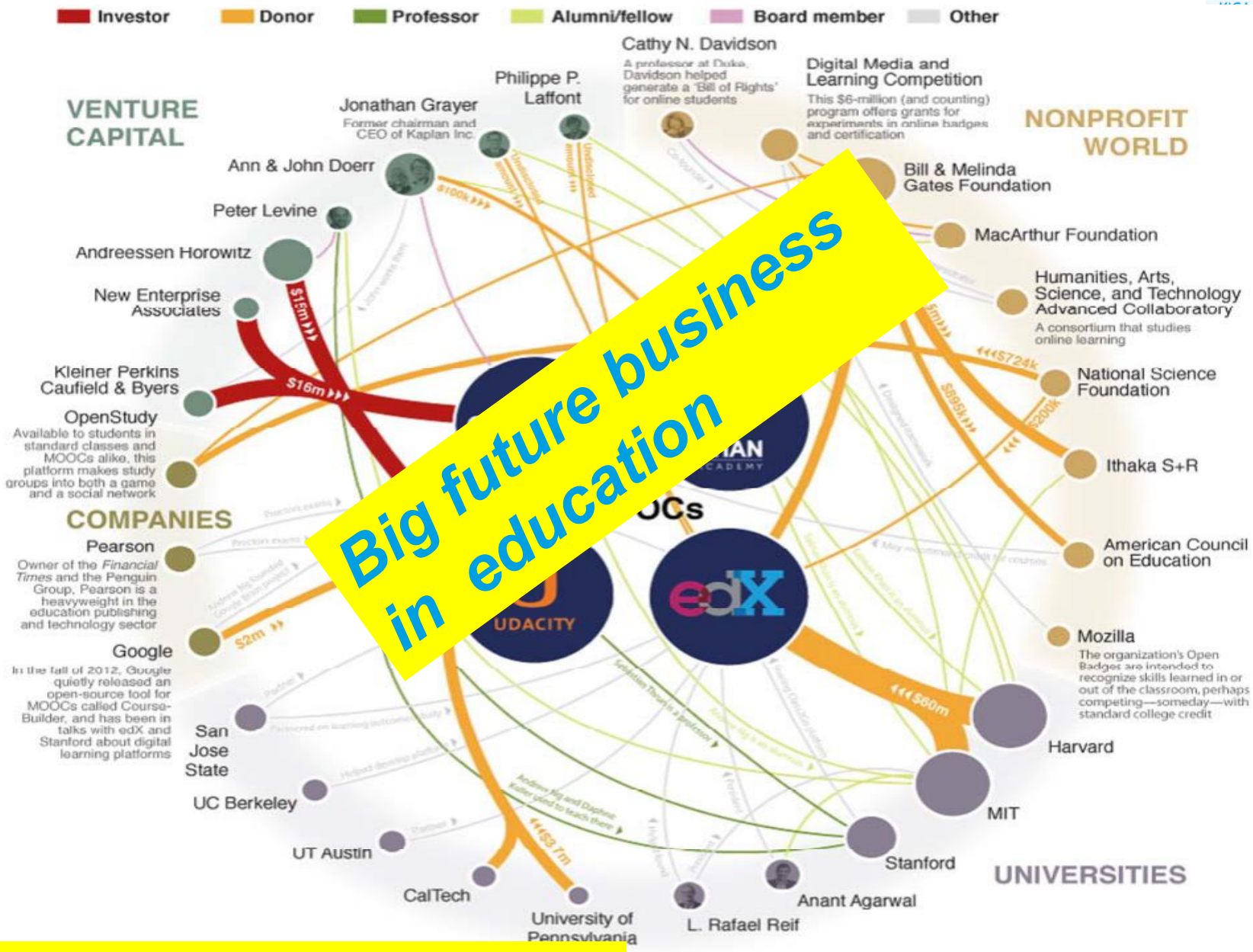
- **Often very low success rate compared to registrations**
- **Different on-line programs start to appear**
- **Virtually no online energy degree programs**

Example: KIC InnoEnergy/UPC/KTH MSc program SELECT

But today everyone talks about MOOCs as the *saviour of the world of education*.

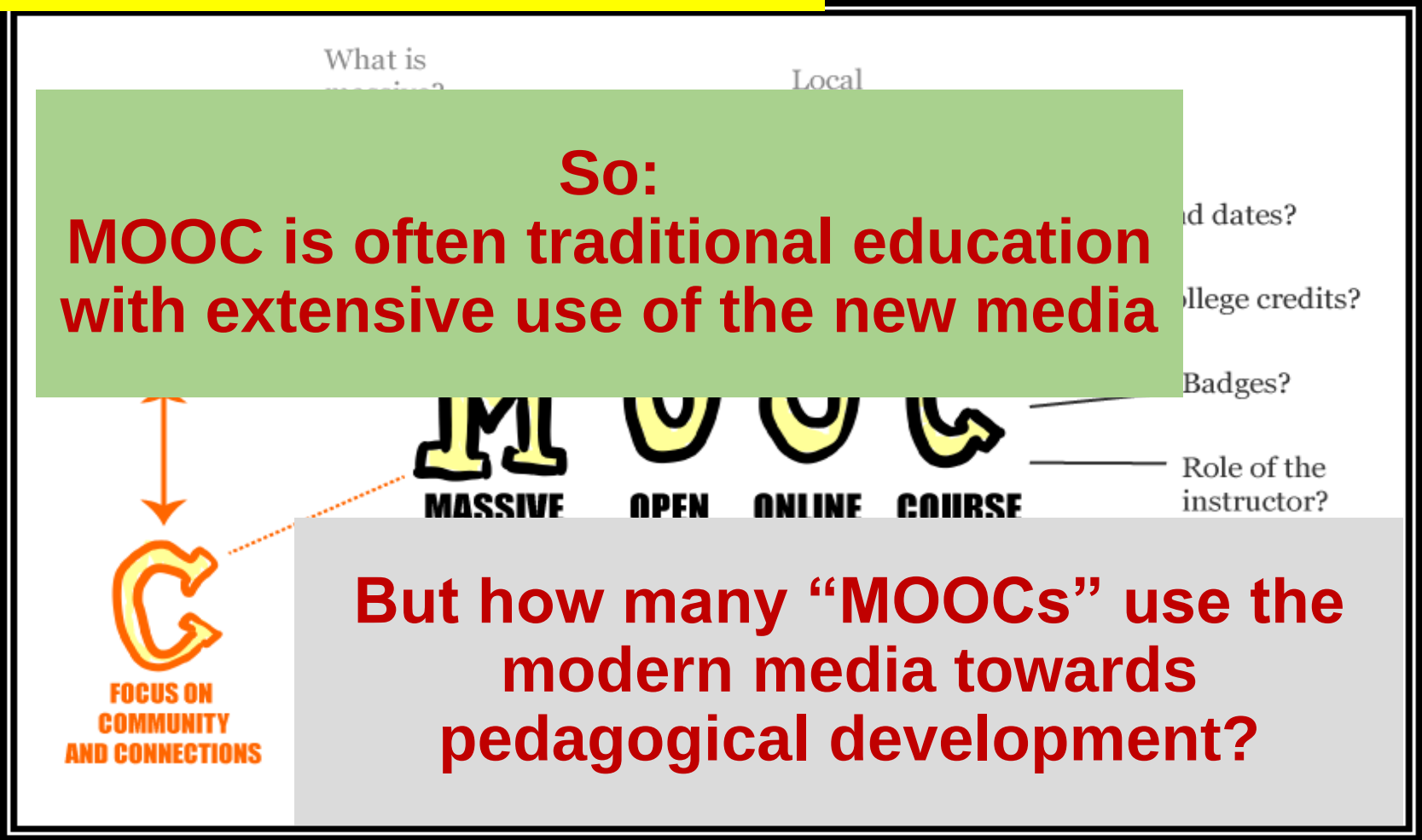
And some mention it as a *threat to universities?*

Major Players in the MOOC Universe



Source: The Chronicle of Higher Education

And then: What is a MOOC?



M ◇ O ◇ O ◇ C

Every letter is negotiable.

What will the universities role be in this perspective?

Will all courses be MOOCs?

Is MOOC really something new or the wave to ride upon presently?

What does MOOCs give us related to didactical development?

Do we focus on the right things?

And if all courses are MOOCs:

- **How many courses are needed?**
- **How do learners distinguish between them?**
- **And learn from which teacher?**
- **How many universities are needed?**
- **What will the teachers' role be?**

At the end of the day: It is the *content*, not the course, that will be the driving force

And what about on-line:

Assessment?
Accreditation?

Technology will soon allow for this also!

Who will be the first to accredit non-university based programs?

What does this lead us to?

Educational platform that is:

- Interactive and international
- Focus: Learning, not teaching.
- Learning independent of specific Course and On/Off-Campus
- In the classroom as well as for self-studies
- All material “at home” exactly as in the classroom.
- Allow for self-assessment and preparation
- Under- and post-graduate level both at universities and industry
- Everything we today associate in ”real-life learning” and much more

All towards: *Quality* time instead of quantity time

For 2030: Students put together their own degree programs?

- ***Project based learning and social interaction all over the globe***
- ***Engineering ethics satisfied in a global environment***
- ***Universities and institutions accredit individual tracks***

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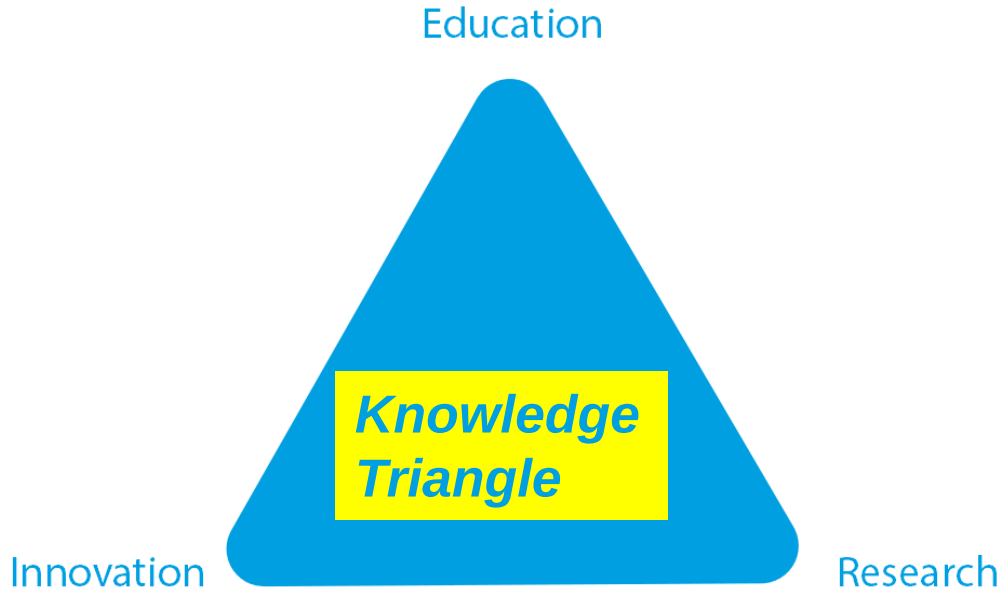
KIC InnoEnergy platform for pedagogical methodology

Supported by European Institute of Innovation and Technology: EIT

The EIT aims to create an unprecedented level of collaboration between innovation and excellence centers with the aim of boosting the innovation process:

- **from idea to product**
- **from lab to market**
- **from student to entrepreneur**



EIT's Educational Mission:

- ***To address Europe's innovation gap and forster EU sustainable growth and competitiveness***
- ***Be influential in modernization of Higher Education in Europe***

EIT funding: 2.7 bEuro 2014-2010

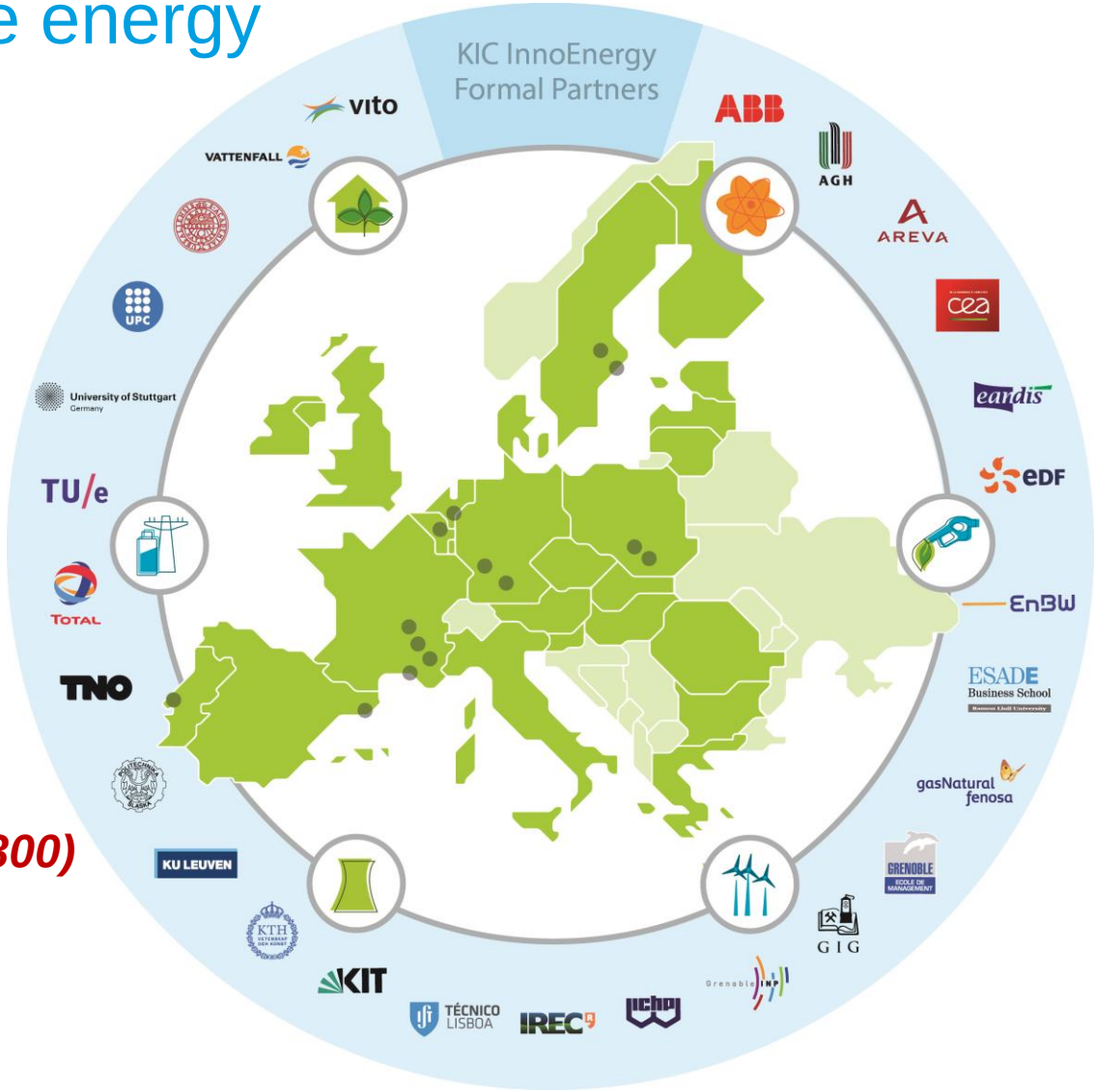
eit European Institute of Innovation & Technology

Who is KIC InnoEnergy?

KIC InnoEnergy – Pioneering change in sustainable energy

The European company for innovation, business creation and education in sustainable energy

A Network of Leading European Universities and Companies as shareholders



<u>On educational side:</u>

Niche player with:

- ***7 MSc programs (2015 intake: 300)***
- ***PhD courses***
- ***Executive courses***
- ***Leading educational offers***

Advantages of KIC InnoEnergy MSc and PhD offer compared to most traditional programs.

Integration of, directly in the curricula:

- Technology at its best as starting point
- Mobility (geographically, organizational, remote)
- Innovation & Management
- Entrepreneurship & Business models
- Industrial collaboration & Professional skills
- *Talents prepared for complex systems*

Access to the KIC InnoEnergy:

- Human Capital Manager from ”Day 1”
- International and remote human and social aspects
- Innovation projects
- Business Highway
- Venture Capital

Enhanced by the

EIT Quality Assurance and Learning Enhancement

EIT Quality Assurance and Learning Enhancement

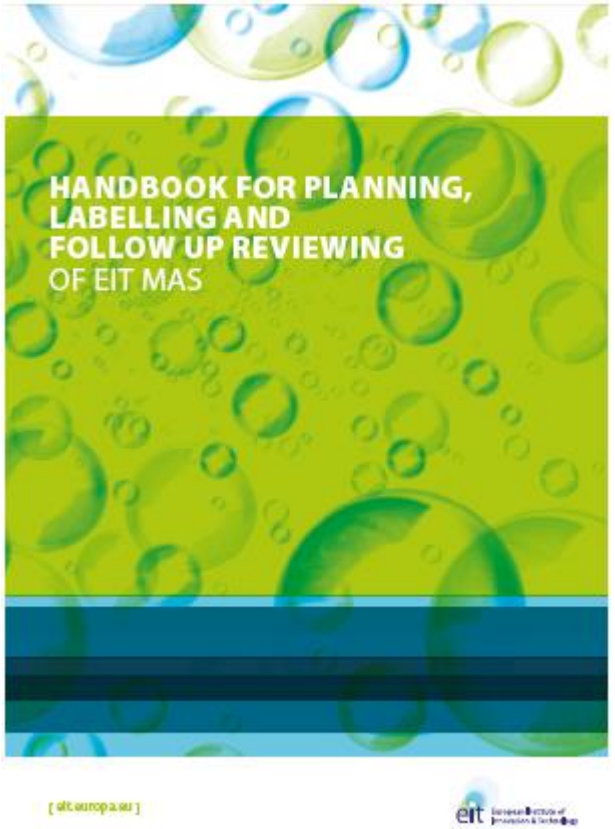
KIC InnoEnergy

EIT degrees and diplomas are based on *integration between education, research and business/innovation*. It is a *learning by doing curriculum*.

Strong focus on *creativity, innovation and entrepreneurship.*

The EIT QALE is the quality assurance model to ensure that all degrees and diplomas are student centred.

Assessments through *Achieved Learning Outcomes (ALO).*



Goal:

New kind of engineering talent more adapt to transformation ("Game Changers")

Outline

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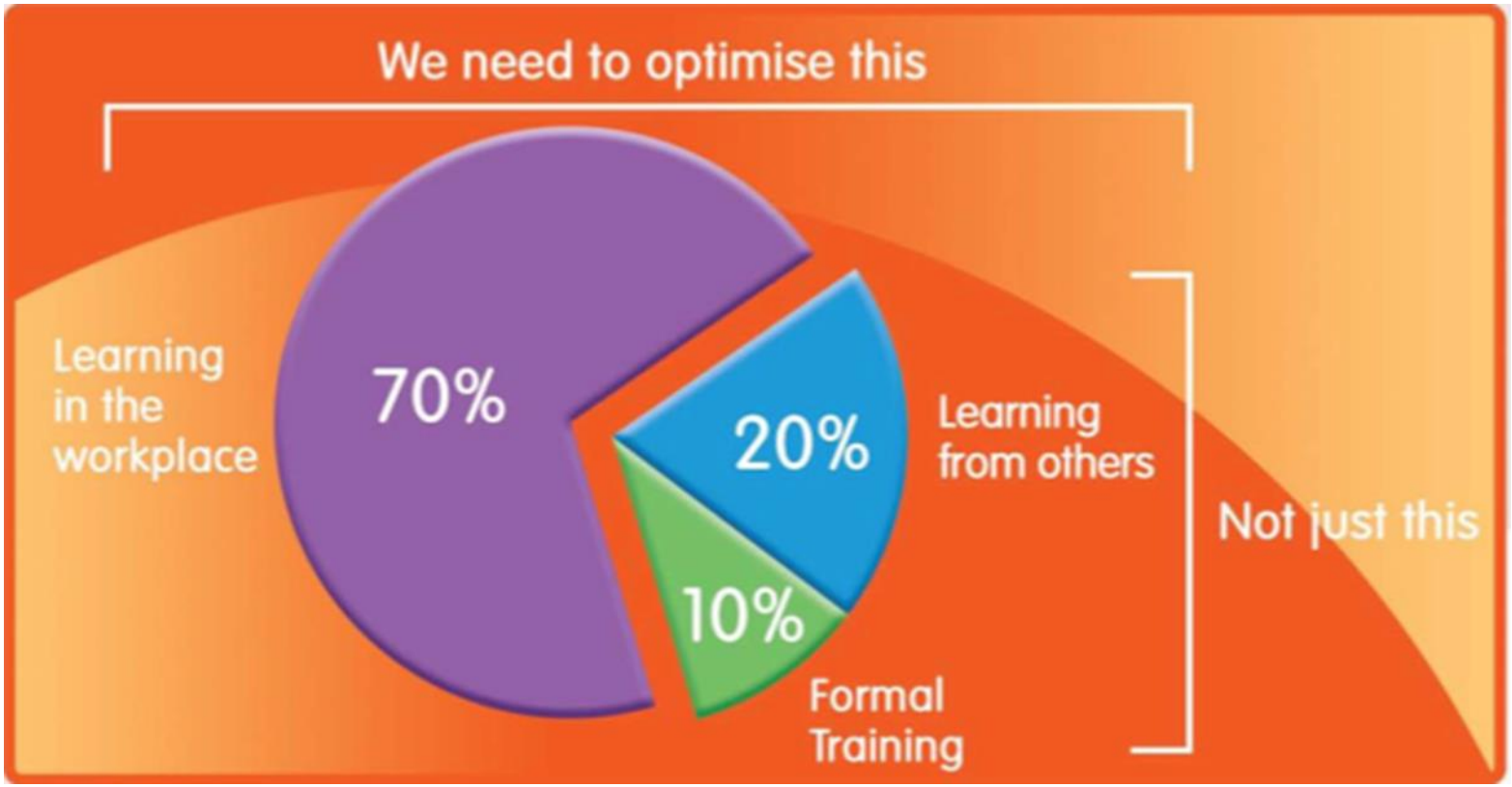
Challenge: Learning in the work place

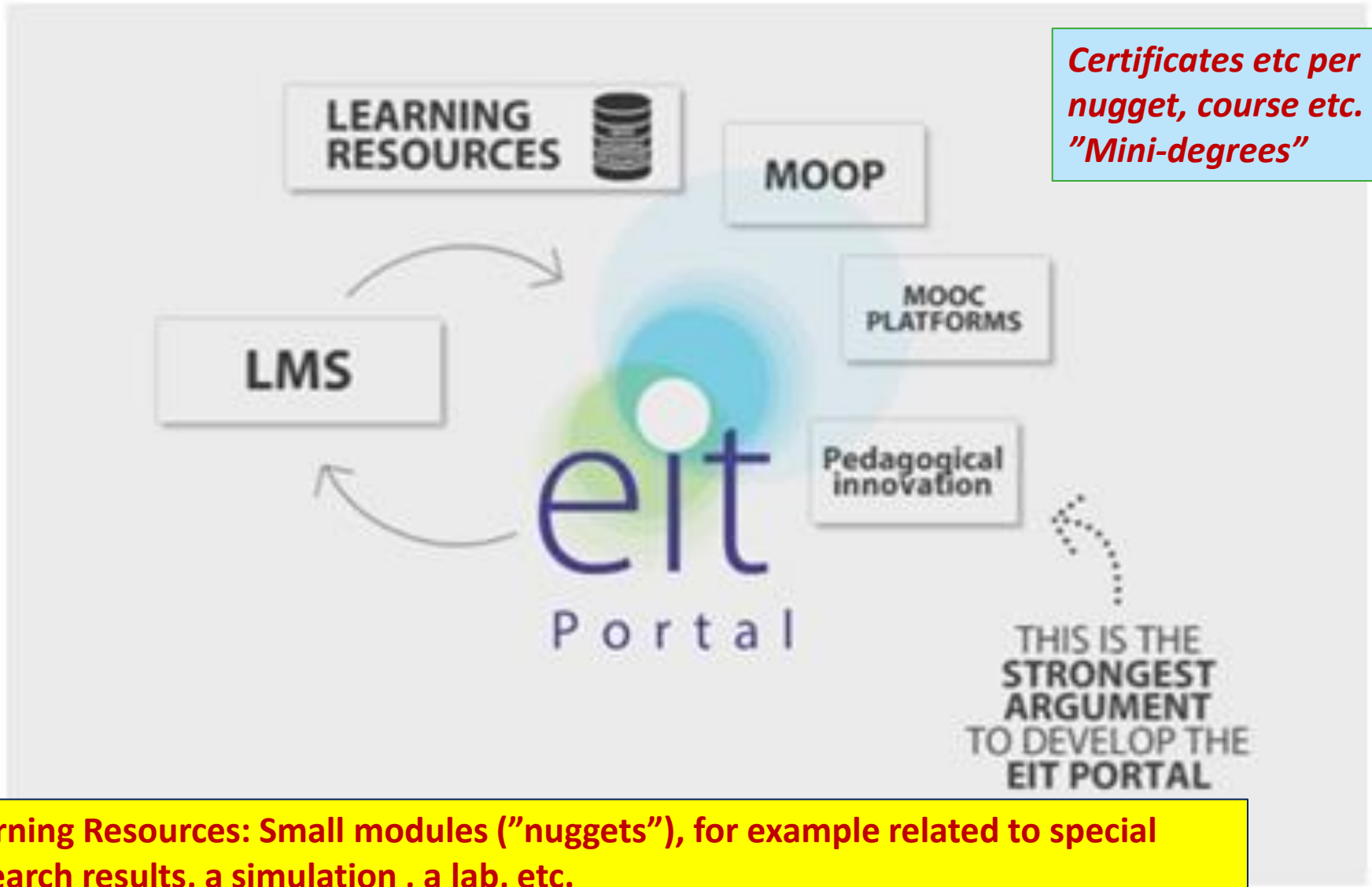


Source: www.bersin.com

Focus on learning, not teaching

- Self-paced
- Any where
- Any time
- Just in time
- Collect knowledge (and points as assesments)
- ILO & ALO
- How to get creativity into “not physical meetings”?
- How to create remote collaboration?

KIC InnoEnergy contribution to implementation



Certificates etc per nugget, course etc. ”Mini-degrees”

Learning Resources: Small modules (”nuggets”), for example related to special research results, a simulation , a lab, etc.

Many non-proprietary sponsored research programs could be ”encouraged” to contribute to these Learning Resources!

How can this EIT QALE model be incorporated in an on-line collaborative perspective? Example:

Present:

Renewable Energy *Innovation* .

Competence & skills driven learning *Outcomes*

Work packages with ILO, ALO.

Individual "nuggets" with ILO, ALO.

Curriculum added with business/ innovation to train competences and skills.

Learners perform WPs before "class".

Teacher time focused on discussions with the learners:

- assessing ILO & ALO for all "nuggets"
- deep reflection with learners

Past:

Renewable Energy *Technology.* Traditional lectures.

Learning *objectives.*

Achieved learning *objectives* (often one final exam).

Teacher time focused on "less-value" creating work:

- checking group assignments
- correcting exams
- giving long lectures

Team

My statistics / ALO 12/20

Course: Introduction to Renewable Energy Innovation

Business challenge

Your business challenge is to help the mayor to find a renewable energy solution for the docklands project, and to establish a business case for such a solution.

Start the film to get your challenge!

Background information:
Read the document to find out the details you need for solving your business challenge.

Open the document!

General Course information

For more information about the course plesae click on the links to the right.

Course description
Course Assessment
Prerequisits

Unique Attributes
Academic value
Target audience

Identification of the competences and skill attributes to be achieved in the course:

- **Of course the technical, but also**
- **Innovation**
- **Management**
- **Entrepreneurship**
- **Business perspective**
- **Professional**

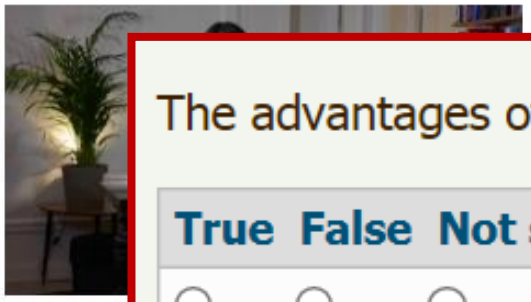
Climate, innovation and entrepreoursship

Biomass

Wind

Course: Introduction to Renewable Energy Innovation

Business challenge



Your business challenge is to help the

Background information:

The advantages of tidal plants are

True	False	Not sure	Alternatives (true and false)
○	○	○	Easy to connect and transport the power to shore
○	○	○	High energy density
○	○	○	Tidal currents have low intermitency
○	○	○	Can work all the time (high capacity factor)

Submit Query | List | Skip | Edit

General

For more
plesae cli

Solar en

Is the sola
the market

Syllabus - ILO - ALO

Climate, innovation and entrepreoursship

Syllabus - ILO - ALO

Biomass

Syllabus - ILO - ALO

Wind

Team

My statistics / ALO 12/20

Course: Introduction to Renewable Energy Innovation

Business challenge

Work packages with *Intended Learning Outcomes*

At the end of this module the learner is expected to have the *skills and competences to be able to:*

- **On the technical side:**
  - **Solve; Assess; Calculate; Change; Chose,; Complete; Construct; …….**
- **On the entrepreneurial side:**
  - **Argue; Arrange; Assemble; Categorise; Collect; Combine; Create …..**
- **On the social and humanity side:**
  - **Act; Adhere; Appreciate; Ask; Accept; Answer; Attempt; Challenge ……**

Solar energy

Is the solar energy ready for the market and is the market ready for it?

Syllabus - ILO - ALO

Energy storage

Which is the best storage solution in a certain application?

Syllabus - ILO - ALO

Geothermal energy

What are the concepts of geothermal energy when you focus on the electricity generation and district heating?

Syllabus - ILO - ALO

Climate, innovation and entrepreoursship

Biomass

Wind

Team

My statistics / ALO 12/20

Course: Introduction to Renewable Energy Innovation

Syllabus
ILO
ALO
- TYMK
- MCQ
- ACCE
- OEQ

Knowledge Material
Forum : Global

In this section learner may find different type of questions for self-assessment.
The following questions are available:

Question type	Questions num	Attempts	Score	%	MaxScore
TYMK	-	-	-	-	-
MCQ	61	3	1.0	2.0	61.0
ACCE	1	-	-	-	25.0
OEQ	3	-	-	-	3.0

Is the solar energy
the market ready fo

Syllabus - ILO - ALO

Climate, innova

- **This You Must Know**
- **Multiple Choice Questions**
- **Automatically Corrected Calculation Exercises**
- **Open Ended Questions**
  - **OEQ-Single Learner**
  - **OEQ-Multiple Learner**

Course: Introduction to Renewable Energy Innovation

In this section learner may find different type of questions for self-assessment.
The following questions are available:

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TYMK	-	-	-	-	-
MCQ	61	3	1.0	2.0	61.0
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OEQ	3	-	-	-	3.0

Is the solar energy ready for the market and is the market ready for it?

Syllabus - ILO - ALO

Which is the best storage solution in a certain application?

Syllabus - ILO - ALO

What are the concepts of geothermal energy when you focus on the electricity generation and district heating?

Syllabus - ILO - ALO

Problem Statement

A hydropower plant in Sweden is going to be installed. The power plant has the following characteristics:

Head = 30 m

Francis turbine

Qdes = 48 m3/s

A 400 m long welded steel penstock with a diameter of 3m will be installed. The new turbine should be selected between a Francis or a Kaplan turbine.

Climate, innovation and

Problem Statement

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Head = 30 m

Francis turbine

Qdes = 48 m3/s

A 400 m long welded steel penstock with a diameter of 3m will be installed. The new turbine should be selected between a Francis or a Kaplan turbine.

Assumptions:

- Generator efficiency is 90%
- Transmission and parasitic losses are 1% each
- Downtime losses are 4%
- The plant operates 8760 h/y
- The electricity price is 0,03 $/kWh
- A gas turbine using natural gas has been operating to cover the electricity production. The turbine has a CO2 emission factor of 56 kg/GJ of fuel and an electrical efficiency of 40%. The hydropower plant will replace the turbine.
- The grid revenues are 5$/MWh
- The operation and maintenace cost (O&M) is 0,01 $/MWh
- The capital cost can be calculated using the following expression

Team

My statistics / ALO 12/20

Course: In

Business chal

Answers

Question	Answer	Unit	Point
f) The power output at design conditions using a Kaplan turbine	...	MW	2
g) Capital cost of the plant with a Francis turbine	...	USD	1

My Statistics

Bonus	ALO
5	12/20

Intro	Hydro	Solar	Wind	Biomass	Geothermal
Details	Details	Details	Details	Details	Details

Team

My statistics / ALO 12/20

Solar energy

Is the solar energy ready for the market and is the market ready for it?

Syllabus - ILO - ALO

Energy storage

Lorem ipsum dolor sit amet, consectetur adipiscing elit.

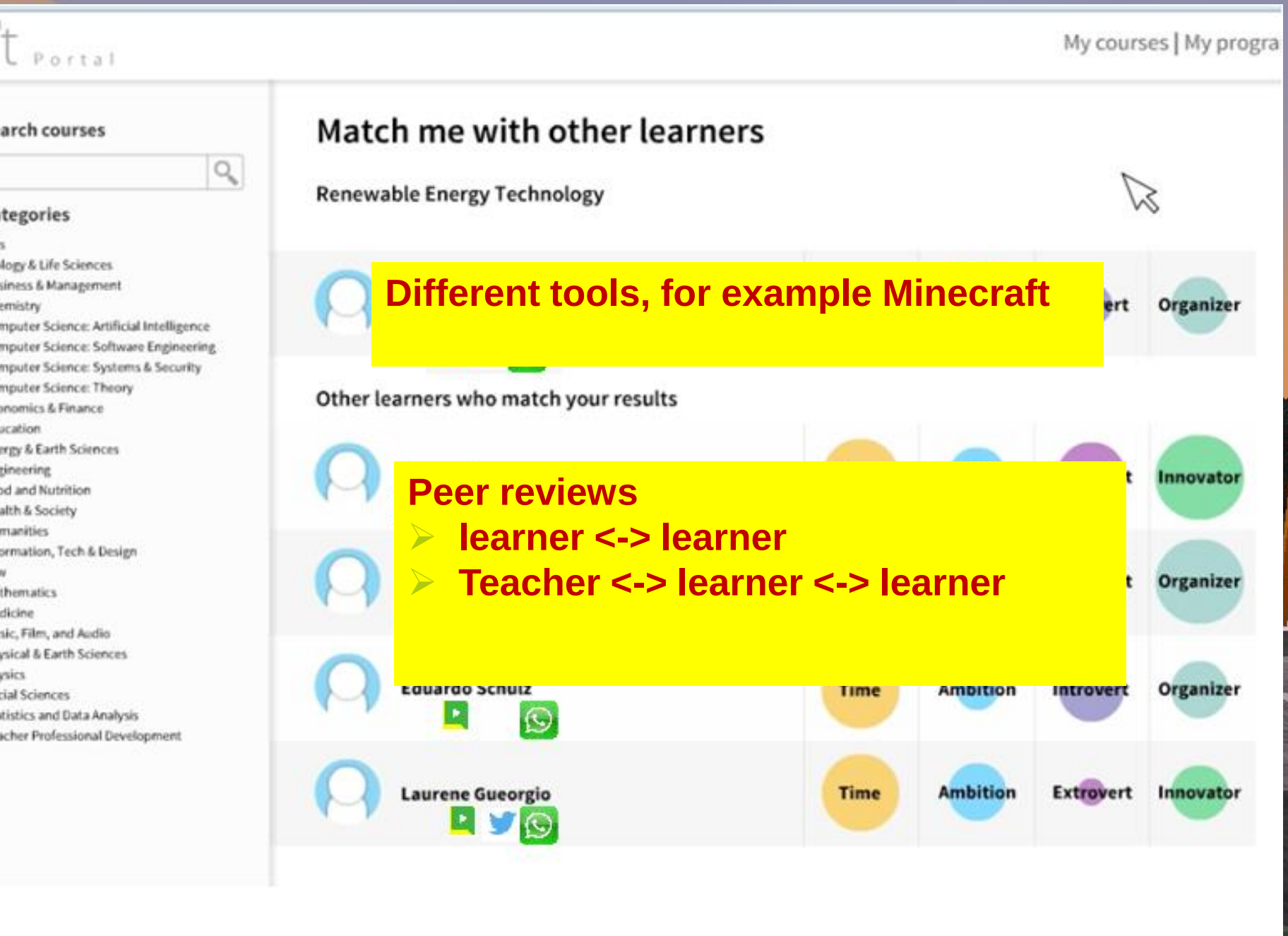
Syllabus - ILO - ALO

Geothermal energy

Lorem ipsum dolor sit amet, consectetur adipiscing elit.

Syllabus - ILO - ALO

Climate, innov


Portal
My courses | My progra
arch courses
tegories
Match me with other learners
Renewable Energy Technology
Different tools, for example Minecraft
Organizer
Other learners who match your results
Peer reviews
learner <-> learner
Teacher <-> learner <-> learner
Innovator
Organizer
Time
Ambition
Introvert
Organizer
Laurene Gueorgio
Time
Ambition
Extrovert
Innovator

To facilitate for teachers: Gamification and Scenario

Scenario engine

eit Portal

My courses | My programs | Recommended for you | **John Doe**

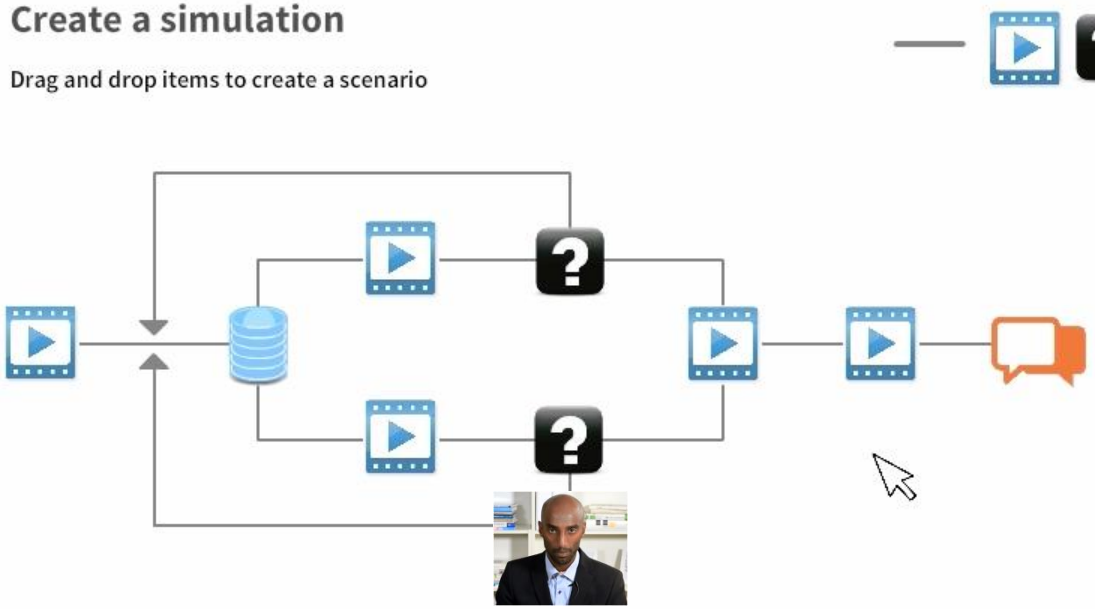
Search courses

Categories

- Arts
- Biology & Life Sciences
- Business & Management
- Chemistry
- Computer Science: Artificial Intelligence
- Computer Science: Software Engineering
- Computer Science: Systems & Security
- Computer Science: Theory
- Economics & Finance
- Education
- Energy & Earth Sciences
- Engineering
- Food and Nutrition
- Health & Society
- Humanities
- Information, Tech & Design
- Law
- Mathematics
- Medicine
- Music, Film, and Audio
- Physical & Earth Sciences
- Physics
- Social Sciences
- Statistics and Data Analysis
- Teacher Professional Development

Create a simulation

Drag and drop items to create a scenario



What will this end up to?

Quality time instead of quantity time

Peer discussion
learner + teacher

A L O | A L O | A L O

ALO including Forum discussions / Papers / Wikipedia contributions / etc

Knowledge material

PDF | YouTube | Wikipedia The Free Encyclopedia


Lecture ILO


Lecture ILO


Lecture ILO

Lectures shortened (to 3 x 7,5 min?) "nuggets" with ILO for each (or no lectures at all???)

22,5 min

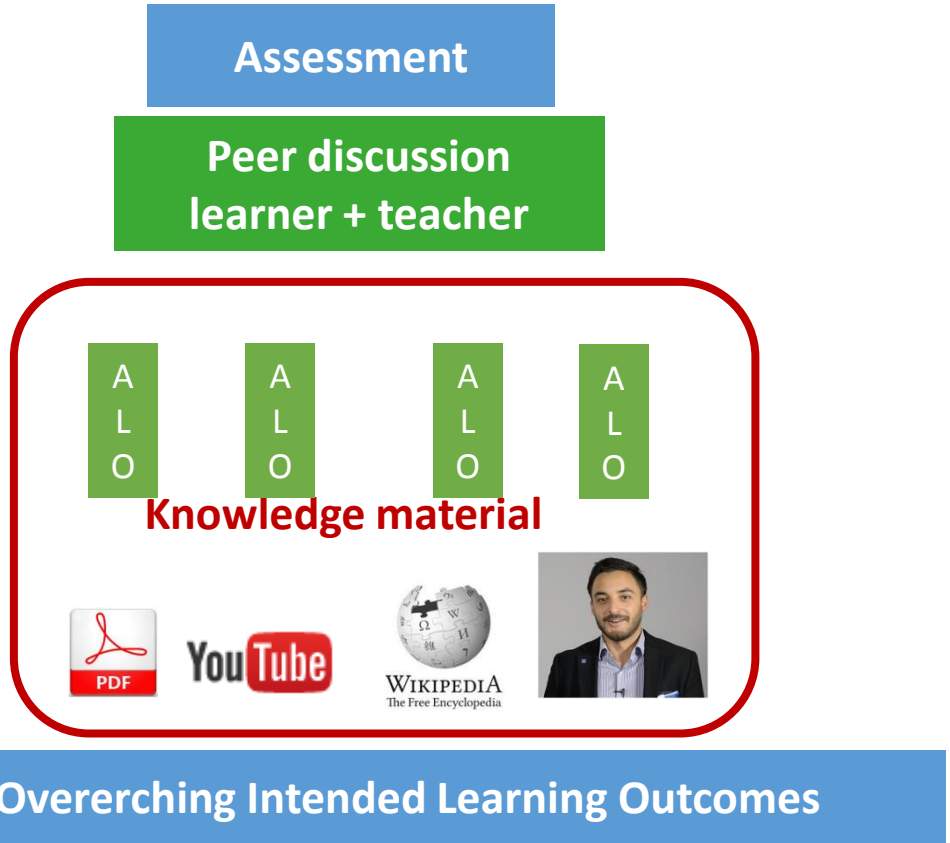
90 min

Schedule lecture time 90 min (2x45)

So: What is the teachers future role?

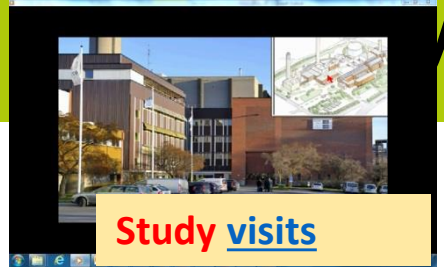
1: *Architect* to design the
- **Overarching Intended Learning Outcomes**
- **assemble the Knowledge Material**
- **all the Achieved Learning Outcomes**
- **moderate peer discussions**

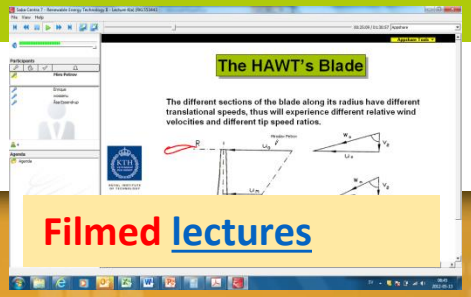
2: *Assess* if achieved competences and skills match the intended design

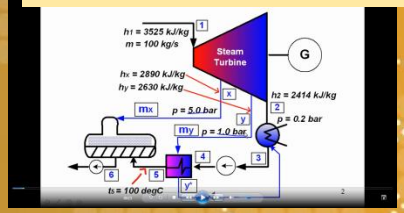


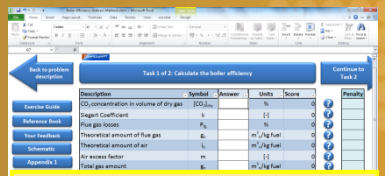
Anywhere on any device

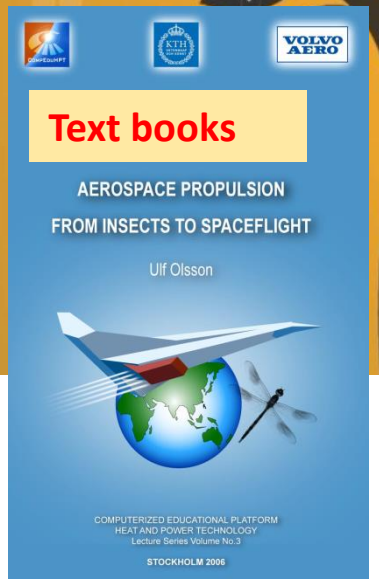
Organized y for the 2030 student

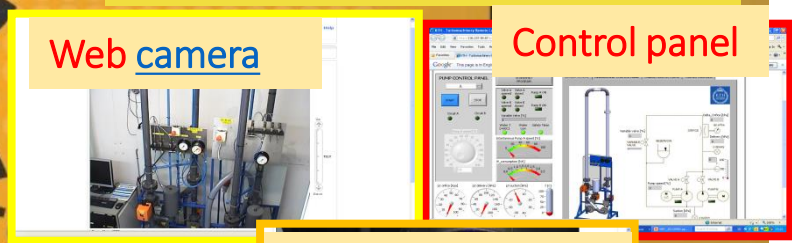


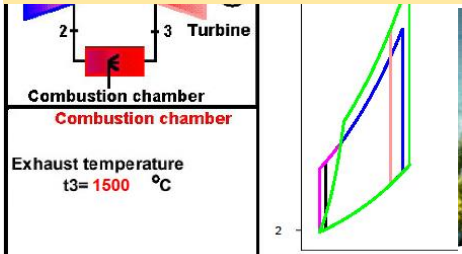




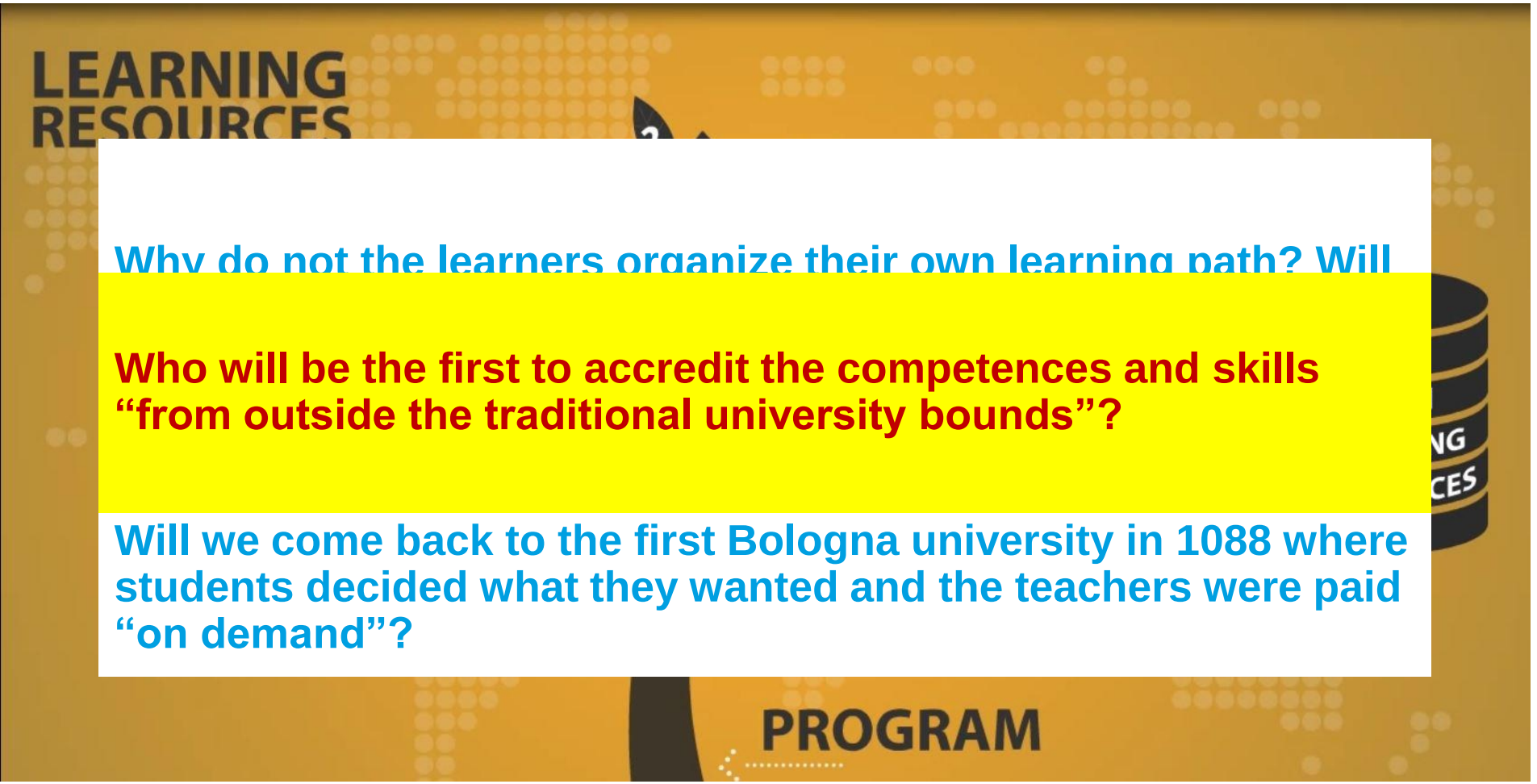








Organized for flexibility for the 2030 student



My conclusions

Drastic changes in Higher Education coming up

- Modernization urgently needed

The 2030 learner will seek knowledge “from anywhere”

- Earlier entry into the labour market(?) & Life-long learning
- Competences & skills proven in other ways than Programs & degrees

“Educator’s” role will change drastically

- Architect / Moderator / Assessor
- With a combined educating/research role?
- Keeping the human aspect in larger & remote “learning processes”

Universities (*most*) will not sustain in the present form

- Where will the public funding for education go?
- Will the academic research faculty also decrease?
- Will professional & research training stay together?

KIC InnoEnergy prepares involved teachers and learners to the change

- Develops the learning and “teaching” tools needed
- For a more innovative, entrepreneurial, sustainable world with increased human and social considerations

Thank you for your attention