Ethical and social issues in Synthetic Biology

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Delft University of Technology &

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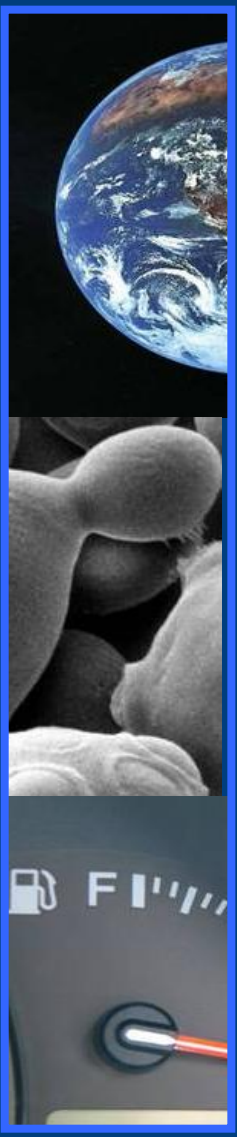
BE-Basic

The Netherlands



Kluyver CENTRE | Kluyver Centre for Genomics of Industrial Fermentation

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National programmes

Public Private partnerships (since 2002)

> 200 MEuro with > 250 researchers from Universities in NL and international industry

Kluyver Centre for Genomics of Industrial Fermentation

BE-basic

Kluyver Centre for Genomics of Industrial Fermentation

"to provide scientific excellence in microbial genomics for quantum-leap innovations in industrial biotechnology"

- Food and food ingredients
- Pharmaceuticals
- Fine chemicals
- Bulk chemicals
- Energy carriers
- Society & communication strategies

BE-Basic develops new bio-based concepts for the chemicals, energy and materials industry as well as

for monitoring, controlling and improving the impact on the environment and society - all at the same metagenomics basis.

BE-Basic

Biobased, Ecologically Balanced Sustainable Industrial Chemistry

Kluyver Centre (2002-2012)

> 100 MEuro > 150 researchers from Universities in NL & international industry

Genomics & Society

Aims to reveal and understand underlying public issues that influence implementation of industrial genomics results and suggests ways of improved communication

DSM applikon HTC HITEXACOAT i.o. B.V. BIRD ENGINEERING Nestlé PURAC TATE & LYLE CONSISTENTLY FIRST IN RENEWABLE INGREDIENTS lifewizz DYADIC Heineken Genedata GSK

Kluyver Centre Society programme

***Three sub-programmes*:**

- **Identification of future issues**
- **Quantification of impact of innovations**
- **Development of pro-active communication strategies**

BE-Basic (2010 – 2015)

120 MEuro > 150 researchers from Universities & international industry

Flagship 9: Societal Embedding of Biobased Products and Processes

A. **Identifying, qualifying and quantifying sustainability issues**

Improved models and measurement techniques (LCAs etc)

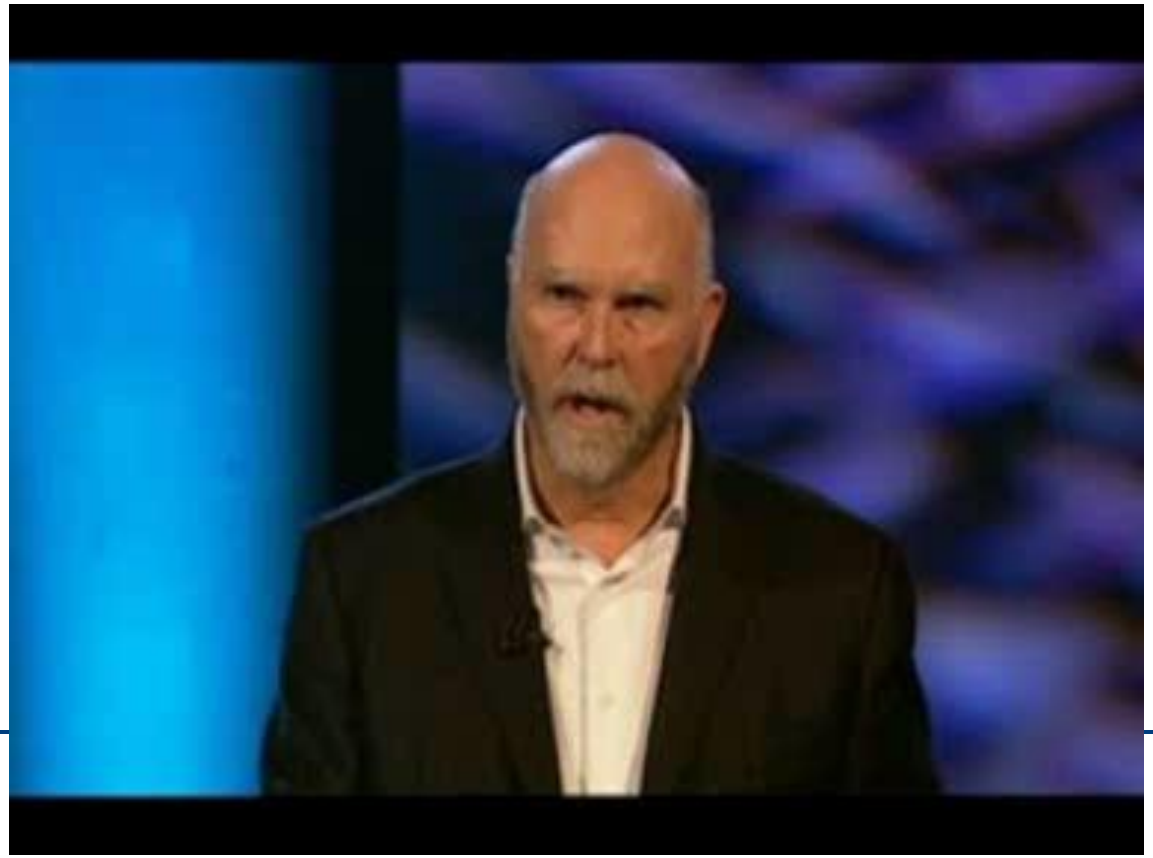
Analysis of public perception and global policy issues

B. **Education, communication and societal valorisation**

Improved education and societal interaction

Some breakthrough?

The ***Richard Dimbleby Lecture 2007*** | ***Dr. J. Craig Venter***



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Synthetic Biology in the news

Synthetic Life By the Year's End? Yes, Proclaims Craig Venter

Discover magazine, 24 August

It's time to play God

If Craig Venter's research leads to engineering new forms of life, mankind has hope for the Future

Guardian 23 August 2009

news

Microbe Metabolism Harnessed to Produce Fuel

By Irene Chang ,
National Science Foundation
posted: 28 August 2009

Joint BioEnergy Institute (JBEI) Director Jay Keasling with Rajit Sapar in lab at JBEI with beaker of cellulose sludge

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news

Hobbyists Are Trying Genetic Engineering at Home

It's not just for Ph.D.s anymore: Amateurs are attempting genetic engineering at home

By MARCUS WOHLSEN Associated Press Writer

'Synthetic biology' holds promise, but doubts simmer

Synthetic Biologists Reengineer Living Things Today, Hope to Create Synthetic Life Tomorrow

USA Today, 30 August

news

Keeping genes out of terrorists' hands

Gene-synthesis industry at odds over how to screen DNA orders

Nature 31 August 2009

news

Biohacking

Hacking goes squishy

Sep 3rd 2009

From *The Economist*

Biotechnology: The falling cost of equipment capable of manipulating DNA is opening up a new field of "biohacking" to enthusiasts

news

A Life of Its Own

Where will synthetic biology lead us?

by Michael Specter

New Yorker

28 September 2009

SynthEthics EU project

- Identify & analyse ethical and social issues in public discourse and science domain
- Define ethical frameworks used in science
- Advice policies and organise public events to inform public in balanced way

Approach

- **Literature study**

  four main issues: Playing God; Governance; Distributive justice; Bio-risk
- **Media analysis**

  environmental issues most mentioned
- **Expert meeting**

  - no-one calls themselves 'synthetic biologist'
  - ethical and regulatory issues rather than technical
- **Interviews**

  preference for Open-source?
- **Analysis of legal framework**

  so far no reason to develop something special

What is synthetic biology

- Lot of ink spent on what is synthetic biology

  deconstructing live versus ***constructing life***

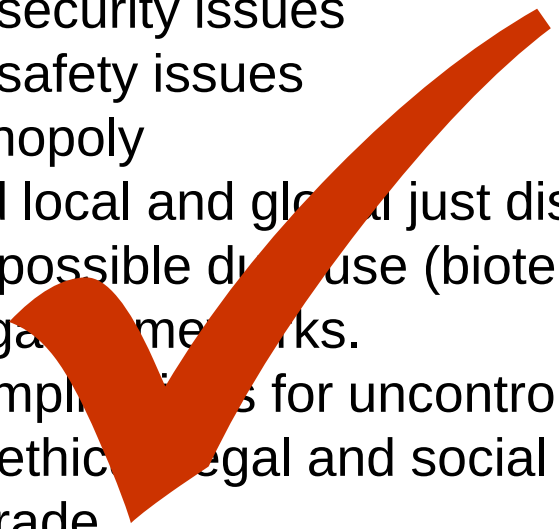
  but ethical issues merely similar to component fields

  How different ? Diminished or amplified?

issues

How to:

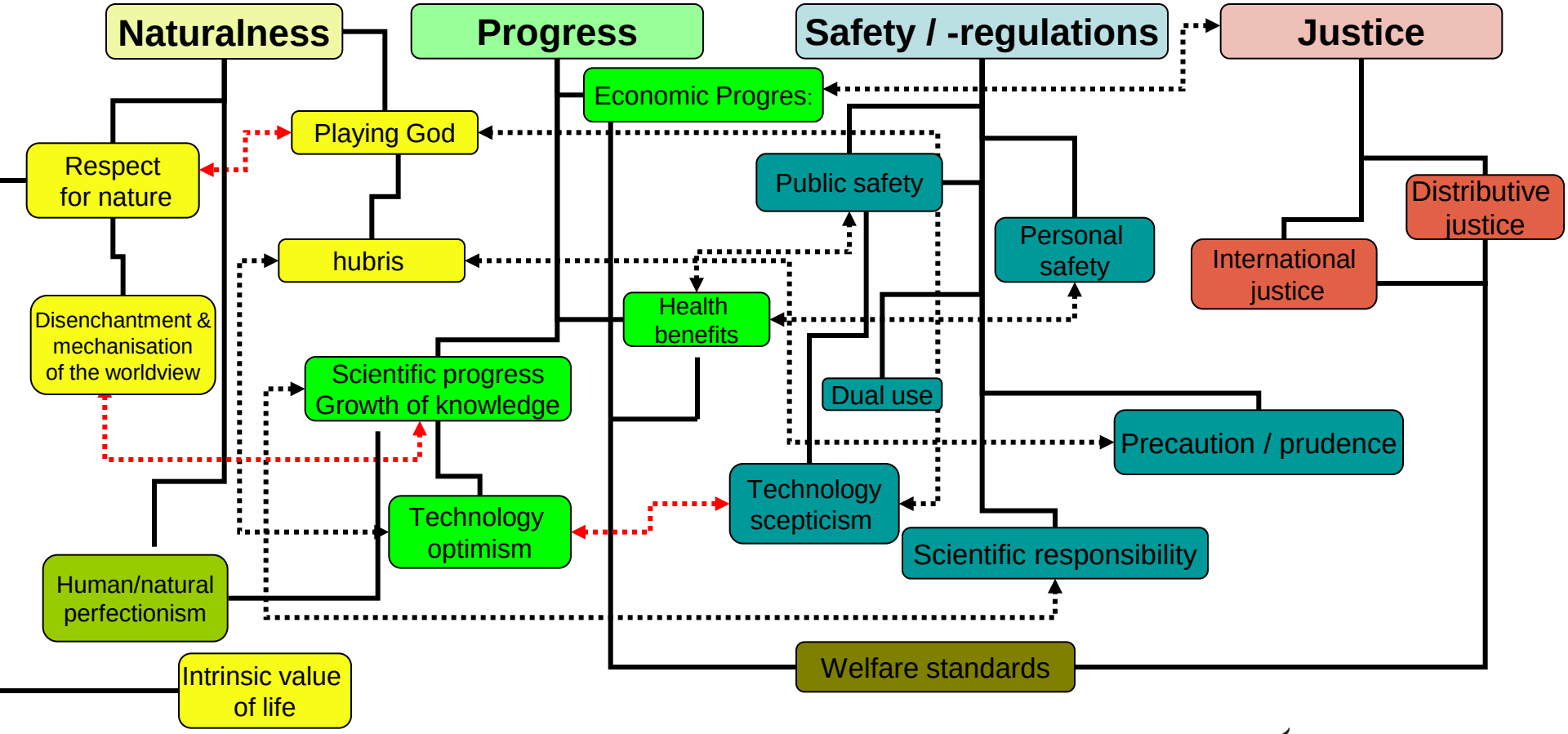
- - deal with risk
- - deal with security issues
- - deal with safety issues
- - avoid monopoly
- - safeguard local and gl al just distribution
- - deal with possible d use (bioterrorism)
- - design lega me ks.
- - map the impl s for uncontrolled release
- - deal with ethic egal and social issues related to patenting
- - regulate trade
- - maintain public legitimacy and support
- - deal with animal rights



Synth-Ethics

Ethical and regulatory issues raised by synthetic biology

Synbioethics: values and principles



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Bio-risk

- Biosafety-biosecurity & dual use

  harm either '*naturally*' or '*intentionally*'

Possible, but likely? But does it matter, effect is the same…→ bio-risk (rising)

Dual use: Prevention from publication?

Playing god

Issue of 'natural' = difficult to handle

Q: What is life? Inherent value

Does life has a worth in itself and does it so because it is natural?

Q: Why is engineering new life forms so different than engineering new machines? Are biological components special? Is self-replicability the issue?

And: what is ***new*** life? Implications self image

But irrational uneasiness should not result in overregulation

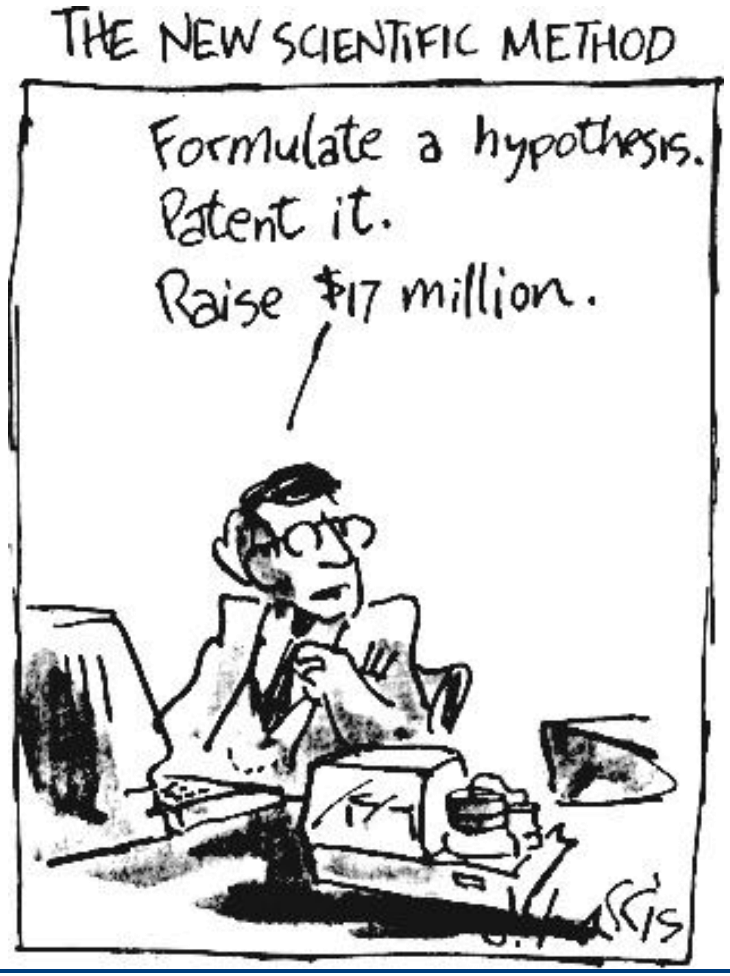
Distributive justice

= Just distribution of harms and benefits

- Social value of novel technology: artemisine from yeast maybe not best way

→ avoid tech-fix: open source versus multinationals

Regulation governance & ownership



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Regulation governance & ownership

- Ownership issue: suggestion: IP add *'little chance to occur in nature*' and '*natural selection would work against the organism produced*'
- Prevent patent thickets or anti-commons (hindering research and commerce): exclude lowest forms

Overall: mix of regulation and self-regulation and open source

~~Issue: setting international guidelines~~

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Media analysis 2009-2010

- Playing God 17%
- Environmental issues 70%
  - 50% positive on fuels
  - 12% positive and negative
- Social issues < 10%
- Legal issues 25% (IP)
- Economic issues 25%
- Biorisk more issue in US than in EU

Balance of public perception

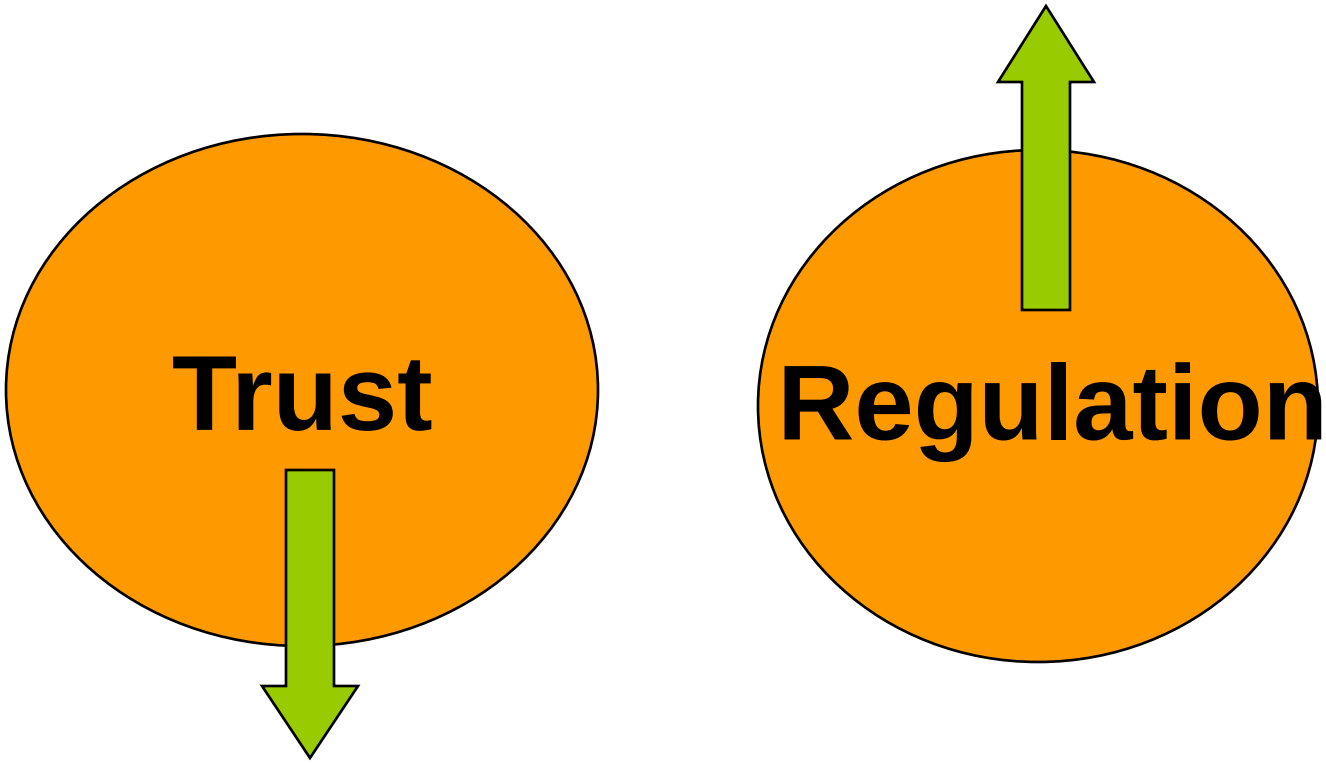
Knowledge is generally low

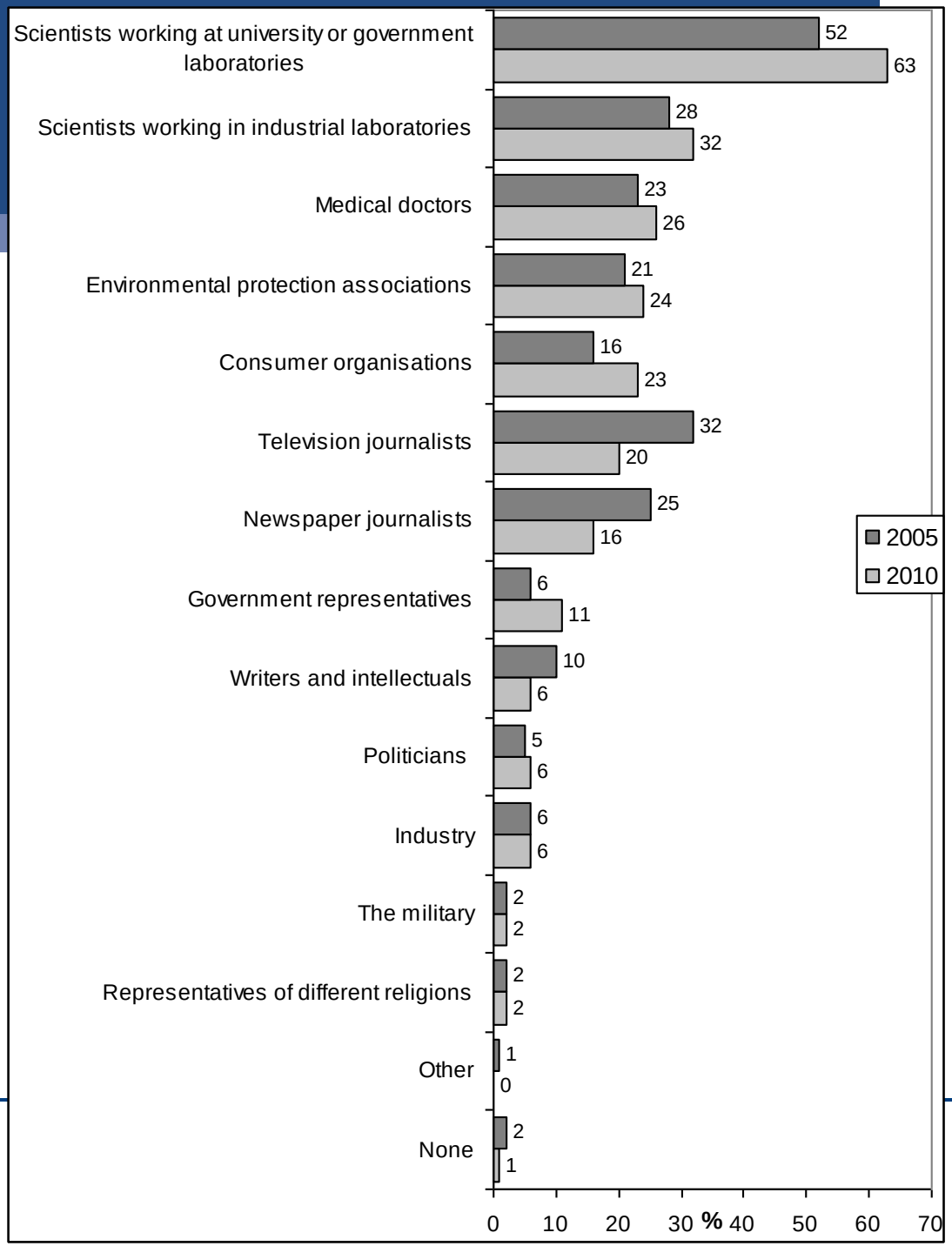
Risks are vague

No control by oneself

- leads to little confidence

Balance of public perception





Best qualified to explain the impact of scientific and technological developments on society,

Europeans, science and technology (2010),

Eurobarometer 340

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Involvement of scientists

Key element in whole approach:

Scientist are or should be involved from outset!

In combined projects: social scientists in the lab or by expert meetings; policy advice; education and public dialogue

Public debate?

- Cannot be planned
- Issues that will be discussed can be anticipated
- Need to be understood, ethics studies can help here
- Methods are important to fully allow addressing concerns
- Trust is important factor
- Scientists do play a role

iGEM Ethics Project 2009

- **Why** ethics in biological design?
  - Scientist's awareness → have an opinion!
  - Responsive capacity of researchers

- **What** did the students do?
  - Survey among 500 students + supervisors world-wide
  - Focus on reductionism in Synthetic Biology
  - 250 responses

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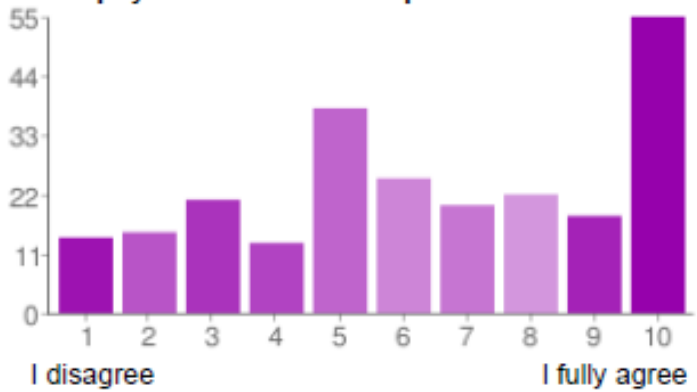
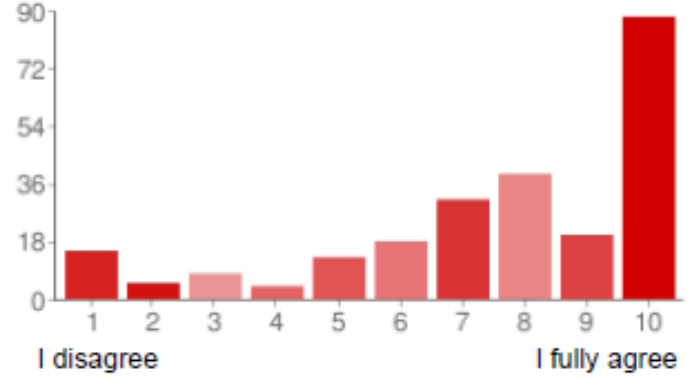
Life is physical and can be explained materialistically

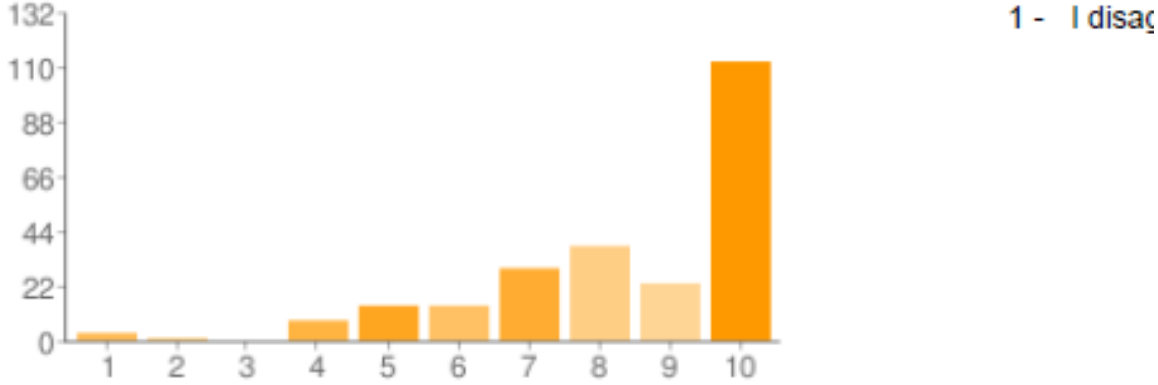


The scientific community and the public have to work together in addressing key ethical and religious concerns.



1 - I disagree	15
2	5
3	8
4	4
5	13
6	18
7	31
8	39
9	20
10 - I fully agree	88

Advances in synthetic biology should be communicated to all of society.



Potential conflicts

- definitional issues
- rational discussion about:
  Nature vs. artifice
  life vs. non-life
  issues of "playing God“
- legitimate incorporation of public in decisions, even where emotions or intuitions guide those decisions

Summary Synthetic Biology

- Disruptive technology with potential for high impact
- Issues circle around the notion of ‘life’
- Scientists have a role to play in addressing these
- **Need for awareness on safety regulations and legal and ethical issues**
- **Important to address these alongside research!**
- **And to be pro-active & creative in communication activities**

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