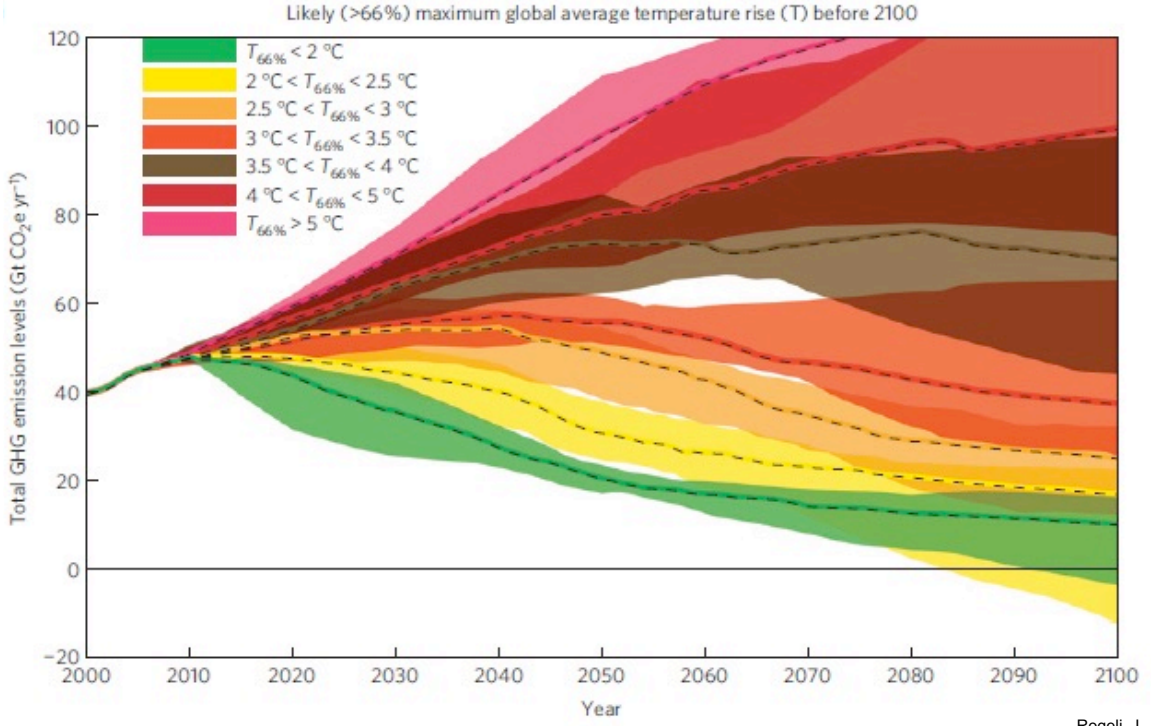
Transitions in the transport sector

Francesco Cherubini

Industrial Ecology Programme
Department of Energy and Process Engineering
Norwegian University of Science and Technology (NTNU)
Trondheim, Norway

Global emissions need to drastically decrease to achieve the 2 °C target

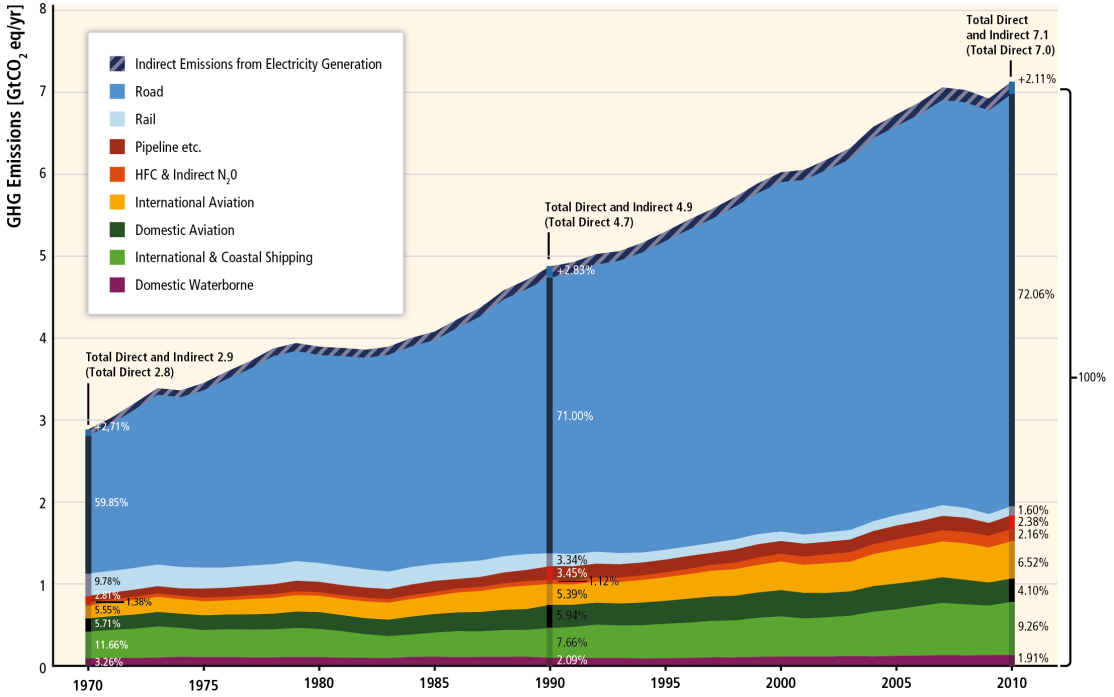


Rogelj, J., et al. (2011). Nature Clim. Change 1(8): 413-418.

NTNU

The transport sector accounts for 7 $GtCO_2$ direct emissions in 2010, of which more than 70% come from road transport

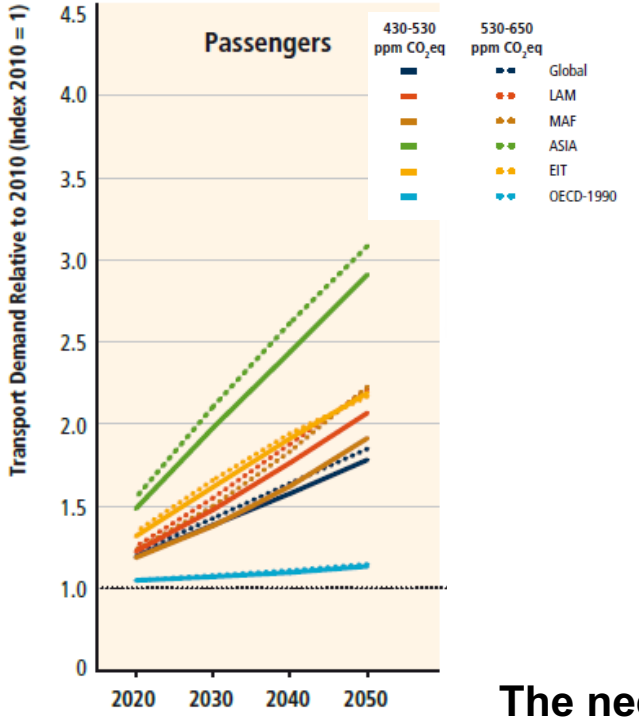
Without implementation of substantial mitigation policies, **transport emissions will increase at a faster rate than emissions from any other sector** and reach around 12 Gt CO_2-eq./yr by 2050

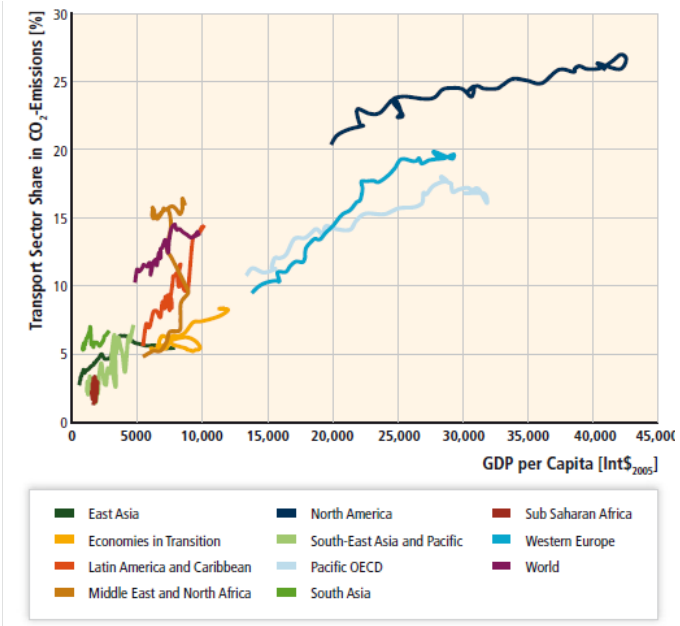


IPCC AR5 WG III

NTNU

Future transport demand



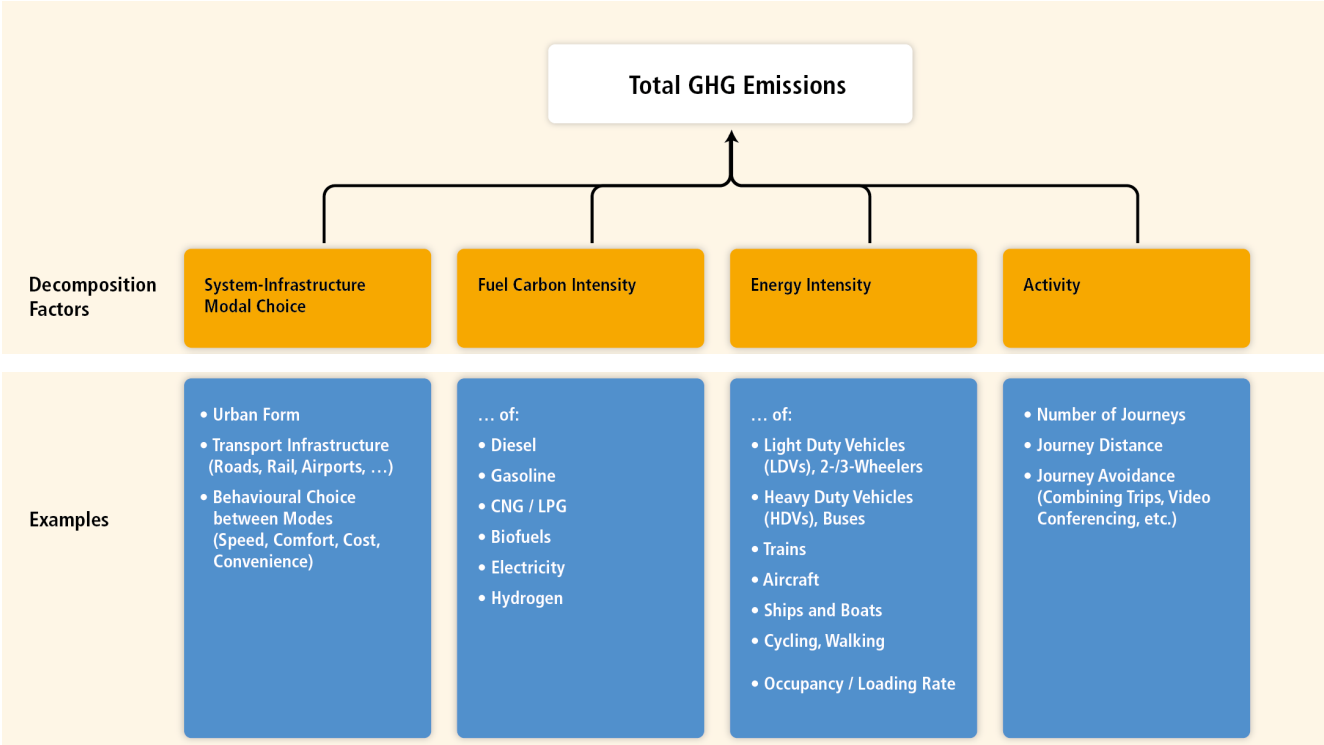


The need to decouple transport demand from GDP growth

IPCC AR5 WG III

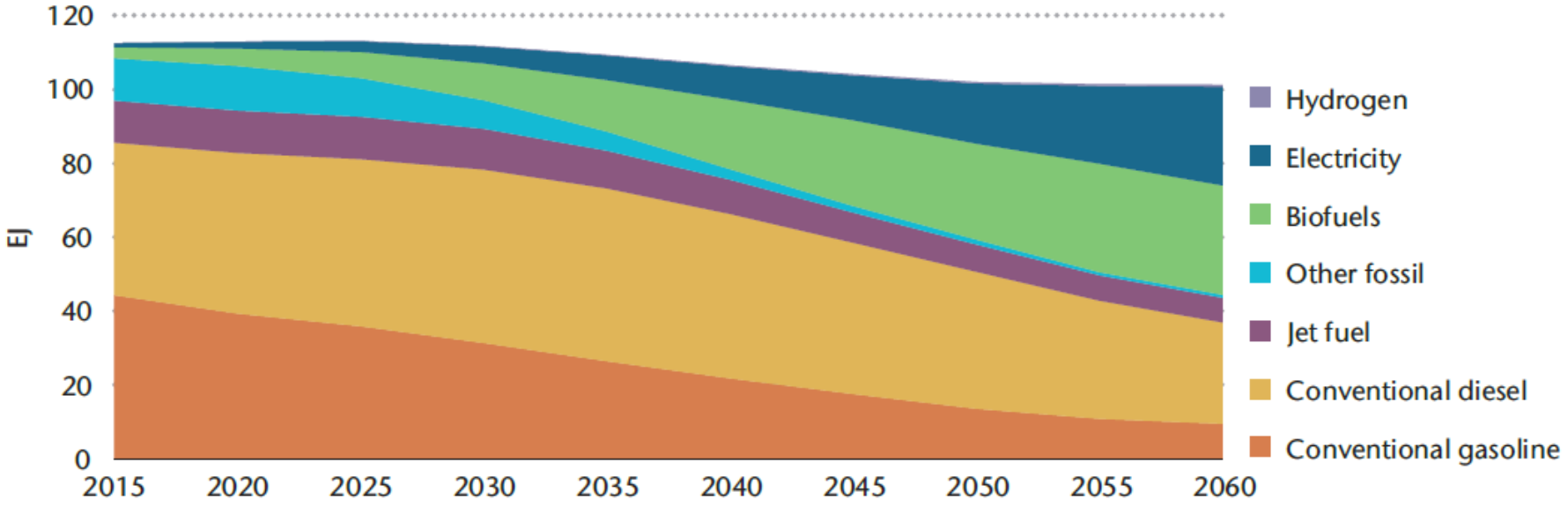
NTNU

Climate change mitigation in the transport sector – where to act



IPCC AR5 WG III

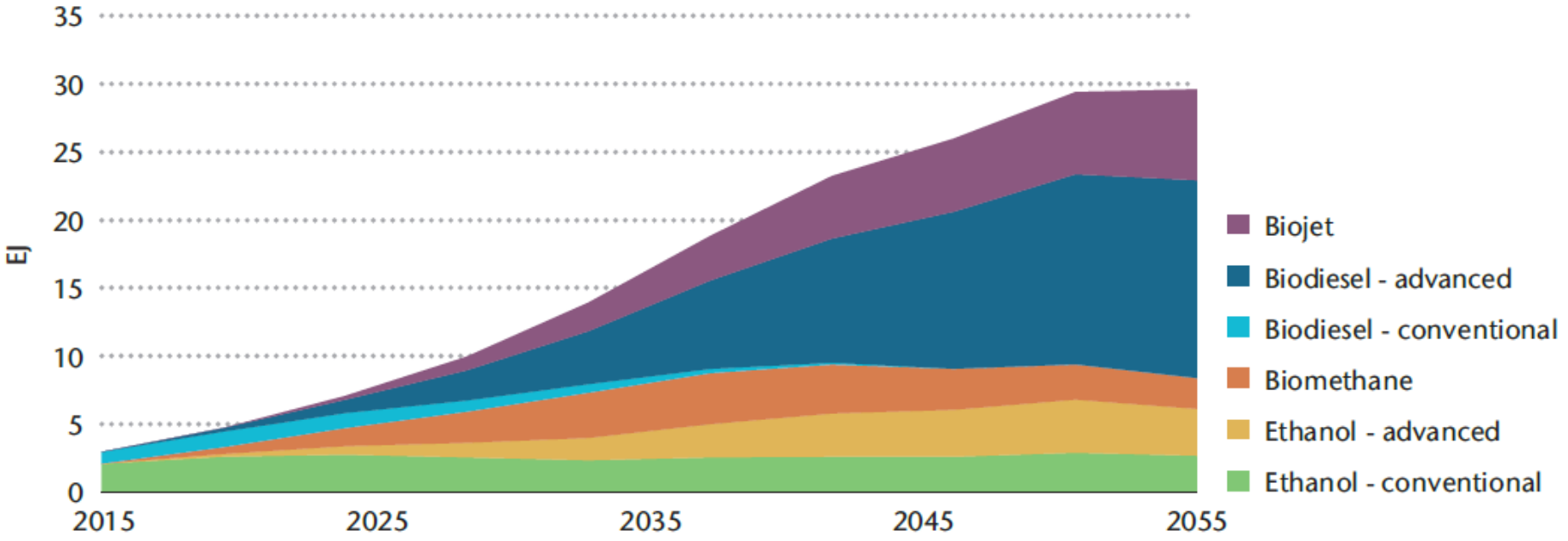
How is the transportation system expected to develop under a 2 °C target?



IEA, 2017. Technology Roadmap

NTNU

Biofuels outlook in a 2 °C world



IEA, 2017. Technology Roadmap. Delivering Sustainable Bioenergy

NTNU

Future biomass energy use under climate change mitigation (low electrification)

In 2010

50 EJ

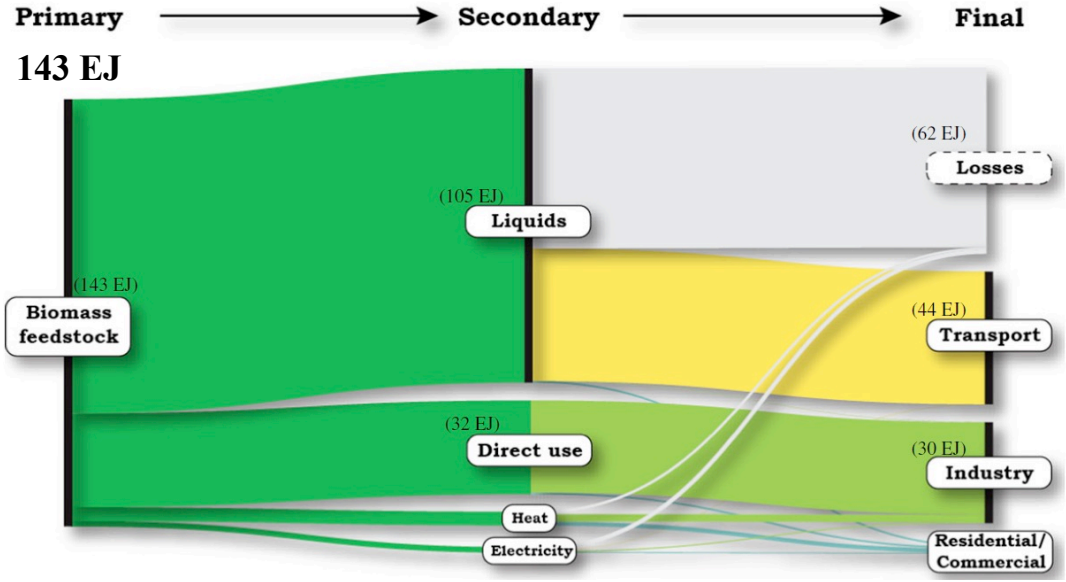
60% Residential

20% Industry

10% Transport

10% Losses

In 2050



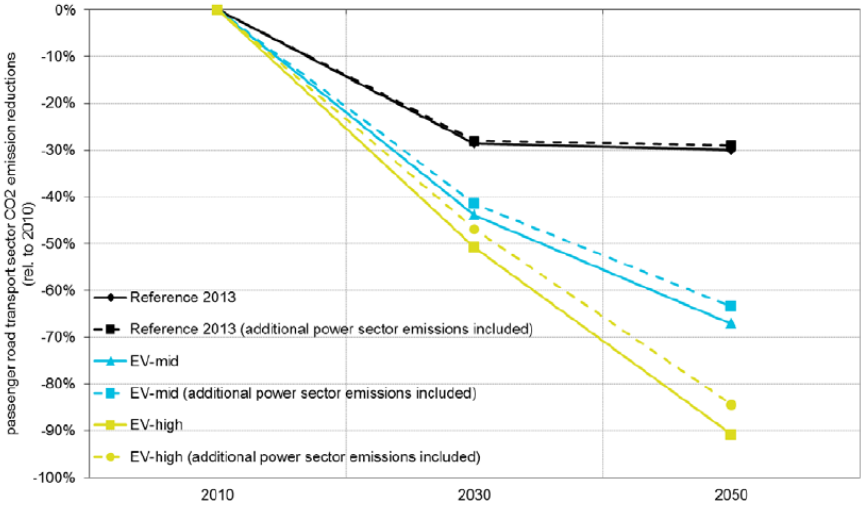
A large shift of bioenergy from the residential to the transport sector is predicted

McCollum, D., et al. (2014). "Climatic Change **123**(3): 651-664.

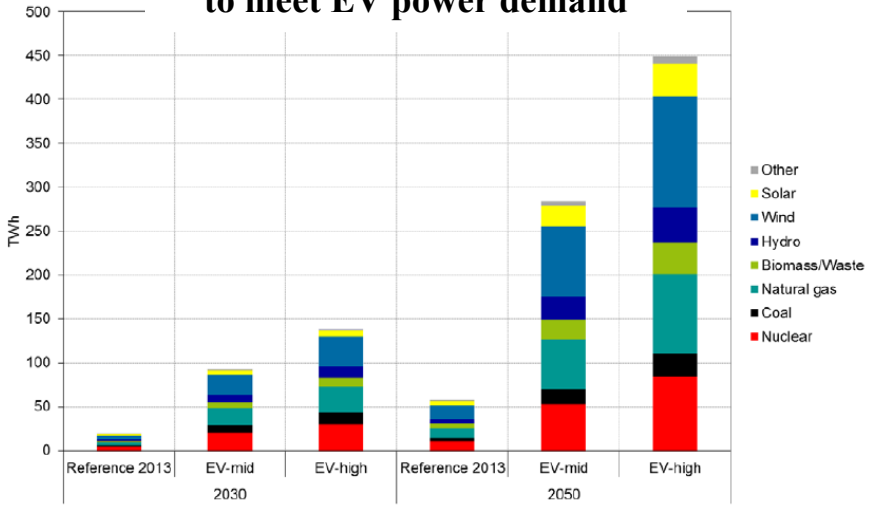
Future transport electrification in EU

Scenario	2030	2050
EV-mid	20%	50%
EV-high	30%	80%

CO_2 emission reduction



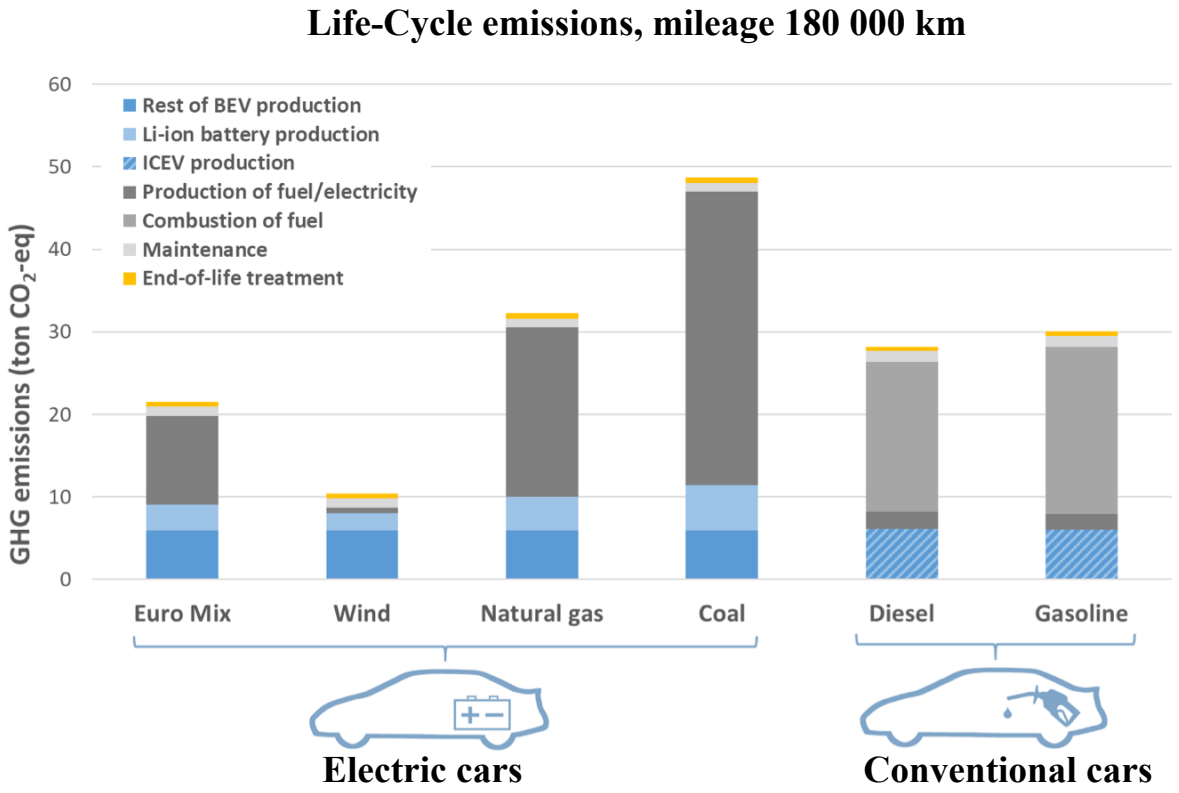
Additional generation required to meet EV power demand



Kasten et al. 2016 Electric mobility in Europe – Future impact on the emissions and the energy systems

NTNU

A clean energy production system is key



Ellingsen et al. (2016) The size and range effect: lifecycle greenhouse gas emissions of electric vehicles. Environmental Research Letters. vol. 11 (5).

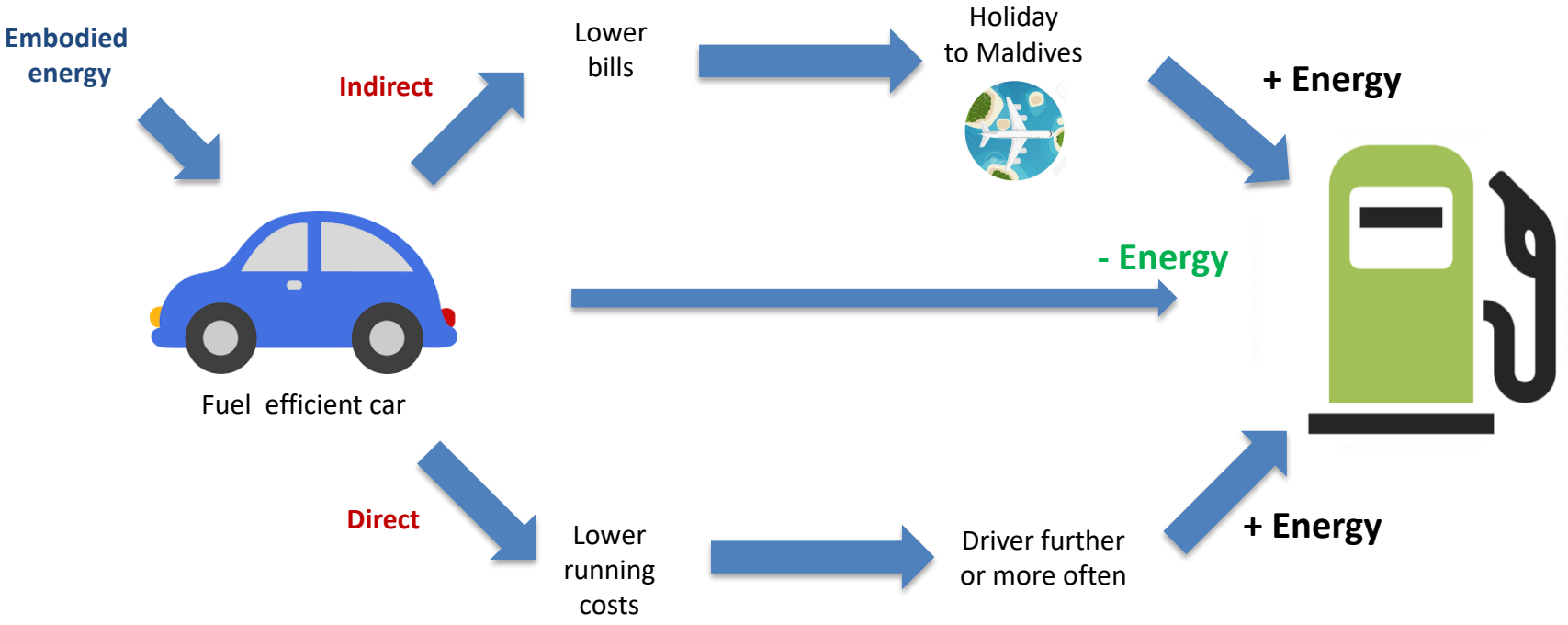
The Jevons Paradox

- More efficient use of coal will lead to an increase in the utilization of coal
- Efficiency leads to substitution of energy for labor and increased income

William Stanley Jevons, 1835-1882

”The coal question”

What is the rebound effect?



Rebound effects can reduce effectiveness of mitigation strategies

Mitigation Option	GHG savings	Savings per household	GHG savings lost from the rebound effect
Electric car	3.7 tCO2-eq.	33 kNOK	42-62% (avg. 48%)

Lekve Bjelle, E., et al. (2018). "Climate change mitigation potential of Norwegian households and the rebound effect." Journal of Cleaner Production 172: 208-217.

Thank you for your attention!