

SKILLS

- Proper combination of skills, not always building new educations from scratch, often better to link existing skill sets across 'disciplines'
- Eg. more demand for a plant biologist also trained in economy than for a "new bioeconomist"
- Entrepreneurial and risk-taking mindset must come out of education
- Industry demands:
 - technical expertise in areas which have lost importance but now becoming crucial, eg. plant breeding
 - Interdisciplinarity, team & networking skills
 - Lifelong learning, both young and old, both academic and professionals/blue collar employees
 - Include demonstration projects in as good translation cases in education – as well as whole value chain incl. side streams
- Map existing skills development programs as basis for discussion with demand side – and for assessing needs and benefits of international collaboration to create a global workforce and increase mobility

JOBS and EMPLOYEES

- There are millions of jobs associated with exploitation and development of blue, green, yellow, brown, white and other biomass (residues, by-products, waste etc.)
- Differentiation of jobs and education requirements along the value chain – e.g., alternative crops / production systems, protect and optimise various biomass types, development and handling of new processes and equipment
- Potentials for export of technology and knowhow – new jobs and skills
- Vertical linking of education and training
 - Farmers/farmworkers – industrial workers – researchers
 - - same for forestry, food industry, renovation and waste sorting etc.
- Trade unions and employers joint design for optimal education and training of workforce – and for choosing best and most relevant ‘supplier’
- Need for ”reciprocal” training: researchers and teachers need to visit farms and go into the fields – incl. the understanding of the workforce needs for training.

EDUCATION MODELS and PRACTISES 1.

- Education programs should focus on diversity and synergies between biological production systems: agriculture/forestry/fisheries etc. -- microbes and industrial biotechnology – the synthetic biology toolbox
- Schools and universities still very weak (and slow) in developing cross-and multi-disciplinary education programs (silo structures and mono-disciplinary thinking)
- Need to combine skills in biology, chemistry, genomics and metabolic engineering, computation and modelling, economy etc. to create ‘designer engineers’
- Learn from other industries prone to major changes and disruptive innovation – e.g. creation of new “Academy” structure tailormade to the sector (ex. automobile industry)
 - The Academy as harbour or hub: a ‘contaminated environment’ where cross-fertilization can take place
 - Industrial and academic people meet and teach / mentor students – and each other

EDUCATION MODELS and PRACTISES 2

Implement "Academy" at 4 levels

- Start at PhD-level – Industrial PhD's have been developed successfully in Denmark and is now an EU model concept
 - Integrated MS education, combining different Bachelor degrees
 - 'Short Master' model from Italy with 250 hours education, combined with job
 - Practise schools incl. apprenticeships and internships in companies
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- Develop "broad specialised curricula" not a contradiction, but need for a balance
 - Build regional education clusters linking academic and industrial expertise
 - "Teach the teachers", cascading for higher speed in development and implementation
 - Systemic thinking – build skills all the way from primary school to PhD
 - Bioeconomy needs to be developed as a mindset, not just a question of research, education and training – starting at an early age and trying to combine 'problem-based-learning' with 'opportunity-based-learning'
 - In that respect, we must teach the whole society, including entrepreneurship and risk-taking

GENERIC observations and comments

- Many interventions confirmed good progress since the Dublin conference with many new but scattered initiatives in education and training
- But overall development and implementation of the Bioeconomy, incl. full scale biorefineries etc., is now accelerating
- Slow development of new and relevant education and training concepts and programs may soon become a serious limiting factor for further growth
- Universities and schools have to demonstrate leadership in stepping up on both volume and speed
- Speed and volume might be increased through integration of education in larger H2020 projects and the new Biobased Industries Consortium, BBI
- There is an increasing need for coordination and certification at both national levels and across MSs
- There is a need for both integration across the knowledge triangle and with the Triple Helix innovation model to include authorities and legislation
- The EIT/KIC model with full integration of education in the knowledge triangle and in the partnership business plans and with incentivizing (competitive) quality labels seems presently to be the only EU-wide systemic approach – and may become an attractive model for the Bioeconomy area.