COLORADOSCHOOLOFMINES
EARTH ENERGY ENVIRONMENT

The Effect of Subsidy Removal on Gasoline and Diesel Fuel Consumption and Carbon Emissions

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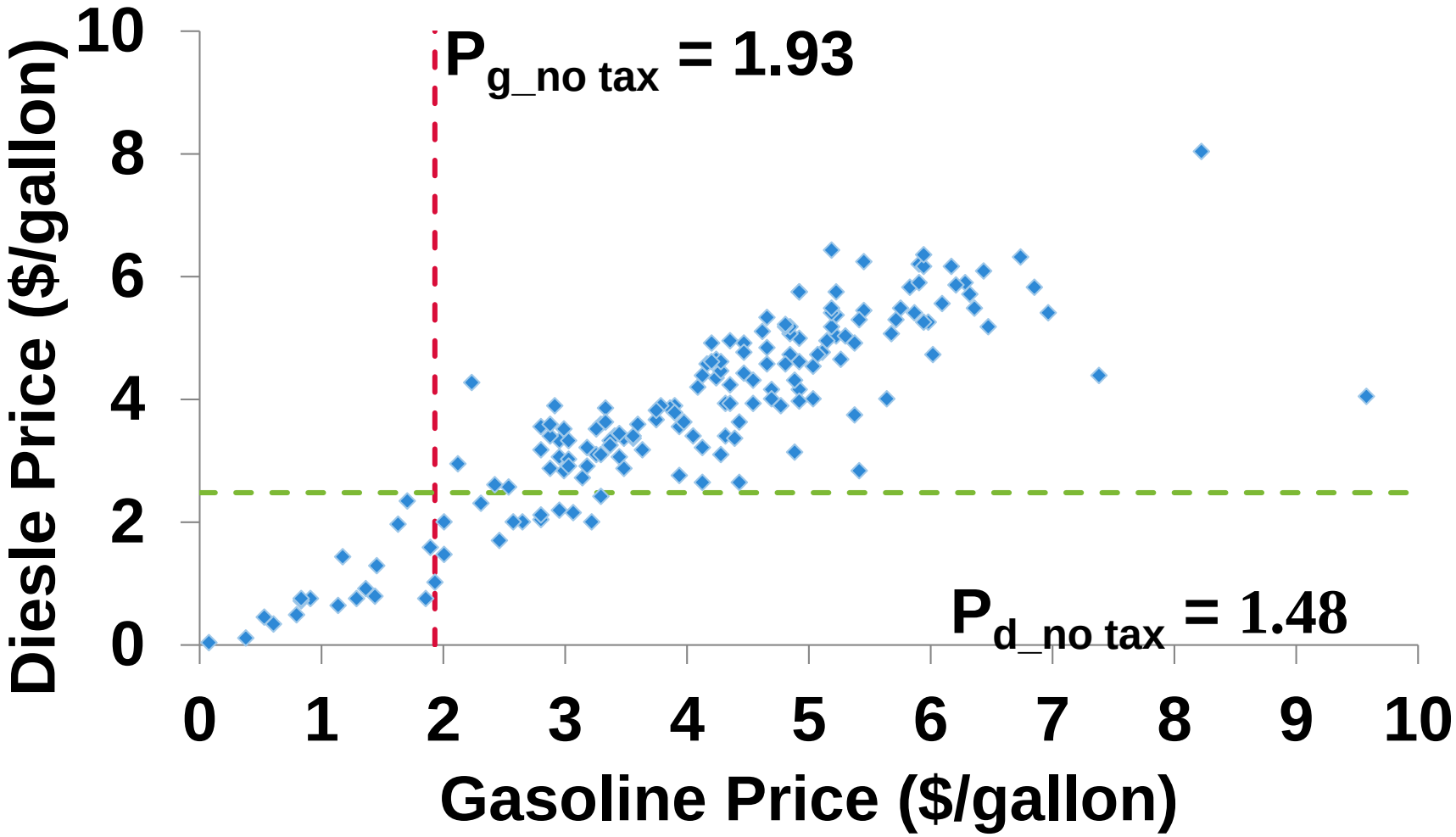
42nd IAEE Conference: LOCAL Energy, Global Markets

Montreal, Canada

May 29-June 1, 2019

Gasoline and Diesel Prices Vary Widely
November 2008



Source: GTZ (2009)

Varying Prices

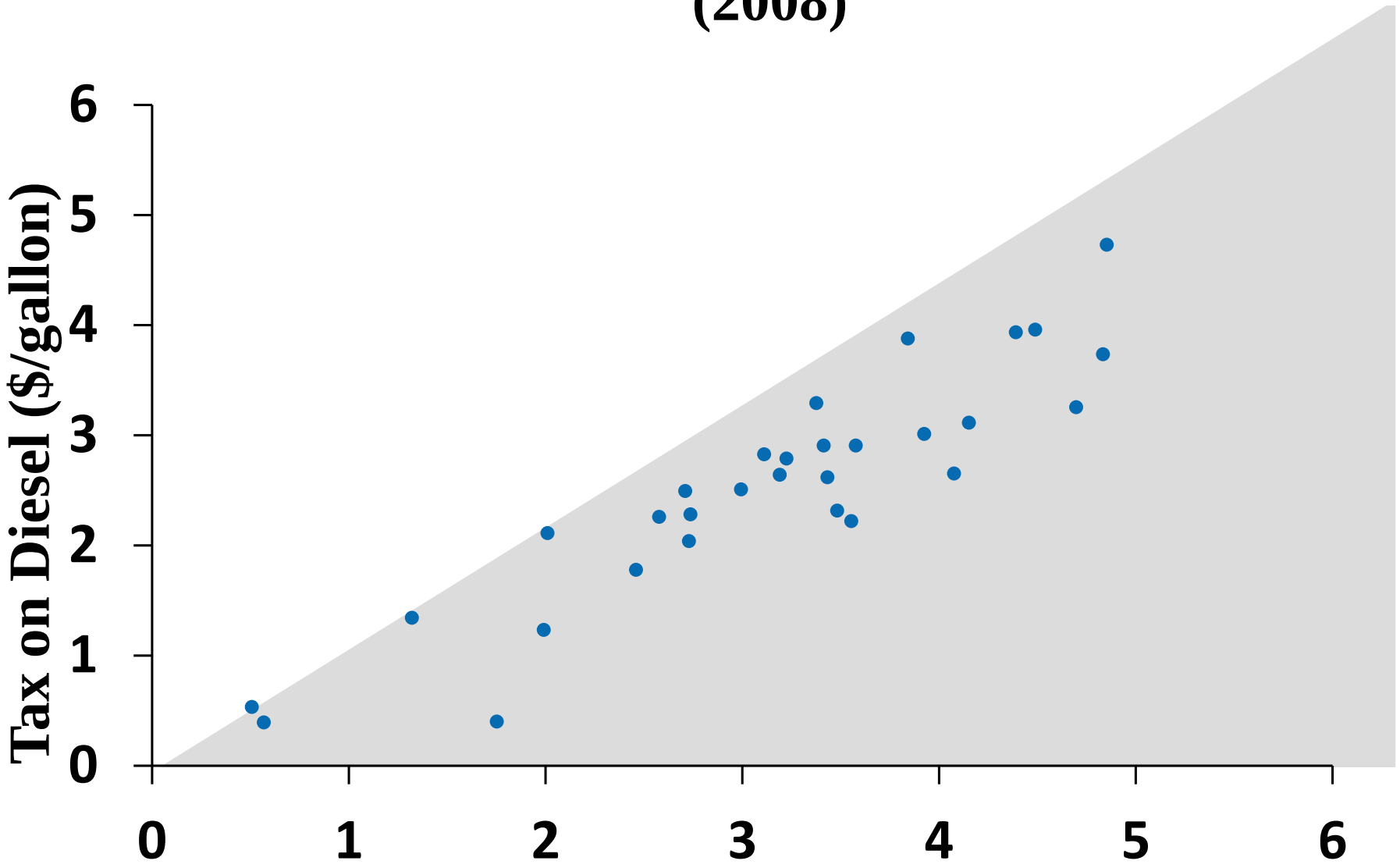
18 countries subsidize gasoline and diesel

13 countries subsidize diesel only

Most countries were taxing fuels

sometimes quite heavily

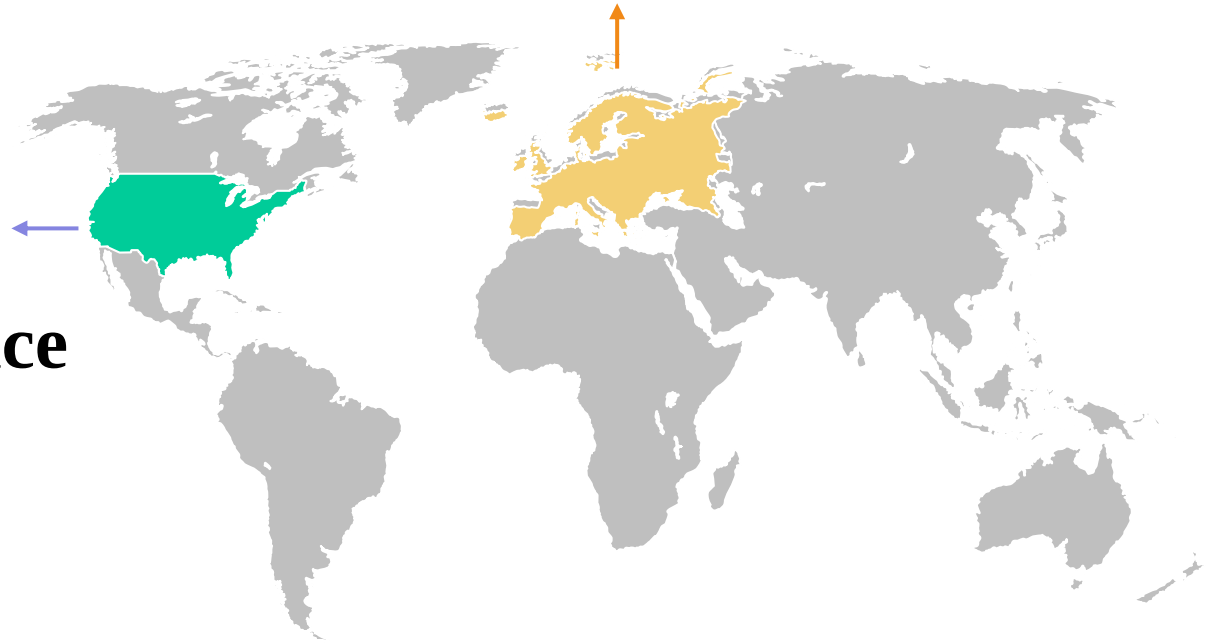
Gasoline vs. Diesel Taxes in Europe has Encouraged Diese
(2008)



Source: IEA (2010)

Transport fuel policies

Revenue After World War II



Road Maintenance

Many oil exporting countries subsidy as social transfer

Momentum Towards Rationalizing Pricing

Socio-economic Factors

- **Equity**
- **Budget Burden of subsidy**
- **Etc.**

Externalities

- **CO2 Emissions**
- **Local Pollutants**
- **Traffic Accidents**
- **Congestion**
- **Etc.**

Rationalize Transport Fuel Prices

Price = Direct Cost + Indirect Cost + Externalities Cost

Outline

Introduction

Schemes for Rationalizing Transport Fuel Prices

Policy Scenarios and Impact Analysis

Conclusion

Rationalize prices

Externalities Cost

Indirect Cost

Direct Cost

Rationalize prices

Direct = Retail - tax

IEA (2011) tax for 25 countries

Where tax not available

Direct = P_{iw}(1+margin)

P_{iw} closest of three international ports

NYH, ARA, Singapore

picked margin that minimized

total squared error (TSE)

direct and Piw

margin of 46.8%

Indirect Cost = Road Maintenance Cost

GTZ (2007)

$0.10 per liter trunk roads

$0.03 - 0.05 per liter for urban road and transit

Statistics Norway

32% of road maintenance cost = labor wages

78 %=material cost.

Adjust labor cost

minimum wage ratio of each country (Wj) to U.S.

$$MC_{Rd}^{j} = MC_{Rd} \times \left[0.32 \times \frac{W_j}{W_{U.S.}} + 0.68 \right]$$

Three Externalities

Externality: Direct Driver

- **Global Externalities (CO2 emissions): Fuel Combustion**
- **Local air pollutant: Fuel Combustion**
- **Traffic accidents: Kilometers Traveled**

Working on

- **Congestion: Kilometers Traveled**

Others not considered

- **Noise: Kilometers Traveled**
- **Water pollution: Kilometers Traveled**
- **Vehicle and Tire Disposal: Kilometers Traveled**

Cost of Externalities – Climate Change

Cost of CO2 Emissions

U.S. Interagency Working Group
Social Cost CO2 = $21 per ton
EU CO2 trades around this number

Adjustment CO2/GDP per capita
Adjustment

$$\frac{\text{purchasing power parity}}{\text{exchange rate}}$$

in local currency per dollar

Cost of Externalities – Climate Change

Adjustment for Fleet Efficiency

Multiplied by country specific fleet emissions adjustment factor (FEAFj) CO2 emitted by every ton of oil equivalent. (IEA's (2011))

Conversion to Fuel Type

converted from dollars per TOE to
dollars per gallon of gasoline
dollars per gallon of diesel

Cost of Externalities – Local Pollutants

National Research Council (NRC 2009)

lifecycle cost of local pollutants damages

gasoline 29.02 cents per gallon and

diesel at 46.65 cents per gallon respectively

assuming 30 percent of cost in combustion phase

adjusting for inflation

marginal cost of 9.0 cents per gallon for gasoline

14.5 cents per gallon for diesel

Cost of Externalities – Local Pollutants

highest damage from local pollutants

- **premature mortality (NRC 2009)**
- **marginal cost of local pollutants**
  - **adjusted by country to reflect the value of statistical life (VSL_j)**

$$MC^{j}_{LP,i} = MC^{US}_{LP,i} \times \frac{VSL_j}{VSL_{US}} \times \frac{\left(NOX + VOC\right)_j}{\left(NOX + VOC\right)_{US}}$$

$$\frac{VSL_j}{VSL_{U.S.}} = \left(\frac{\text{Real GDP/Capita}_j}{\text{Real GDP/Capita}_{U.S.}} \right)^{\eta_{VSL}}$$

Cost of Externalities – Traffic Accidents

International Road Federation (2010)

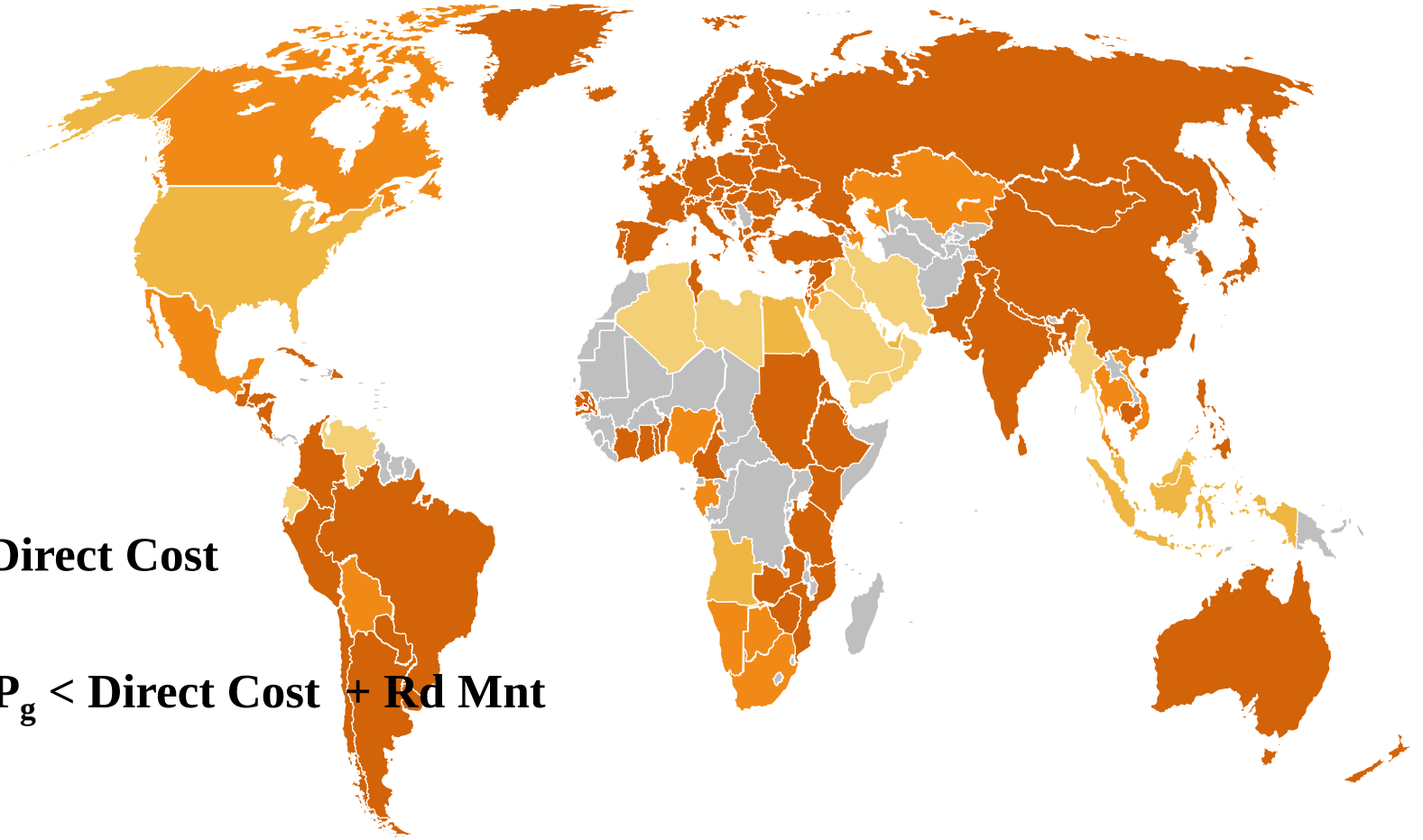
- **reports fatalities**
- **applying Parry's (2011) approach to fatalities**
- **reported by IRF leads to remarkably high costs**
- **we assume that 15% of fatalities are externalities**

$$MC_{AC}^{j} = \frac{\text{Traffic Fatalities(j)} \times \text{VSL}_{\text{j}} \times 15\%}{\text{Q}_{\text{j}}}$$

converted to cents per gallon of gasoline and diesel

multiply by 280.2&317.6 ton of oil equivalent per gallon

Gasoline Prices Map



P_g < Direct Cost

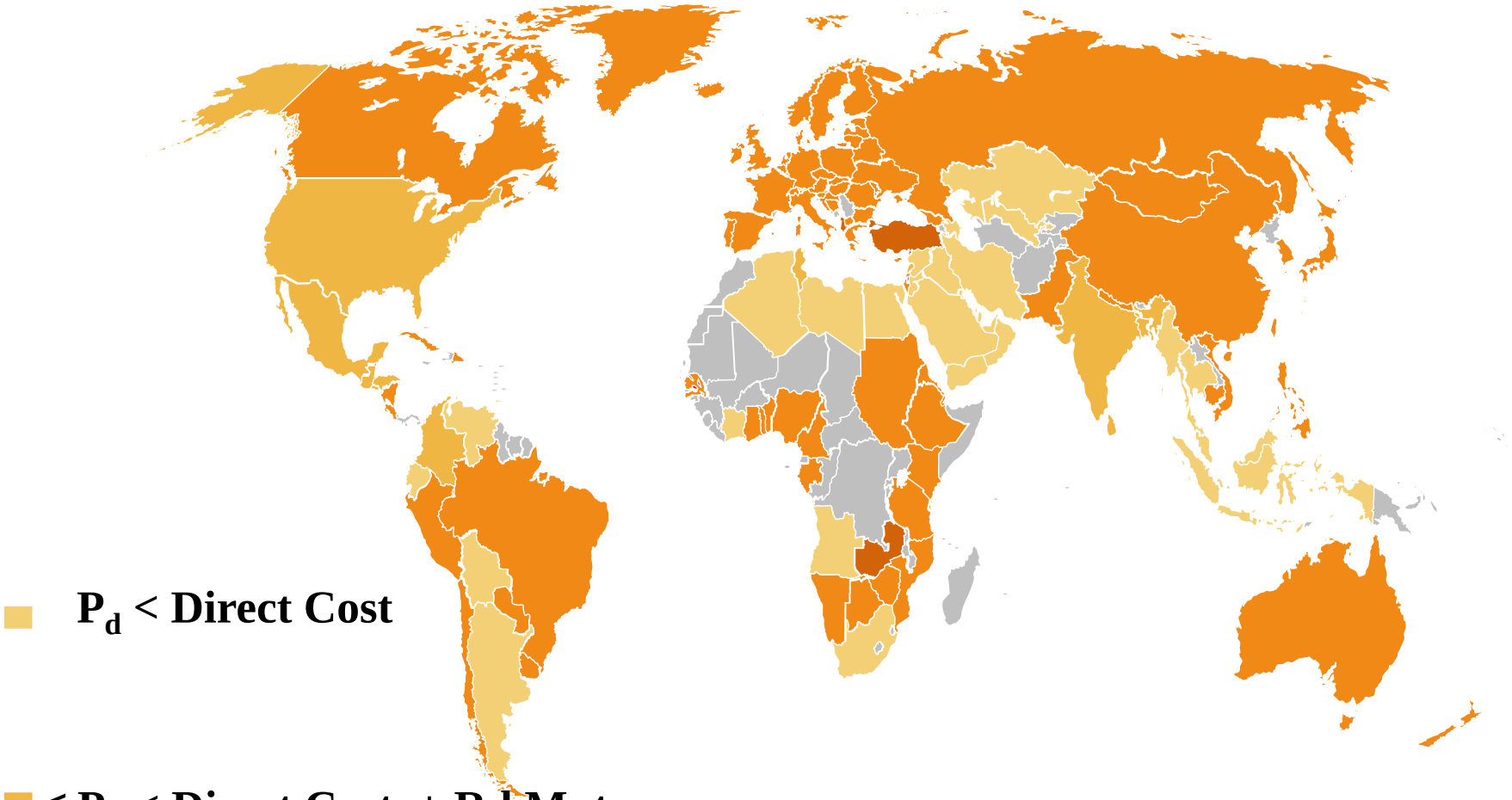
≤ P_g < Direct Cost + Rd Mnt

≤ P_g < Direct Cost + Rd Mnt + Externalities Cost

≤ P_g

Not Considered

Diesel Prices Map



Use Price Elasticities in Dahl (2011) to Evaluate

Price and income elasticities for 123 countries

> 98% of gasoline and diesel used in transportation

From static models

Initially hold income and population constant

$$Q_{i2} = Q_i \left(\frac{P_{i2}}{P_i} \right)^{\beta_2}$$

Gasoline Price Elasticities Stratified by GDP per Capita and Price

		Price 2008 cents per Gallon		
		<106.8	106.8-267	>267
GDP	<$10680	-0.15	-0.22	-0.26
per	$10680-$21360	-0.11	-0.24	0.32
Capita	>$21360	-0.22	-0.22	-0.33

Notes: 1 gallon = 3.785 liters

Source: Dahl (2012). Price and GDP per capita converted from 2006 to 2008 $ using the U.S. CPI of 1.068 from ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt

Diesel Price Elasticities Stratified by GDP per Capita and Price

		Price 2008 cents per Gallon	
		<267	>267
GDP per Capita	<$16020	-0.22	-0.38
	>$16020	-0.13	-0.27

Notes: 1 gallon = 3.785 liters

Source: Dahl (2012). Price and GDP per capita converted from 2006 to 2008 $ using the U.S. CPI of 1.068 from ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt

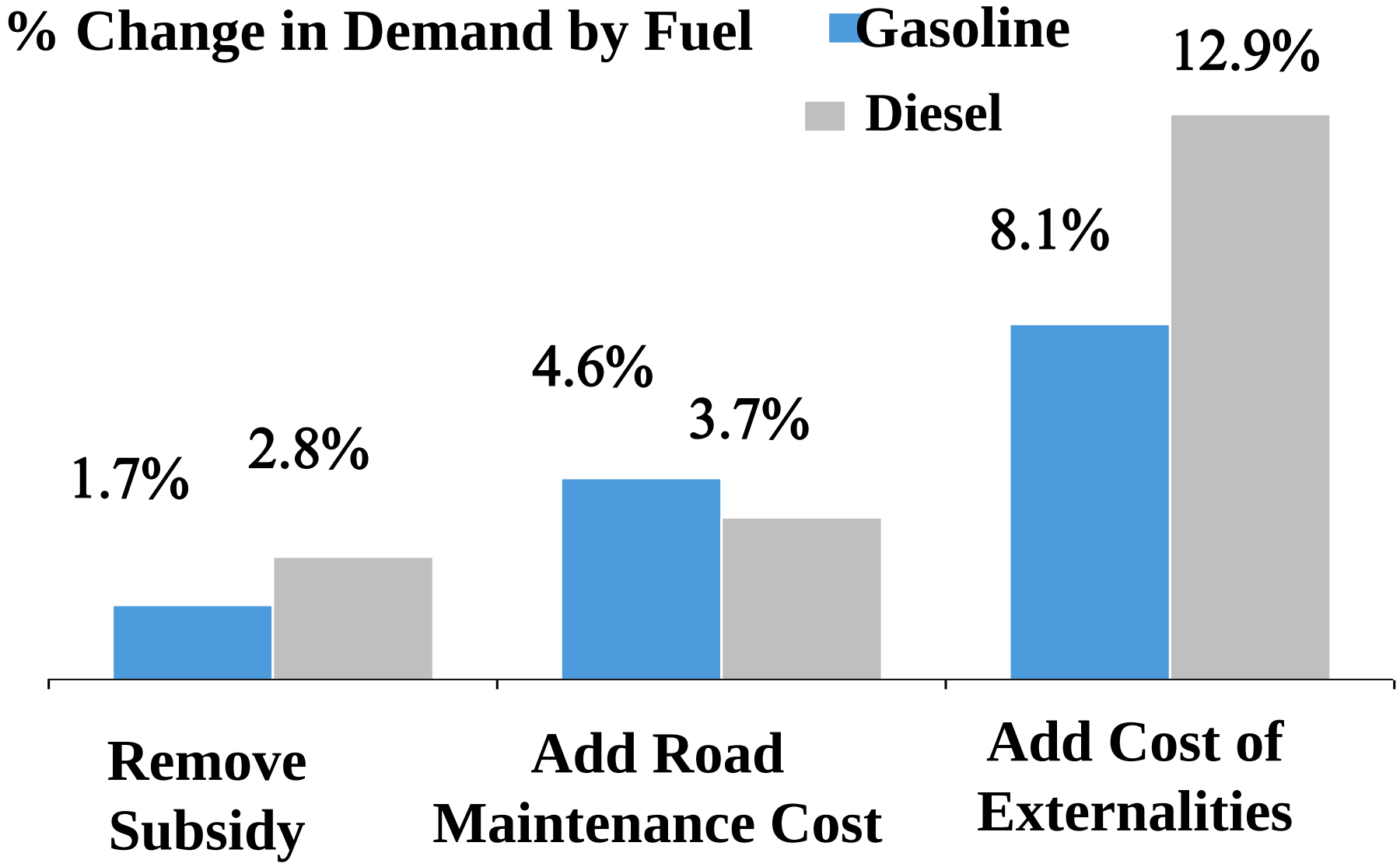
Three Rationalization Scenarios:

1. **Remove fuel subsidies**
2. **Add road maintenance cost**
3. **Add externality costs**

elasticities adjusted as prices increase

demand price elasticities become more elastic

Reduction in Fuel Consumption



% Change in Emissions by Fuel