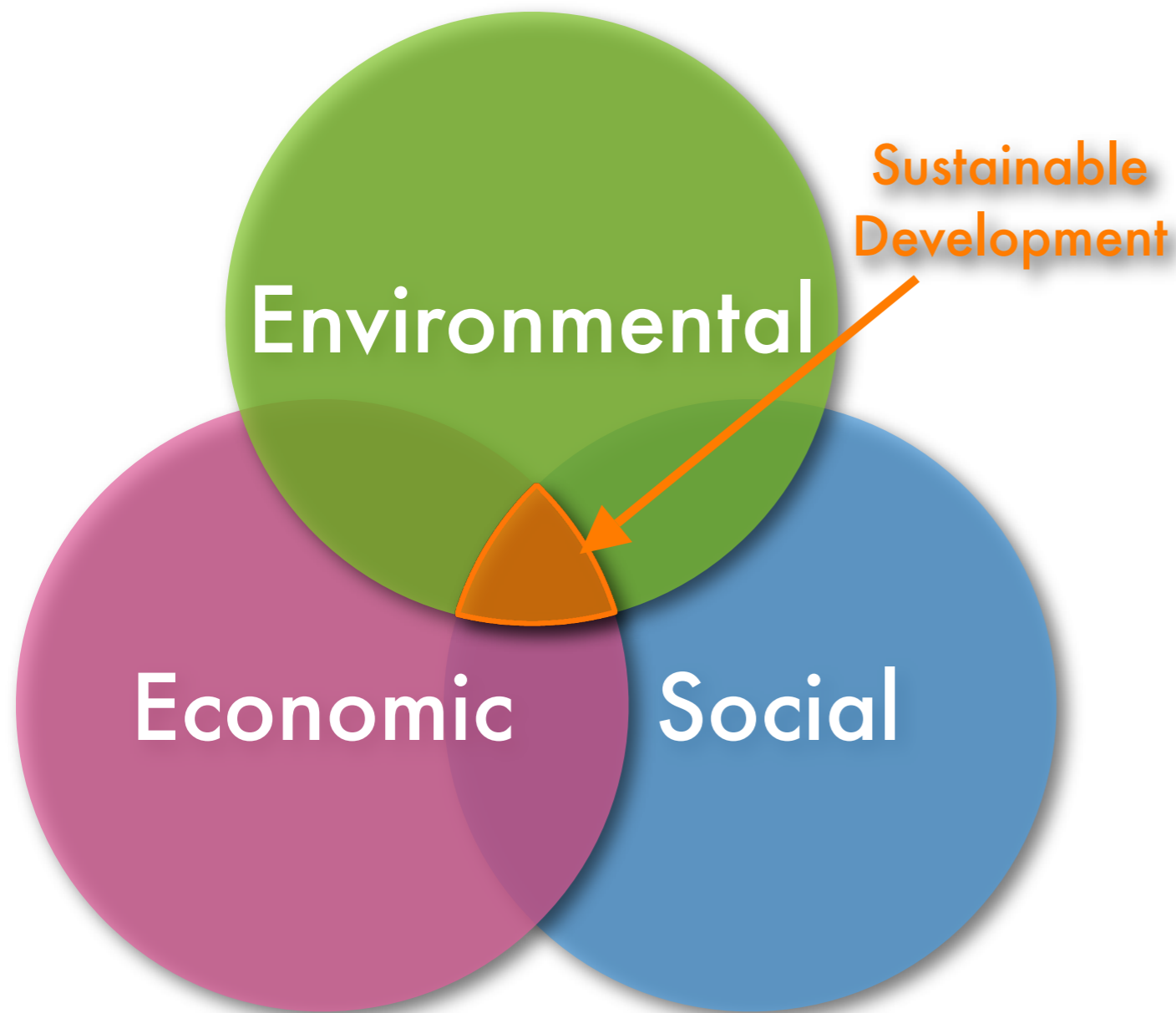# THE ImpEE PROJECT

IMPROVING ENGINEERING EDUCATION

What do engineers need to learn about sustainable development?

The Cambridge-MIT Institute

UNIVERSITY OF CAMBRIDGE

Engineering Sustainable Development aims to balance the three elements:

Sustainable Development

Environmental

Economic   Social

- **Economic:** what things cost - and how to make a business out of providing infrastructure, goods or services

- **Environmental:** what impact those things have on nature and the earth's support systems - which are finite

- **Social:** how those things serve the needs and quality of life of people and their communities
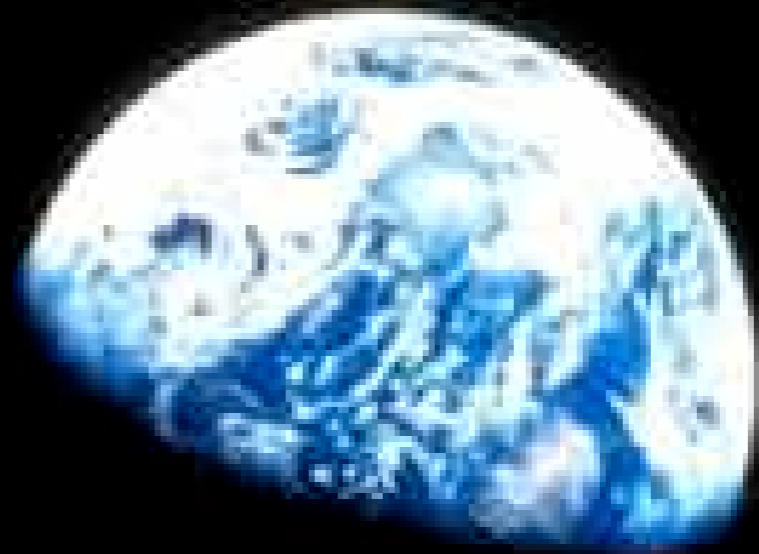
The current world view - relative importance?
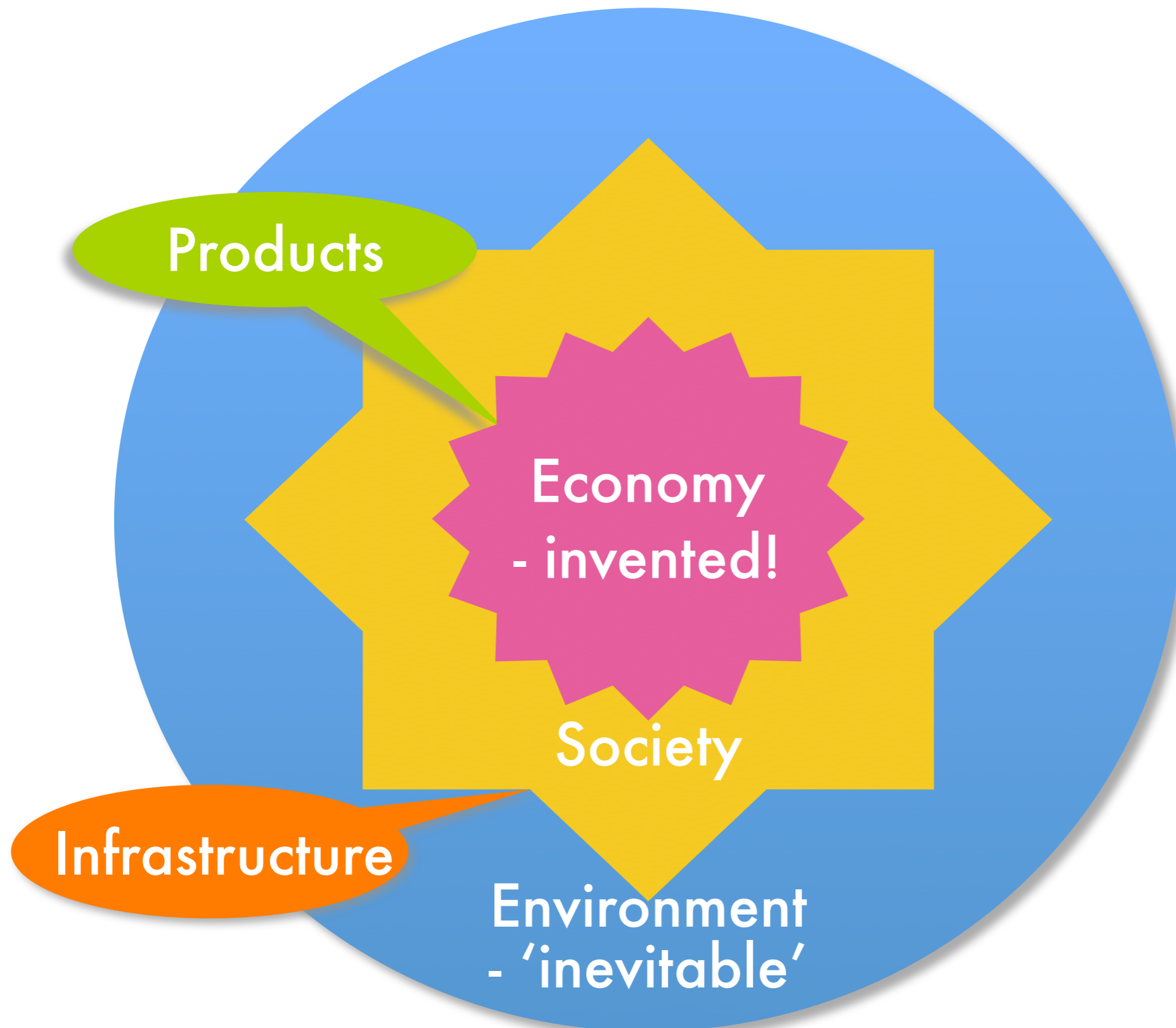
Environment ("technology can fix it")

Economy ("inevitable laws")

Society

But *this* is what we all ultimately depend on for life - so...

Engineers' designs have a *critical sustainability impact:*

- "by the time the design for most human artefacts is completed….80-90% of their life-cycle economic and ecological costs have already been made inevitable"

- Or, in design:

  "All the really important mistakes are made on the first day"

  "Natural Capitalism" - 1999

So: to lead sustainable development, engineers must think differently - use a different design mentality - from that first day

THE ImpEE PROJECT

- Over the last 50 years, 'development' - comprising engineering projects, and products - has benefited large numbers of people, world wide……………*but:*

- The way we have been doing our development is often "unsustainable" - in social and environmental terms

- This leads to real fears about the security and quality of life that my children, and grandchildren - and yours - and the world's - can expect

"We do not inherit the earth from our ancestors - we borrow it from our children"
(Anon – Native American Indian)

Sustainable Development is the journey *towards* Sustainability

Global Society in 2005: Unsustainable → Sustainable Development → **A Future Sustainable Society**

inequality, much poverty left; threat of decreasing quality of life

basic needs and life quality provided; tolerable inequality; living within the Earth's limits
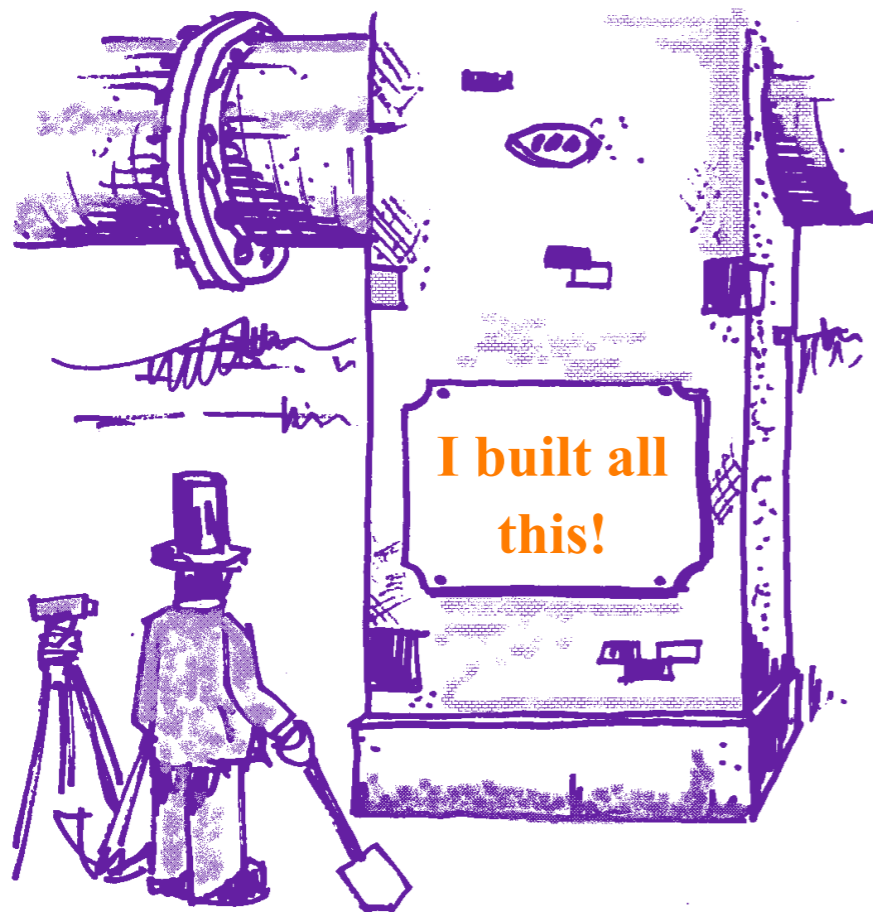
What should engineers be doing about it?

- Choosing Technology

- Understanding the environment

- Appreciating the social challenges in making it happen

We need new challenges - redefine engineering culture away from "Building things"

The 19th (& 20th?) Century Engineer

I built all this!

Visible construction, at great public expense, to meet society's wants

The 21st Century Engineer

I didn't need to build anything new!

Providing and Refurbishing the minimum to meet society's needs

A huge new technical challenge:
- *energy and materials efficiency*

We can drive materials efficiency:

- "600 tonnes of material are used to make 60 tonnes of product of which 6 tonnes are in use 6 months later"

(Lord Sainsbury, Minister for Science and Industry)

We can drive energy efficiency:

- "The whole economy is less than 10% as energy-efficient as the laws of physics permit"

(From "Natural Capitalism" 1999)

Which of these is worth more of an engineer's purpose, energy & interest?

"Video toothbrush"

In development by Panasonic, this electric toothbrush has a miniature video camera mounted beside the bristles to allow the user to see on a monitor the '40%' of debris they normally miss."
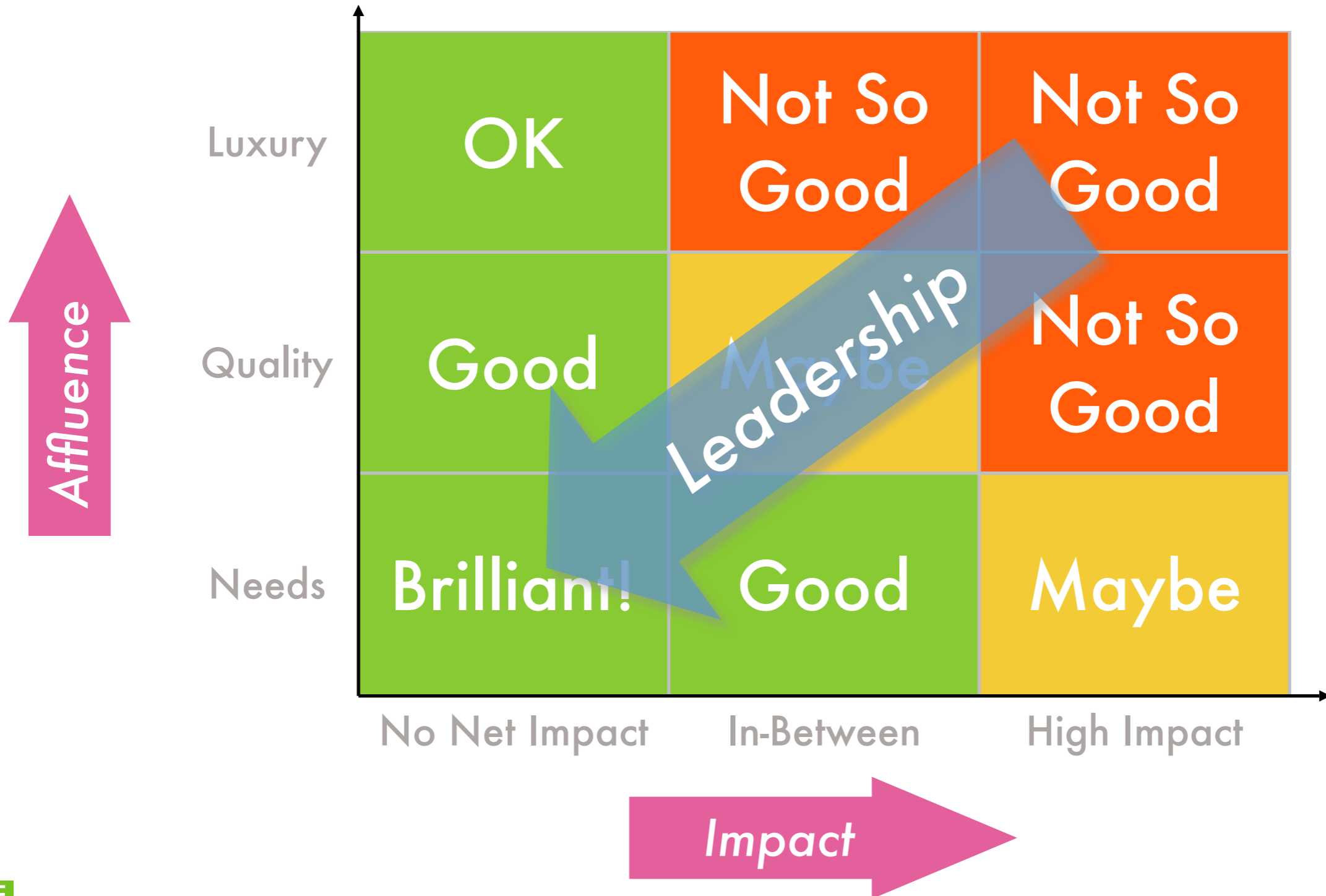
(TYNKYN - EC 11/01)

Rachel Battilana - refugee tent linings - 2001 Young Engineer of the Year

Choosing what you are engineering for - engineers can't be neutral

A new approach

- Sustainable development is NOT about doing things we are doing now, but doing them "less bad".

- It IS about designing and producing products we need for a growing and prosperous society that are actually good.

Bernard Bulkin, Chair of the Sustainable Development Commission

The environment is unknowably complex. We need a "paradigm shift" in how we think about it...

Mechanistic World → **Systemic, Complex World**

Newtonian Mechanics → Chaos and Complexity Theory

Independant, linear, cause and effect → Interconnected, feedback loops

Predictable outcomes → Uncertainty; patterns within disorder

Arrogance over nature → Humility, within nature

So - technology can remove "natural" limits → Maybe, *but not affordably, nor with predictable outcomes*

Hence - narrow, blinkered, technical solutions → Hence, *analyse systems holistically; understand feedback loops; apply the "Precautionary Principle"*
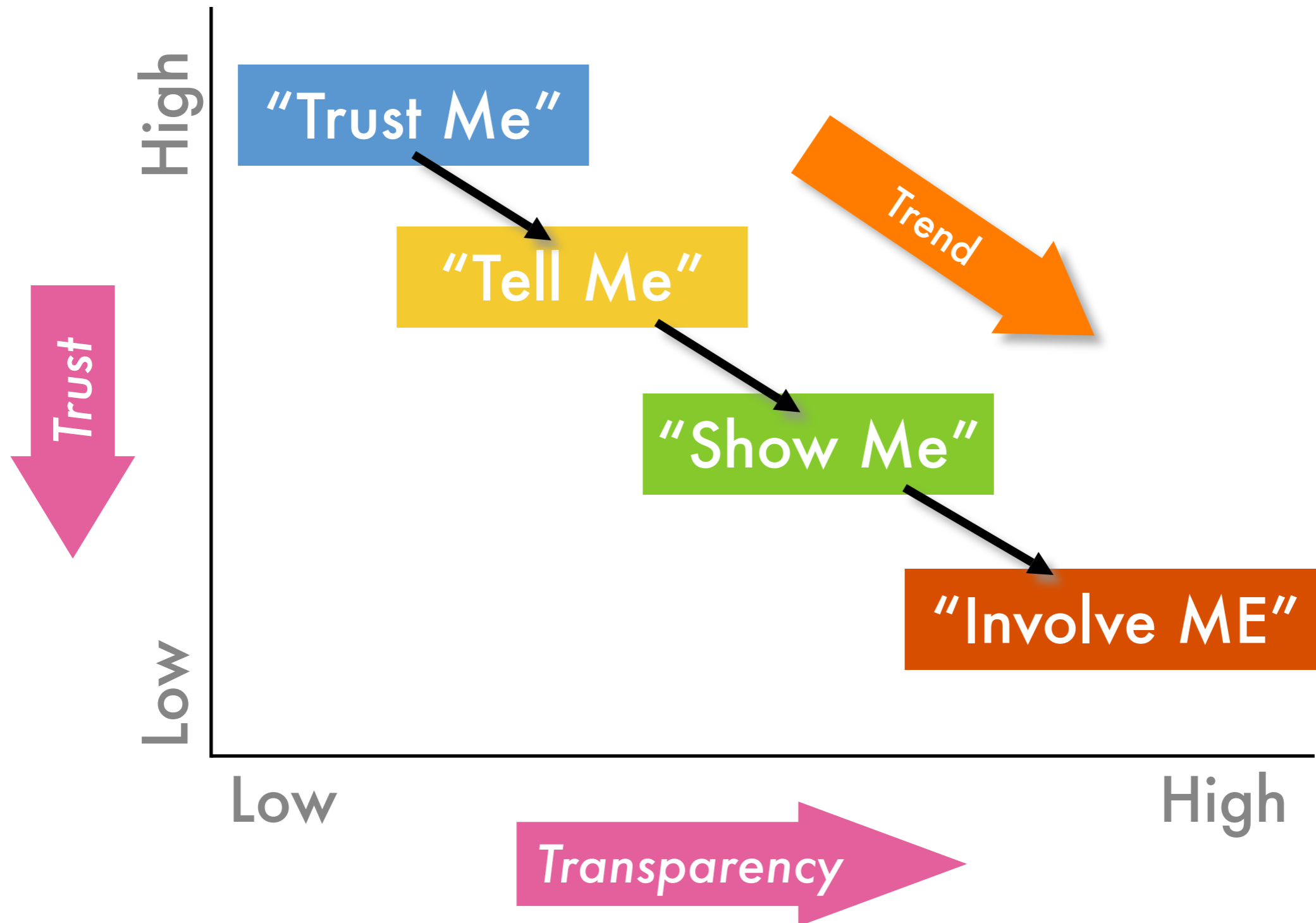
'Social' components can help deliver sustainable solutions

Local community ownership:

- 70% local co-operative ownership seems to be the key to Denmark's success in avoiding 'NIMBY' for
  wind farms - ~ 10% of Danish power

- UK, wind farms are almost entirely private corporation owned, and overall market penetration is less than 0.15%

Is there any connection?

©National Wind Power

Engineers need to learn to engage better with communities, to implement the complex solutions that sustainability needs

Technical Complexity:

We are developing the GIS, data handling and modelling to deal with geography, physics, chemistry ,and even with the uncertainties of biology

Social Complexity:

Now we also need to engage with the community, and develop the capability to consult, facilitate and agree on the complex solutions.

This needs new engineering skills

What do *you* think?
- do you agree, or not?

- Should engineers be concerned with the 'purpose' and social dimensions of technology application?

- Is all this soft 'society' stuff not a proper subject for 'real', scientific engineers?

- How well do we really need to understand the environment?

- Can we extend our professional 'ethic' to include the environmental and social consequences?

- Can engineers take a lead in ESD – and would this encourage more young people to be engineers?

'The Engineer of the 21st Century' - some of the outputs:

- "Individual engineers should understand their personal ethics and values and those of their employers if they are to recognise those of others and influence change."

- "Our vision is of an engineer who **demonstrates** through everyday practice:
  - an **demonstrates** of what sustainability means
  - the **demonstrates** to work towards this aim
  - **demonstrates** that relate to their wider social, environmental and economic responsibilities
  - and encourages and enables others to learn and **demonstrates**"

Conclusion…?

- *So: we are not (yet) educating our engineering graduates to deal with the key issue of the 21st Century*

Engineers can invent a sustainable future?

"We are all part of the continuum of humanity and life. We will have lived our brief span and either helped or hurt that continuum and the earth that sustains all life. It's that simple.Which will it be?"

Ray Anderson, Interface Carpets - to other CEOs

"The best way to predict the future, is to invent it"

Alan Kay, Apple Computer

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