

MOBILITY ENERGY ENVIRONMENT



The future moves us.

*Technologies and policies for a better world*

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Serralves Foundation, Porto, 15 October 2015

*Global trends 2030: Global technological trends – contributing to a better world?*

# Which future technologies will be successful? And why?



Futuretechnology500.com

## Current model: market-based evaluation

- Success = Market uptake (diffusion)
- Constrained by requirements on efficacy, quality and safety
- Suppliers are responsible for ensuring compliance with standards and procedures: evaluation of the “properties” of individual technologies
- Users are expected to make safe and responsible use of available technologies and products

# Which future technologies will be successful?

## Risks and benefits

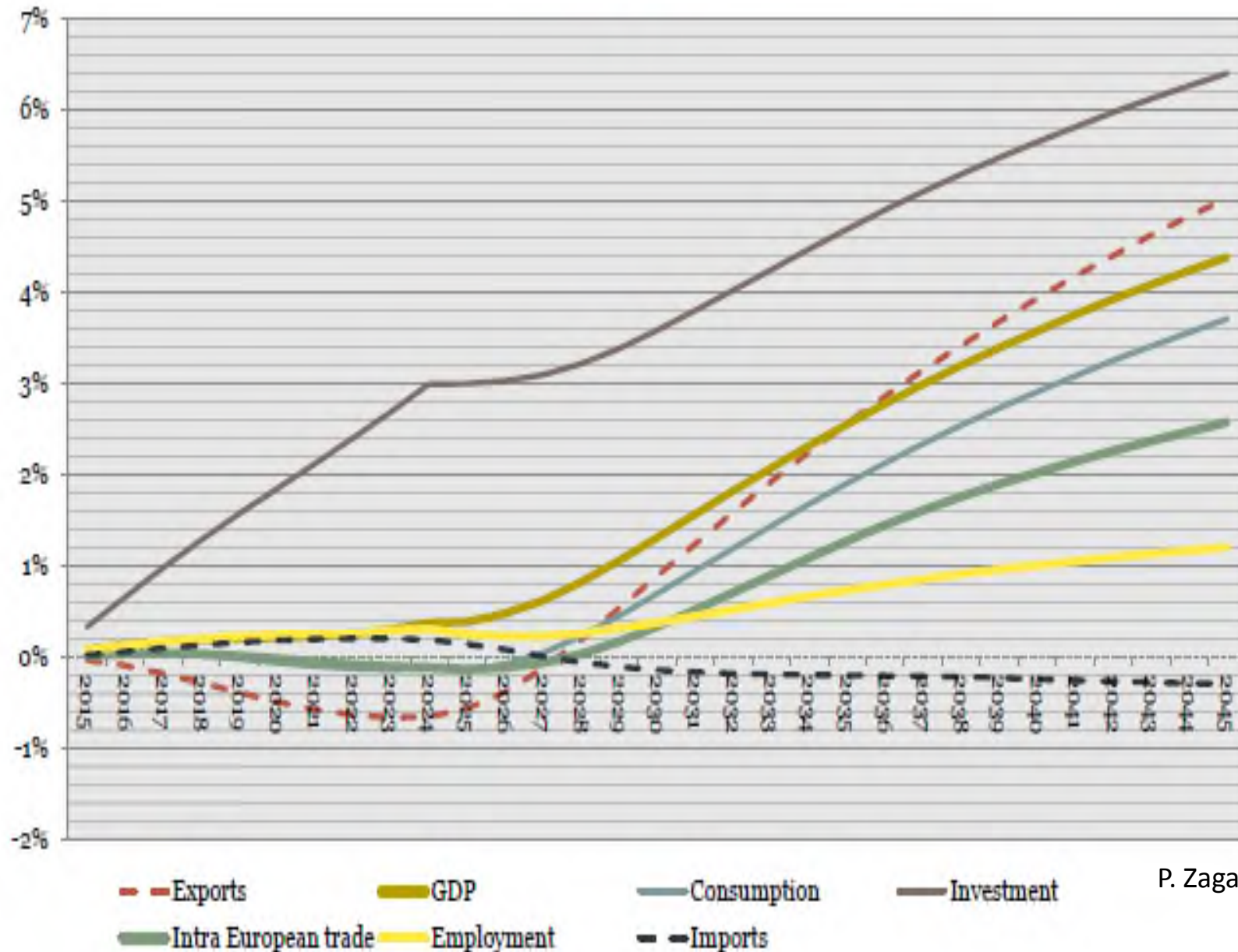
### Current model: market-based evaluation

- Risks appraised through formal procedures
- Benefits primarily (only?) assessed (and RTD investments justified) in terms of macro-economic impacts (GDP and jobs for society as a whole)



Bluesyemre.com

# Macroeconomic effects of technological progress



P. Zagamé 2015

# Which future technologies will be successful?

## Issues

- Absence of a normative baseline to assess societal benefits
- Fast dynamics of societal needs and preferences

## Papal inauguration 2005



Hargrave 2014

## Papal inauguration 2013



Hargrave 2014

# Which future technologies will be successful?

## Issues:

- Absence of a normative baseline to assess societal benefits
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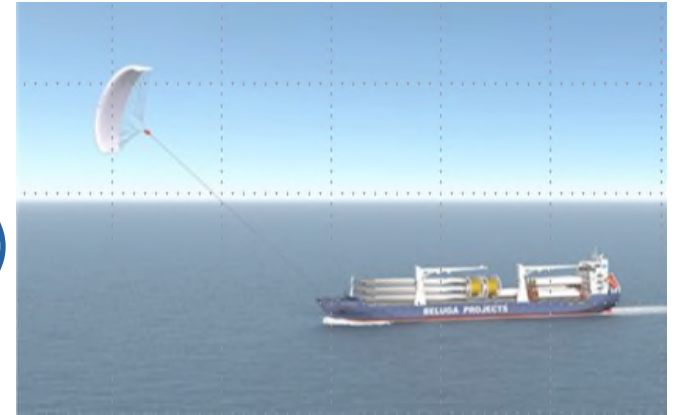
How to make systematic attention to the ethical dimension of technologies and their capability to successfully address critical societal problems/needs (equity, privacy, freedom, self fulfillment, well-being...)?





# Example: technological progress in transport

- Expected technological progress “in the cards”:
  - H<sub>2</sub> fuel cells
  - Advanced biofuels (cellulose biomass)
  - In vehicle storage of electricity (batteries)
- Most critical uncertainties surround
  - the role of each technology option and its share in the ultimate basket of technological solutions (how much electric vehicles, fuel cells, fast trains, short distance air traffic, waterborne goods traffic, etc.)
  - the timing of their market penetration, including the important issue of differentiating between transition technologies (hybrid cars?) and “ultimate” technologies (H<sub>2</sub> fuel cells?)



# What will drive the take-up of transport technologies?

- Speed as the (currently) prevailing driver of modal choice => is the “speed paradigm” sustainable?



- Will the conjecture of “time budget invariance” hold in the future?
- Will nanotech allow for a significant reduction in the movement of raw materials? And of goods in general?
- Will virtual/augmented reality lead to a redefinition of mobility function and services?

# Key message

Most of the challenges and barriers are explicitly pointing at the need for a better understanding of the interrelations between the desired features of a future sustainable transport system and the future dynamics of society, its norms and values, its culture, its preferences and aspirations, its lifestyles and behaviours.



**Do it together**

More care for nature  
and social well being



**Growth within limits**

**Do it fast**

More consumption of mass-  
produced goods ("industrial  
GDP" civilization)

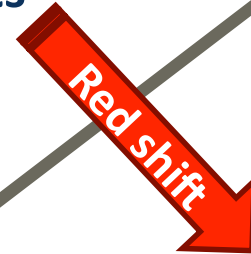


**Growth without limits**

**Blue shift**



**New Welfare**



**Stagnation**



**Do it alone**

Less care for nature  
and social well being

**Do it slow**

Less mass consumption –  
Dematerialization - ("cognitive  
GDP" civilization)



# Growth without limits: no shift

- Continuing hyperconsumerism and globalization
- New tech wave (ICT, nano, bio) – Technofixes
- Considerable EE increase, largely offset by lifestyles
- Continuing urban sprawl and car dependency
- Overall energy consumption increases
- CCS grows, Fossil phase-out “moved” to 22<sup>o</sup> century (50% in 2050, 35% RES, 15% Nuclear)
- Post-Kyoto failure – GW >2°C
- Agriculture yields increase (OGM)
- Environmental costs of agriculture increase
- Local food security not achieved (in many DCs)
- Increased corporate power, “lobbycracy”
- Increased inequality (between and within countries)



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**Totemic measure of progress: GDP**



# Growth within limits: the “green” shift

- Global “Climate capitalism”
- Massive decarbonization of economy
- New and expanded ETS, CDM and other carbon instruments (taxation, Personal Carbon Allowance, voluntary offsets etc.)
- Increase in EE (industry, vehicles, housing retrofit)
- Breakthroughs in electricity (Smart and Super Grids)
- Growth of RES (50% in 2050, 40% fossil with CCS, 10% Nuclear)
- Eco-labels, -design, etc. become pervasive
- Networks of transit-oriented cities
- Major investments in High Speed Rail
- Sustainable management of forests, agricultural land and water, and increased agriculture yields
- Reduction of post harvest losses and meat consumption (in affluent economies)
- No significant reduction in unemployment, inequalities



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- Networks of transport and cities
- Major investment in R&D
- Sustainable management of forests, agricultural land and water, and increasing agriculture yields
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**Totemic measure of progress: GDP + GHG**





## New Welfare Storyline

- Societal (lifestyles) + technological innovation => More consumption of services and intangibles
- New paradigm: natural capitalism, the “economics of enough”.
- From global unequal growth to global prosperity in a multi-polar, globally interdependent world
- **Social (ICT-based) production of open knowledge and intangibles**
- New global and local democracy institutions
- Reduction of (i) overall energy consumption and (ii) energy intensity
- **Shift from fossil to RES predominance, smart grids, active demand management (some gas or small nuclear to fill intermittency gaps)**
- Carbon pricing and “Climate Marshall Plan” (Climate Keynesianism) => fall of GHG
- Polycentric networks of compact and resilient cities
- More collective, less individual travel, consistent share of electromobility



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- New economic paradigm: natural capitalism, “economics of enough”.
- From global unequal growth to globally interdependent world, multi-polar, globally interdependent world
- Social (ICT-based) production of goods and intangible products
- New global energy transitions Reduction of (i) overall energy intensity
- Smart grids, smart grids, active demand (gas or small nuclear to fill intermittency gaps)
- “Climate Marshall Plan” (Climate Keynesianism) =>
- Decentralized networks of compact and resilient cities
- More collective, less individual travel, consistent share of electromobility

**Totemic measure of progress:  
Well-being/sustainability indicator(s)**



Pear World



Apple World



Orange World



Potato World

	Pear World	Apple World	Orange World	Potato World
Population	↑↑	↑	↔	↑↑↑
Settlements: Urban society	↑	↔	↓	↑↑
Rural land overexploitation	↑	↔	↓	↑↑
Technology	↑↑↑	↑	↑	↔
GDP	↑↑	↑	↔	↓↓
Energy consumption	↑↑	↑	↓↓	↔
Transport	↑↑	↑	↔	↓
Climate change	↓	↓↓	↓↓↓	↔
Biodiversity	↔	↑	↑↑	↓
Governance	↓	↑	↑↑	↓↓

Are we ready for trade-offs?



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Apple World



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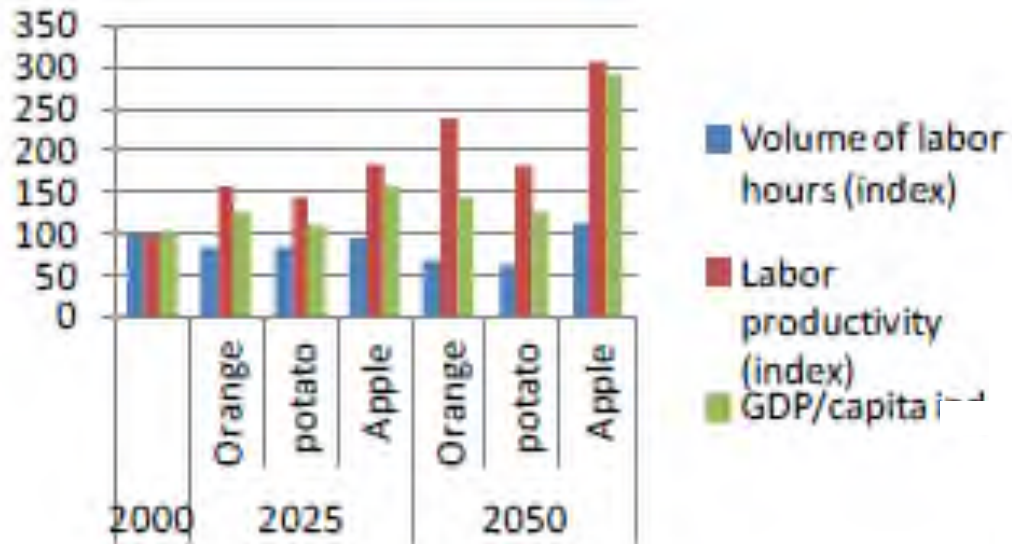
Are we ready for trade-offs?

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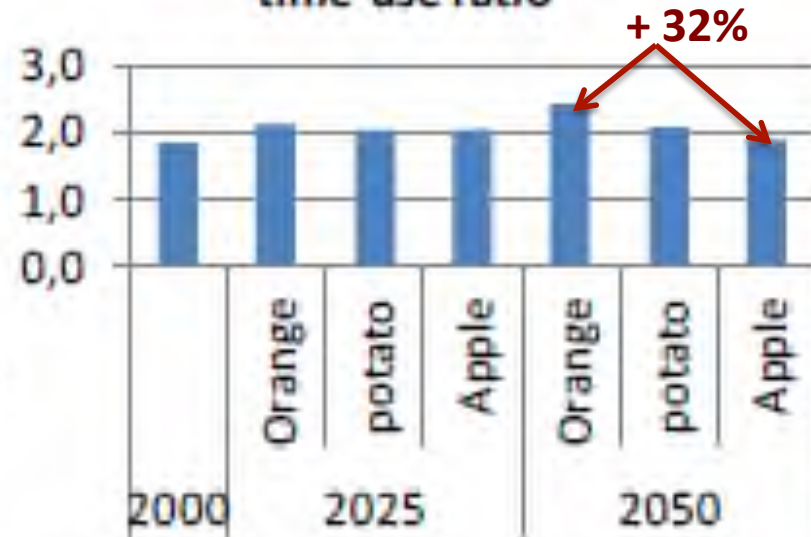
**Wealth disparities = GDP/capita dispersion  
relative to mean**

	2010	2050
Apple (green growth)	2.3	1.2
Orange (new welfare)	2.3	0.9

# Are we ready for trade-offs?

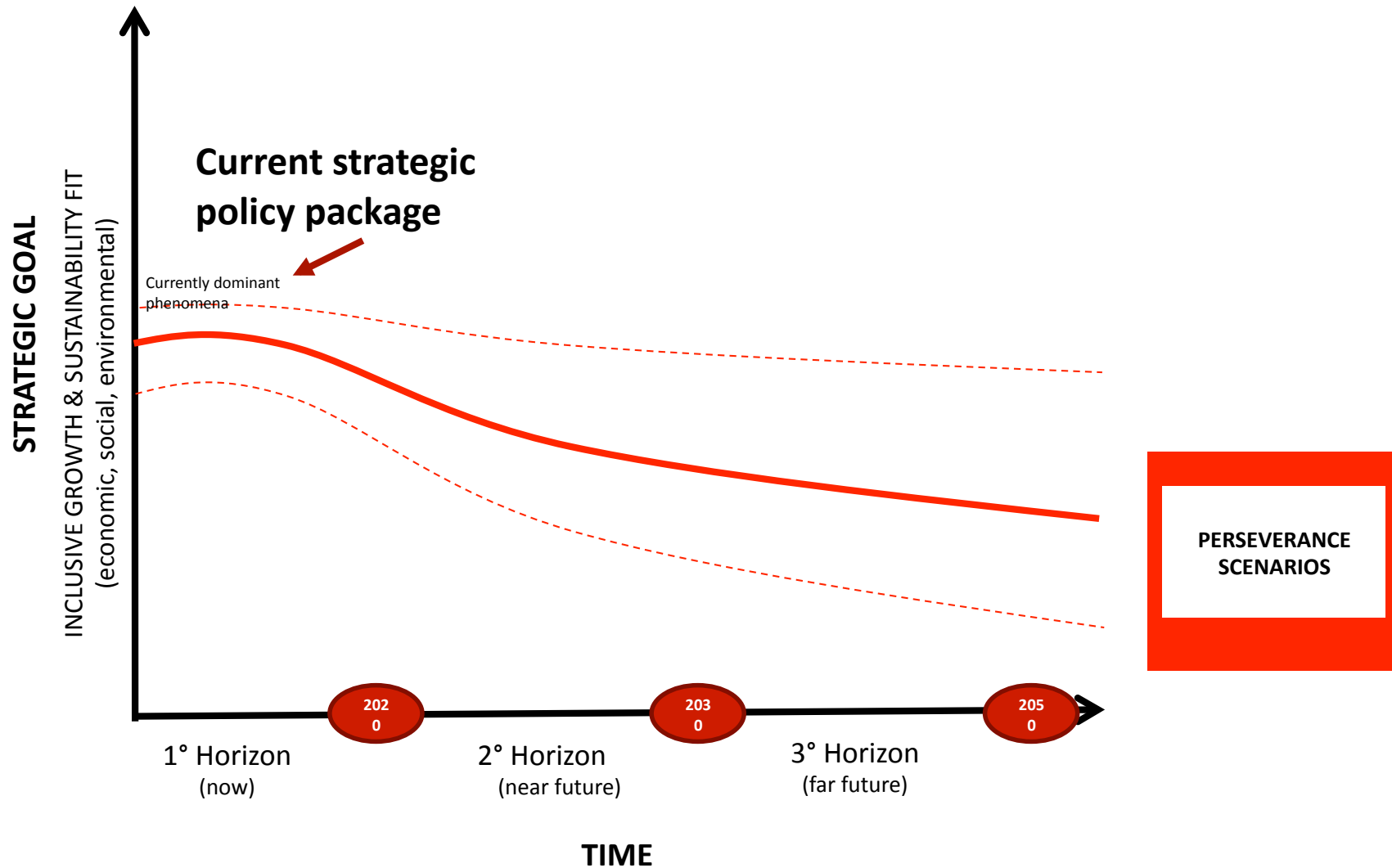


self-accomplishment / work time-use ratio





# Where do we go from here?



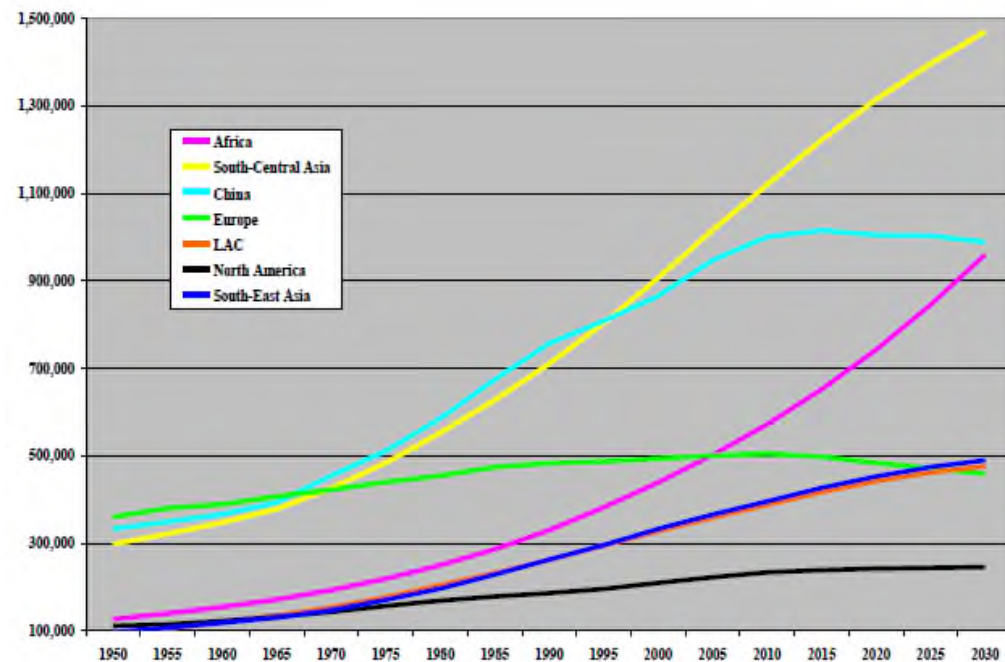
# The pessimism of perseverance

Global demographic ageing

Declining investment rate

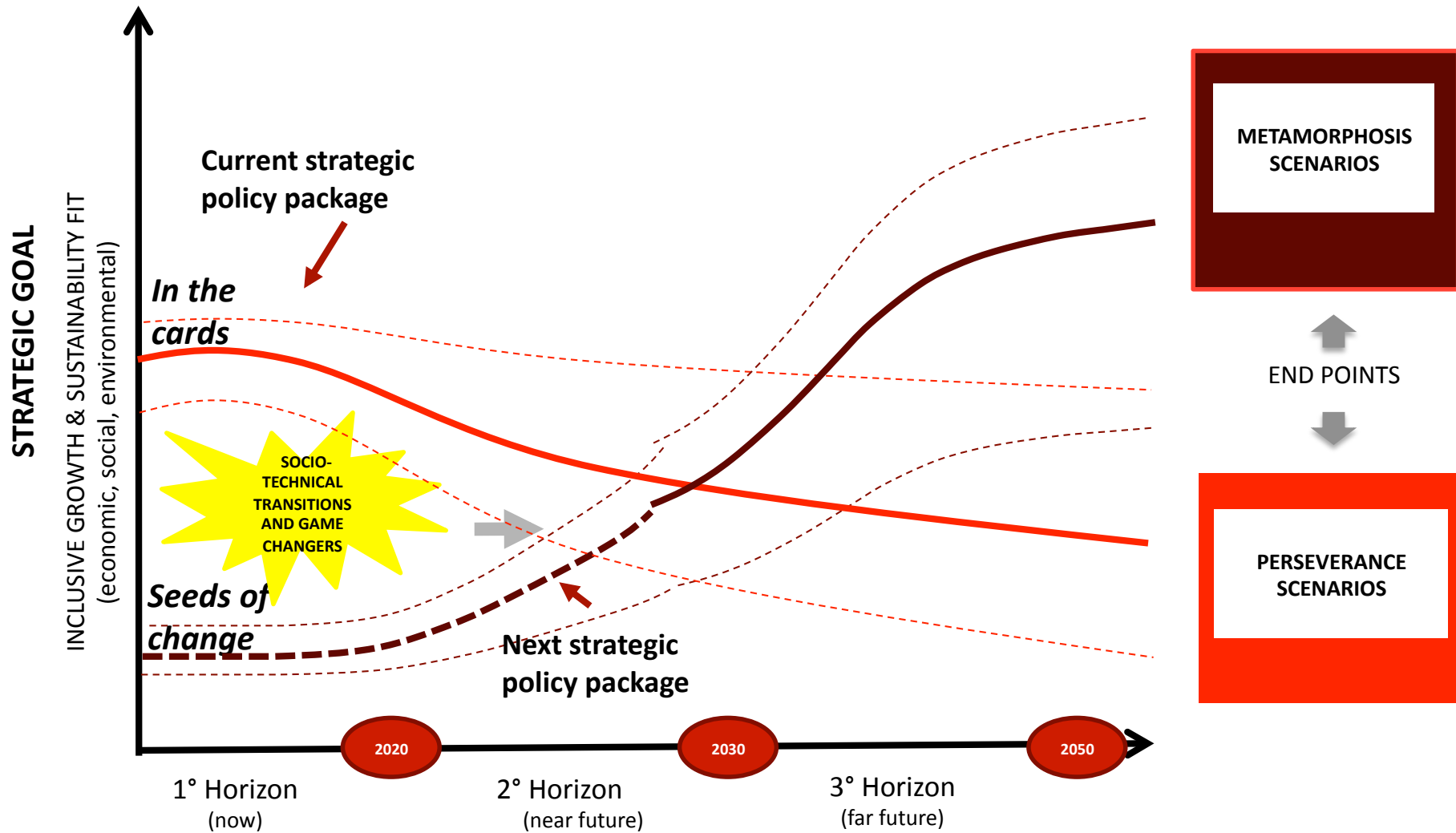
Uncertain prospects of innovation and policy reforms

Working age (15-64) population by regions, in thousands, 1950-2030

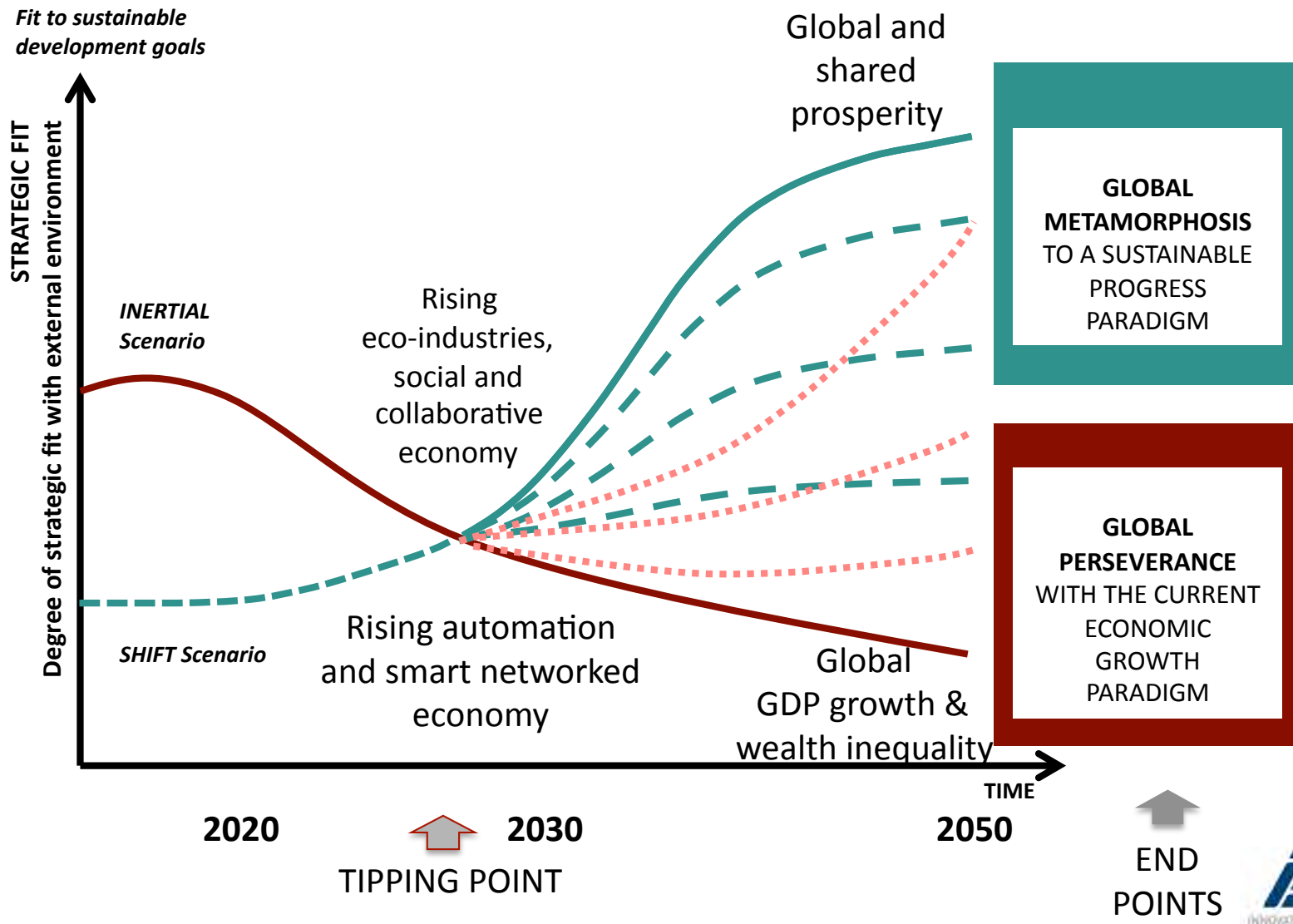


Note: for 2015-2030 Medium Variant Projection; LAC – Latin America and Caribbean  
Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2012 Revision, <http://esa.un.org/unpd/wpp/index.htm>

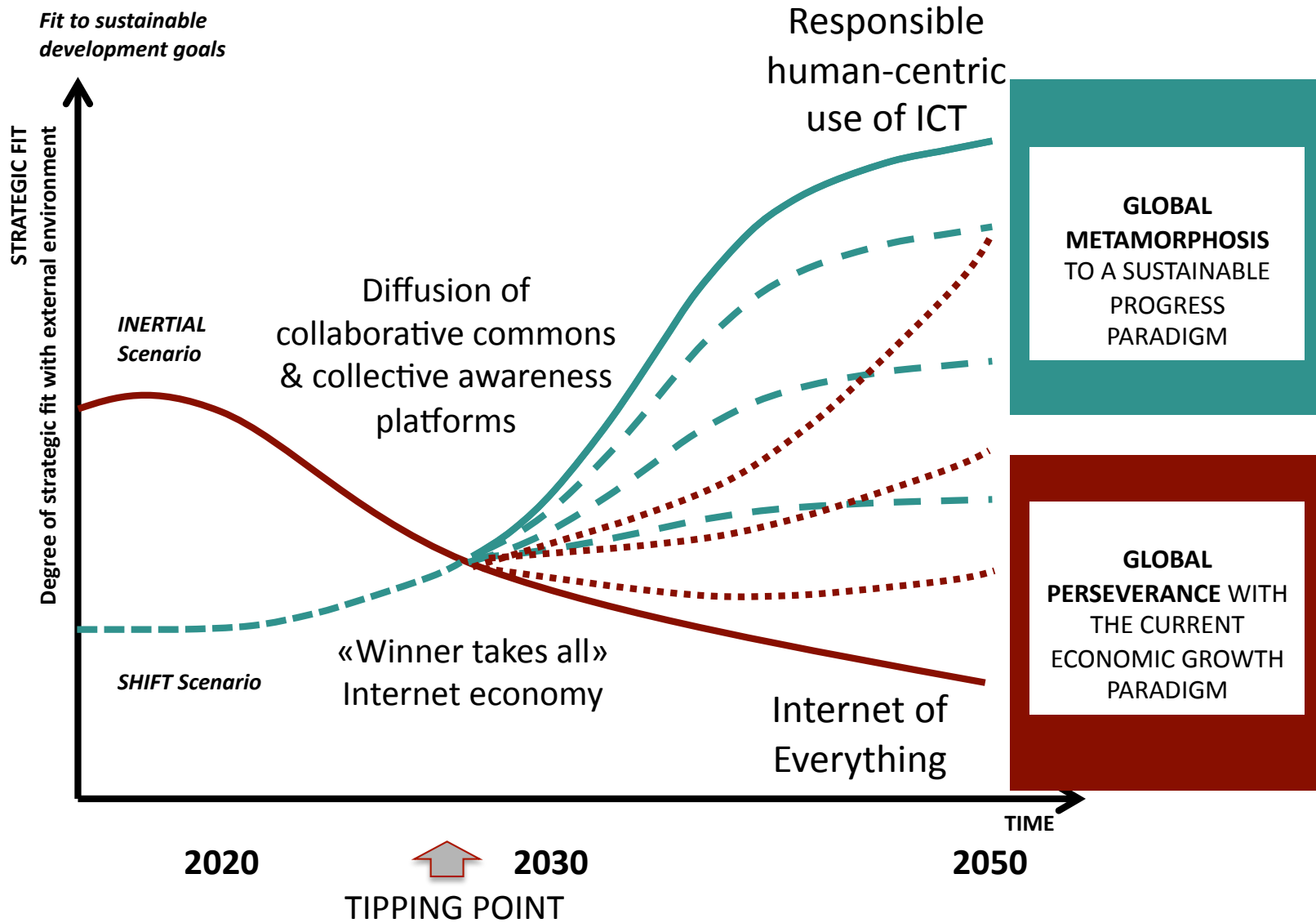
# From perseverance to metamorphosis: making the most of the *seeds of change*



# Economy and innovation changes



# The societal impact of ICT



# Transformative strategies and the role of Key Enabling Technologies

- Micro/nano electronics
- Nanotechnologies
- Industrial biotechnologies
- Advanced materials
- Photonics
- Advanced manufacturing technologies

# The 10 top technologies of the future

2014	2015
1. Body adapted wearable electronics	1. Fuel cell vehicles
2. Nanostructured carbon composites	2. Next-generation robotics
3. Mining metals from desalination brine	3. Recyclable thermoset plastics
4. Grid scale electricity storage	4. Precise genetic-engineering techniques
5. Nanowire lithium-ion batteries	5. Additive manufacturing
6. Screenless display	6. Emergent artificial intelligence
7. Human Microbiome Therapeutics	7. Distributed manufacturing
8. RNA-based Therapeutics	8. 'Sense and avoid' drones
9. Quantified Self (Predictive Analytics)	9. Neuromorphic technology
10. Brain-computer Interfaces	10. Digital genome

Adapted from World Economic Forum, 2014 & 2015

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# From perseverance to metamorphosis: ICT

- **Inertial scenario (perseverance)**

- ✓ ICT developments are mostly technology-driven (to be adapted to consumers when available)
- ✓ ICT players mostly care about profit (and winner takes all)
- ✓ Policy makers mostly see ICT as contributor to economic growth
- ✓ Big data, Internet of things remain hypnotising/totemic concepts

- **Shift scenario (metamorphosis)**

- ✓ ICT for inclusive growth and for sustainable development (and more generally ICT for societal challenges) are given increased priority
- ✓ More attention to ICT-based grassroots initiatives & social innovation (notably from local communities) and to ICT-based commons
- ✓ Internet of mankind: a more relevant concept than Internet of things?
- ✓ More efforts are devoted to international cooperation (to address global challenges)



techntechie.com

# RRI as a policy response

*Responsible Research and Innovation: “an inclusive approach to Research and Innovation (R&I), to ensure that societal actors work together during the whole research and innovation process. It aims to better align both the process and outcomes of R&I, with the values, needs, and expectations of European society. In doing so, it fosters the creativity and innovativeness of European societies to tackle the grand societal challenges that lie before them, while at the same time pro-actively addressing potential side-effects”*

Adapted from EC, RRI declaration

# RRI: approach and tools

- Public engagement
- Gender equality
- Science education
- Ethics
- Open access
- Governance

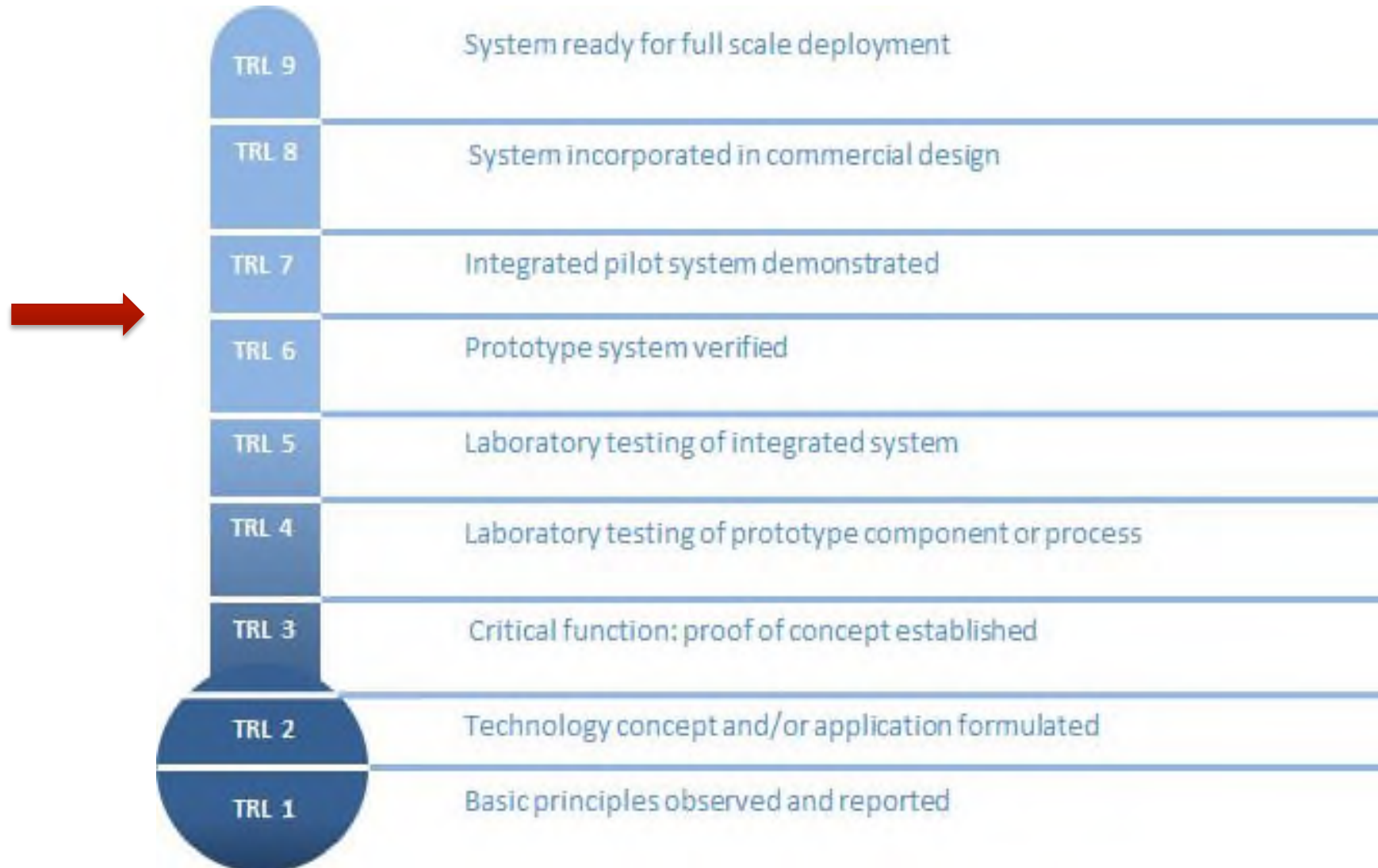


[beinghumanfestival.org](http://beinghumanfestival.org)



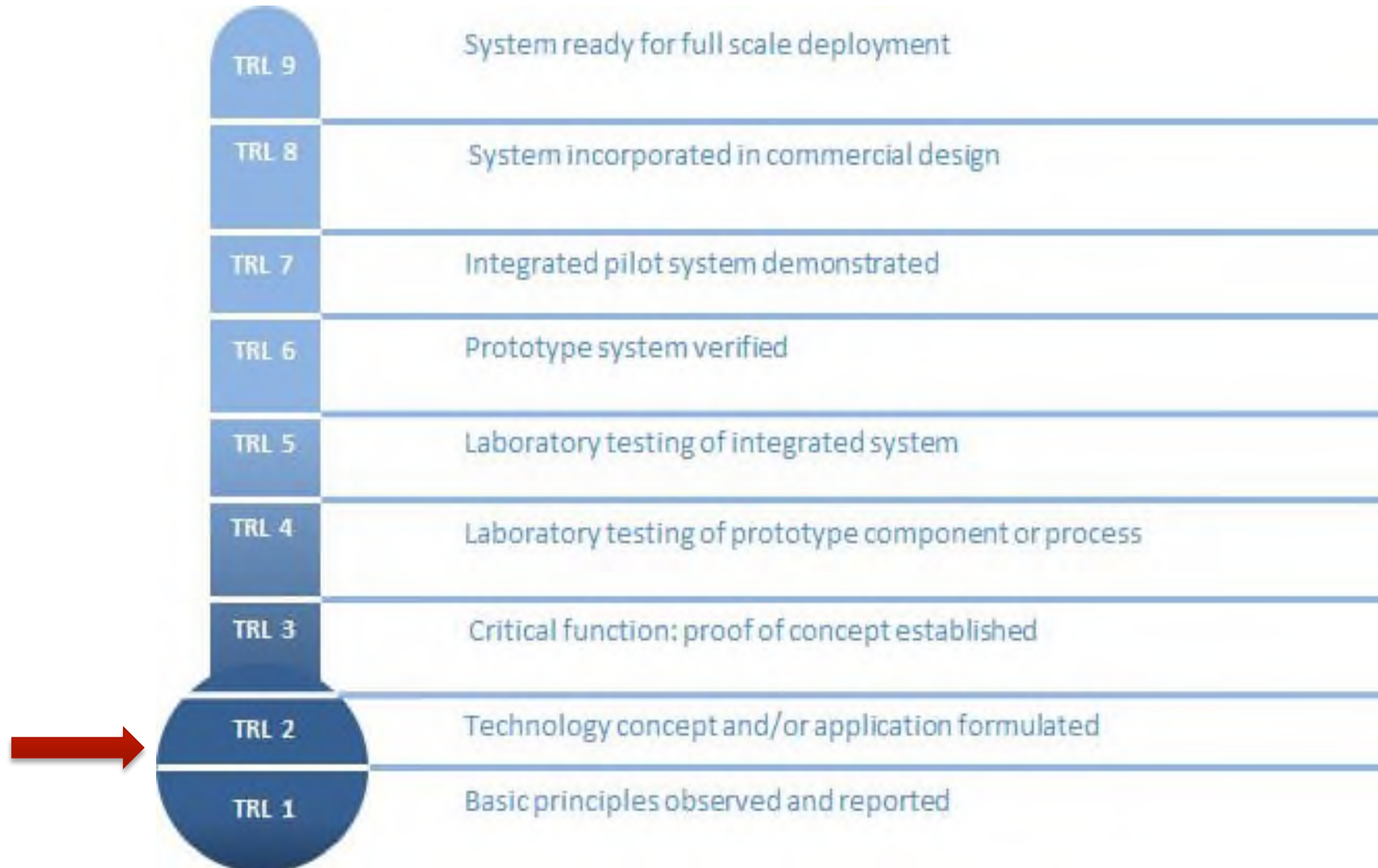
[users.uoi.gr](http://users.uoi.gr)

# Timing is of the essence



Source: Innovation Seeds

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Muito obrigado

