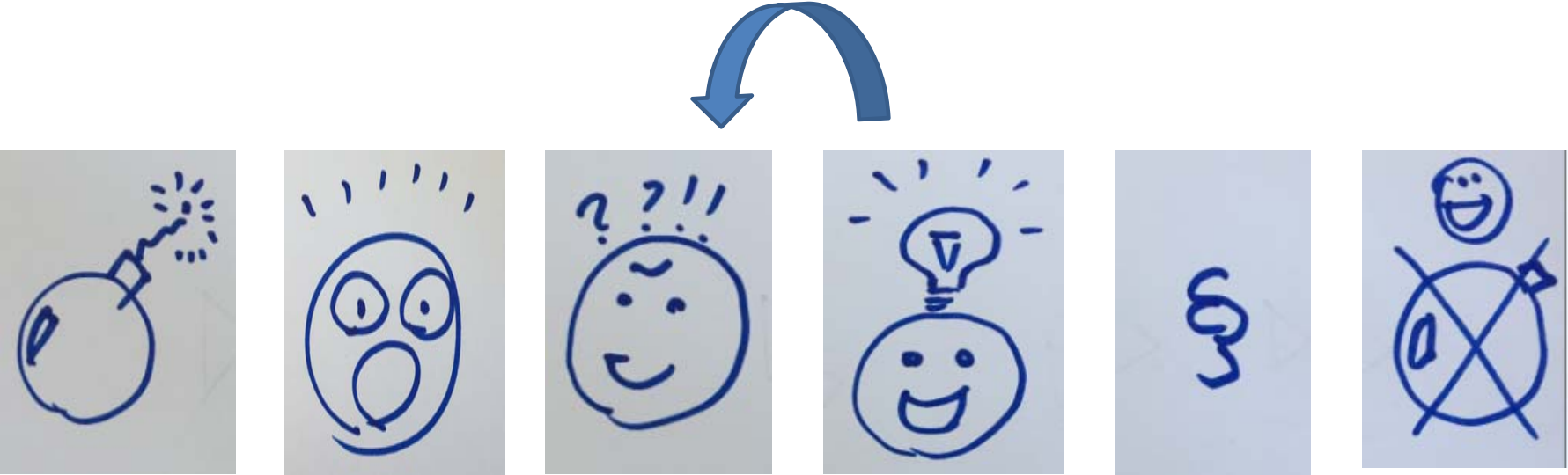


Missing links in the GHG abatement process: systemic evaluation of flaws in legislation in transport sector

Dr. H. Pengg, Audi

Problem solving process



Problem

Awareness

Modeling

Measure

Legislation

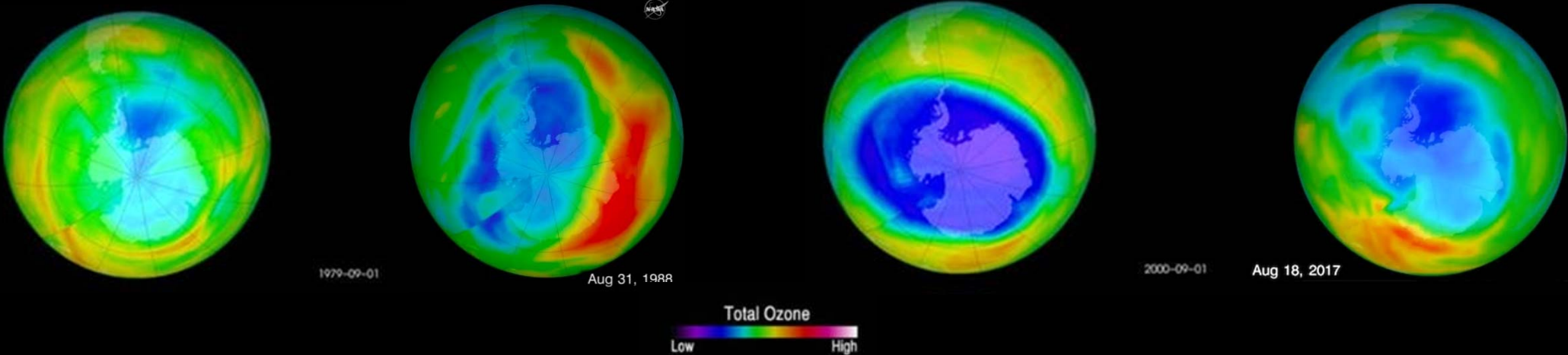
Problem solved



Time

This worked well sometimes...

Ozone layer problem – before and after



Without regulation
Until **1987**

The ozone hole growing steadily bigger

Montreal Protocol 1987

Signal for the global phase-out of CFC production and use

The Montreal Protocol has helped to slow dangerous climatic changes such as global warming by reducing CFCs

2016

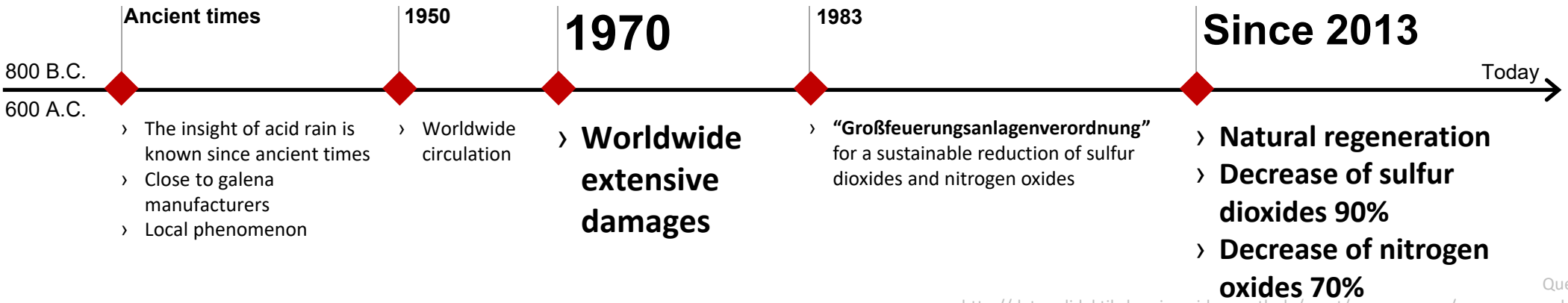
Contracting states to the Montreal Protocol agreed on a roadmap for the limitation of HFCs

today

Ozone hole is continuing to heal

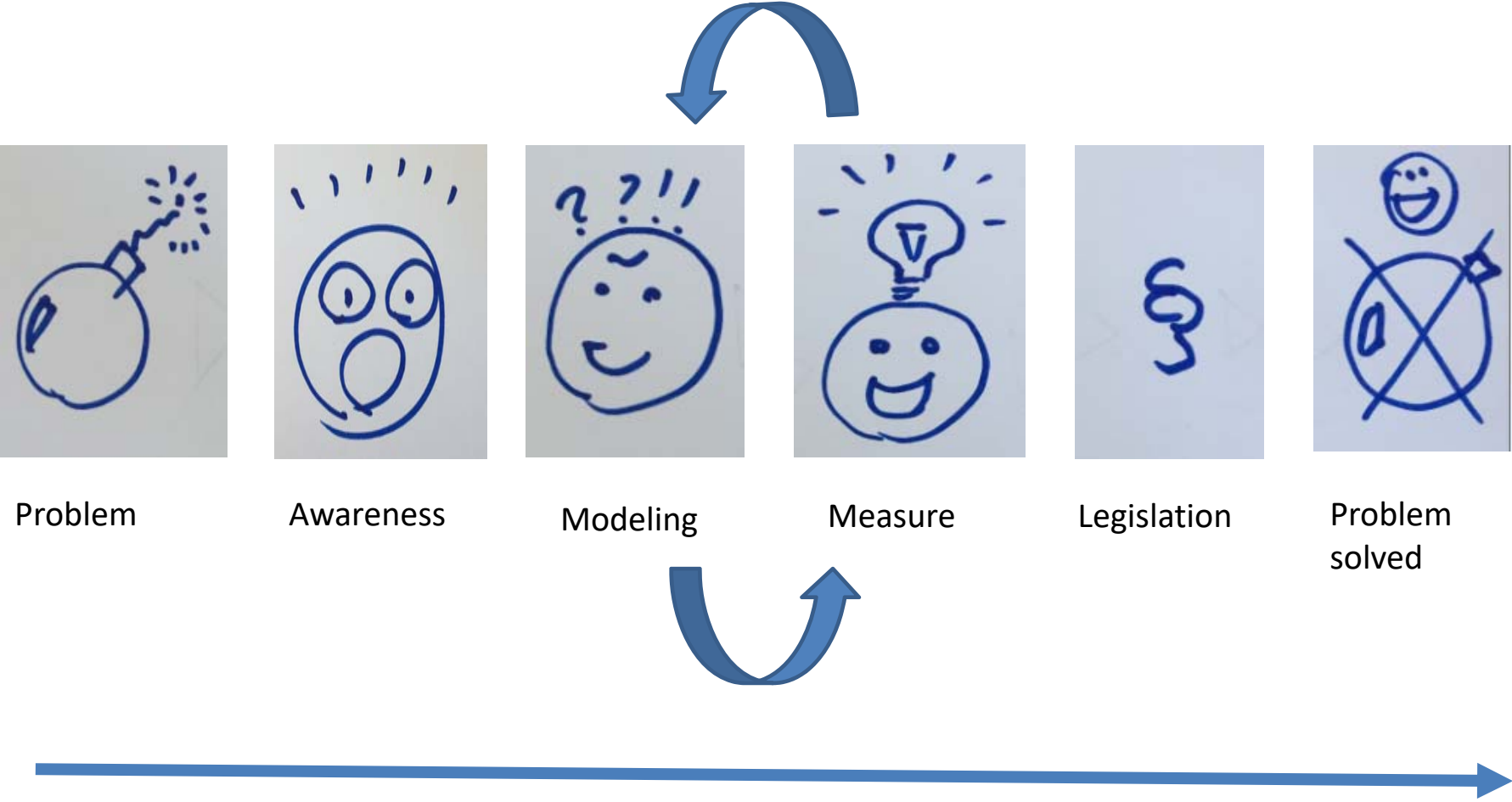
<https://www.skincancer.org/prevention/uva-and-uvb/ozone>
<https://www.umweltbundesamt.de/themen/wirtschaft-konsum/produkte/fluorierte-treibhausgase-fckw>
<https://www.umweltbundesamt.de/themen/wirtschaft-konsum/produkte/fluorierte-treibhausgase-fckw/rechtliche-regelungen/eu-verordnung-ueber-fluorierte-treibhausgase#textpart-2>
<https://www.sciencenews.org/article/antarctica-ozone-hole-top-science-stories-2016>

Acid rain problem in Europe – before and after



Quelle http://daten.didaktikchemie.uni-bayreuth.de/umat/saurer_regen/saurer_regen.htm

How about the process for climate change?



Problem

Awareness

Modeling

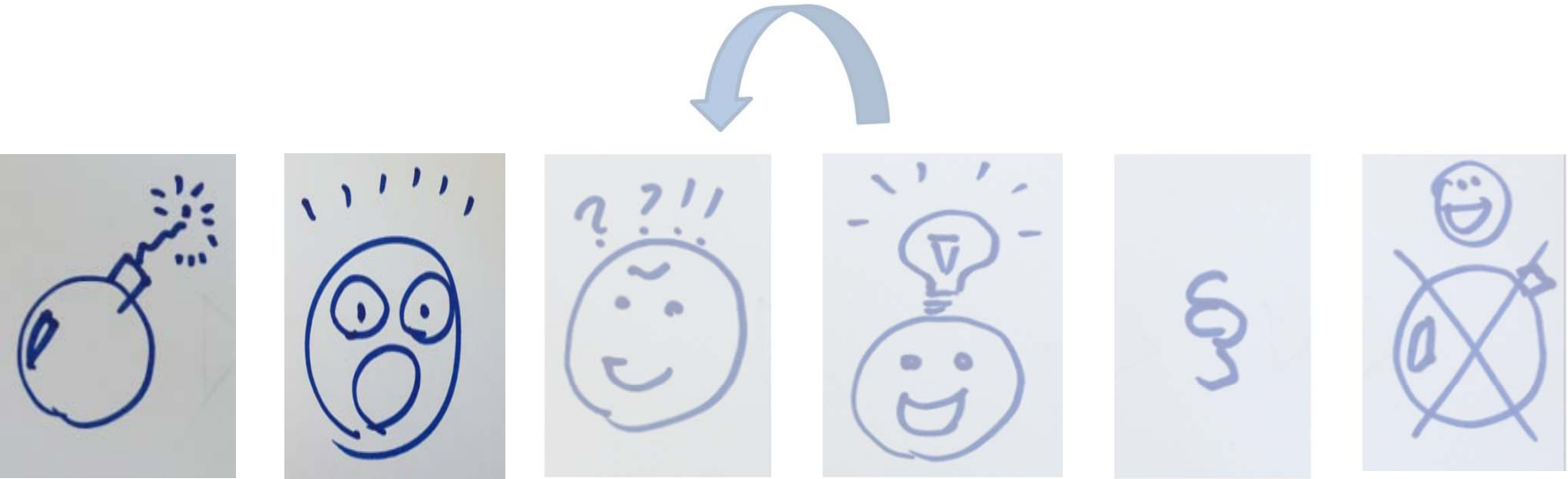
Measure

Legislation

Problem
solved

Time

Awareness: big problem



Problem

Awareness

Modeling

Measure

Legislation

Problem solved



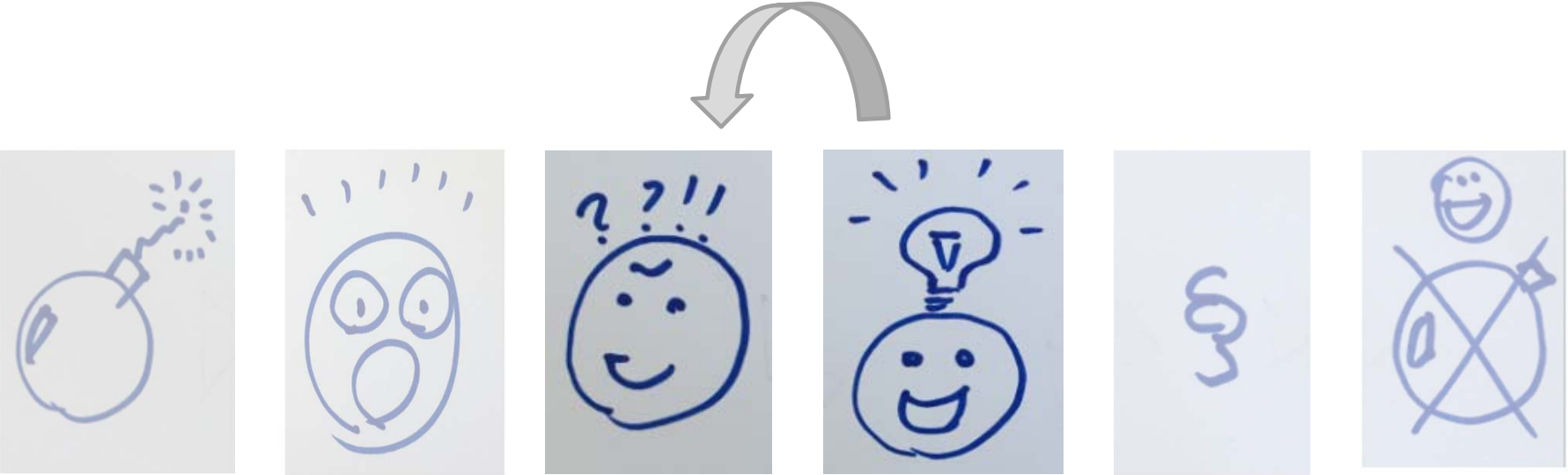
Time

Awareness:

„Climate change has been invented by the Chinese“.



Modeling & Measures: OK!



Problem

Awareness

Modeling

Measure

Legislation

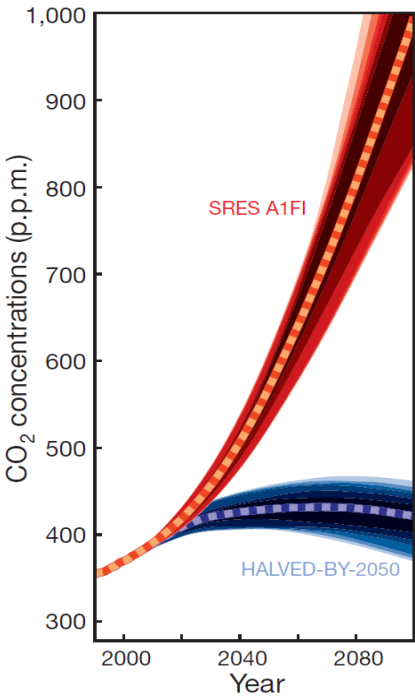
Problem solved



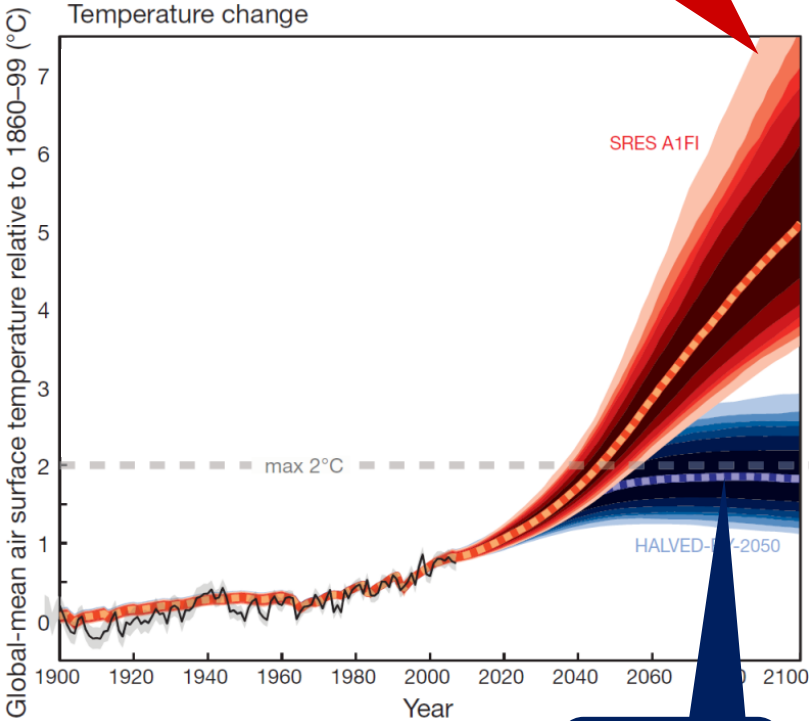
Time

Reduce CO2 rapidly

CO2 concentration

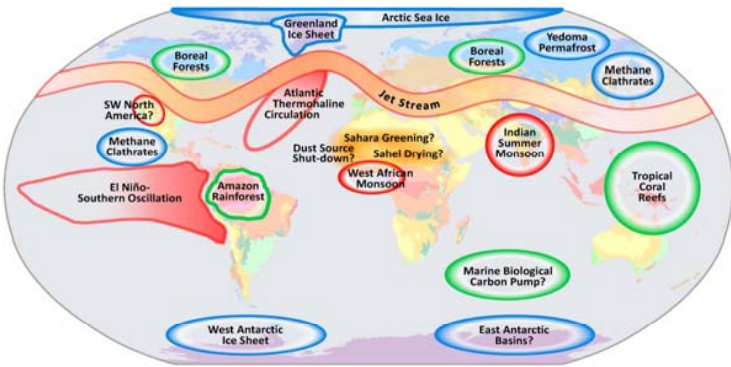


Temperature change



More than 6°

Below 2°

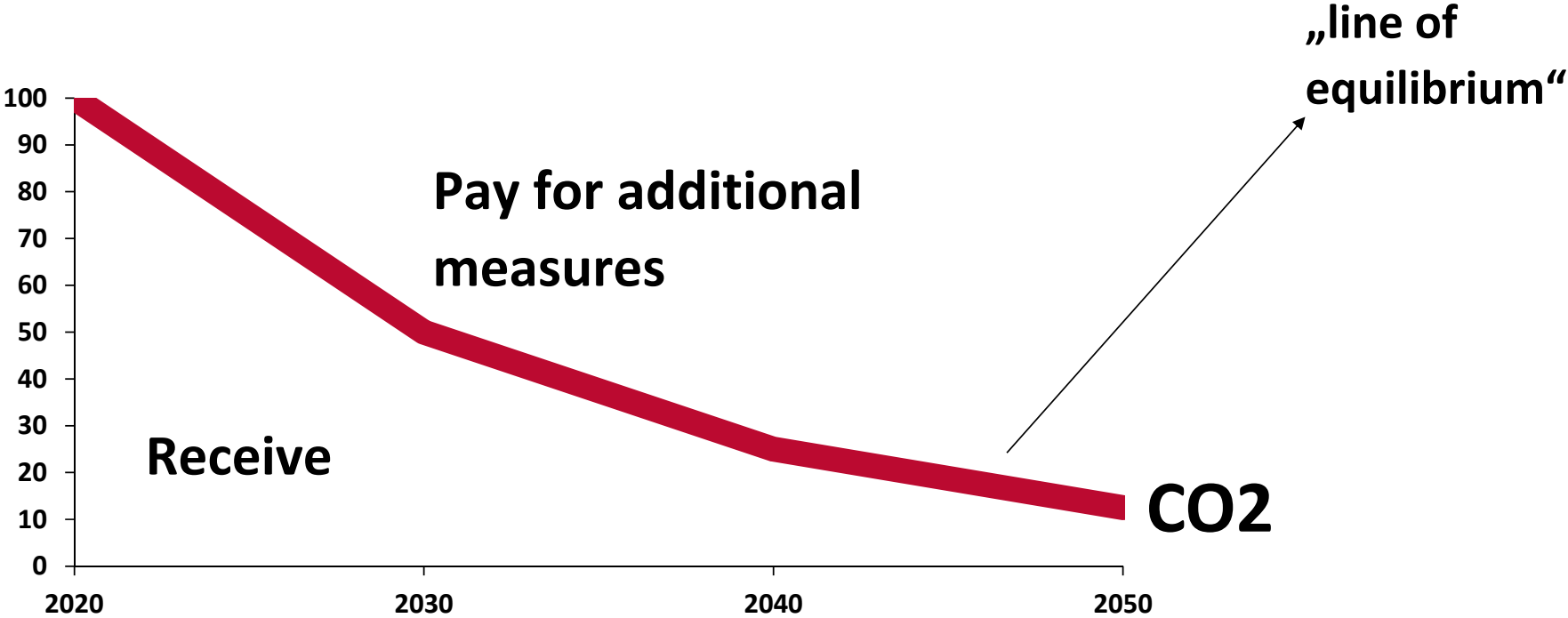


■ Cryosphere Entities
■ Circulation Patterns
■ Biosphere Components

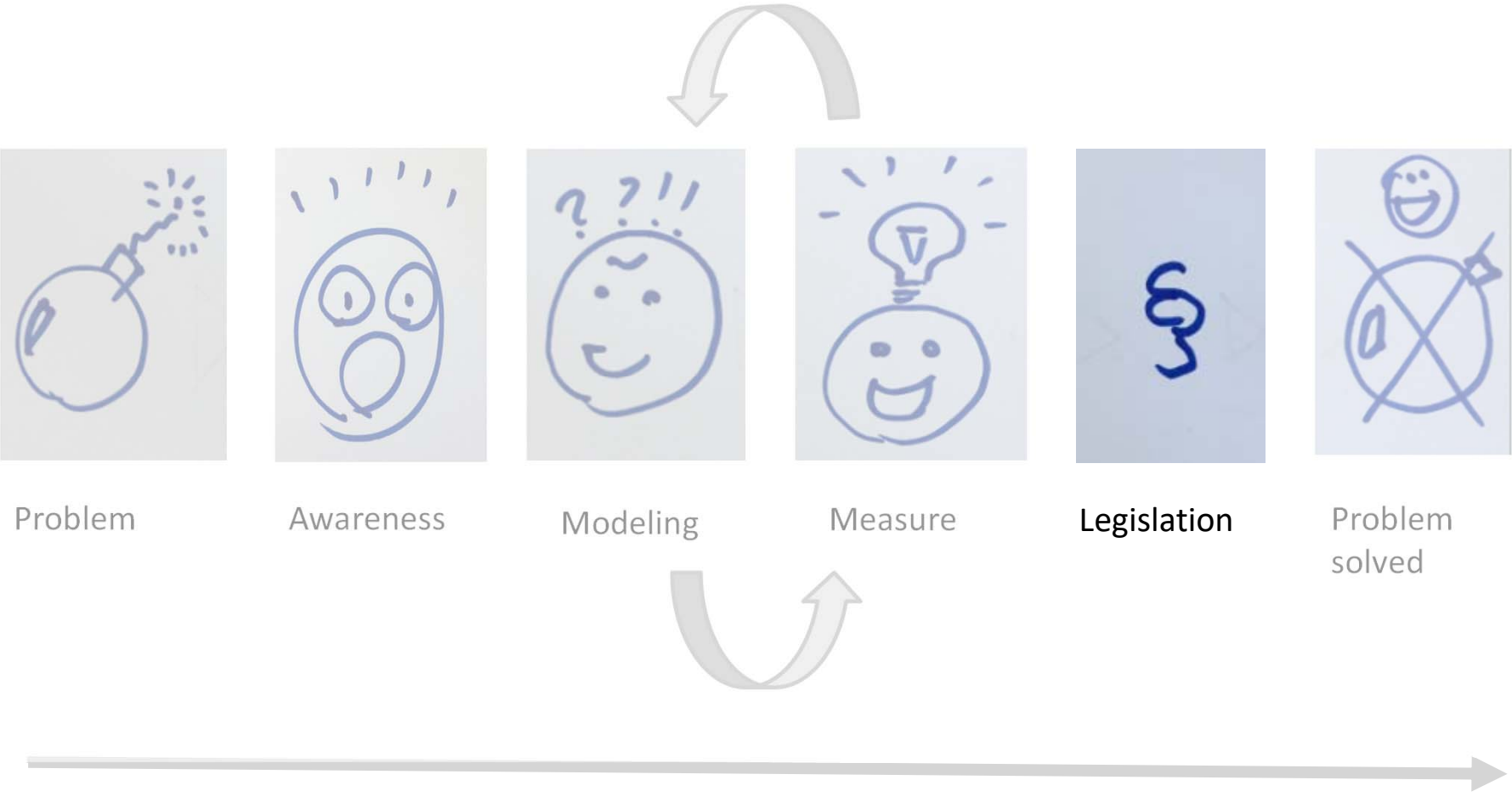
Köppen Climate Classification
 Ar Am Aw As BS BW Cr Cs Cw Dc Dc Eo Ec FT FI

Source: Meinshausen (2009) „Greenhouse-gas emission targets for limiting global warming to 2 °C“; IEA (2015) „Key trends in CO2 emissions“; VW (2014) „Nachhaltigkeitsbericht“ Scope 3 THG Emissions für 2013 321 Mio. t CO2

Global Carbon Law (Rockström et al)

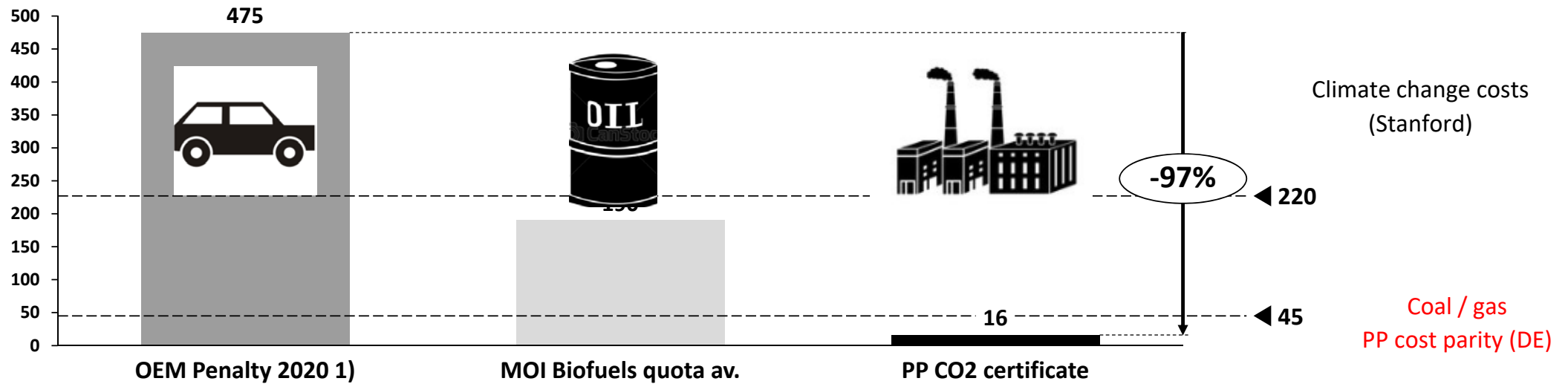


Legislation: big problem



Current CO2 pricing shows a non-efficient pricing system

€/tonCO2



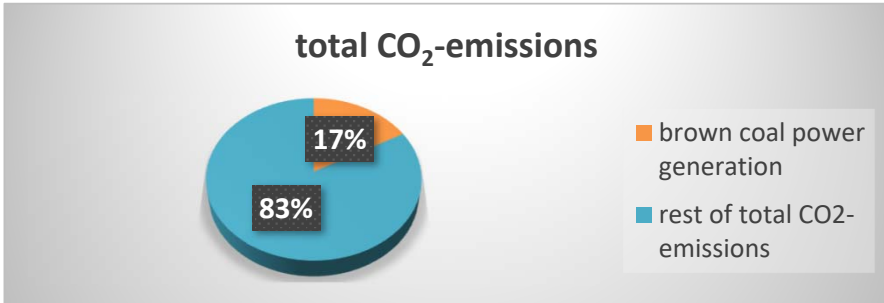
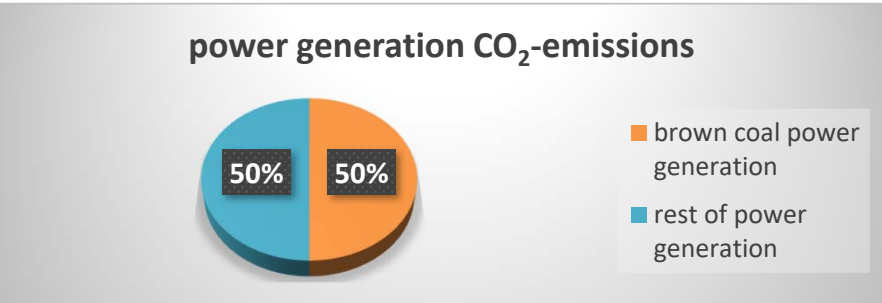
OEM: automotive
 MOI: mineral oil producer
 PP: power production

1) OEM will have to pay penalty if electrification is too slow („CO2 gap“ by 2020)

Sources: Stanford 2014; EU 43/2009; Peiffer/Assmann; FQD; certificate stock market

Coal industry (only brown coal) in Germany – 68 Mt per year, could be abated @ 50 €/ton

- total CO₂-Emissionen in Germany 2016: 909 Mio. t ⁽¹⁾
- CO₂-emissions caused by power generation: 306 Mio. t ⁽²⁾
- CO₂-emissions caused by brown coal: 153 Mio. t ⁽²⁾



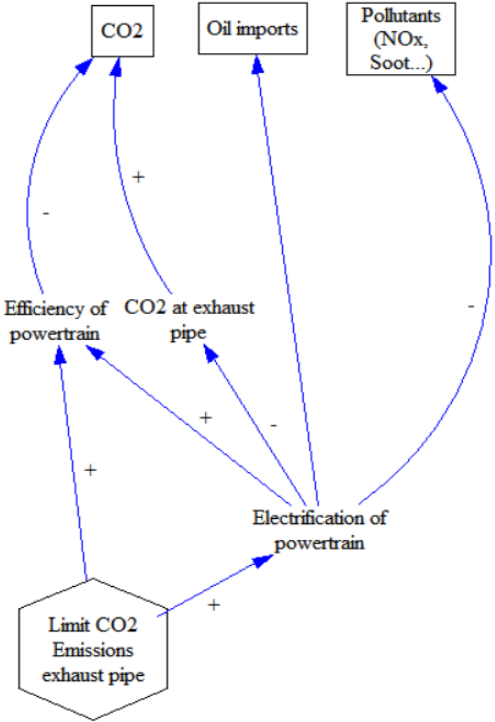
- brown coal power generation in 2016: 150 TWh ⁽²⁾
- reduction CO₂-emissions by substituting brown coal with natural gas: 68 Mio. t CO₂ ⁽⁴⁾
- cost of substitution: 340 Mio. € ⁽⁵⁾

⁽¹⁾ <https://www.umweltbundesamt.de/daten/klima/treibhausgas-emissionen-in-deutschland#textpart-3>
⁽²⁾ <https://www.umweltbundesamt.de/publikationen/daten-fakten-zu-braun-steinkohlen>
⁽³⁾ brown coal 0,36 kgCO₂/ kWh | natural gas: 0,20 kgCO₂/ kWh
⁽⁴⁾ 150 TWh x (((0,36 - 0,20)/0,36) kgCO₂/ kWh) ⁽³⁾
⁽⁵⁾ 68 Mio. tCO₂ x 50 €/ t. CO₂

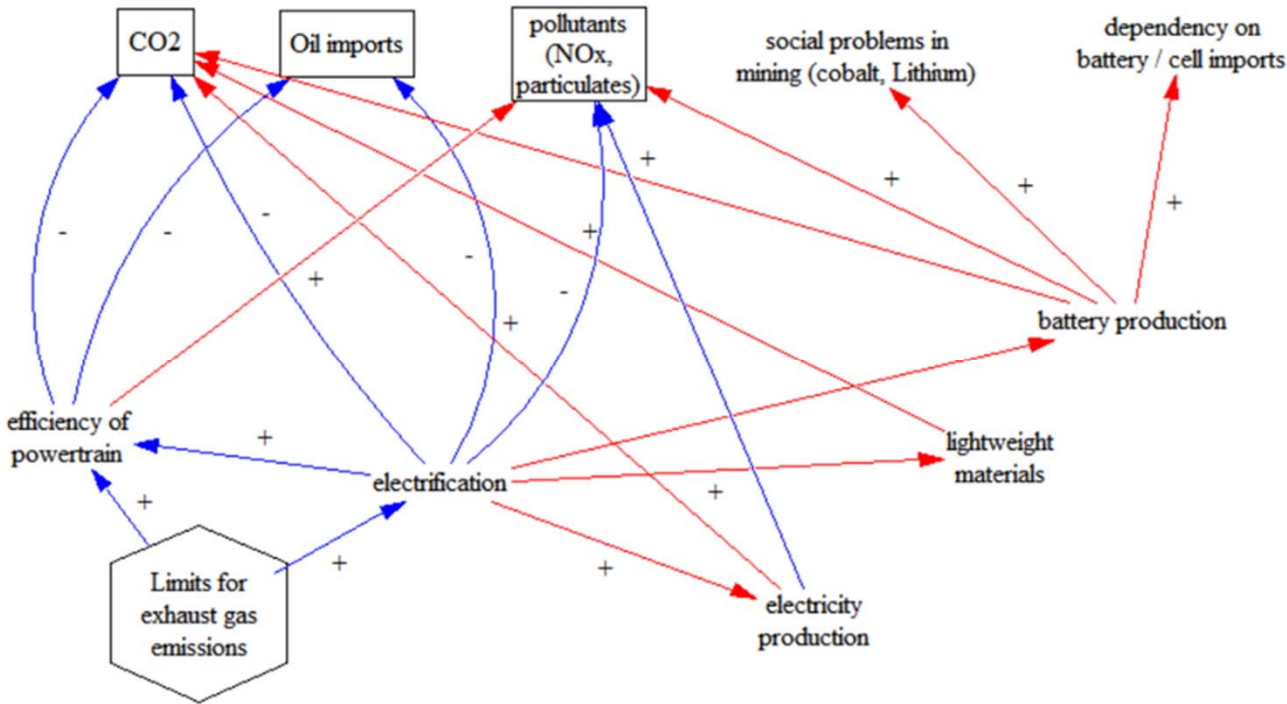
Inefficient legislation leads to inefficient implementation

Category	Coal	Cars
emission factor	1 kWh coal = 100 kWh wind	1 km electric = 0,7 km gasoline (electricity mix)
		e-fuels: 1 km electric = 1 km e-gas (wind energy)
price for substitution	natural gas: @ 50 €/ton CO2	> 1000 €/tonCO2 (2016)
lifetime of assets (eventual sunk costs)	50 years	13 years
# google hits	0,3 bln	5,9 bln

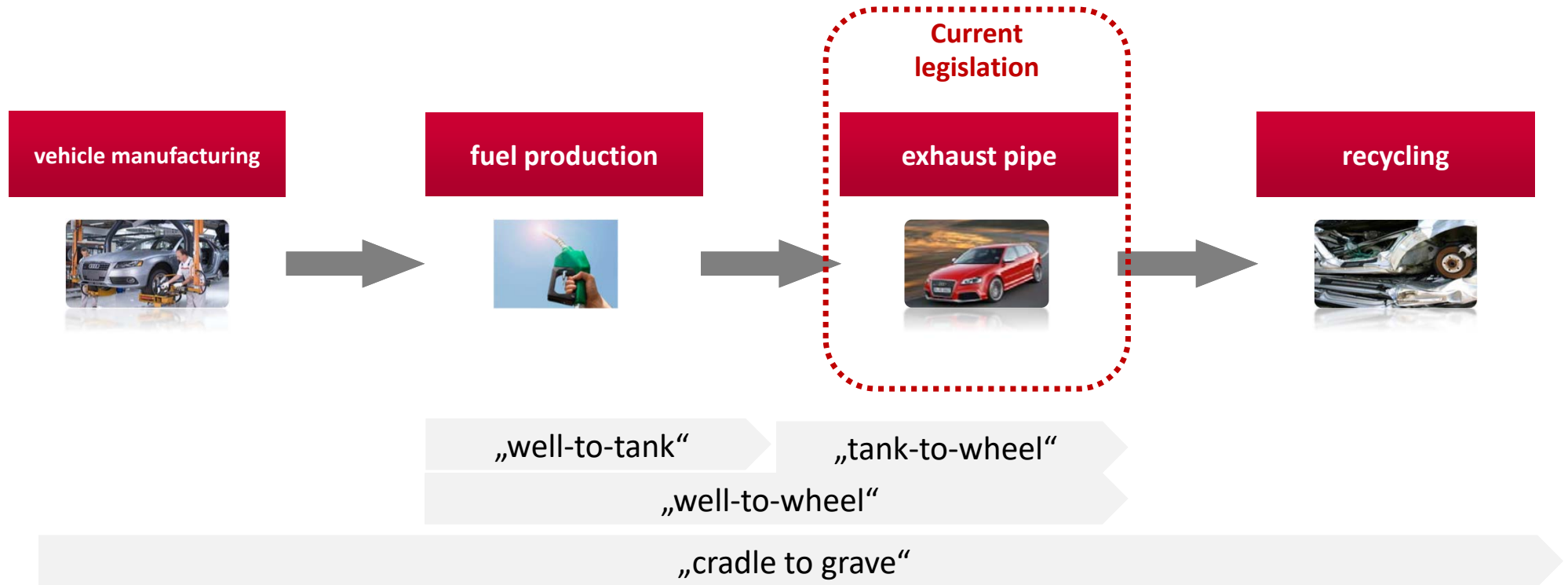
Cars: Current legislation only looks at tailpipe



Systemic evaluation shows loopholes in legislation



Lifecycle Analysis (LCA): all emissions monitored



Solution: systemic legislation

