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Investigating the potential of applying theories on rebound effects and mechanisms in climate change adaptation and mitigation research

Little attention has been given to the *rebound effects* within climate change mitigation and adaptation literature. Still, a growing attention has been given to the need of avoiding *mal-mitigation* and *mal-mitigation* to take place, and to integrate in a more systematic way adaptation and mitigation policies in order to foster positive and avoid negative feedback mechanisms to take place between the two. This poster investigates the potential of applying theories of rebound effects on the climate change change discourse in order to gain a better understanding of the following processes: The effectiveness of climate change mitigation and adaption measures, and the feedback mechanisms between the two.

The rebound effect

A large number of studies have analysed the systemic relationship between efficiency and expansion; notably, that it is the efficiency improvement as such that enables, or even causes, an increase in demand. This phenomenon is termed the '*rebound effect'* and was first described in 1865 by William Stanley Jevons. More generally we can define the rebound effect as *the reduction in expected gains from new technologies that increase the efficiency of resource use, because of behavioural or other systemic responses.* The rebound effect is generally expressed as a ratio of the lost benefit compared to the expected environmental benefit when holding consumption constant. For instance, if a 5% improvement in vehicle fuel efficiency results in only a 2% drop in fuel use, there is a 60% rebound effect (since $^{(5-2)}/_{5}$ = 60%).The 'missing' 3% might have been consumed by driving faster or further than before.

Rebound mechanisms

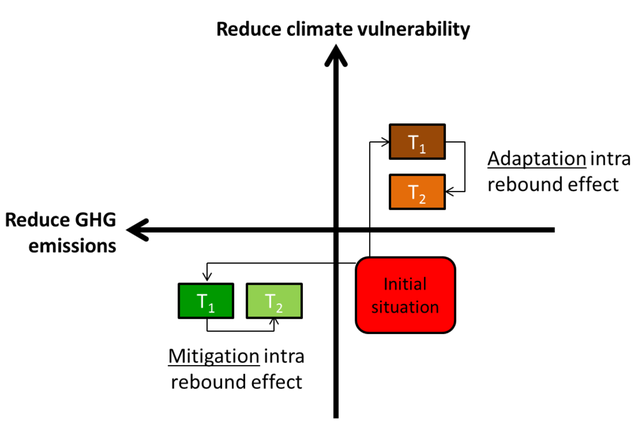
Economic mechanisms causing rebound effects have attained most attention (e.g. money saved from installing an energy-saving device in your home is spent on more energy-intense consumption), but other and more complex mechanisms can also come into play. These mechanisms can play out on an *individual* and a *societal* level, and they can involve *producers* as well as *consumers*.

Nature of mechanisms:	Production		Consumption	
	Actor	Societal	Actor	Societal
Economic				
Psychological				
Sociological				
Others				

A proposed model for understanding and identifying rebound effects in climate policies

Intra rebound effects:

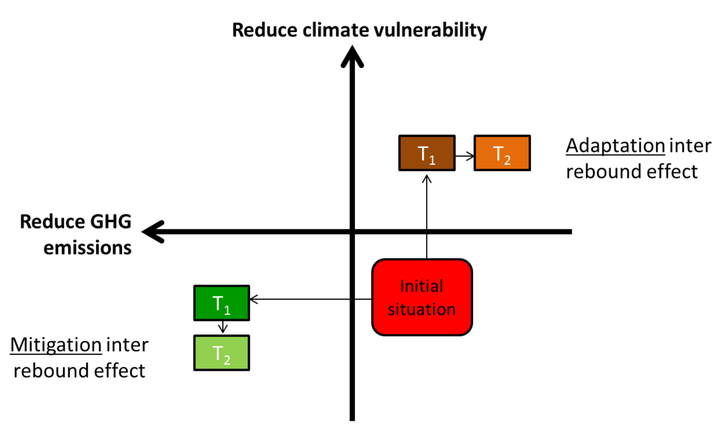
Causing ineffectiveness within mitigation and adaptation policies



The situation in which net GHG reduction is lower than anticipated, or the net effect of climate change adaptation is lower than anticipated

Inter rebound effects:

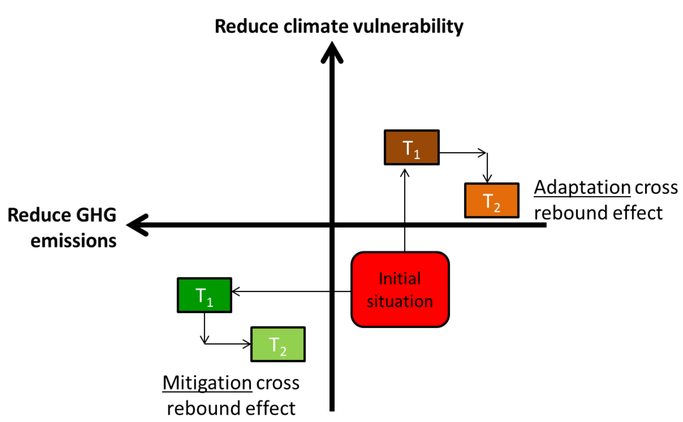
Causing ineffectiveness between mitigation and adaptation



The situation in which climate change mitigation efforts increases climate change vulnerabilities, or climate change adaptation increases GHG emissions

Cross rebound effects:

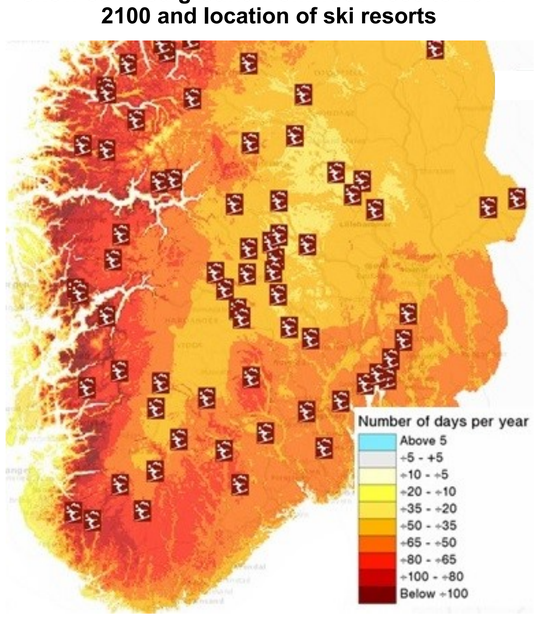
Causing ineffectiveness within and between mitigation and adaptation



The situation in which intra and inter rebound effects takes place *at the same time*

Examples of climate policy related rebound effects involved in winter tourism in Norway

Expected changes in mean number of days with snow covered ground from 1961-1990 to 2071-2100 and location of ski resorts



Producer adaptation

- Artificial snow production at ski-resorts
  - Direct effect: GHG emissions from artificial snow production
  - Indirect effect: Extended skiing season, leading to more GHG emissions from increased consumption of "skiing"
- Moving ski-lifts to nearby areas with higher snow-reliability
  - Direct effect: GHG emissions from construction of new infrastructure
  - Indirect effect: May lead to also moving away from well established public transportation nodes (e.g. major train stations) and thus leading to a modal shift from public to private transportation (and therefore an accompanying increase in GHG emissions from transportation)

Consumer adaptation

- Chasing for snow
  - The closing down of ski-resorts (often, for geographical reasons, those closest to major cities) may lead to more GHG emissions from transportation to new and more far distant ski resorts
- Adaptation to increased weather variability
  - More frequent shift between wet/dry and hard/soft snow may lead to an increased demand for diversified skiing equipment (skis and clothes for different snow conditions), which again will increase GHG emissions from production of this equipment

A recently released book on rebound effects and climate policy edited by TilmanSantarius, Hans Jakob Walnum and Carlo Aall

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