



Conferência Annual do BCSD Portugal  
20 de Outubro de 2016

---

## Inovar com Restrições Ambientais: Oportunidades e Desafios

---

*Tiago Domingos \**

*com*

*João Santos*

*Kai Whiting*

*Luis Gabriel Carmona*

*Tânia Sousa*

*\* [tdomingos@tecnico.ulisboa.pt](mailto:tdomingos@tecnico.ulisboa.pt)*

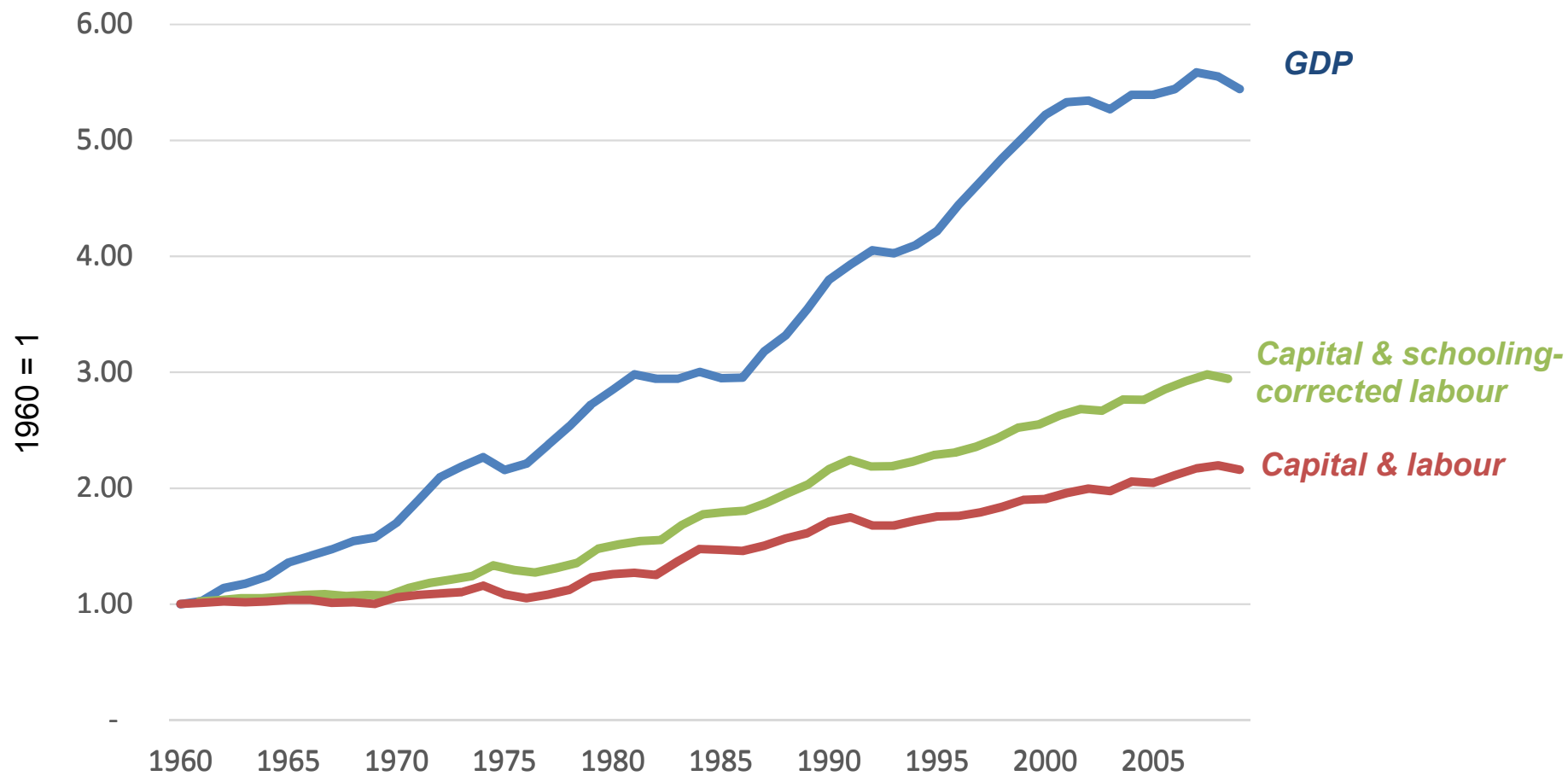
## Introduction

- The recent Paris climate agreement effectively stipulates a transition to a low or zero-carbon economy along the next decades
- We know that

$$\text{CO}_2 = \frac{\text{CO}_2}{\text{Energy}} \cdot \frac{\text{Energy}}{\text{GDP}} \cdot \text{GDP}$$

- So, reducing carbon emissions may require:
  - (1) decarbonising the energy system
  - (2) decreasing the energy intensity of the economy
  - (3) reducing economic growth
- This presentation focuses on the synergies between (2) and the promotion of economic growth, i.e., the opposite of (3)

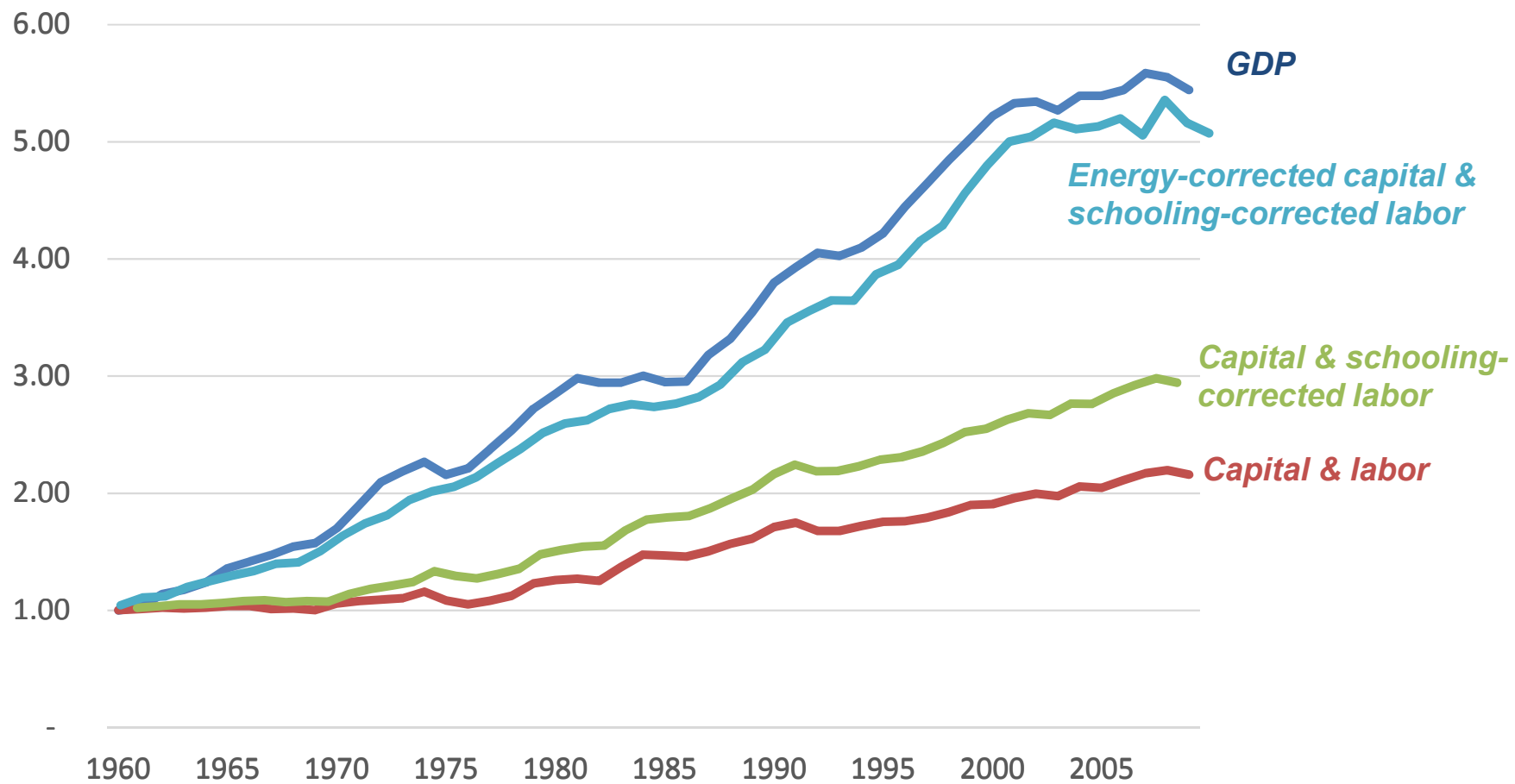
## GDP and production factors: Portugal 1960-2009



## The main source of economic growth is essentially unknown

- Economic growth cannot be explained just by the increase in production factors: capital and labour
- Most of economic growth is explained by total factor productivity growth, the Solow residual
- As Abramovitz (1956) said, the Solow residual represents “a measure of our ignorance” of the growth process
- Could energy be an explanatory factor for the Solow residual?
- Let us measure energy considering *useful exergy*

## Energy-corrected capital explains the Solow residual



## Taking stock

- Increases in energy efficiency are intrinsically related to economic growth
- Economic growth does not happen just because of increases in energy efficiency, it is associated to a whole “development block”.

## A New “Industrial” Revolution: Matching Capacity to Use

- The new industrial revolution probably has to be based on a broader definition of efficiency, now matching capacity to use, by (1) increasing the variety of capital and (2) and increasing the load factor of capital.

# TOYOTA's Activities towards SMART MOBILITY SOCIETY

Toyota aims to create a smart mobility society where people feel secure and happy in transport and everyday life.

## COMFORT Connected with people...

The vehicle will become a trusted partner through close communication with the driver.

- The vehicle complies with the driver's mental and emotional commands.
- The vehicle predicts the driver's actions in order to provide services.



## ECOLOGY Connected with the community...

Optimizing the energy use of the entire community. Achieving eco-friendly lifestyles with a high quality of life.

- Adapting to low-carbon society where houses and vehicles share energy with each other.
- Promoting local energy production/consumption.
- Creating communities that are strong enough to withstand natural disasters.



Future

Around 2020

## SAFETY Connected with safety...

Toward the realization of Toyota's ultimate goal: zero casualties from traffic accidents.

- Vehicles exchange their locations and speeds in all directions.
- Vehicles receive useful information from various infrastructures.



## CONVENIENCE Connected with safety...

Building a stress-free traffic environment where everyone can move around as they wish.

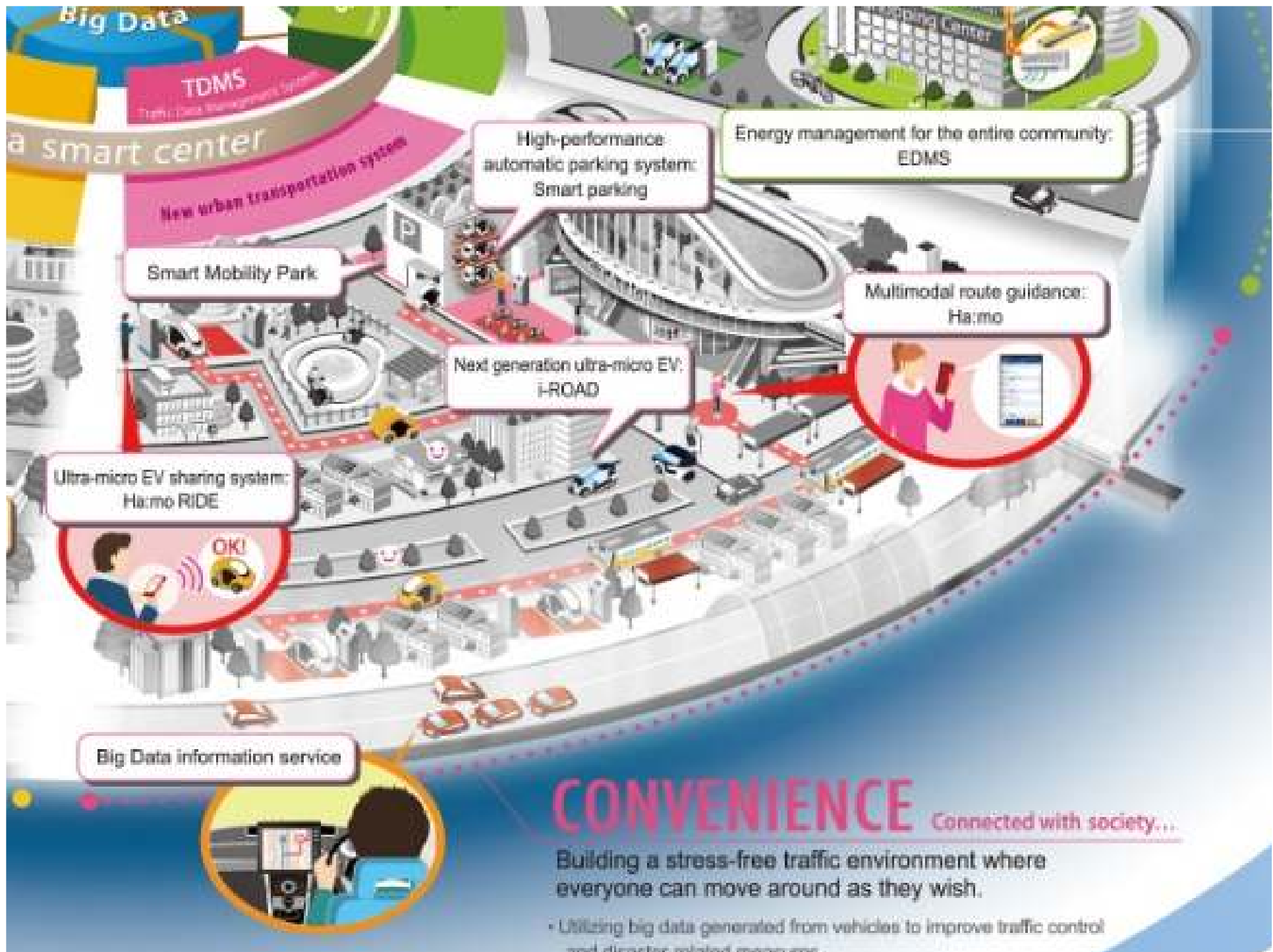
- Using Big Data generated from vehicles to improve traffic control and disaster-related measures.
- Implementing an efficient EV sharing service integrated with public transportation.



Past

Present





Ultra-micro EV sharing system:  
Ha:mo RIDE



Big Data information service



High-performance automatic parking system:  
Smart parking

Energy management for the entire community:  
EDMS

Multimodal route guidance:  
Ha:mo



Next generation ultra-micro EV:  
i-ROAD

# CONVENIENCE Connected with society...

Building a stress-free traffic environment where everyone can move around as they wish.

- Utilizing big data generated from vehicles to improve traffic control and disaster-related measures.



## A new “industrial” revolution: why is this possible now?

- Because of (among others)
  - distributed sensing (massive gathering of data);
  - communications infrastructure (massive transport of data);
  - data analytics (massive processing of data)

## Conclusions

- Energy efficiency has historically been crucial in promoting economic growth
- Climate commitments may be reconciled with the promotion of economic growth, through a new age of increased energy efficiency



Conferência Annual do BCSD Portugal  
20 de Outubro de 2016

---

## Inovar com Restrições Ambientais: Oportunidades e Desafios

---

*Tiago Domingos \**

*com*

*João Santos*

*Kai Whiting*

*Luis Gabriel Carmona*

*Tânia Sousa*

*\* [tdomingos@tecnico.ulisboa.pt](mailto:tdomingos@tecnico.ulisboa.pt)*