

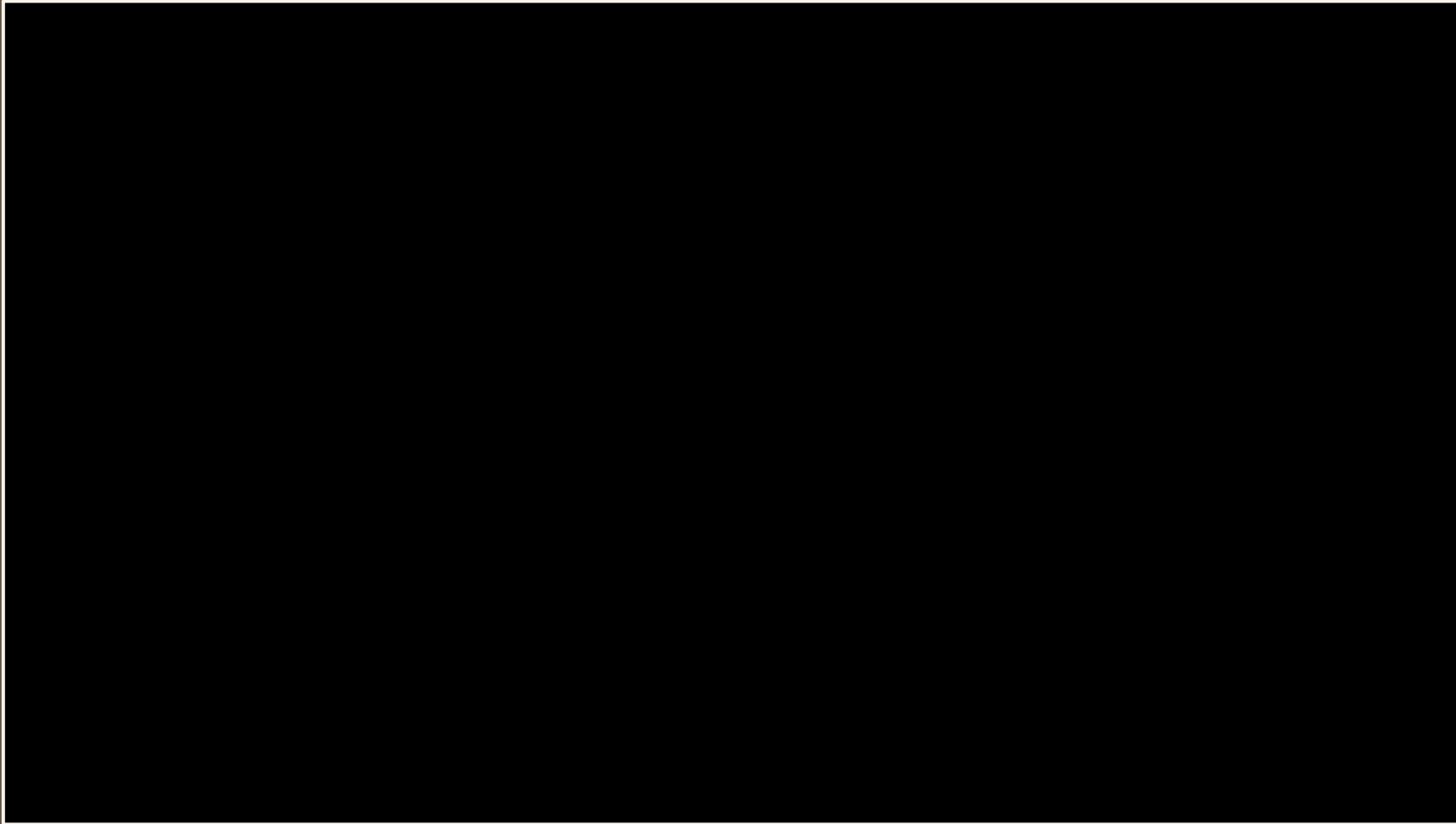
WELCOME TO ATHENS, GREECE

Prof. Christina Plati



ERPUG

GREECE





GREECE

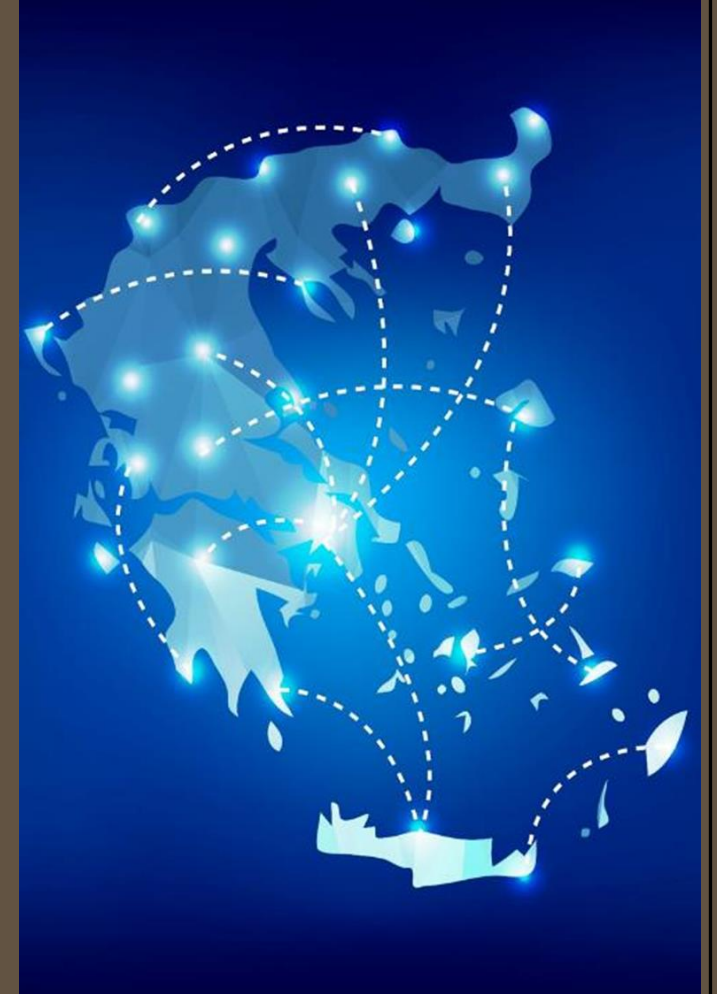
- ❖ *Ελλάδα* (pronounced as Elláda) - **Hellas** (Ελλάς) - **Greece** or **Hellenic Republic**
- ❖ An EU country in the Southeast Europe sharing borders with Europe (north/west), Asia (east) and Africa (south through Mediterranean Sea)
- ❖ Government: Unitary Parliamentary Republic
- ❖ Population: 10.5 million
- ❖ Currency: Euro

GREECE



GREECE

- ❖ In terms of Transportation:
 - ✓ 42.000 km Interurban Road Network
 - ✓ 2.500 km Railway Network
 - ✓ 40 Major Airports
 - ✓ 60 Major Ports
 - ✓ >100.000 km Urban Road Network





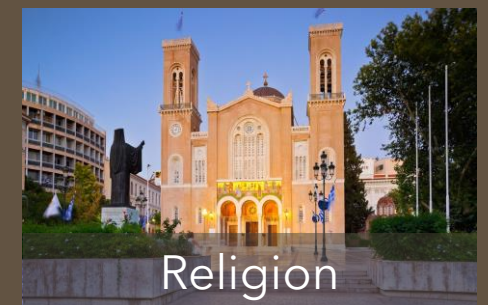
ATHENS

- ❖ Its name is *Αθήνα* - *Athina* - *Athens*. The city named after Athena, the ancient Greek goddess of wisdom.
- ❖ It is the capital and the largest city of Greece, with its recorded history spanning over 3,400 years.
- ❖ It is a huge cosmopolitan metropolis and central to economy, transportation, maritime, sport, religious, political and cultural life in Greece.

ATHENS



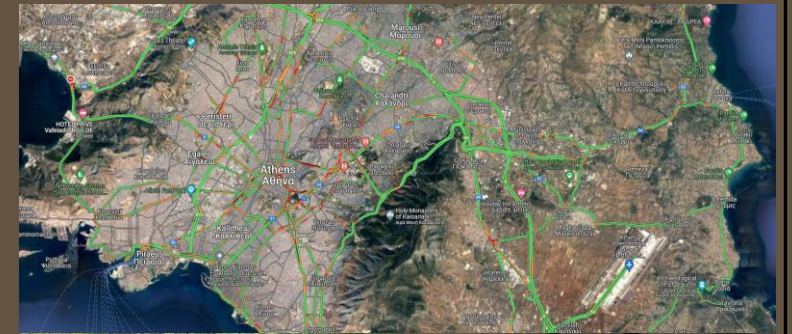
Αθήνα



ATHENS

❖ In terms of Transportation:

- ❖ 2 main highways passing through Athens
- ❖ 3 metro lines – 90.1 km metro line network
- ❖ 5 lines of suburban railway - 230.9 km railway network
- ❖ 322 bus and trolleybus lines
- ❖ 27 km tram network





NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA

- ❖ The center of technological advances in Greece and the most prestigious Greek Technical University
- ❖ The oldest of the eight engineering Schools in country - since 1837
- ❖ With global reputation: among the 500 best universities worldwide (QS 2022).

NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA

Currently, it consists of **9 Schools, 39 Departments** and **152 Laboratories**.

It's mission:

- ❖ to **provide advanced higher education** of outstanding quality in science and technology
- ❖ to **promote scientific research** and technological development
- ❖ to **contribute actively in the global production of new knowledge**
- ❖ to **support** the overall complex of scientific, technological, social and cultural **development of Greece and international community**

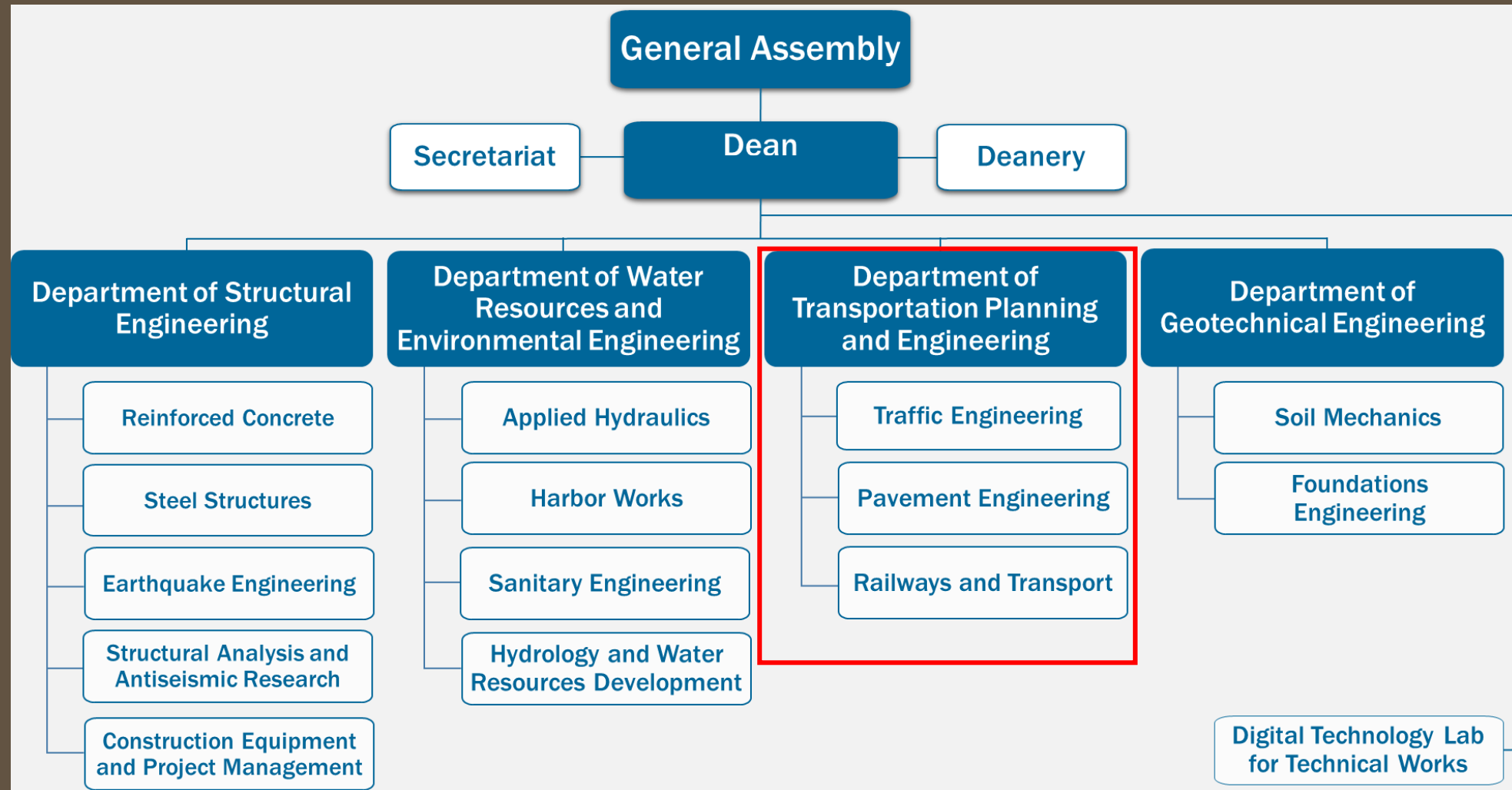




SCHOOL OF CIVIL ENGINEERING

- ❖ The oldest school of engineering in country
- ❖ One of the five Departments in Greece
- ❖ Ranked **3rd** in Europe and **11th** worldwide (Shanghai Ranking's 2019), **11th** in Europe and **42nd** worldwide (QS 2018)

SCHOOL OF CIVIL ENGINEERING





Laboratory of Pavement Engineering



Laboratory of Traffic Engineering



Laboratory of Railways and Transport

DEPARTMENT OF TRANSPORTATION PLANNING AND ENGINEERING

- ❖ Established in 1982, is a **Center of Research and Innovation Excellence** in Transportation, with global recognition
- ❖ 3 separated Laboratories:
 1. Laboratory of **Pavement Engineering**
 2. Laboratory of **Traffic Engineering**
 3. Laboratory of **Railways and Transport**



LABORATORY OF PAVEMENT ENGINEERING

- ❖ Established at early '60s
- ❖ It includes two sections:
 1. Section of testing and characterization of pavement materials in laboratory
 2. Section of in-situ pavement testing and evaluation

LABORATORY OF PAVEMENT ENGINEERING

- Section of laboratory testing:
 - Evaluation and proportioning of raw materials
 - Materials (bound or unbound) testing and mechanical characterization
 - Compaction
 - Low-energy mixes testing and evaluation
 - Assessment of alternative materials for pavement construction

LABORATORY OF PAVEMENT ENGINEERING

- Section of in-situ testing:
 - Non Destructive Testing (NDT) in the field
 - Pavement instrumentation (fiber optics)
 - In-situ performance evaluation of pavement materials
 - Pavement evaluation (structural and functional)
 - Bearing capacity of roads and airfields



LABORATORY OF PAVEMENT ENGINEERING

- Section of in-situ testing:
 - Geophysics applications using Ground Penetrating Radar (GPR)
 - Dielectric properties of pavement materials
 - Pavement structure inspection (layers, cracks, moisture)
 - Railway ballast assessment using GPR
 - Post compaction assessment - Quality control
 - Thermal camera use - Quality control



LABORATORY OF PAVEMENT ENGINEERING

- Other aspects-goals:
 - Sustainable and innovative pavement materials – adaptation on climate changes
 - Remote and automated systems for pavement rehabilitation
 - Advances in systems assessing pavement condition
 - Using vehicle communication systems for assessing pavement performance
 - Pilot studies for assessing the performance of pre-fabricated pavements that contain sensors
 - Life Cycle Assessment (LCA) of pavements

Ancient roads

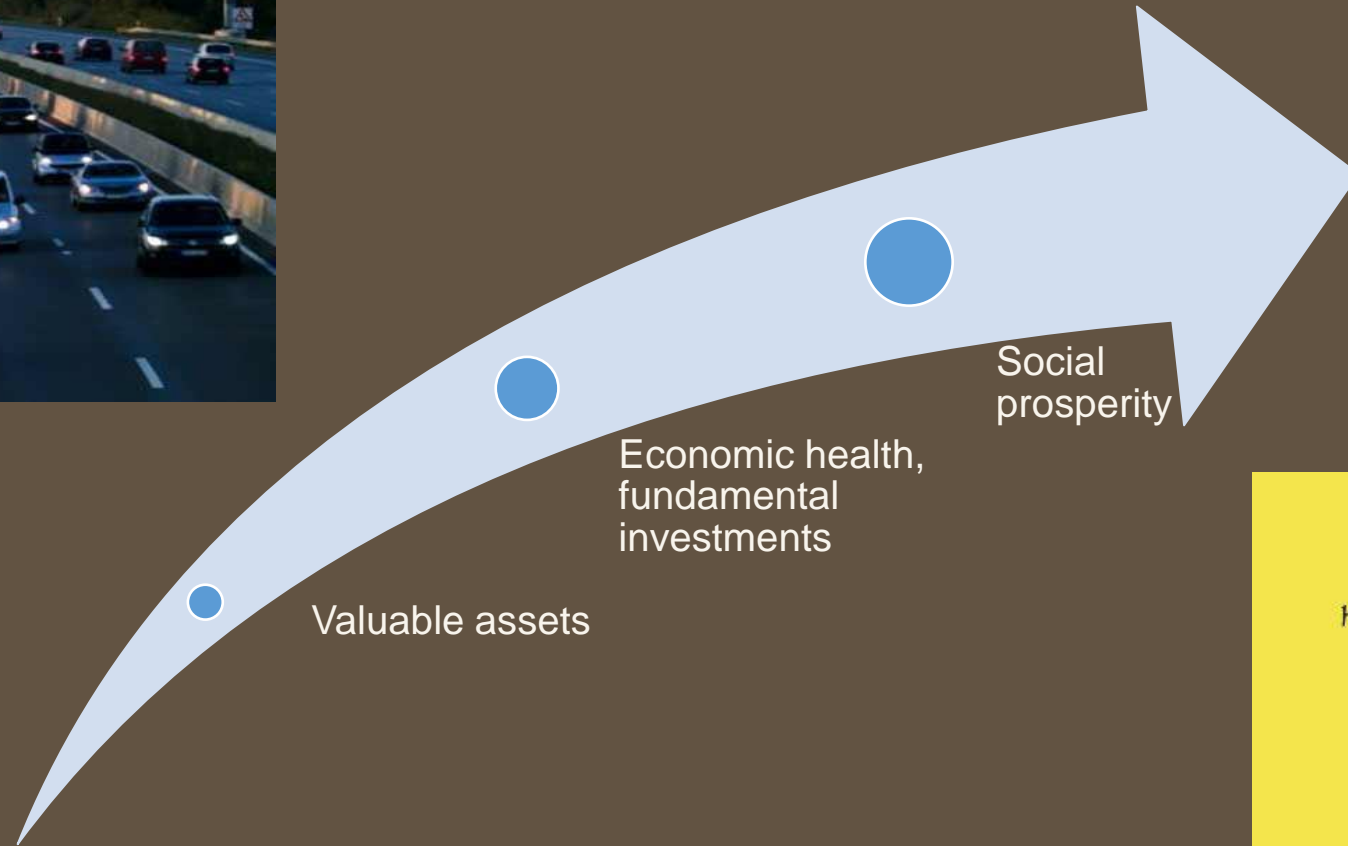


... still there!!!

CONSIDERING...



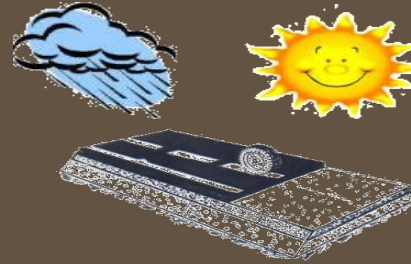
OUR MOTIVATION



Critical Transportation Infrastructure

☐ Pavements good physical condition is important for safe and uninterrupted transportation of **human beings** and **freights**.

OUR MOTIVATION



Structural defects

Loss of functional performance



OUR MOTIVATION



Excellent



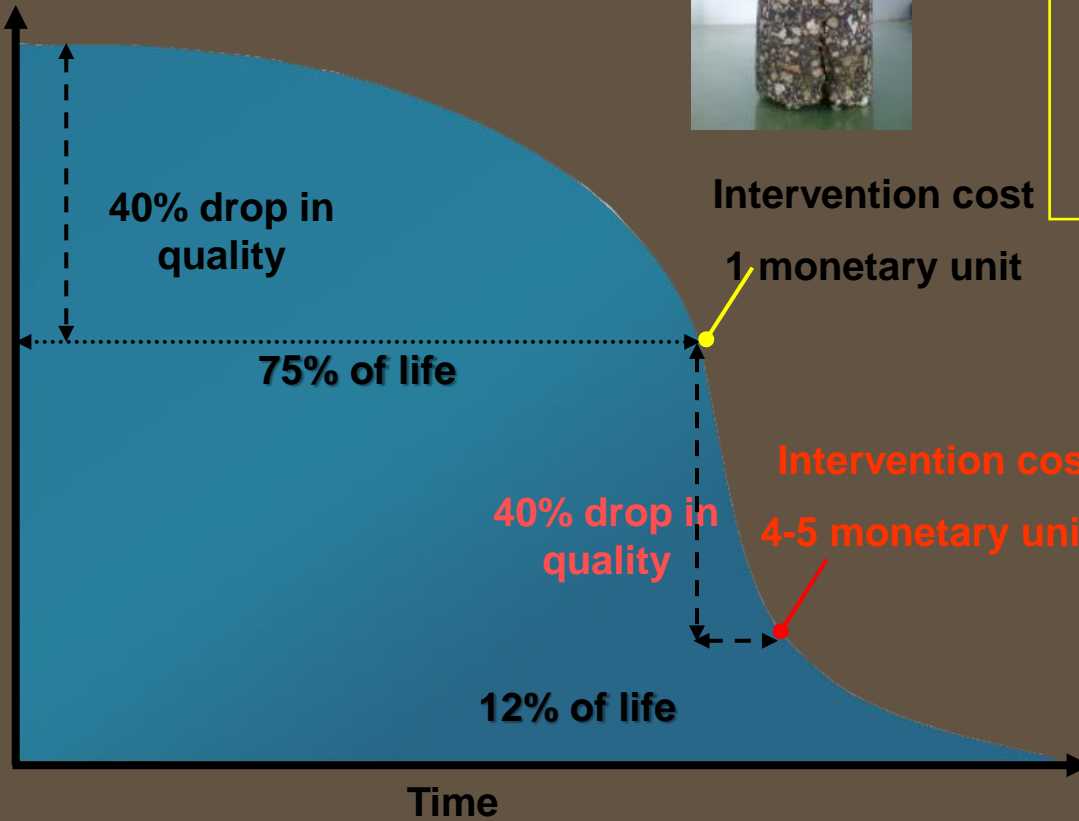
Bound courses

Unbound or Stabilized Base

Subgrade

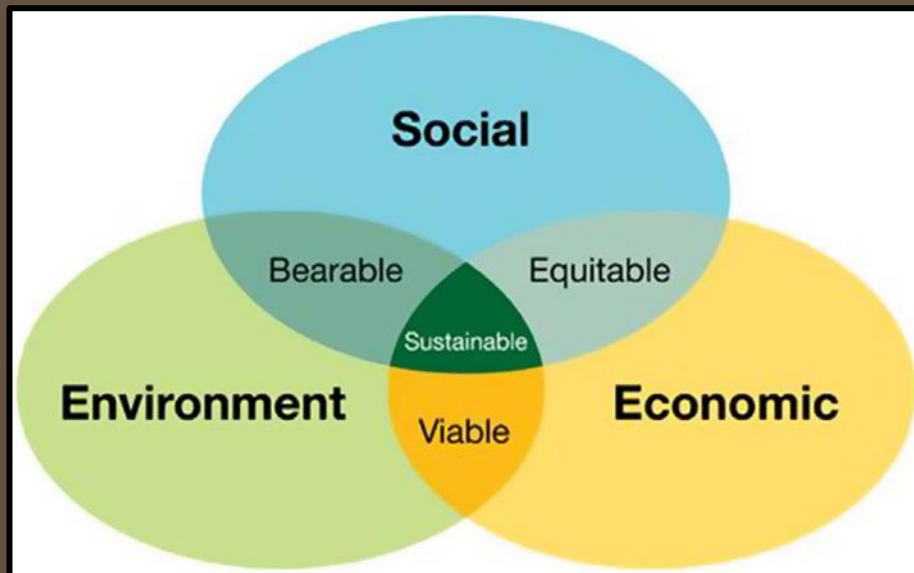
Condition

Poor



OUR MOTIVATION

Design and construction of durable, sustainable and long life pavements



❖ This means that a pavement...

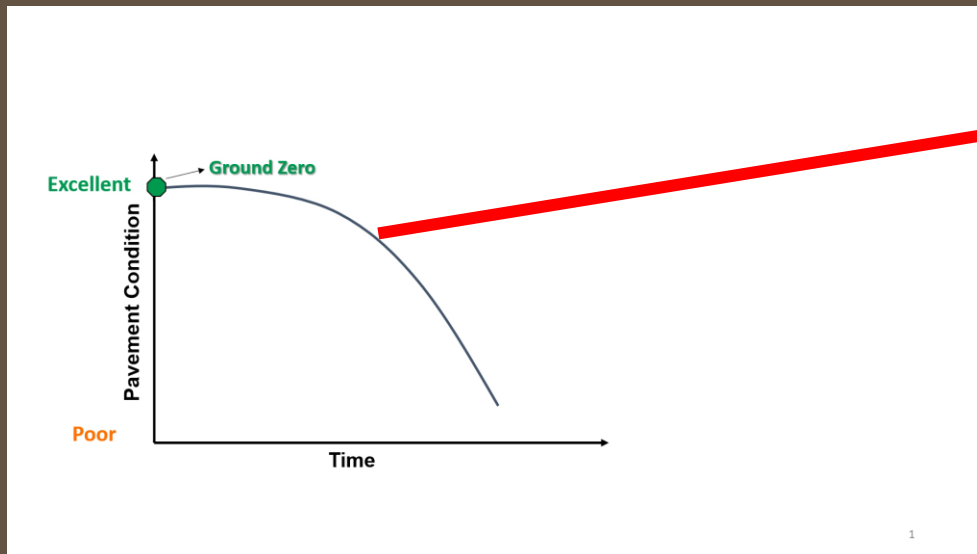
1. remains in good physical condition being an asset for the transportation of people and freights
2. is environmentally friendly (material selection, construction techniques and emissions, etc.)
3. results from an optimal combination of materials and construction techniques that guarantee its cost-effectiveness throughout its life cycle.

ON THIS CONTEXT,...

Keeping in mind:
Long Life pavements

A good question is...

When it's time to intervene for improving pavement condition?



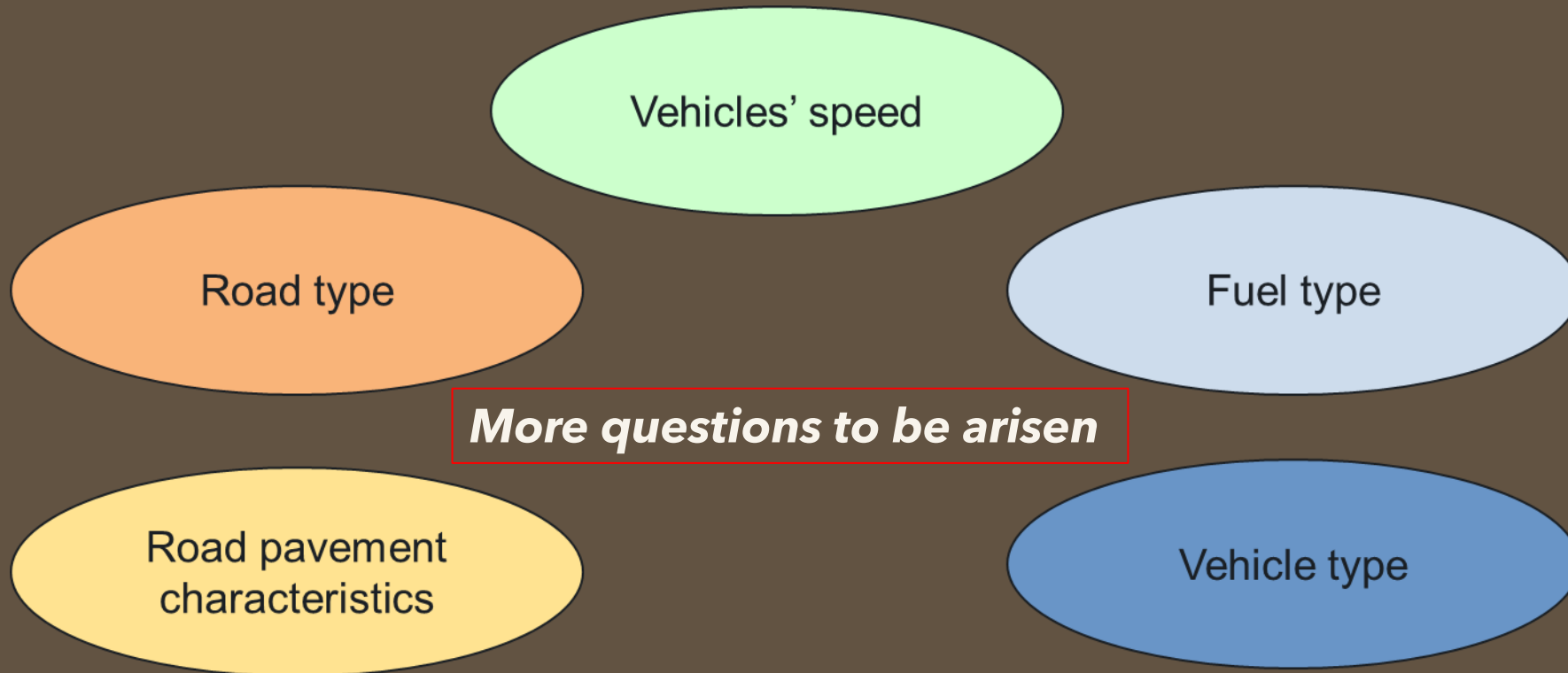
Is this the right point for pavement preservation ?

More questions to be arisen...

- *What is the size of the pavement network?*
- *What condition is it in?*
- *How fast is it deteriorating?*
- *When do we need to perform repairs to maximize pavement life?*
- *Where should we focus our maintenance?*
- *How much will it cost?*

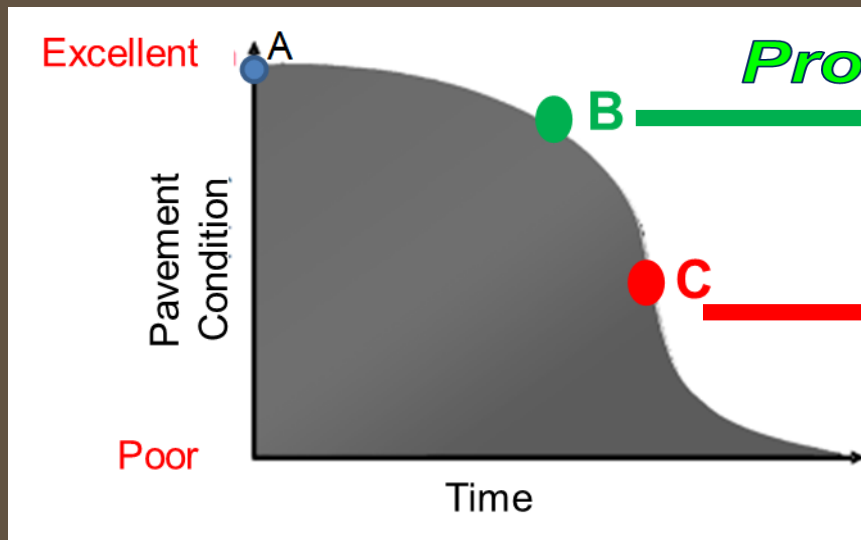
ALONGSIDE,...

Transport is a major source of Green-House Gas (GHG) emissions that are affected by - amongst others:



THEREFORE,...

Continuous pavement monitoring is the key in order to achieve proactive pavement maintenance



LABORATORY OF PAVEMENT ENGINEERING - NTUA

**Ground Penetrating Radar
(GPR)**



**Falling Weight
Deflectometer (FWD)**



Thermographic system



**Weight In Motion system
(WIM)**



Laser Profiler



Grip tester

OUR VISION

*Knowing that the world is in the midst of **climate** shift,*

- ❖ *Sustainable pavements*
- ❖ *Smart pavements*
- ❖ *Autonomous vehicles – electric trucks*
- ❖ *Solar Pavements- Electrified roads*

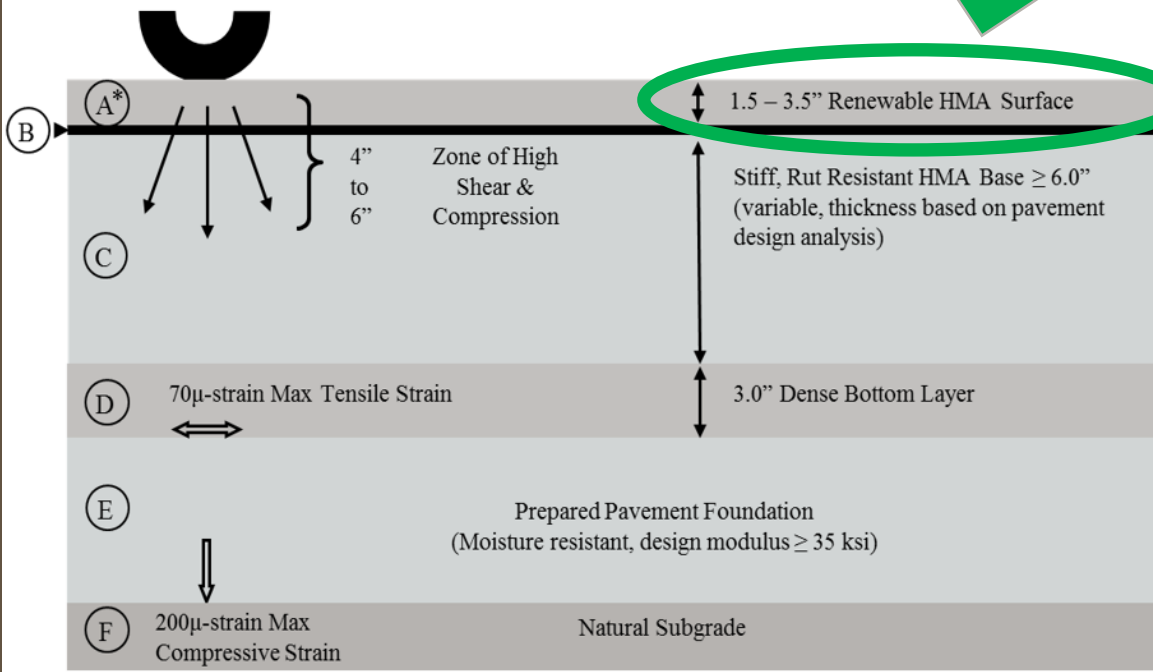
SUSTAINABLE PAVEMENTS



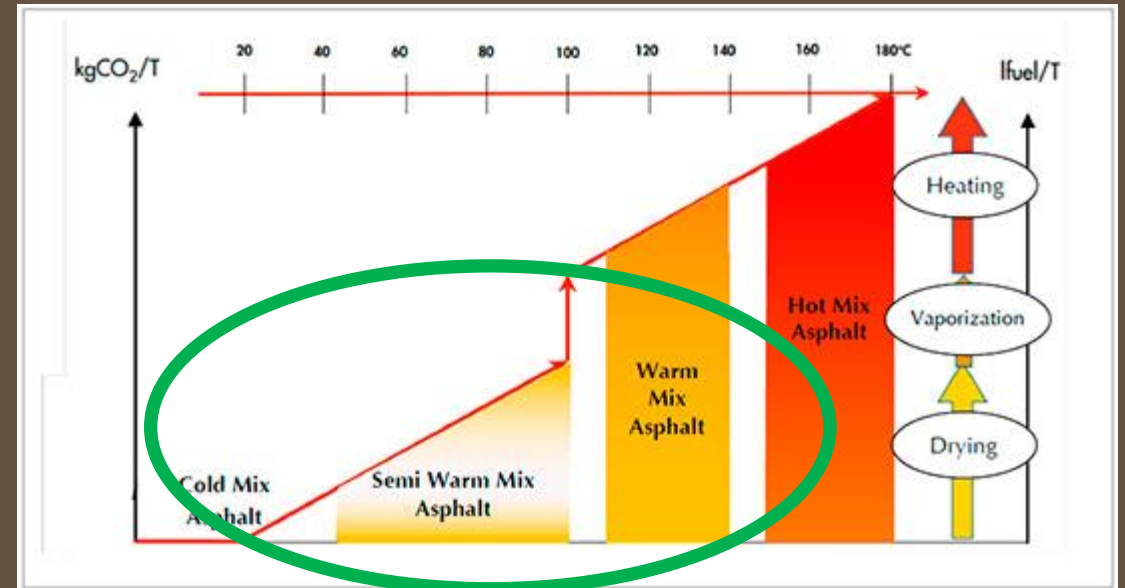
Anti-skid wearing courses mix technologies



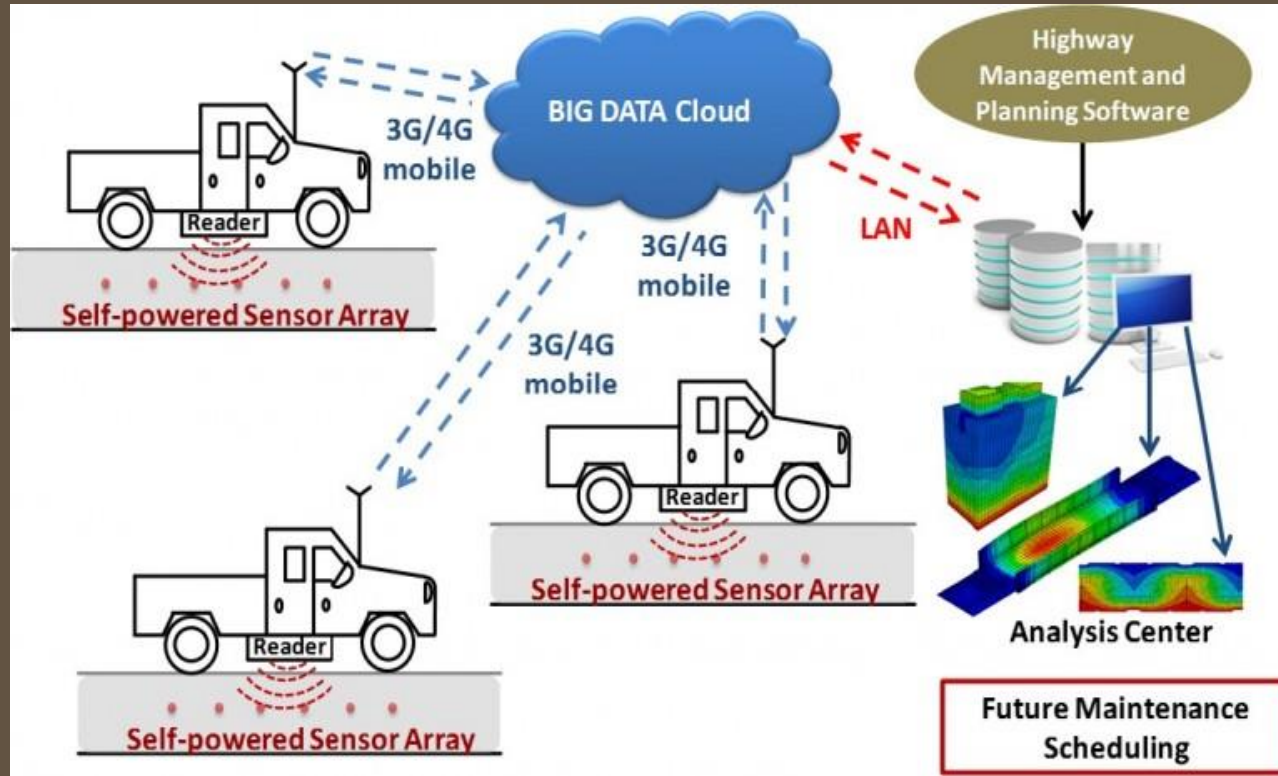
Perpetual pavements



Green road materials



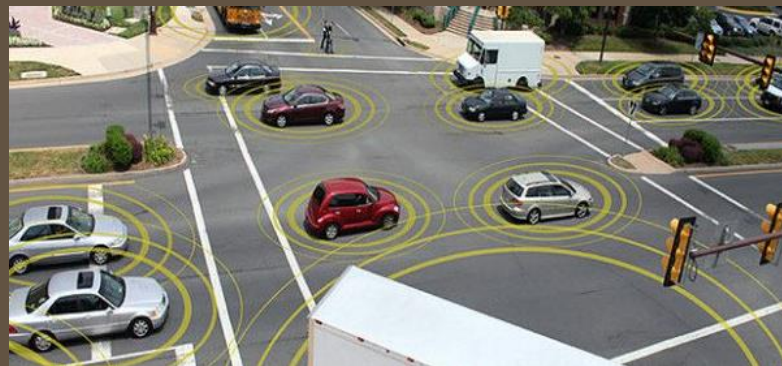
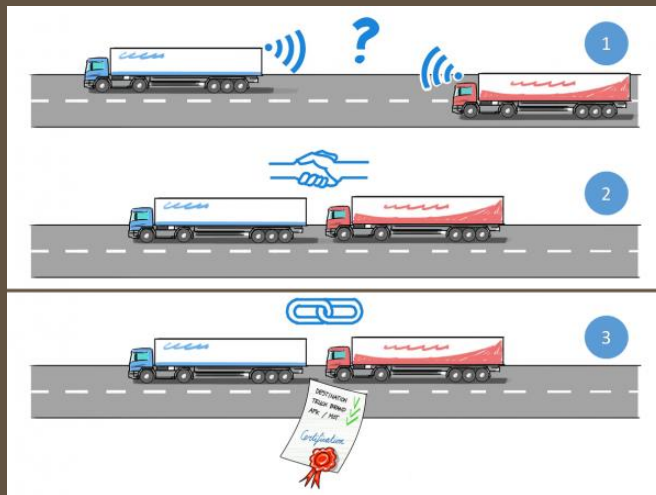
SMART PAVEMENTS



AUTONOMOUS VEHICLES

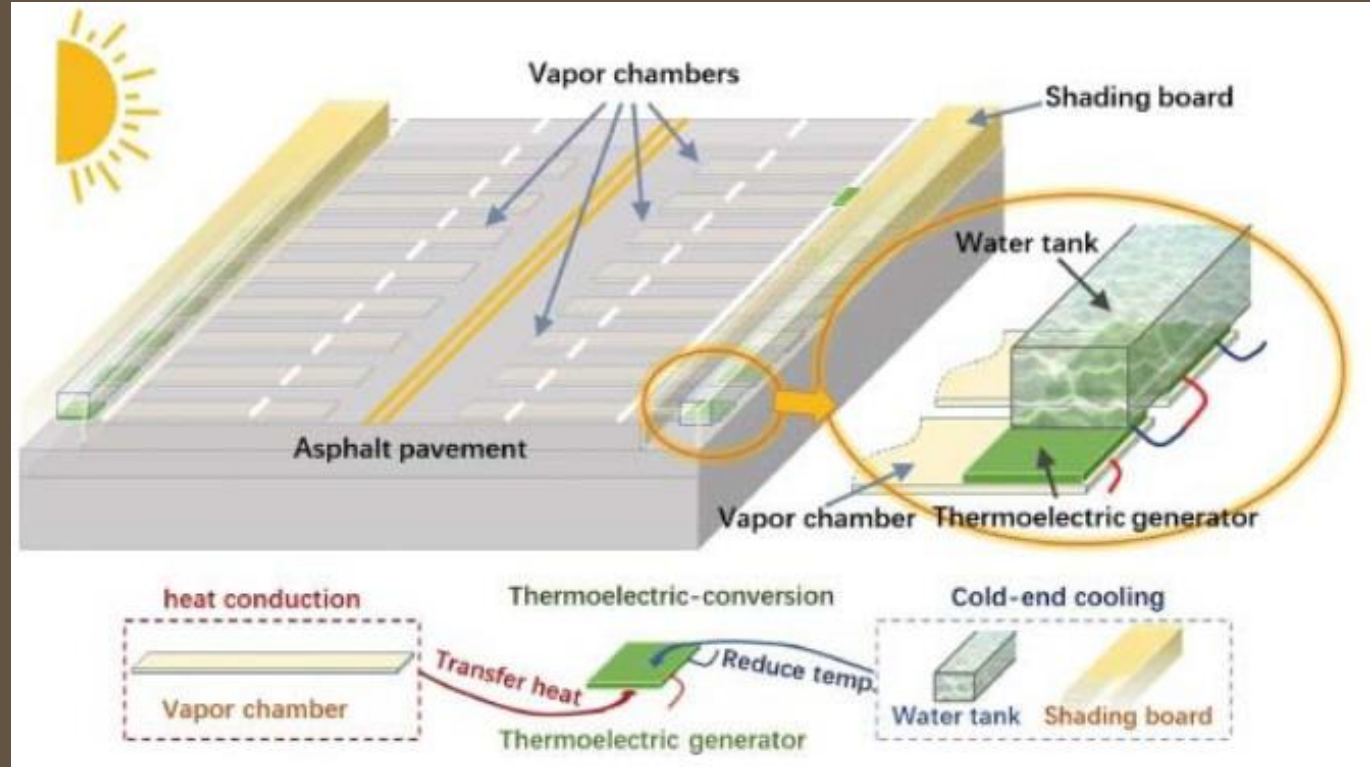
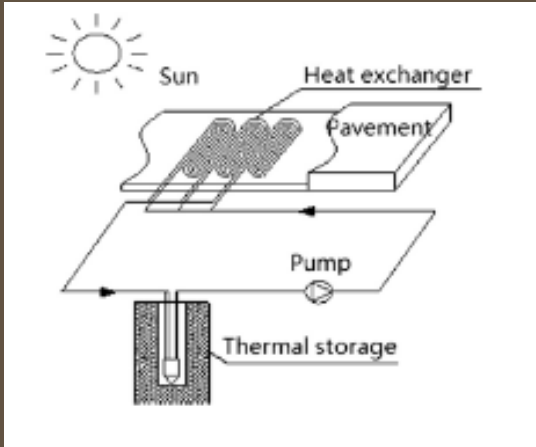
NEAR FUTURE CHALLENGES

- Truck platooning
- Intelligent vehicles



...how these issues may affect pavement engineering?

SOLAR PAVEMENTS



References: 1. Zihua Zhou, Xiaojuan Wang, Xiaoyan Zhang, Guanyi Chen, Jian Zuo, Stephen Pullen, Effectiveness of pavement-solar energy system - An experimental study, *Applied Energy* (138) (2015): 1-10.
 2. Wei Jiang, Jingjing Xiao, Dongdong Yuan, Hehe Lu, Shudong Xu, Yue Huang, Design and experiment of thermoelectric asphalt pavements with power-generation and temperature-reduction functions, *Energy and Buildings*, Volume 169, 2018, pp. 39-47.

ELECTRIFIED ROADS



Goals:

- ✓ Extend application
- ✓ Minimize fuel consumption
- ✓ Minimize vehicle emission coming from heavy duty vehicles

New aspects and challenges in pavement design and construction issues

INNOVATION THEMES, EU concepts (FEHRL 2030)

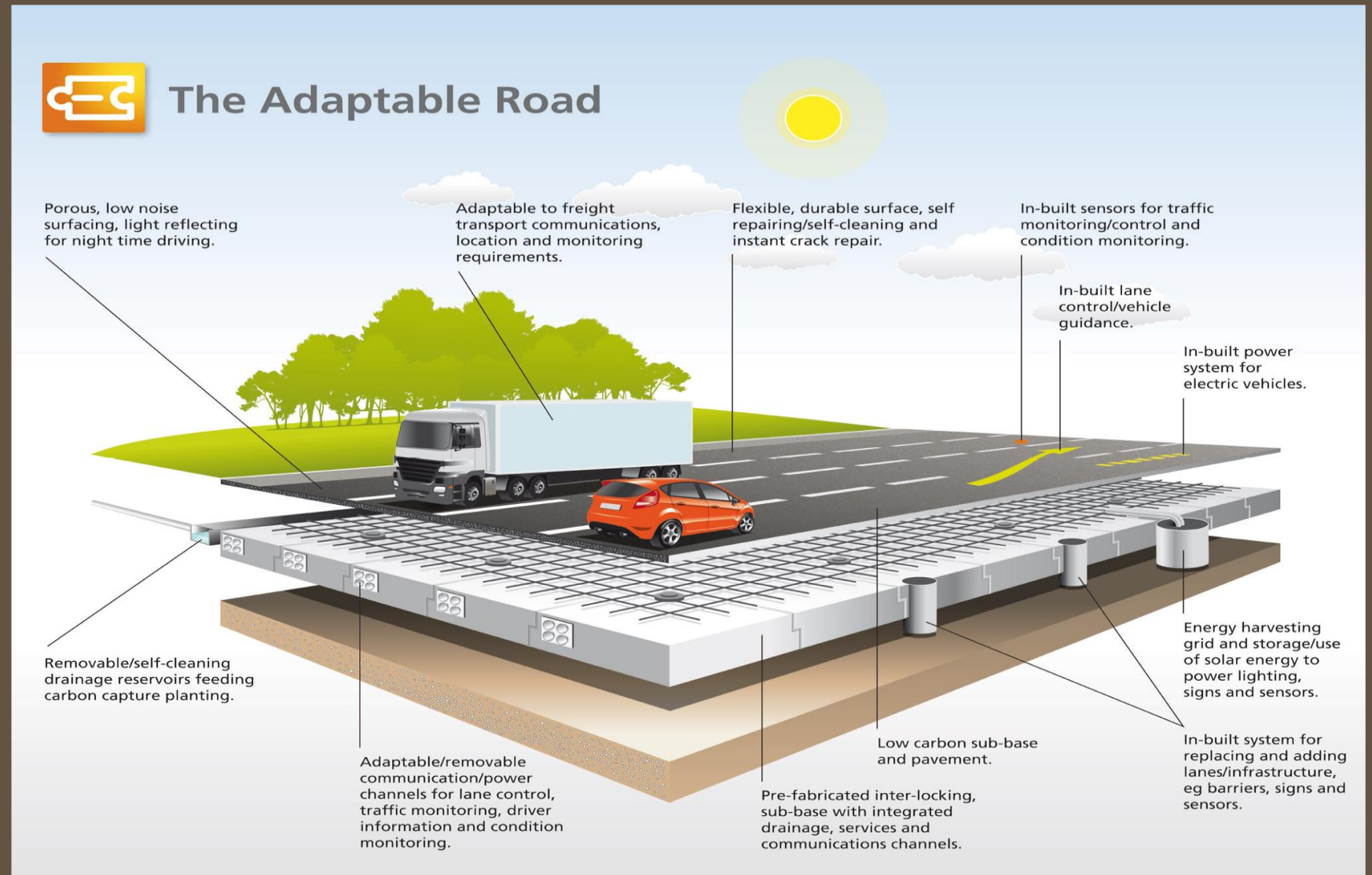
The next generation of roads will require high levels of adaptation, automation and resilience. These three elements will define the next generation of roads. The **latest one - the adaptable road** follows:



Forum of European National Highway Research Laboratories



EU Innovation – Concepts



Road Construction EU concepts for 2040, FEHRL platform



Goals set on 2006

2018

Till not completed (ongoing)

**Reliable
Infrastructure**

Mostly achieved

**Green
Infrastructure**

**Safe & Smart
Infrastructure**

**Human
Infrastructure**

- ✓ Research performance and failure mechanisms
- ✓ European wide Standards
- ✓ Use of durable materials to reduce maintenance
- ✓ New technologies to accelerate maintenance
- ✓ Monitoring road condition
- ✓ Use of in-situ sensors
- ✓ Develop LCA tools
- ✓ Low energy techniques
- ✓ Use of sustainable materials (by-products)
- ✓ Quantify the effects of road condition on fuel consumption
- ✓ New materials and construction parts to support a higher degree of safety (light reflecting surfaces etc.)
- ✓ Guidelines for safe Design

- Infrastructures that temporarily increase road capacity
- Real time inspection techniques
- Design systems that recover energy from road
- Design more aesthetical infr.
- Systems to reduce vehicle wastes
- Reduce impact of noise, rolling resistance
- Improve vehicle safety in extreme conditions (skidding)
- Develop all-round Dynamic Road Information Panels
- Automatic Vehicle Guidance
- Smart warning Systems
- Design compact cities
- Re-design aesthetical infrastructure
- Design separate infrastructure for vulnerable users

LOOKING AT THE CONFERENCE PROGRAM...



ERPUG 2023 25-27 October

Athens, Greece

www.erpug.org

Wednesday 25 October

10:00-10:20 **Welcome to ERPUG 10th annivers**
 10:20-10:40 **Welcome to Athens, Greece**
 10:40-11:10 **Keynote: New mechanistic paver prediction method**



ERPUG 2023 25-27 October

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www.erpug.org

Structural capacity, Moderator: Sigurdur Erlingsson

11:10-11:30 Collecting network-level paver line between network and project
 11:30-11:50 Combining deflection measureme
 11:50-12:10 Implementation of structural data Norway
 12:10-13:40 **Lunch and exhibition visit**
 13:40-14:00 The introduction of Pavement Sur automatic distresses computatio
 14:00-14:20 Evaluation of homogeneity and ai GPR in Norway and Sweden
 14:20-14:30 **Discussions and questions**
 14:30-15:00 **Vendors presentation, 2 min each**
Evenness, quality, and management, Moderator: St
 15:00-15:20 Quality assurance and data analy
 15:20-15:40 Error analysis for inertial profilers
 15:40-16:10 **Coffee and exhibition visit**
 16:10-16:30 Development of new performanc

Wednesday 25 October

16:30-16:50 Human-centred evaluation of expressway surfaces focusing on mental stress of road users with bio signals
 16:50-17:10 Improvements of PCI
 17:10-17:30 Case studies showcasing the value of comprehens used for pavement condition evaluation
 17:30-17:50 Relationship between measured passenger accele roughness on urban and low-speed roadways
 17:50-18:10 **Discussions and questions**
 19:00 **Ice breaker in the exhibition area**



ERPUG 2023 25-27 October

Athens, Greece

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Thursday 26 October

12:20-12:40 INFRACOMS methodology for appra explained by examples
 12:40-13:00 AI and its potential impact on future
 13:00-14:00 **Lunch**
 14:00-14:20 Measurement of speed humps
 14:20-14:40 Digital twins of road infrastructure c
 14:40-15:00 **Discussions and question**
 15:00-15:30 **Coffee and exhibition visit**
 15:30-23:30 **Surprise**



ERPUG 2023 25-27 October

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Friday 27 October

11:20-11:40 Standard requirements for friction on bike paths, is it worth i
 11:40-12:00 **Discussions and questions**
 12:00-12:20 **ERPUG 2024, Equipment evaluation at duraBAST etc.**
 12:20-12:40 **Farewell and lunch**

Friday 27 October

Cycle paths, Moderator Carl Van Geem
 09:00-09:20 Cycle path condition monitoring tec
 09:20-09:40 Digitizing bike lanes for Bike PMS
 09:40-10:00 Comprehensive analysis of walkway challenges of 3D measurement and
 10:00-10:20 Evenness, texture and comfort mea
 10:20-11:00 **Check out rooms**
 11:00-11:20 Update on cycle path research in US





Welkom!



Willkommen!



Välkommen!



Velkommen!



Καλώς ήρθατε!



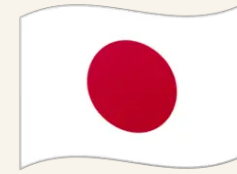
Bienvenue!



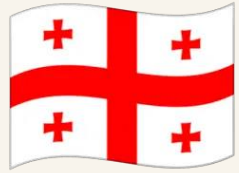
მისასალმებელი!



Welcome!



ようこそ!



Tere tulemast!



Üdvözöljük!