CIrClE 2019

Challenges for the Islands in the era of the Circular Economy

LaB *for* TRANSPORT ENGINEERING

Appraisal of Non-Motorized Road Traffic Levels in Cyprus, taking into account socio-demographic and Economic Characteristics

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Lab for Transport Engineering

University of Cyprus

Under the auspices of ENV MOVE

Πανεπιστήμιο Κύπρου

Τμήμα Πολιτικών Μηχανικών και Μηχανικών Περιβάλλοντος

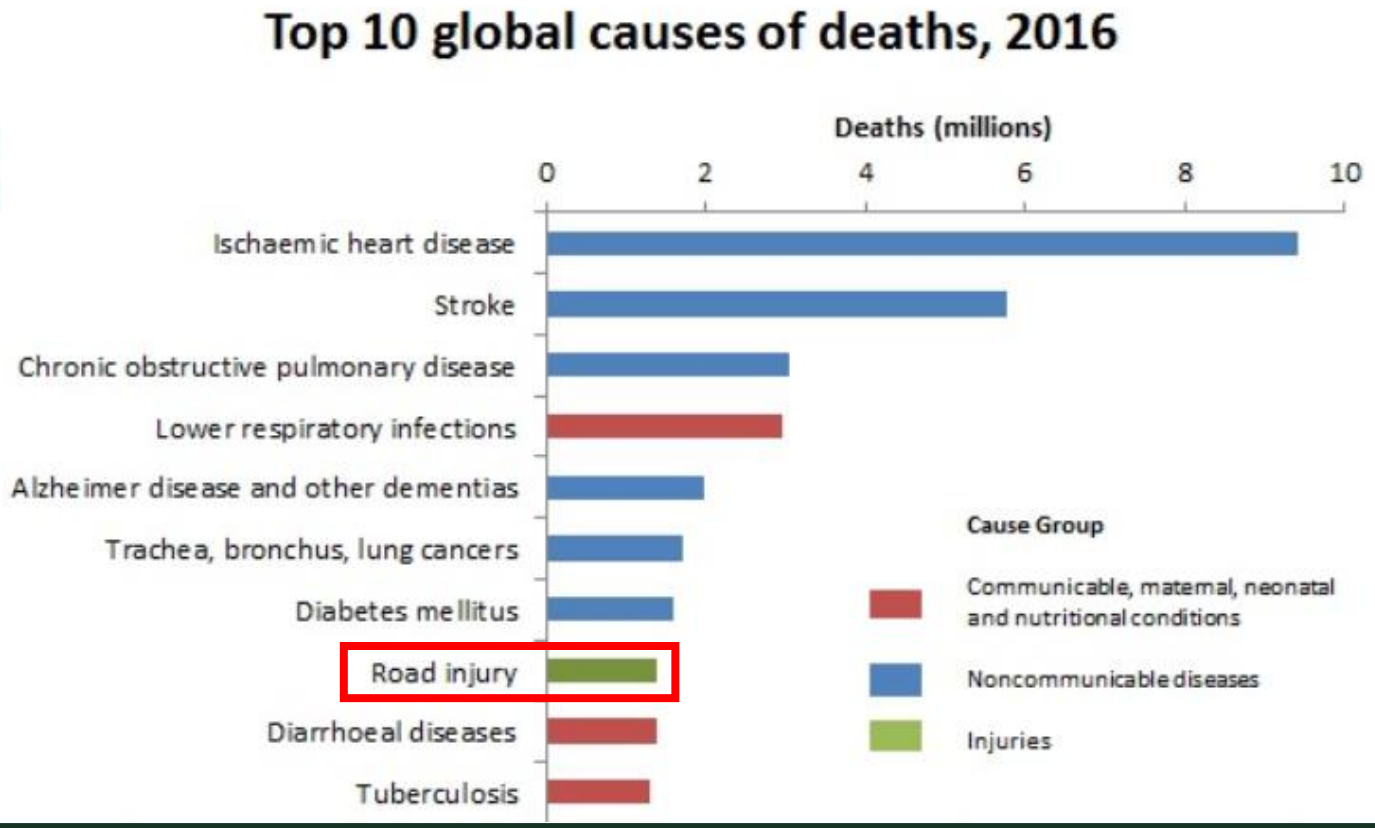
SMile 2019

6th **Sustainable Mobility & Intelligent Transport conference**

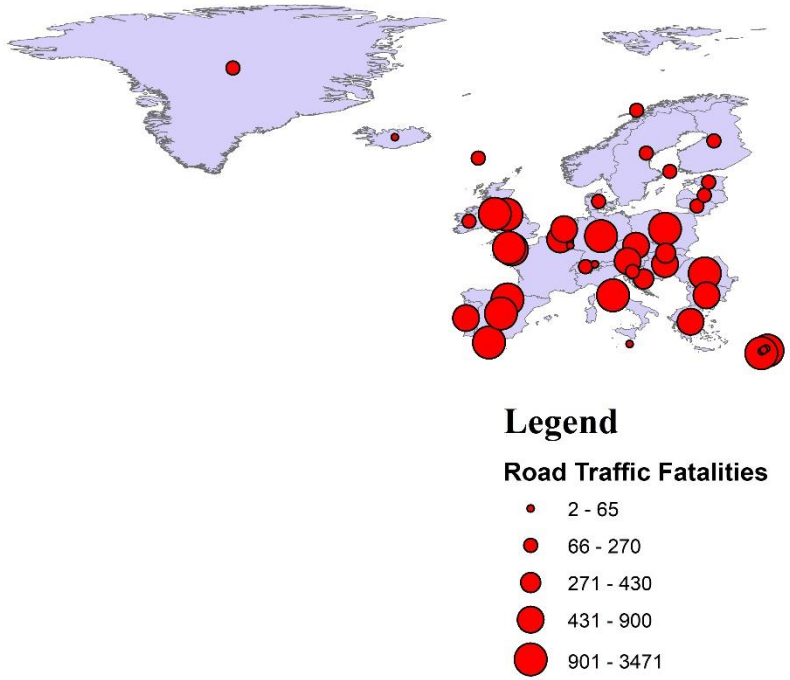
Road Traffic Fatalities are one of the most serious problems in Europe.

According to Eurostat's annual report for 2016, we had a total of 25,800 deaths from road accidents.

World Health Organization

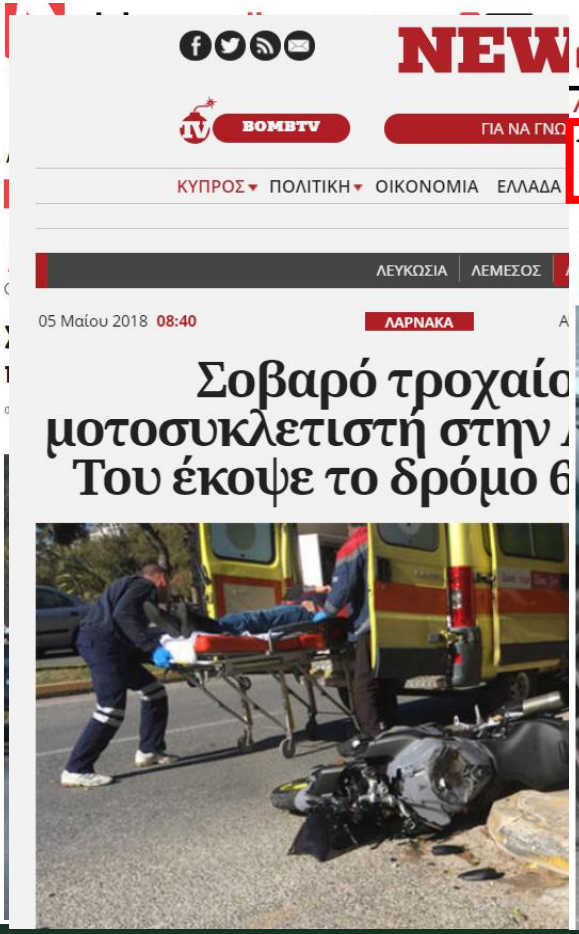


Number Road Traffic Fatalities in Europe



..... and in Cyprus.

Road Traffic Fatalities from the media in Cyprus



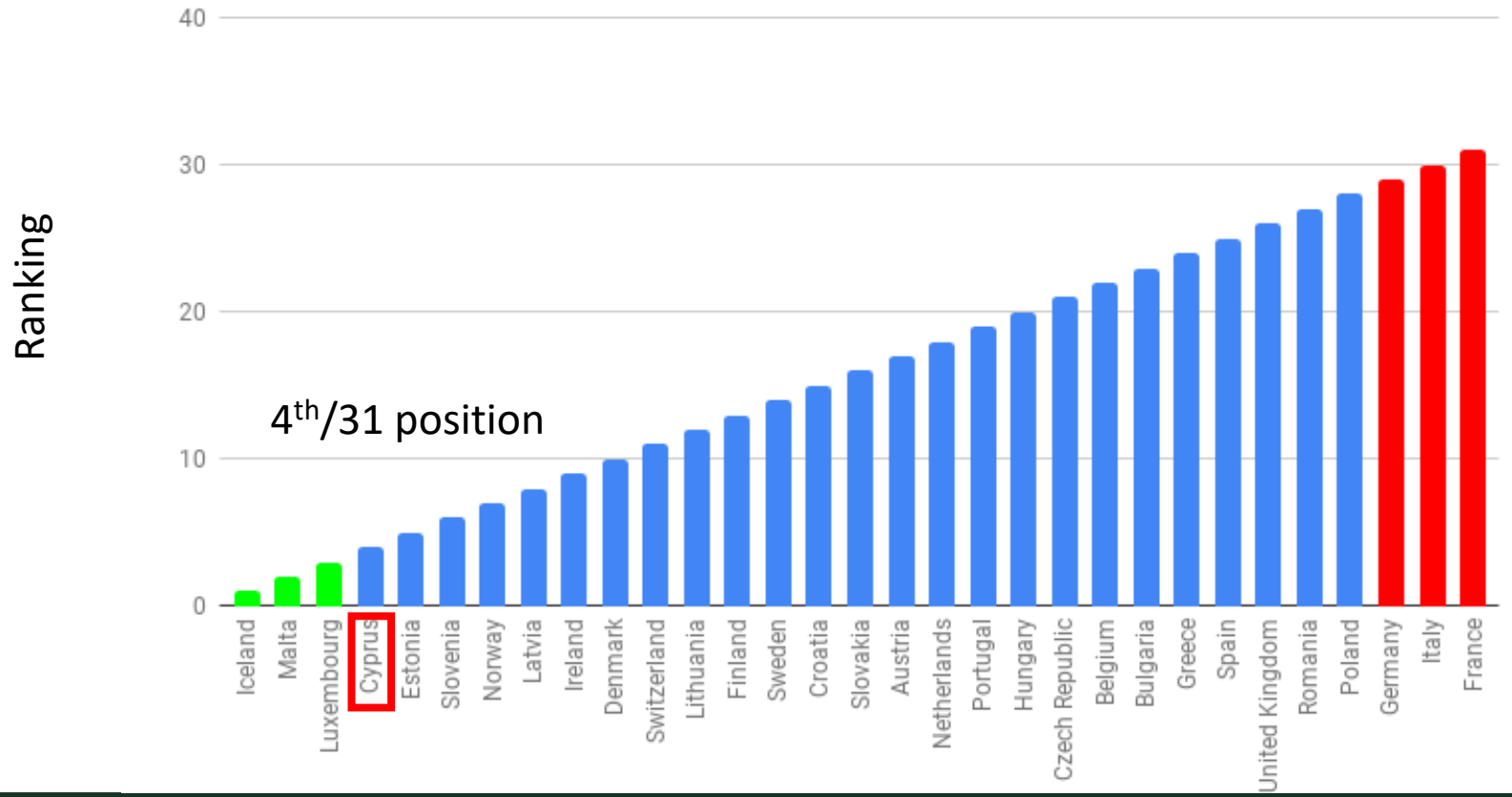
The scope of this presentation is:

The investigation of road traffic fatalities in the European region -specifically in Cyprus- through Benchmarking Analysis.

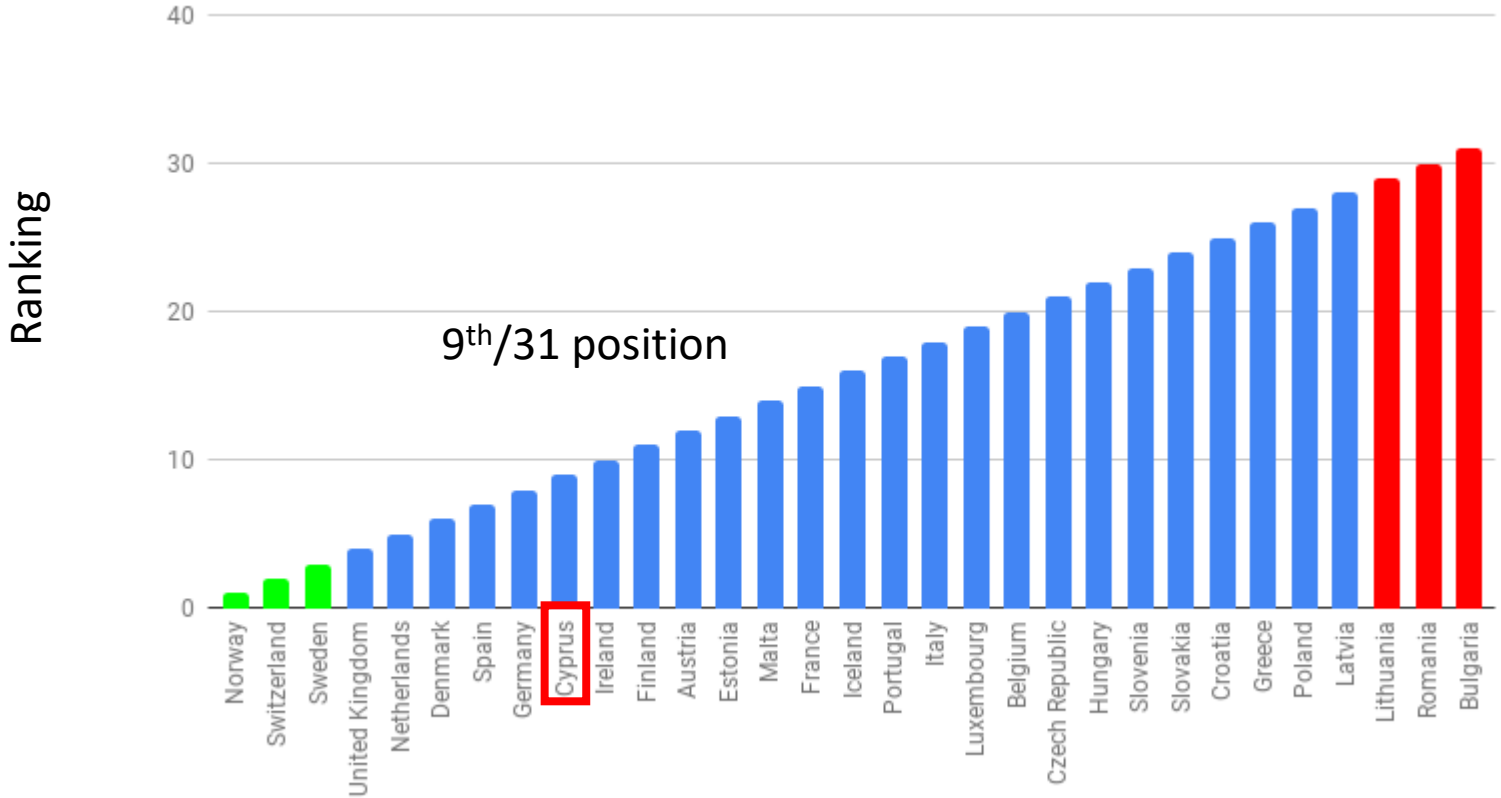
Benchmarking Analysis: Provides unbiased ranking of the countries based on their road safety performance.

In which way can the ranking be validated?

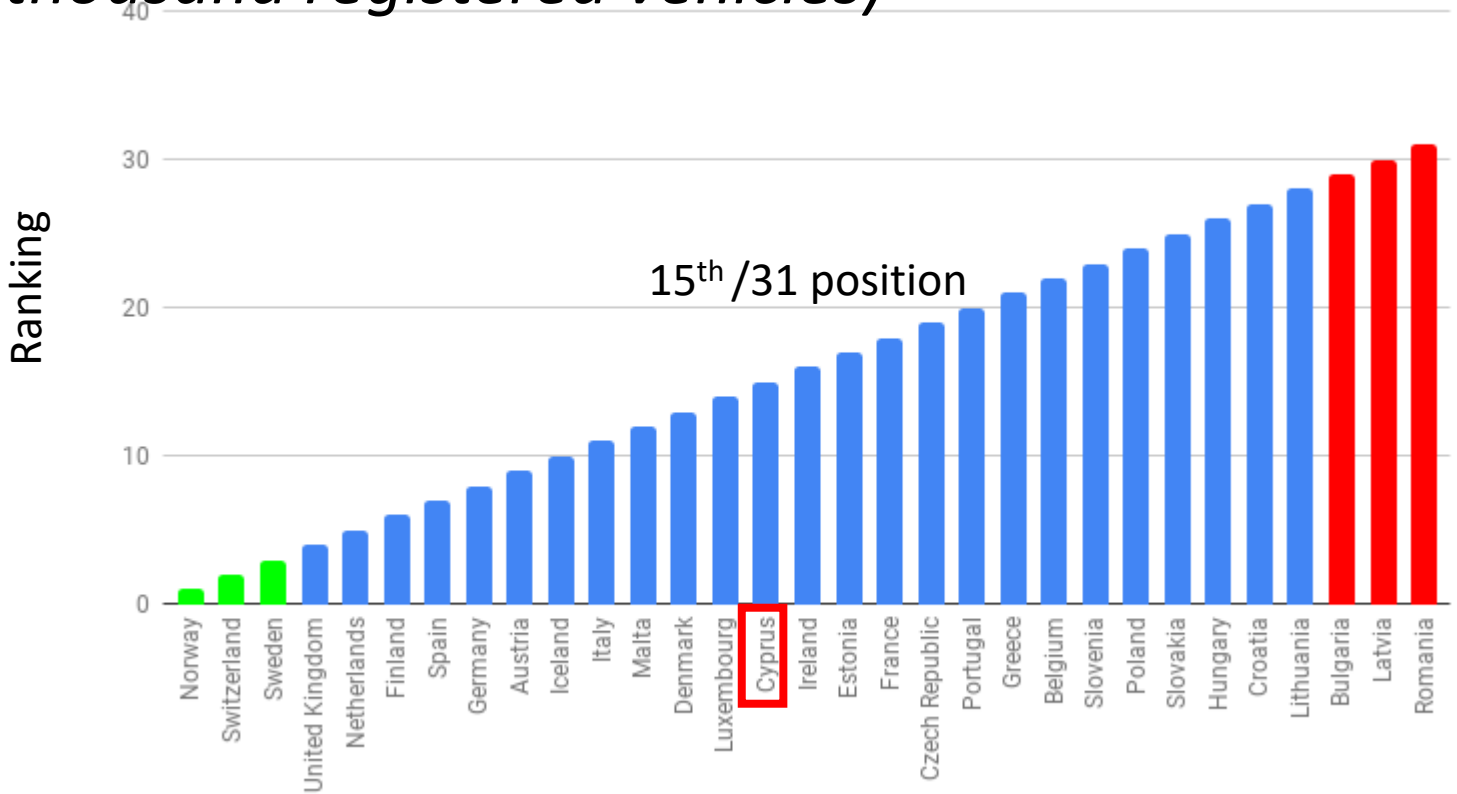
*Ranking of the EU countries based on the **number** of road traffic fatalities*



*Ranking of the countries based on the index mortality **rate** (number of traffic fatalities per million people)*



*Ranking of the countries based on the index fatality **rate** (number of traffic fatalities per thousand registered vehicles)*



*So, what is the **TRUE** Cyprus' ranking in road safety?*

Which variable/s should be used in order to capture the phenomenon of road traffic fatalities?

The use of indices (e.g. mortality and fatality rates) provide valid comparisons among the countries' road safety performance.

However, according to the literature, the current phenomenon can be captured adequately by the socio-economic and demographic context of the countries. Therefore, an extended dataset was created including such characteristics.

Such variables could be:

GDP, Unemployment, Land area, Internet users and Mobile cellular, etc.

Therefore, having this socio-economic and demographic information of the EU countries and the two indices (mortality and fatality rate) the next step was the implementation of the Benchmarking Analysis.

A suitable method that can handle such multi-input, multi-output information and provide valuable results, is Data Envelopment Analysis (DEA).

How does DEA work?

DEA – Mathematic Formulation

$$min \quad \theta_o^t$$

subject to:

$$\sum_{j=1}^{s} x_i^t \lambda_j^t \geq x_{io}^t; \quad i = 1, \ldots, m$$

$$\sum_{j=1}^{m} y_{ij}^t \lambda_j^t \leq \theta_o^t y_{ro}^t; \quad r = 1, \ldots, s$$

$$\lambda_j^t \geq 0; \quad j = 1, \ldots, n$$

λ_j : lambda weights assigned to countries

y: denotes the output variables

x: denotes the input variables

i, r: denotes the number of input and output variables, respectively.

o: denotes the country that we want to calculate it's efficiency rate.

φ,θ: denotes the efficiency rate

DEA – Target Setting

$$Target_j = \sum_{i=1}^{m} \lambda_{ij} y_i$$

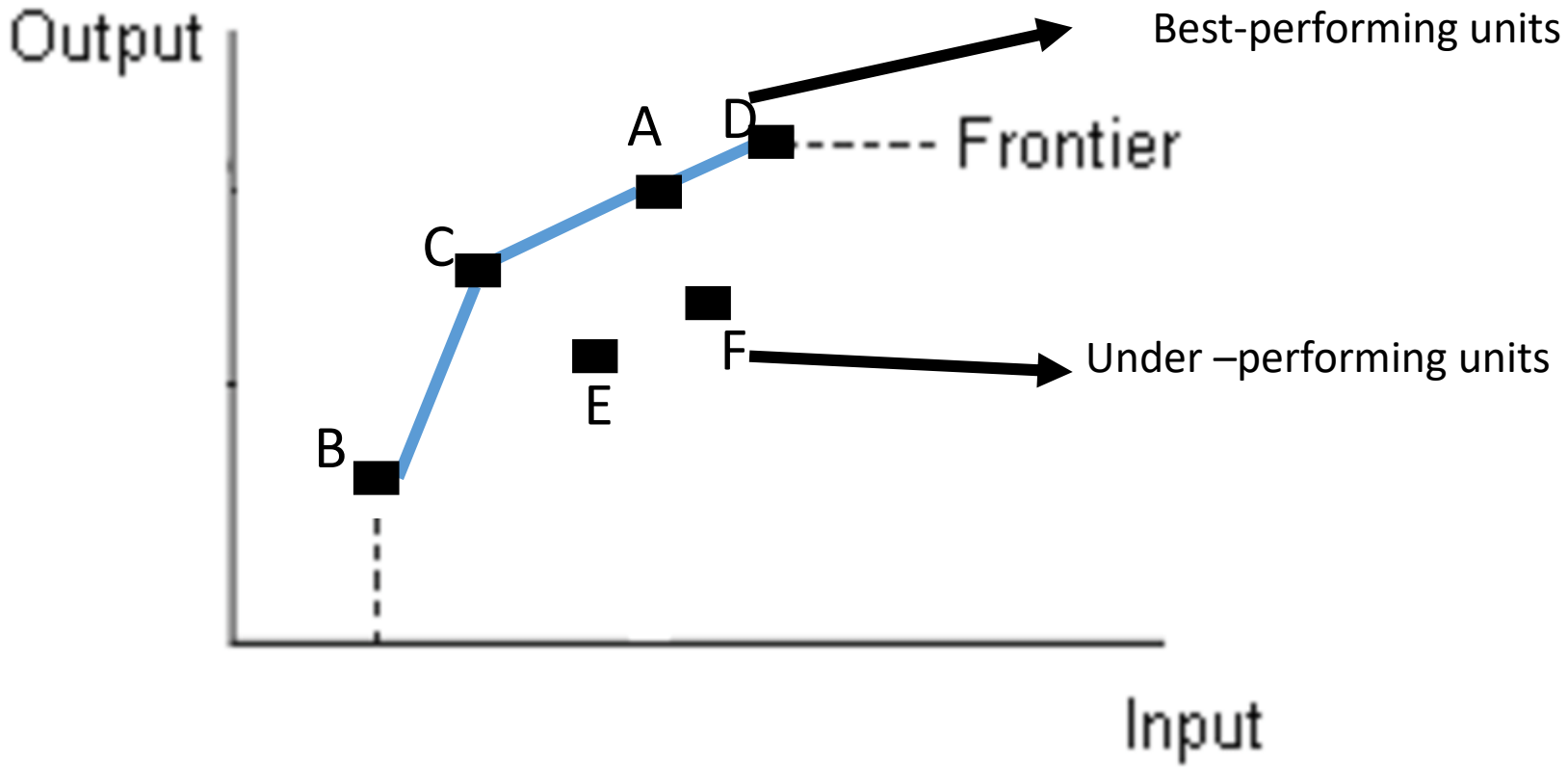
$j=1...n$

$i=1...m$

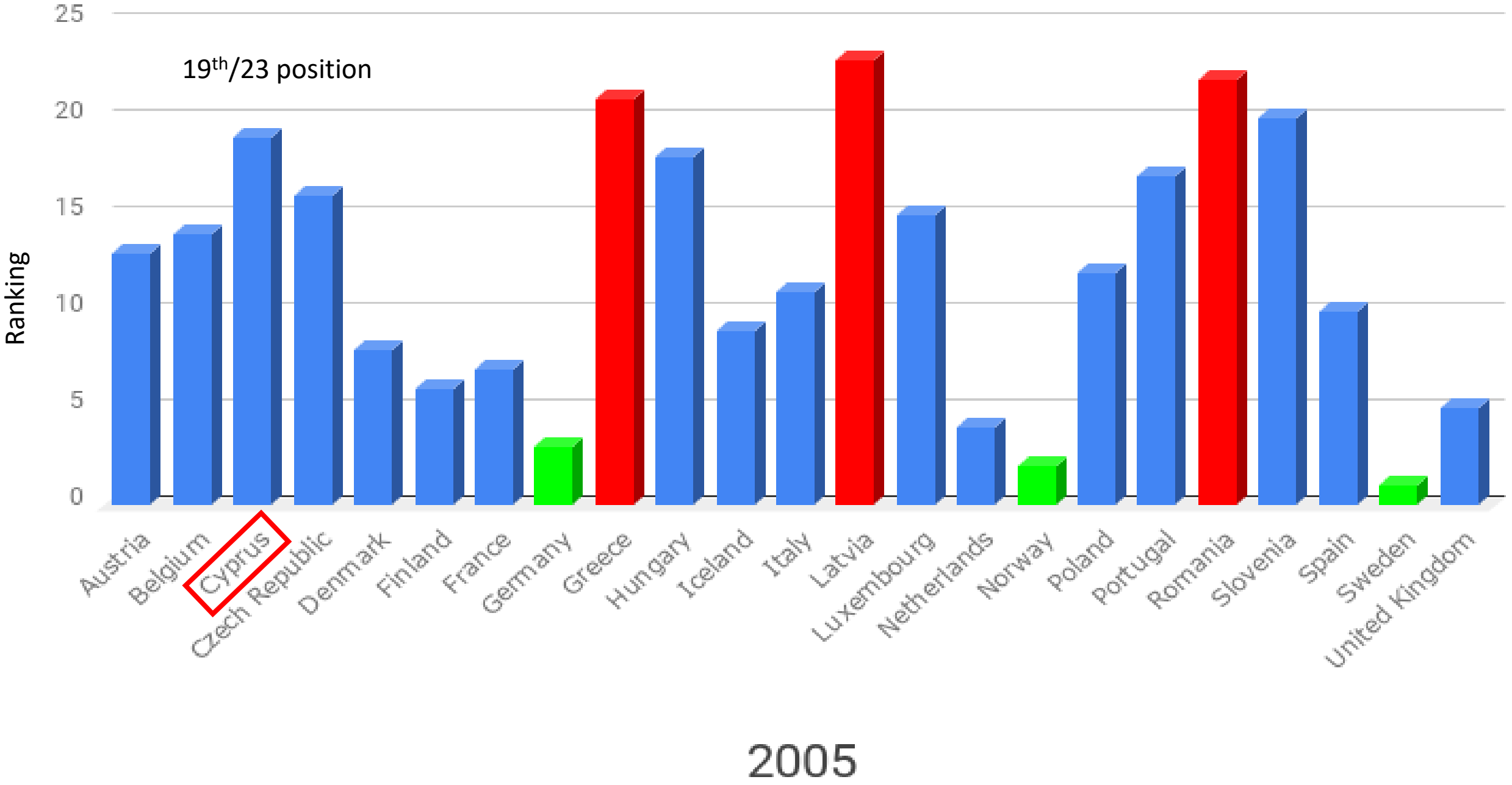
$\boldsymbol{\lambda_{ij}}$: lambda weight matrix that was occurred form the DEA implementation

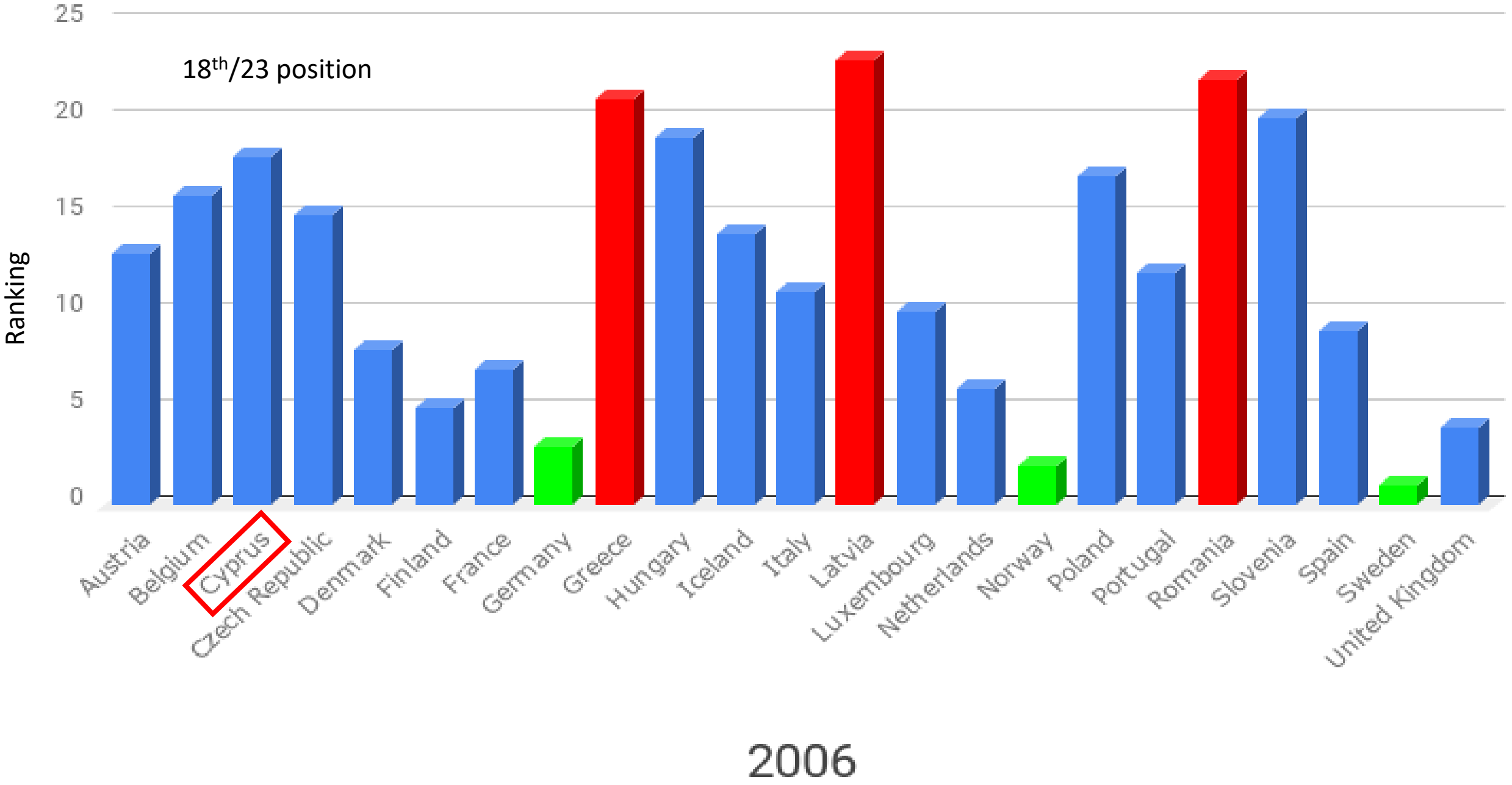
$\boldsymbol{y_i}$: denotes the output variables for country i.

$Target_j$: denotes the targeted number of fatalities for the jth under-performing country.


Output
Best-performing units
A
D
Frontier
C
F
Under –performing units
E
B
Input

RESULTS


19th/23 position
Ranking
25
20
15
10
5
0
Austria
Belgium
Cyprus
Czech Republic
Denmark
Finland
France
Germany
Greece
Hungary
Iceland
Italy
Latvia
Luxembourg
Netherlands
Norway
Poland
Portugal
Romania
Slovenia
Spain
Sweden
United Kingdom
2005


18th/23 position
Ranking
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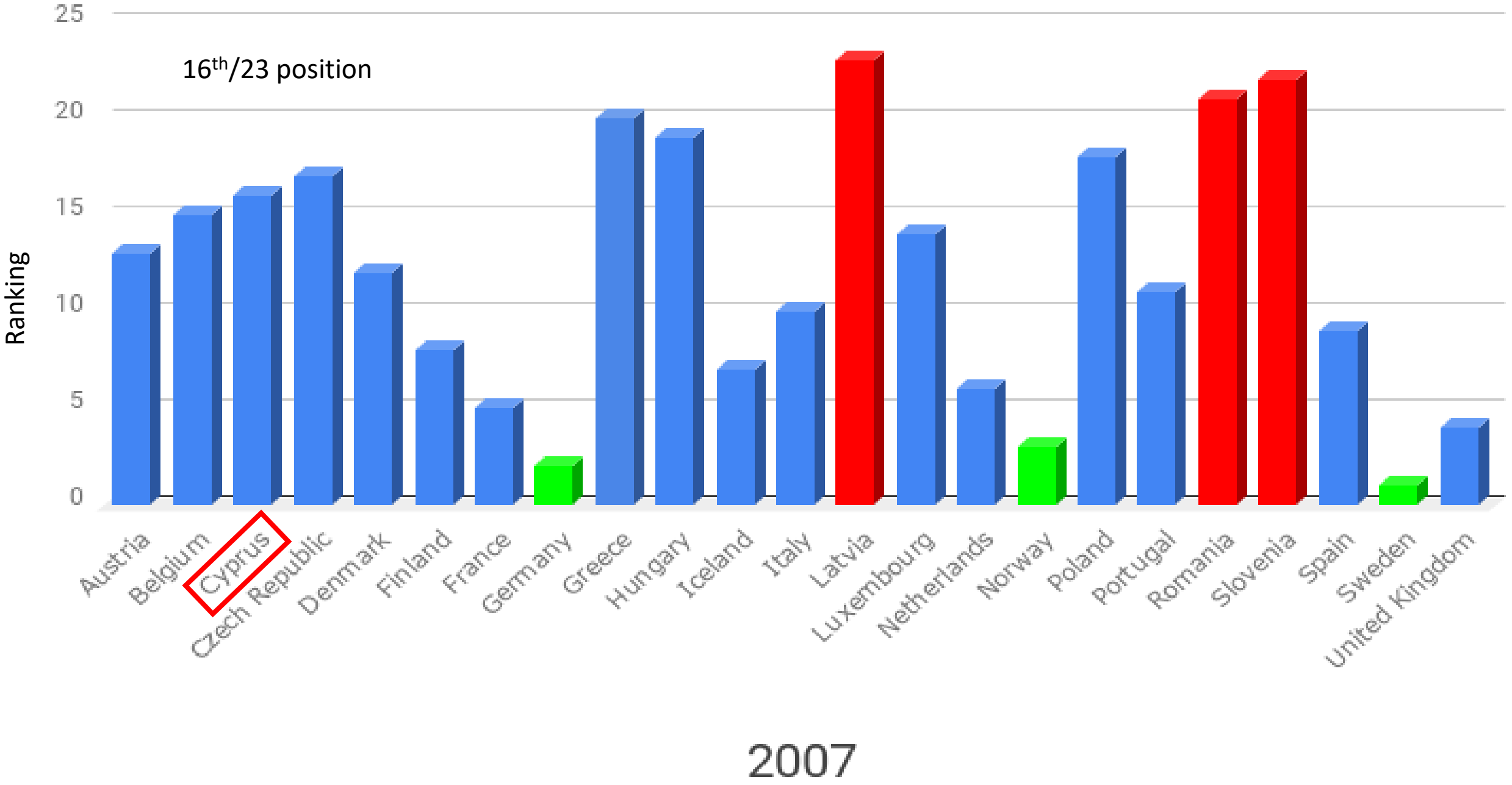
Slovenia
Spain
Sweden
United Kingdom
2006


16th/23 position
Ranking
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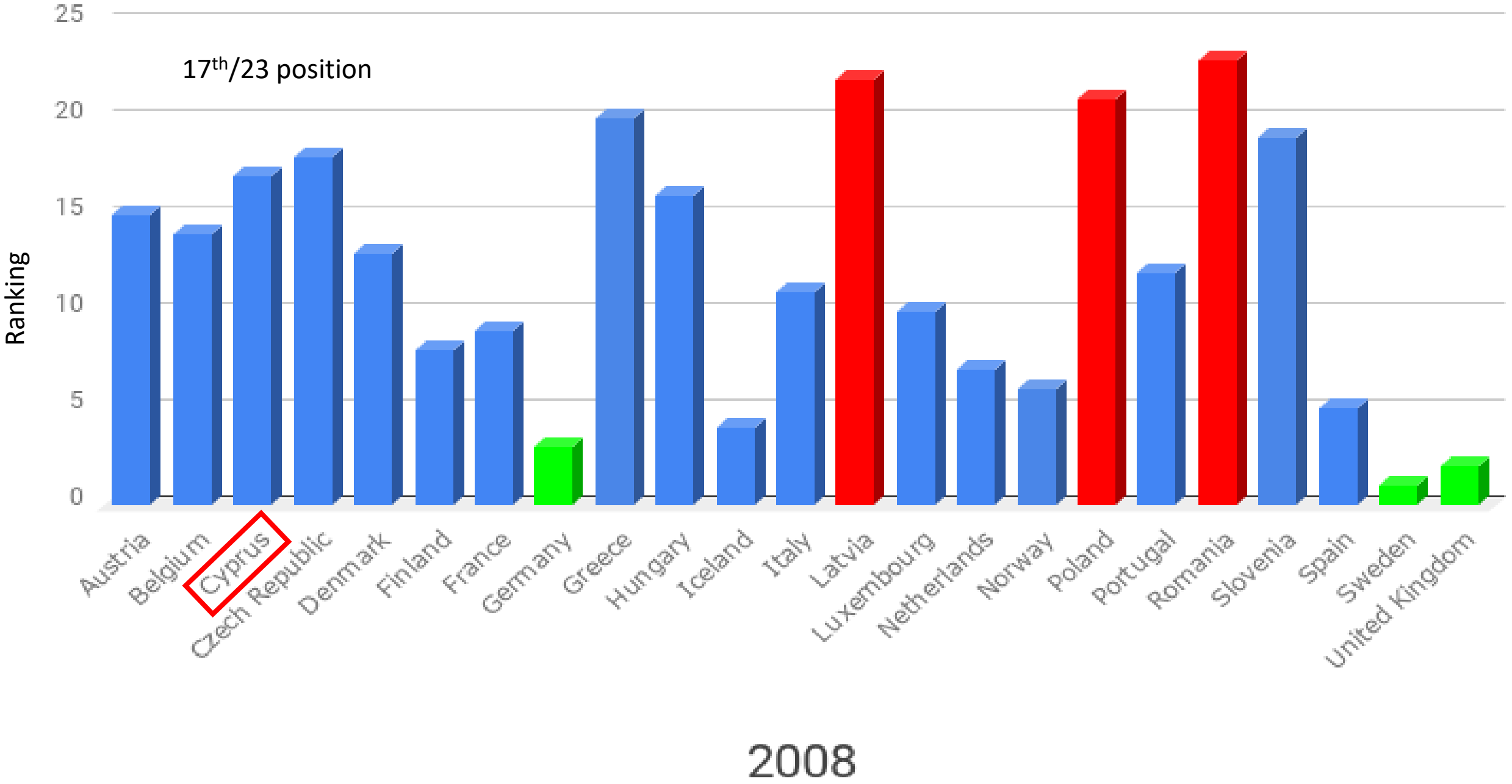
Slovenia
Spain
Sweden
United Kingdom
2007


17th/23 position
Ranking
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Austria
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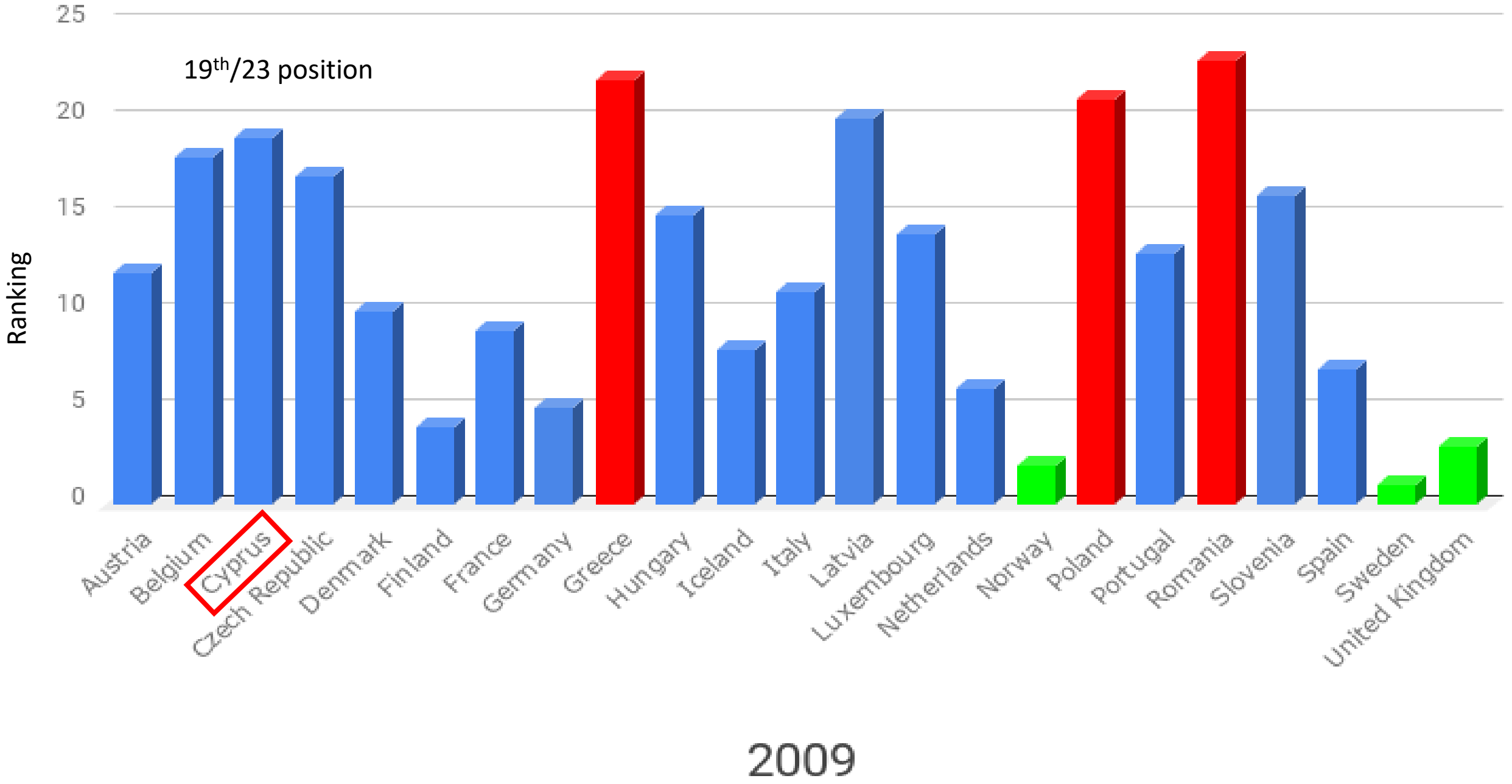
Romania
Slovenia
Spain
Sweden
United Kingdom
2008


19th/23 position
Ranking
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Austria
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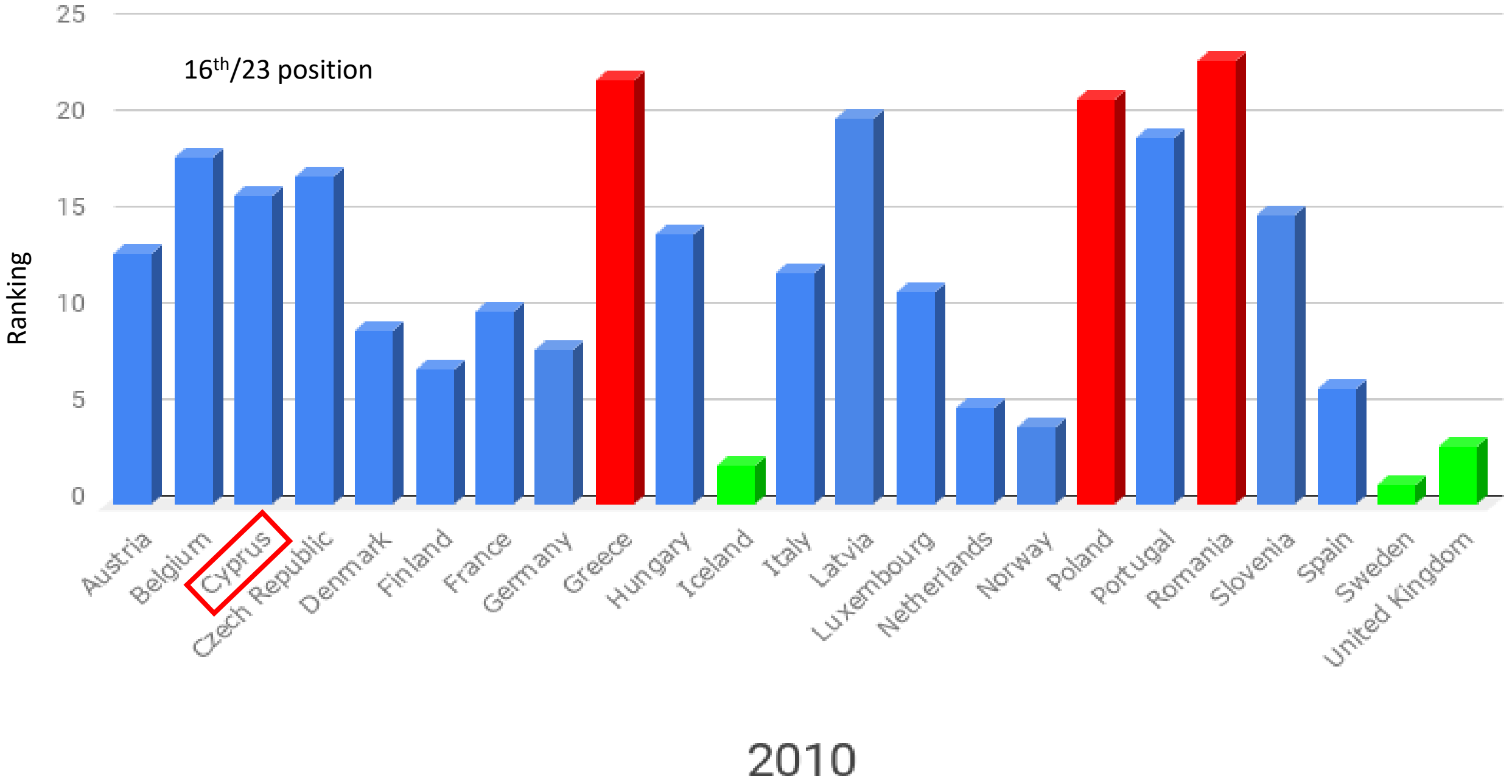
2009


16th/23 position
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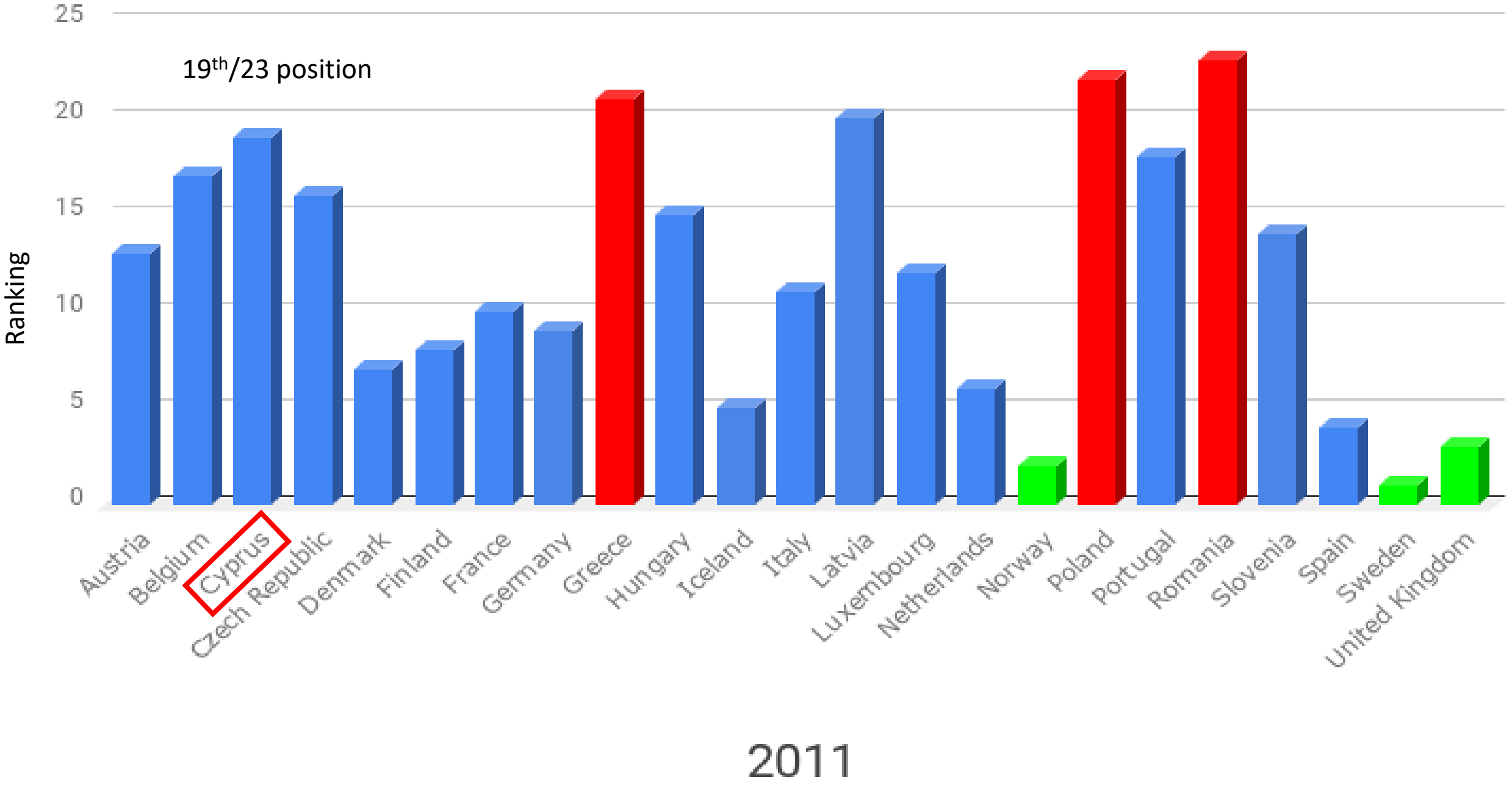
Sweden
United Kingdom
2010


19th/23 position
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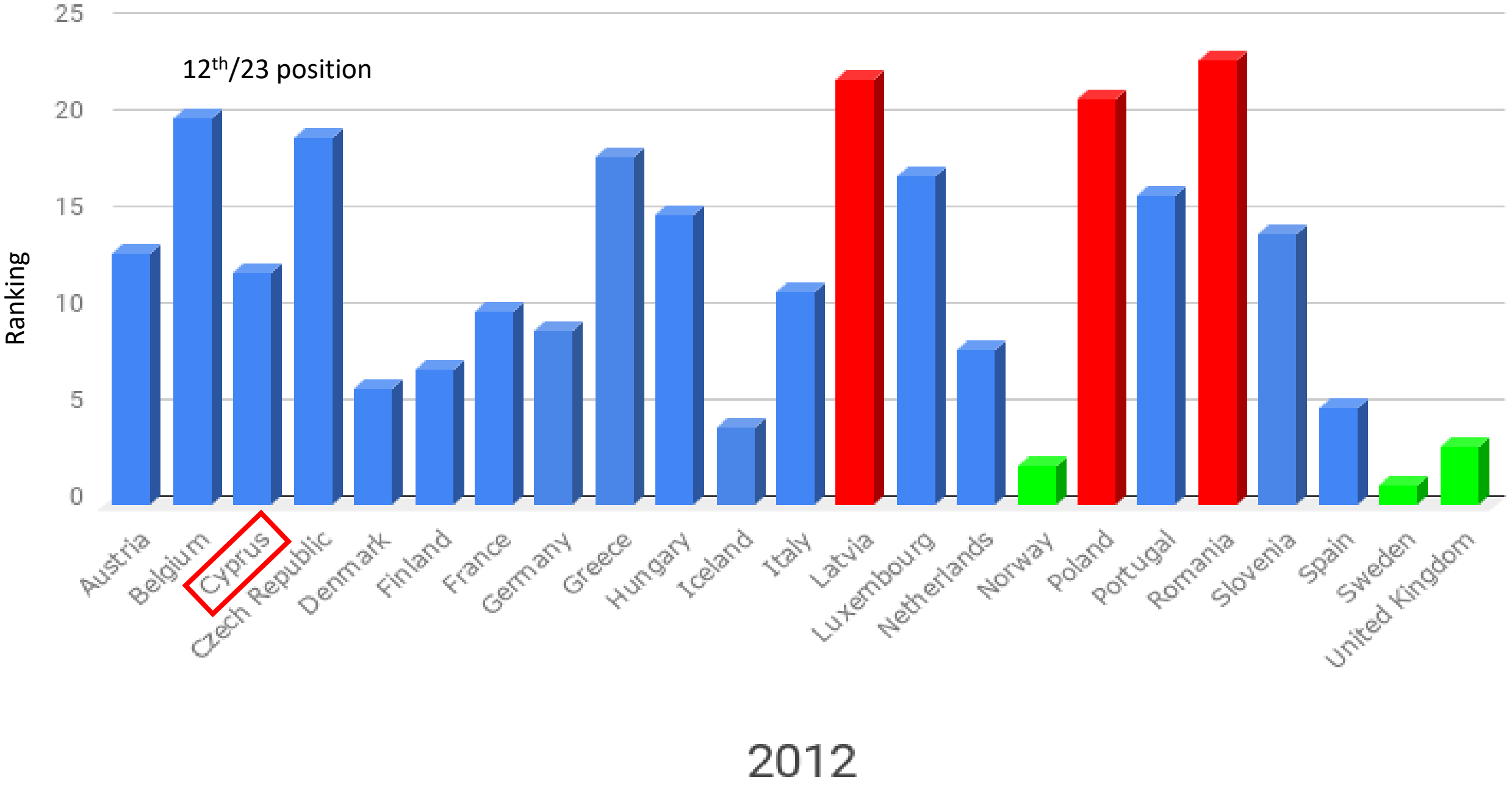
United Kingdom
2011


12th/23 position
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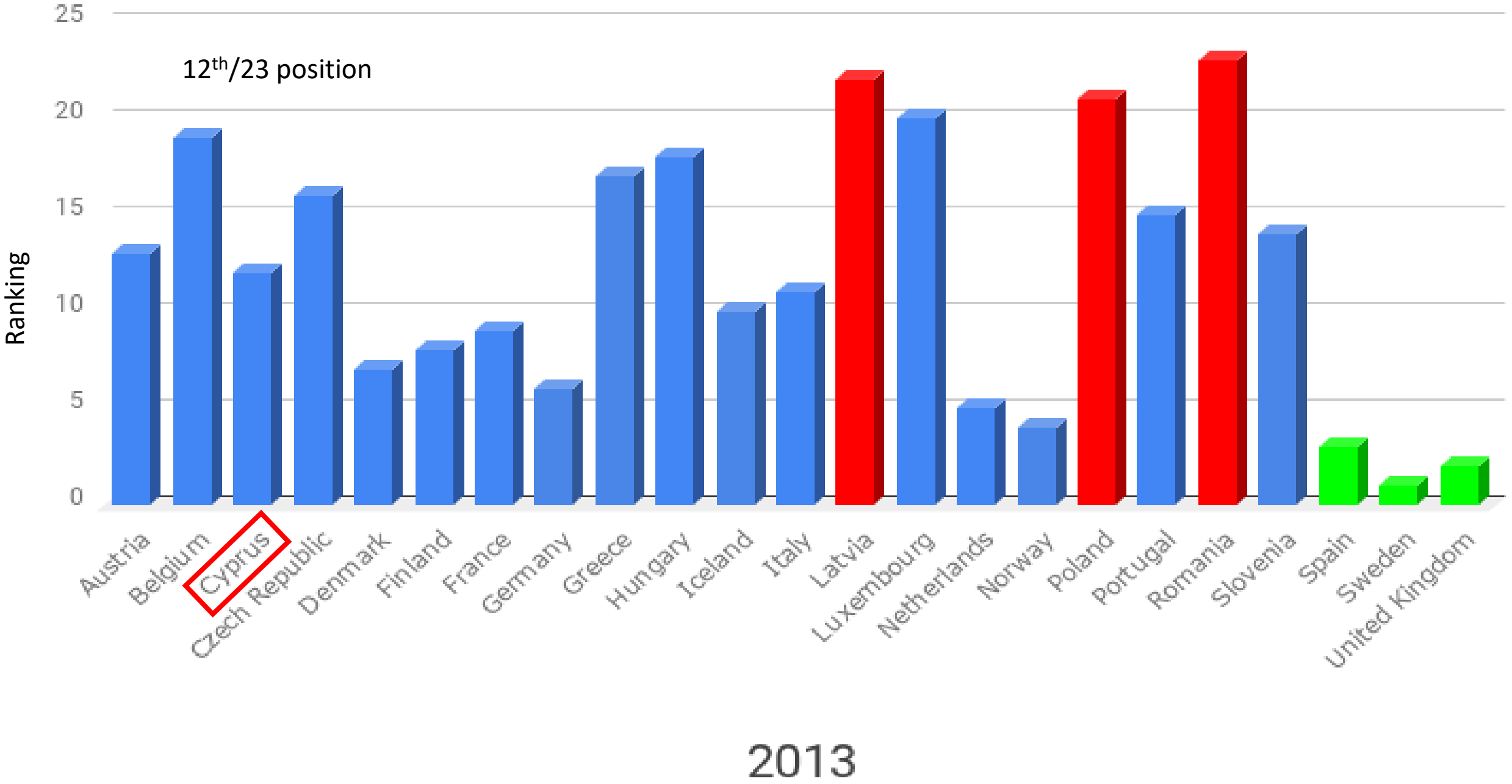
Sweden
United Kingdom
2012


12th/23 position
Ranking
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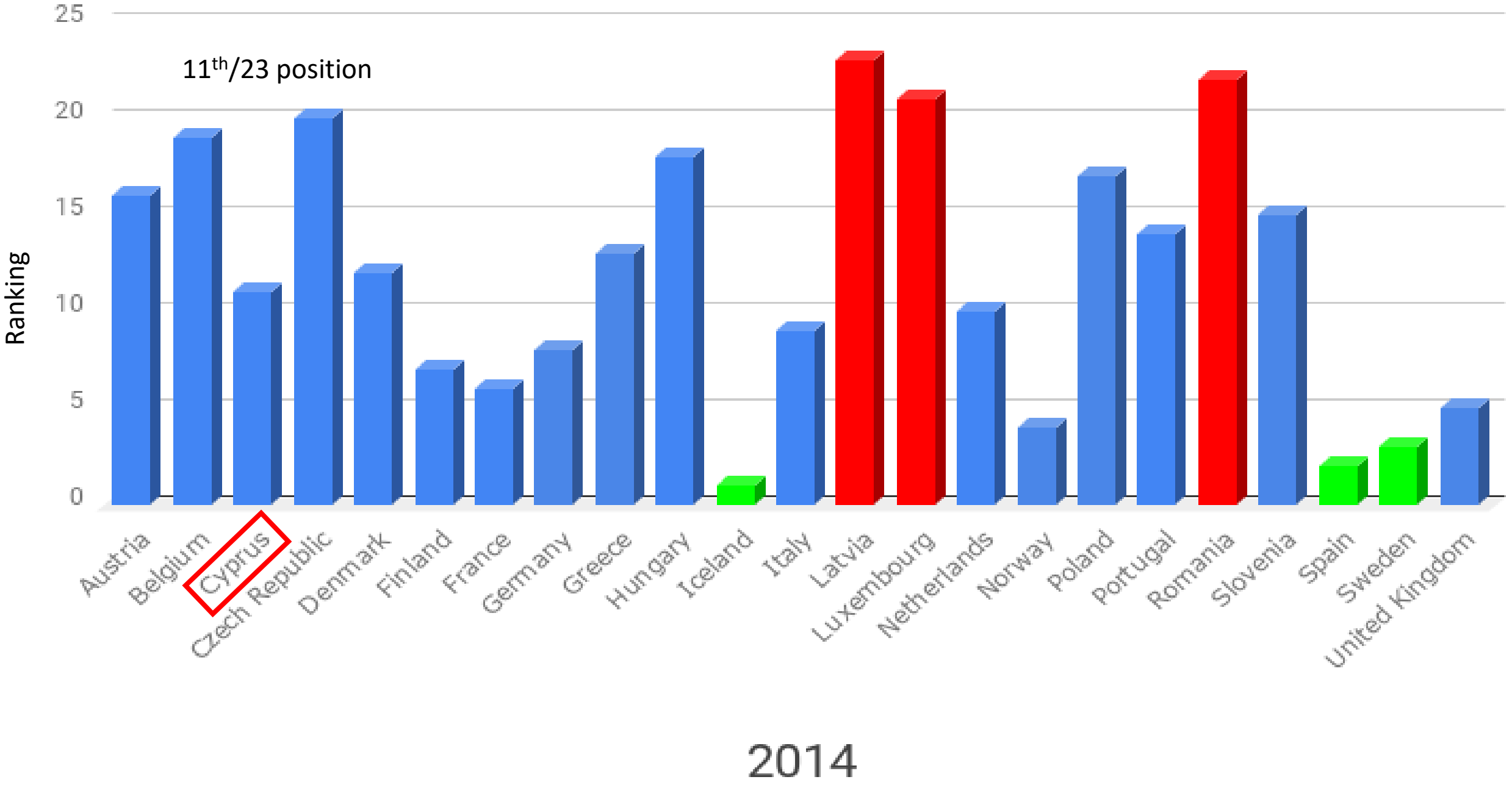
Slovenia
Spain
Sweden
United Kingdom
2013


11th/23 position
Ranking
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Greece
Hungary
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Latvia
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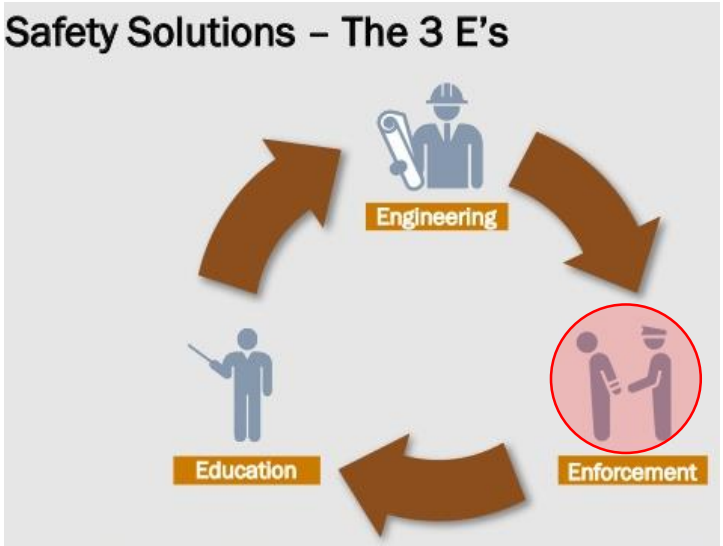
Norway
Poland
Portugal
Romania
Slovenia
Spain
Sweden
United Kingdom
2014

*From the 25,800 road traffic deaths that were recorded in EU countries in 2016 the 50% of them concern **vulnerable users** (pedestrians, 2-W users). Taking into consideration that the number of vulnerable users is way too smaller (compared to other users), it is essential to investigate the road safety performance of the countries with respect to these users' class.*

The road safety performance of the countries is also expressed through the three E's of road safety, which are:

- *Engineering*
- *Education*
- *Enforcement*

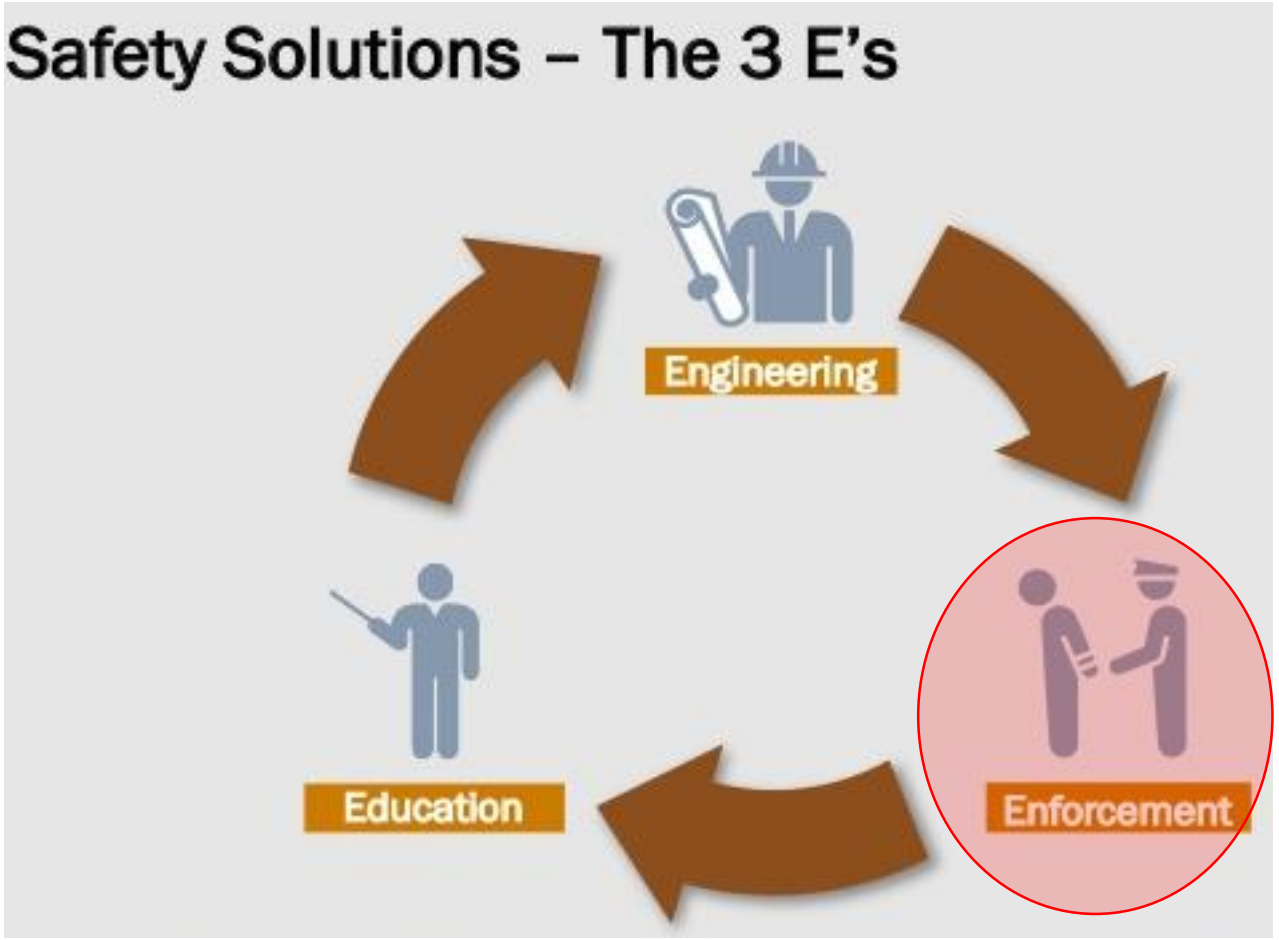


Therefore, we can evaluate the national road safety performance based on the law enforcement related to road traffic behavior.

Which laws?

- Speed limit laws.
- Drink ‘n drive laws.
- Helmet wearing laws.

The enforcement of these laws (ranked from 1 to 10) was used as information in order to provide an evaluation of the countries based on there road safety performance, focusing to vulnerable users class.



How effective are these legislations to the road safety performance of the countries?

What position does Cyprus holds on the road safety map regarding the vulnerable users?

In order to address these questions we implemented DEA using as inputs the enforcement ranking of the three legislations and as outputs the following variables:

Number of fatalities using bicycle, mopeds, motorcycles and pedestrians all expressed per million people.

RESULTS

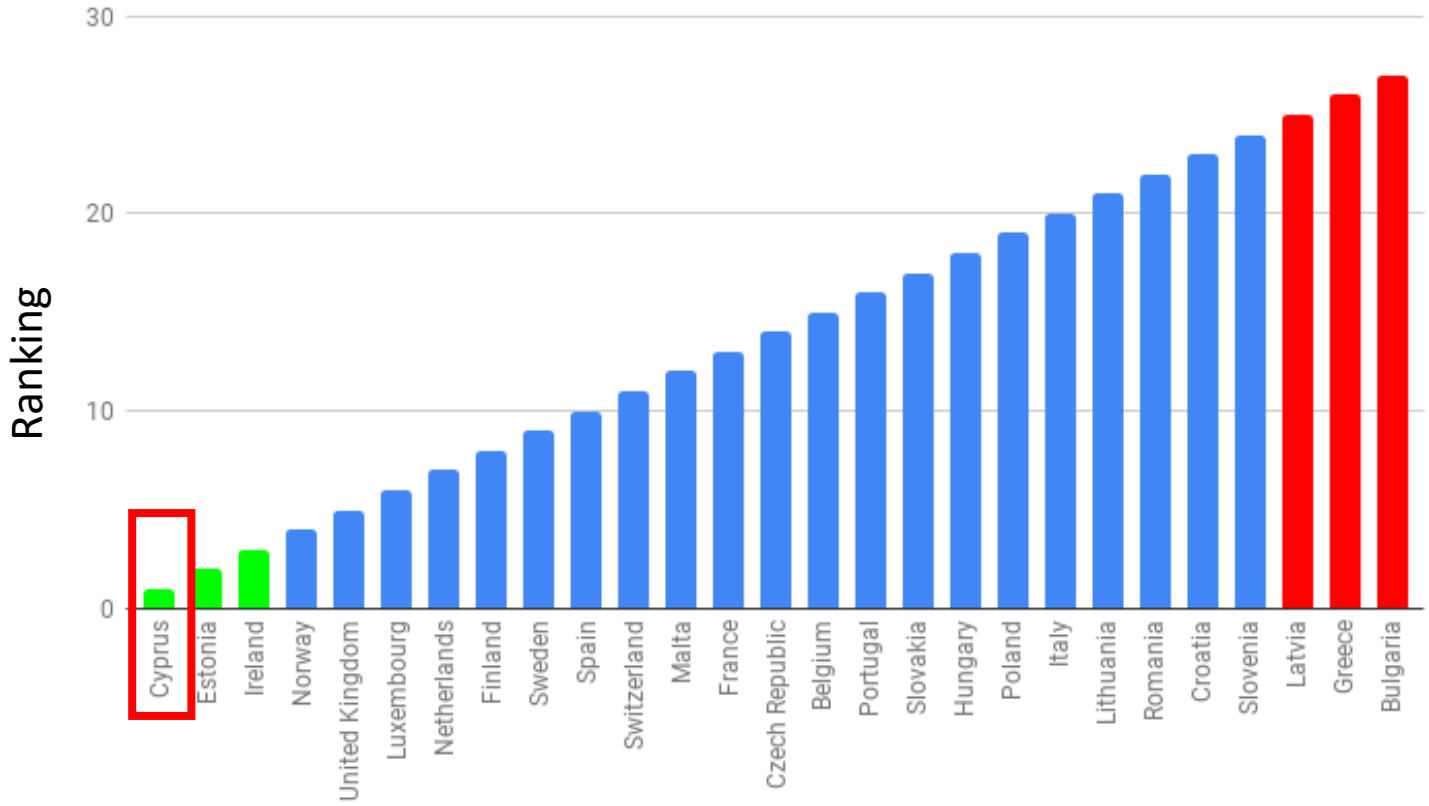
Inputs:
Enforcement level of;

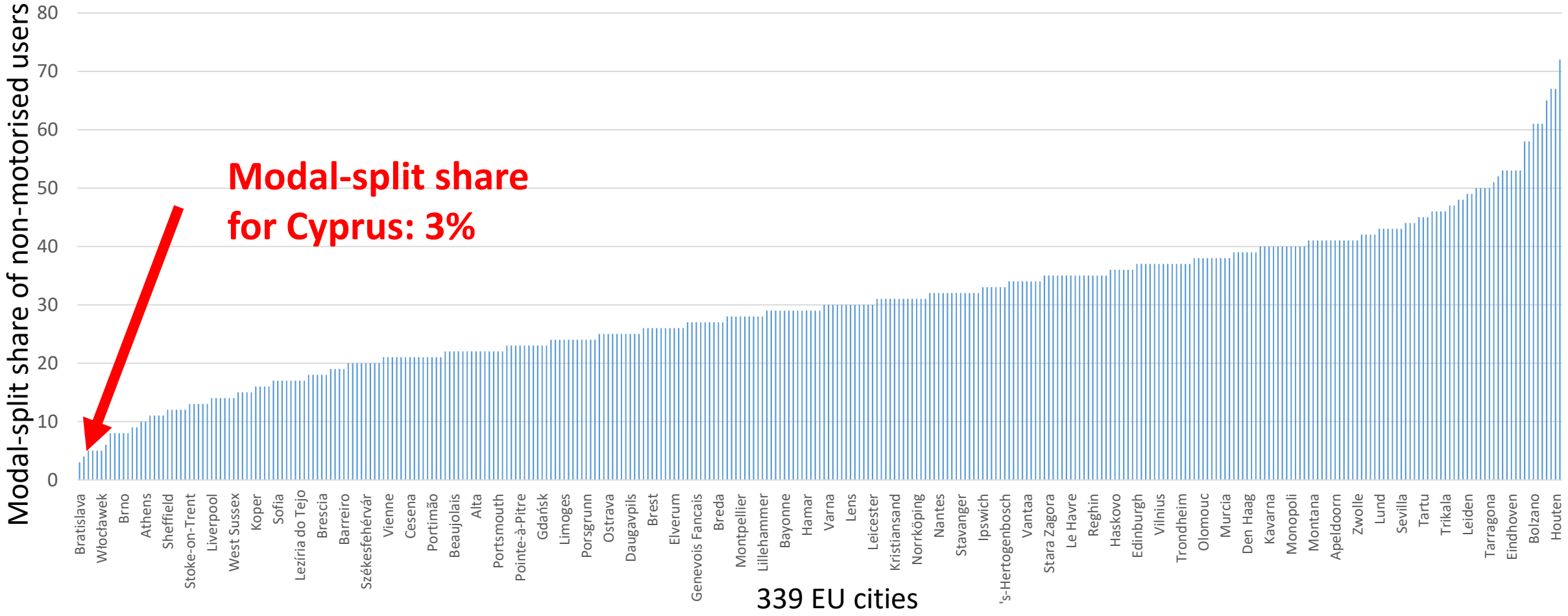
- Speed limit laws.
- Drink ‘n drive laws.
- Helmet wearing laws

Outputs:
Non-motorized fatalities per

Million Population

Resulted ranking of the countries based on DEA outputs (non-motorized fatalities per million population)




Modal-split share of non-motorised users
0
10
20
30
40
50
60
70
80
Modal-split share for Cyprus: 3%
Bratislava
Włocławek
Brno
Athens
Sheffield
Stoke-on-Trent
Liverpool
West Sussex
Koper
Sofia
Lezíria do Tejo
Brescia
Barreiro
Székesfehérvár
Vienne
Cesena
Portimão
Beaujolais
Alta
Portsmouth
Pointe-à-Pitre
Gdańsk
Limoges
Porsgrunn
Ostrava
Daugavpils
Brest
Elverum
Genevois Fancais
Breda
Montpellier
Lillehammer
Bayonne
Hamar
Varna
Lens
Leicester
Kristiansand
Norrköping
Nantes
Stavanger
Ipswich
's-Hertogenbosch
Vantaa
Stara Zagora
Le Havre
Reghin
Haskovo
Edinburgh
Vilnius
Trondheim
Olomouc
Murcia
Den Haag
Kavarna
Monopoli
Montana
Apeldoorn
Zwolle
Lund
Sevilla
Tartu
Trikala
Leiden
Tarragona
Eindhoven
Bolzano
Houten
339 EU cities

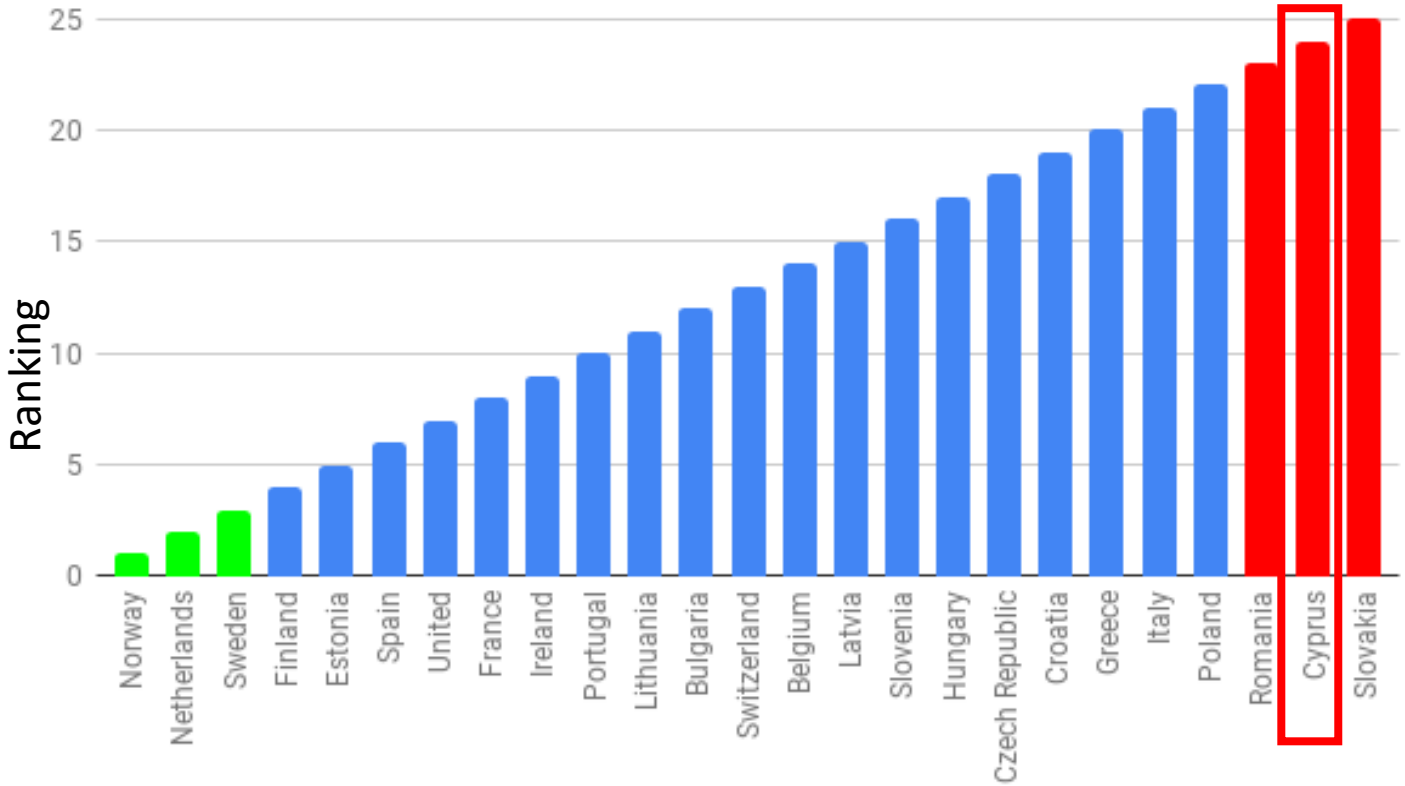
Inputs:
Enforcement level of;

- Speed limit laws.
- Drink ‘n drive laws.
- Helmet wearing laws

Outputs:
Non-motorized fatalities per

Non-motorized Users

Resulted ranking of the countries based on DEA outputs (number of non-motorized fatalities per non-motorized users)

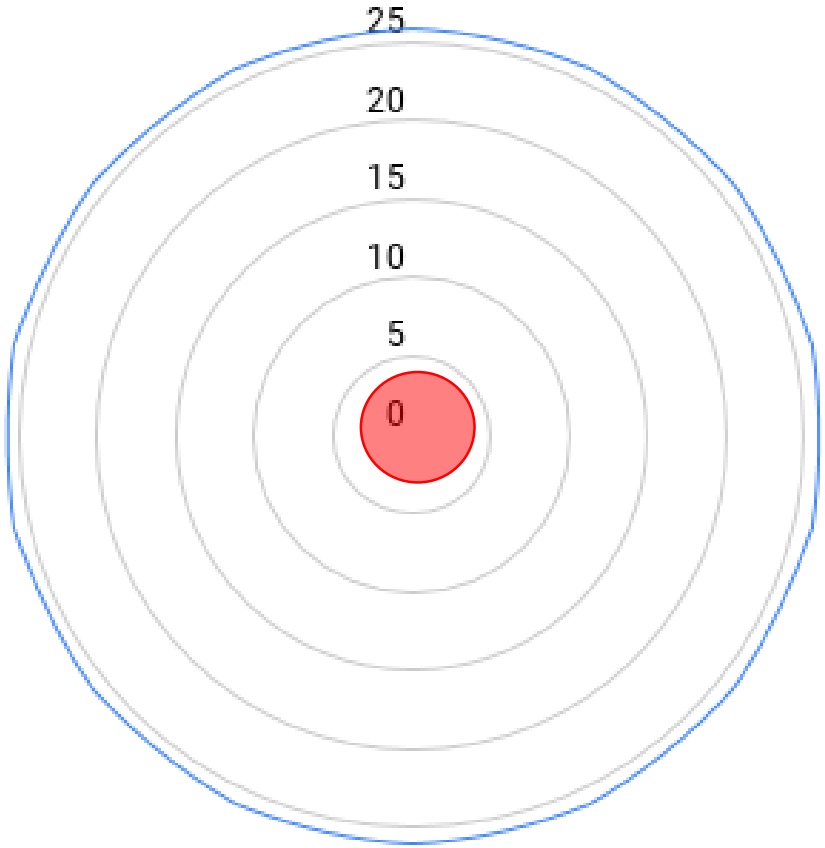


No doubt police authorities puts significant effort in Cyprus, however there is a need for further improvement of Cyprus' road safety performance.

What should be done?

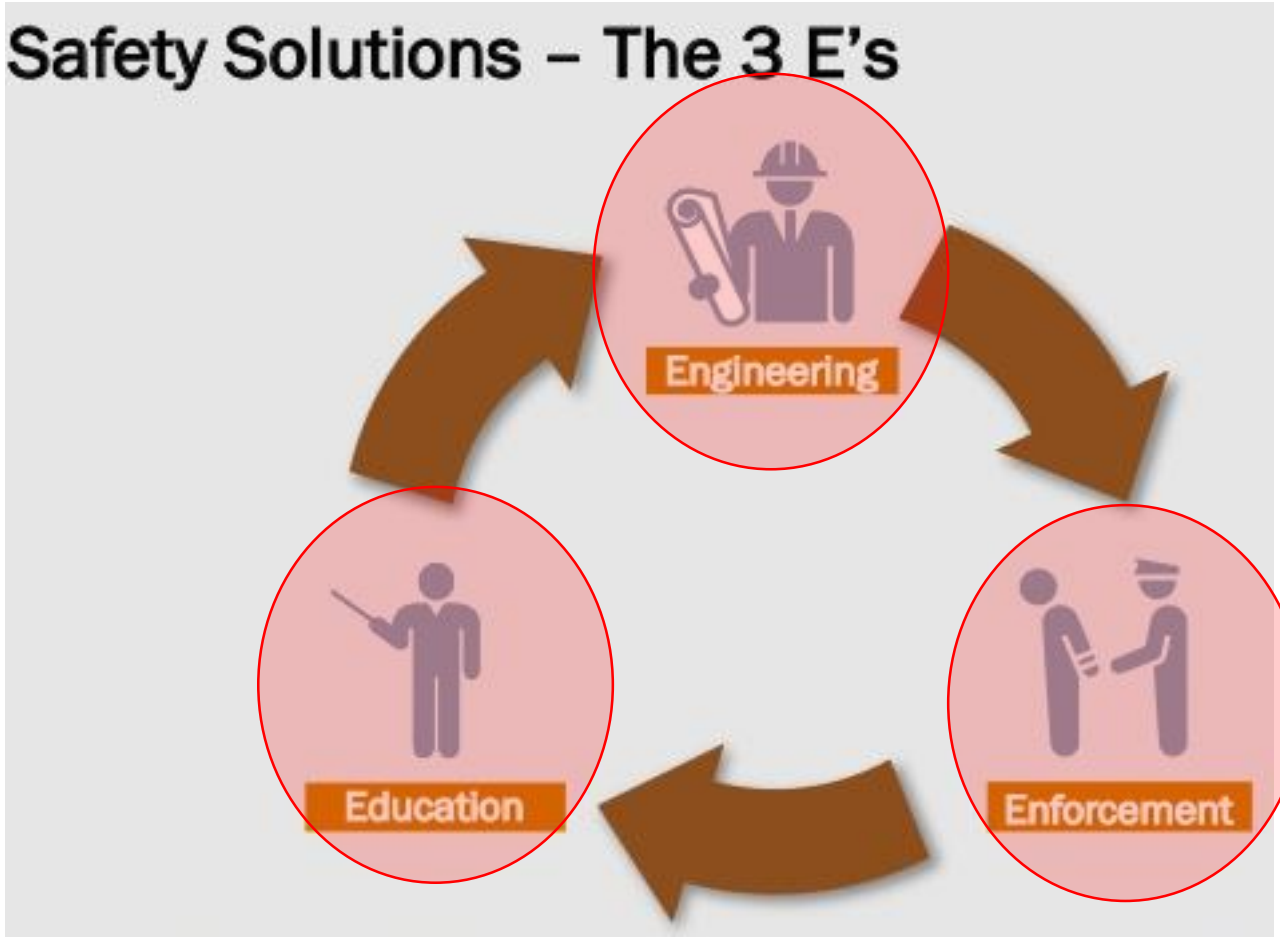
Target Setting for the case of Cyprus

Regarding the enforcement levels of the three legislations Cyprus should have had a different number of fatalities. This number can be identified by the Target Setting development of DEA.



CONCLUSIONS

So Cyprus needs to change its legislative framework in order to improve its road safety performance?


Safety Solutions – The 3 E's
Engineering
Enforcement
Education

Πανεπιστήμιο Κύπρου
Τμήμα Πολιτικών Μηχανικών και Μηχανικών Περιβάλλοντος

LaB for TRANSPORT ENGINEERING

Thank you for your attention

Lab. for Transport Engineering
Department of Civil and Environmental Engineering,
University of Cyprus
75 Kallipoleos Str., P.O. Box 20537, 1678 Nicosia, Cyprus

P. Nikolaou & L. Dimitriou

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Thursday **28** - Friday **29 March** 2019, Nicosia, Cyprus

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