

Kulstof i skovene og klimaet

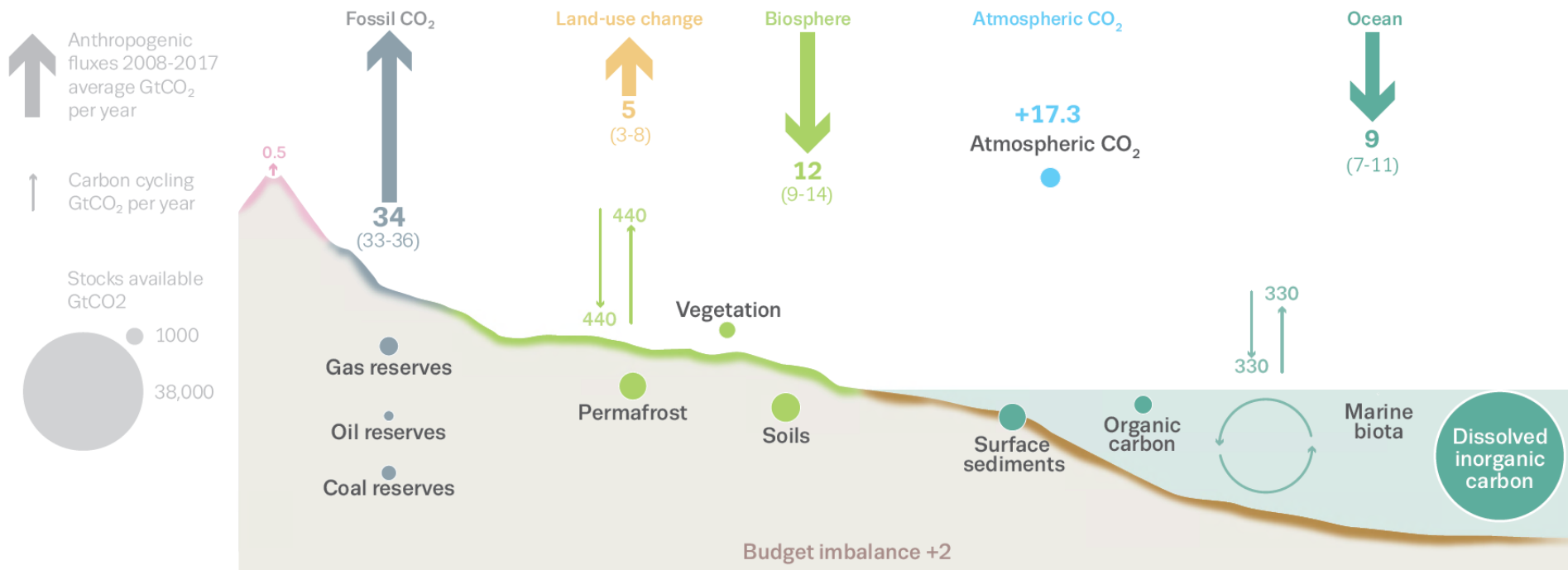
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Problemet:

Perturbation of the global carbon cycle caused by anthropogenic activities, averaged globally for the decade 2008–2017 (GtCO₂/yr)

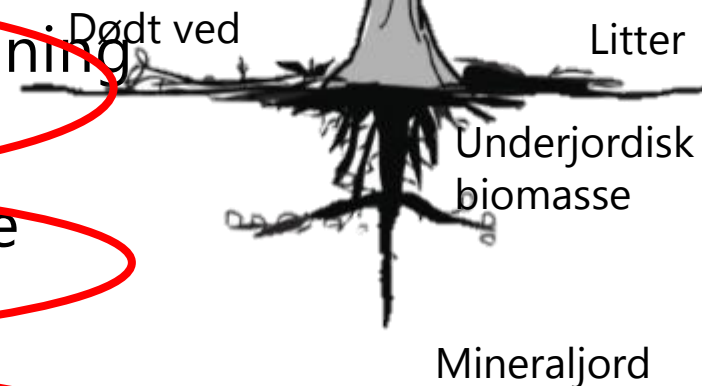


Source: [CDIAC](#); [NOAA-ESRL](#); [Le Quéré et al 2018](#); [Ciais et al. 2013](#); [Global Carbon Budget 2018](#)

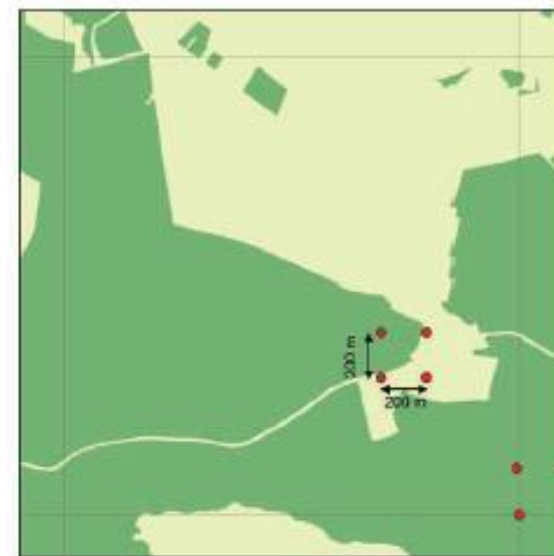
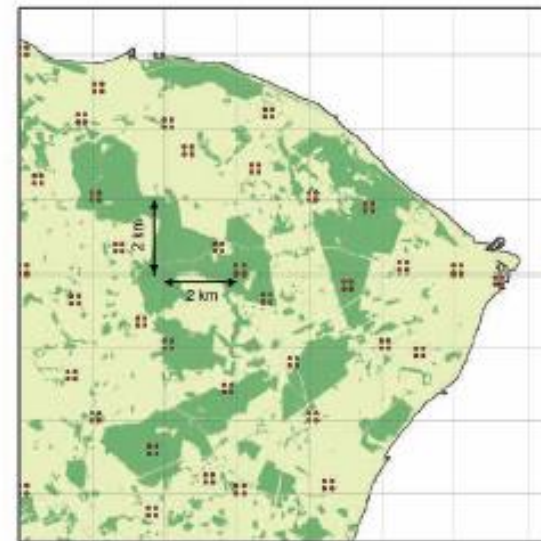
Klimaforandringer kan modvirkes gennem 4 overordnede skovbrugsrelaterede aktiviteter:

- (i) øge skovarealet gennem skovrejsning og gentilplantning,
- (ii) øge kulstofpuljerne i eksisterende skove,
- (iii) øge anvendelsen af træ til energi og materialer som erstatning for fossile kilder og CO₂-dyre materialer, og
- (iv) reducere afskovning og skovødelæggelse.

Overjordisk
biomasse

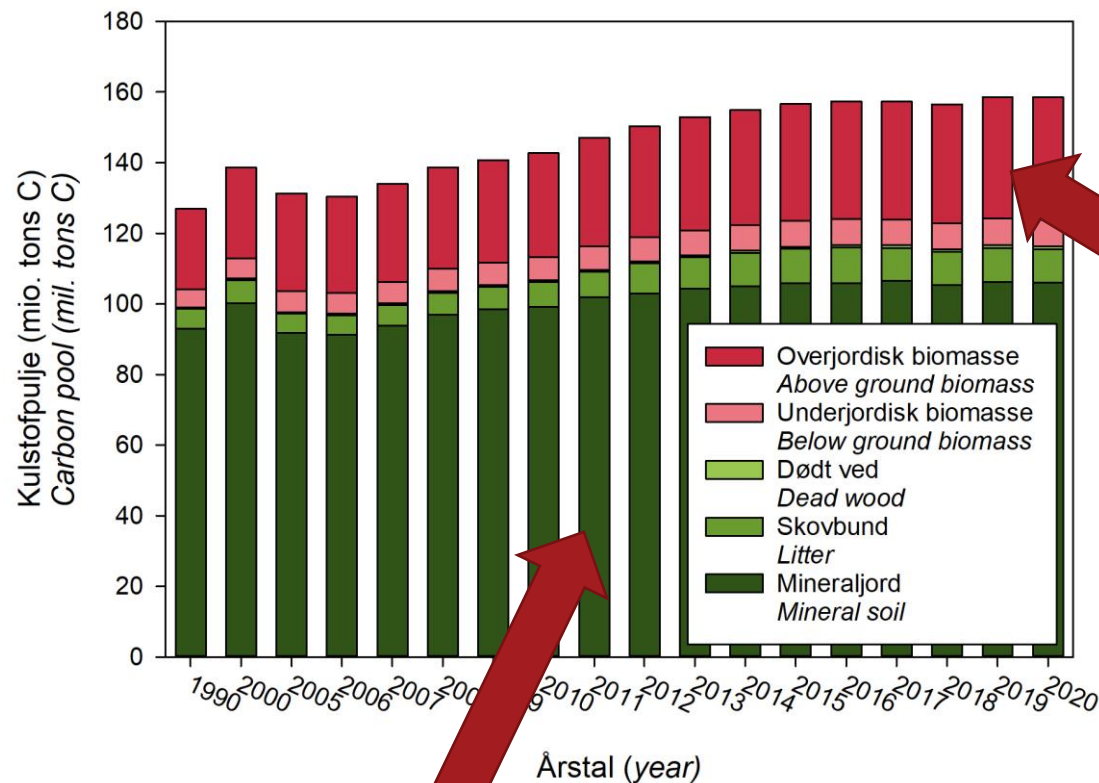


Kulstof i de danske skove



Årstal Year	Grupper Clusters		Prøveflader Sample plots	
	I alt Total	Skov Forest	I alt Total	Skov Forest
2016	2.184	857	8.572	1.858
2017	2.212	853	8.652	1.900
2018	2.191	903	8.586	2.018
2019	2.186	844	8.597	1.896
2020	2.190	887	8.569	1.886
I alt Total	10.963	4.344	42.976	9.558

Kulstof i de danske skove



Levende biomasse
155 mio. tCO₂-eq

Skovjorden:
2/3 af det samlede lager

Den gode nyhed ... ?

1.7-1.8 mia ha skov

0.9 mia. ha kronedække

Opsparing af 205 mia. tons kulstof

RESEARCH

RESTORATION ECOLOGY

The global tree restoration potential

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The restoration of trees remains among the most effective strategies for climate change mitigation. We mapped the global potential tree coverage to show that 4.4 billion hectares of canopy cover could exist under the current climate. Excluding existing trees and agricultural and urban areas, we found that there is room for an extra 0.9 billion hectares of canopy cover, which could store 205 gigatonnes of carbon in areas that would naturally support woodlands and forests. This highlights global tree restoration as our most effective climate change solution to date. However, climate change will alter this potential tree coverage. We estimate that if we cannot deviate from the current trajectory, the global potential canopy cover may shrink by ~223 million hectares by 2050, with the vast majority of losses occurring in the tropics. Our results highlight the opportunity of climate change mitigation through global tree restoration but also the urgent need for action.

Potential synthetic carbon capture by trees is likely to be among our most effective strategies to limit the rise of CO₂ concentrations across the globe (1–3). Consequently, a number of international initiatives (such as the Bonn Challenge, the related APF100, and the New York Declaration on Forests (4, 5)) have established ambitious targets to promote forest conservation, afforestation, and restoration at a global scale. The latest special report (7) by the Intergovernmental Panel on Climate Change (IPCC) suggests that an increase of 1 billion ha of forest will be necessary to limit global warming to 1.5°C by 2050. However, it remains unclear whether these restoration goals are achievable because we do not know how much tree cover might be possible under current or future climate conditions or where these trees could exist. Previous efforts to estimate global tree cover potential have scaled existing vegetation estimates to the biome or ecoregion levels to provide coarse approximations of global forest degradation (6, 7). However, quantitatively evaluating which environments could support trees requires that we build models using direct measurements of tree cover (independent of satellite-derived models) from protected areas, where vegetation cover has been relatively unaffected by human activity. With enough observations that span the entire range of environmental conditions, from the lowest to the highest possible tree cover, we can interpolate these “natural tree cover” estimates across the globe to generate a predictive understanding of the potential tree cover in the absence of human activity.

To explore the determinants of potential tree cover, we used 78,774 direct photo-interpretation

measurements (data file S1) (8) of tree cover across all protected regions of the world (fig. S1) (9, 10). Using global environmental layers (table S1) (11), we examined how climate, edaphic, and topographic variables drive the variation in natural tree cover across the globe. The focus on protected areas is intended to approximate natural tree cover. Of course, these regions are not entirely free of human activity (12), presenting slightly lower tree cover than expected in some regions or higher tree cover than expected in other regions because of low fire frequency, but these ecosystems represent areas with minimal human influence on the overall tree cover. We then used a random forest machine-learning approach (12) to examine the dominant environmental drivers of tree cover and generated a predictive model (Fig. 1) that enables us to interpolate potential tree cover across terrestrial ecosystems. The resulting map—Earth’s tree carrying capacity—defines the tree cover per pixel that could potentially exist under any set of environ-

with minimal human activity is directly underpinned by a set of direct tree cover measurements (independent of climate and soil estimates) (12) across the

of the world’s protected areas (fig. S2), between peaks of 0% in dry dense equatorial forest, with We paired these tree cover measurements (12) global layers of soil and climate (12). Our resulting random forest predictive power (coefficient of determination (R^2) = 0.86; intercept = -2.05% (fig. S4A) (12) revealed that our model explains ~71% of the variation in tree cover (fig. S3, E and C). Our 5-fold cross-validation approach also allows us to generate a spatially explicit understanding of model uncertainty (figs. S5 and S6) (12). Across all pixels, the mean standard deviation around the model estimate is ~9% in tree cover (28% of the potential tree cover) (figs. S5 and S6) (12). As such, the model accurately reflected the distribution of tree cover across the full range of protected areas. We then interpolated this random forest model across all terrestrial ecosystems using all 30 soil and climate variables to project potential tree cover across the globe under existing environmental conditions.

The resulting map reveals Earth’s tree carrying capacity at a spatial resolution of 30 arc sec (Fig. 2A). The model accurately predicts the presence of forest in all existing forested land on the planet (fig. S7A) but also reveals the extent of tree cover that could naturally exist in regions beyond existing forested lands. The most recent Food and Agriculture Organization of the United Nations (FAO) definition of “forests” corresponds to a land of at least 0.5 ha covered by at least 10% tree

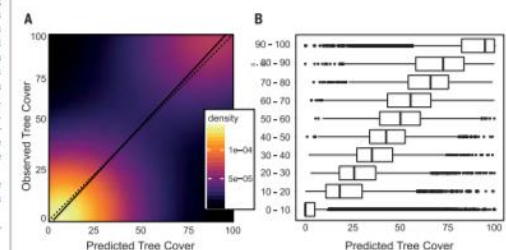
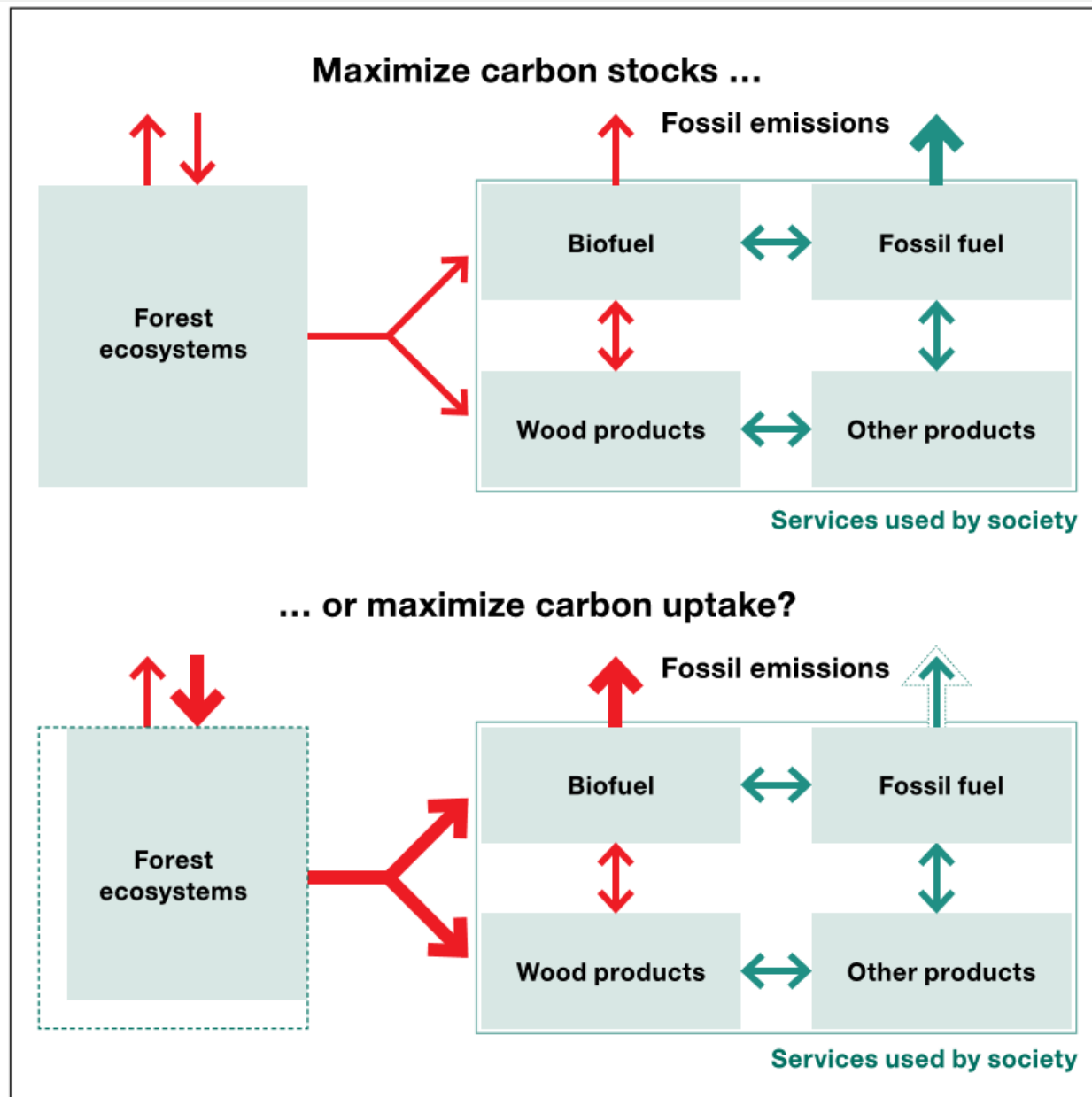


Fig. 1. Predicted vs. observed tree cover. (A and B) The predicted tree cover (x axis) compared with the observed tree cover (y axis). (A) Results as a density plot, with the 1:1 line in dotted black and the regression line in continuous black (intercept = -2% forest cover; slope = 1.06; $R^2 = 0.86$), which shows that the model is unbiased. (B) Results as boxplots, to illustrate the quality of the prediction in all tree cover classes.

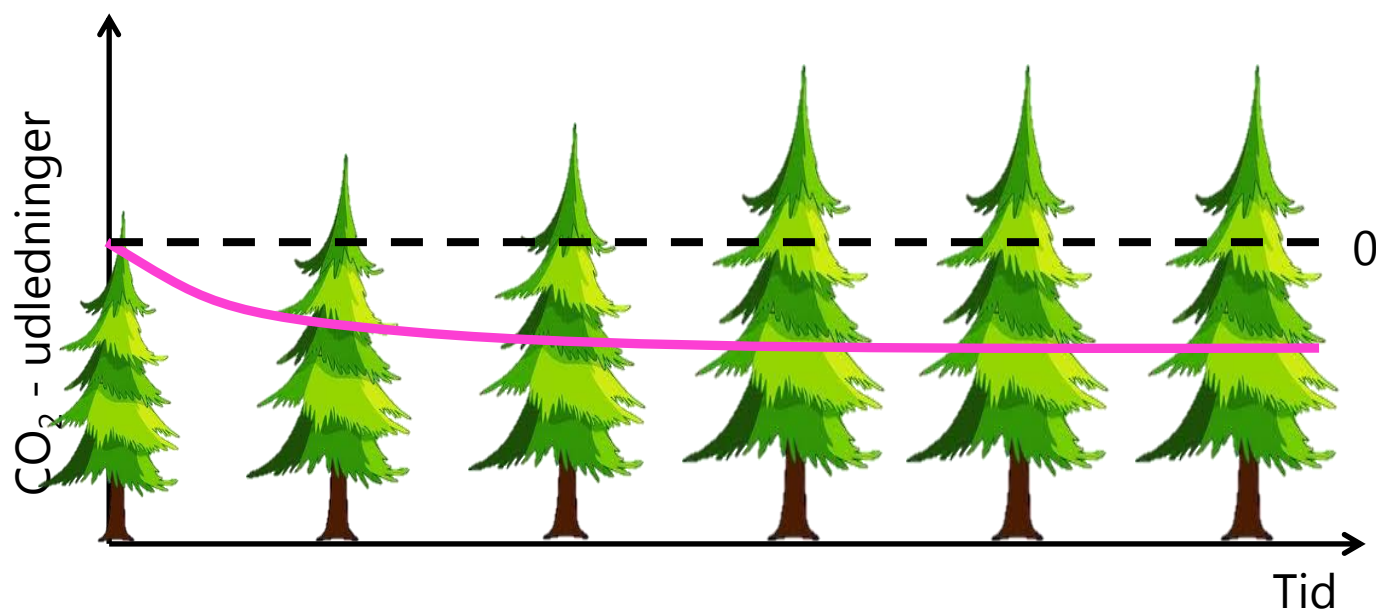
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Kurz et al. (2016). Climate change mitigation through forest sector activities: principles, potential and priorities. *Unasylva* 246, 61-67.

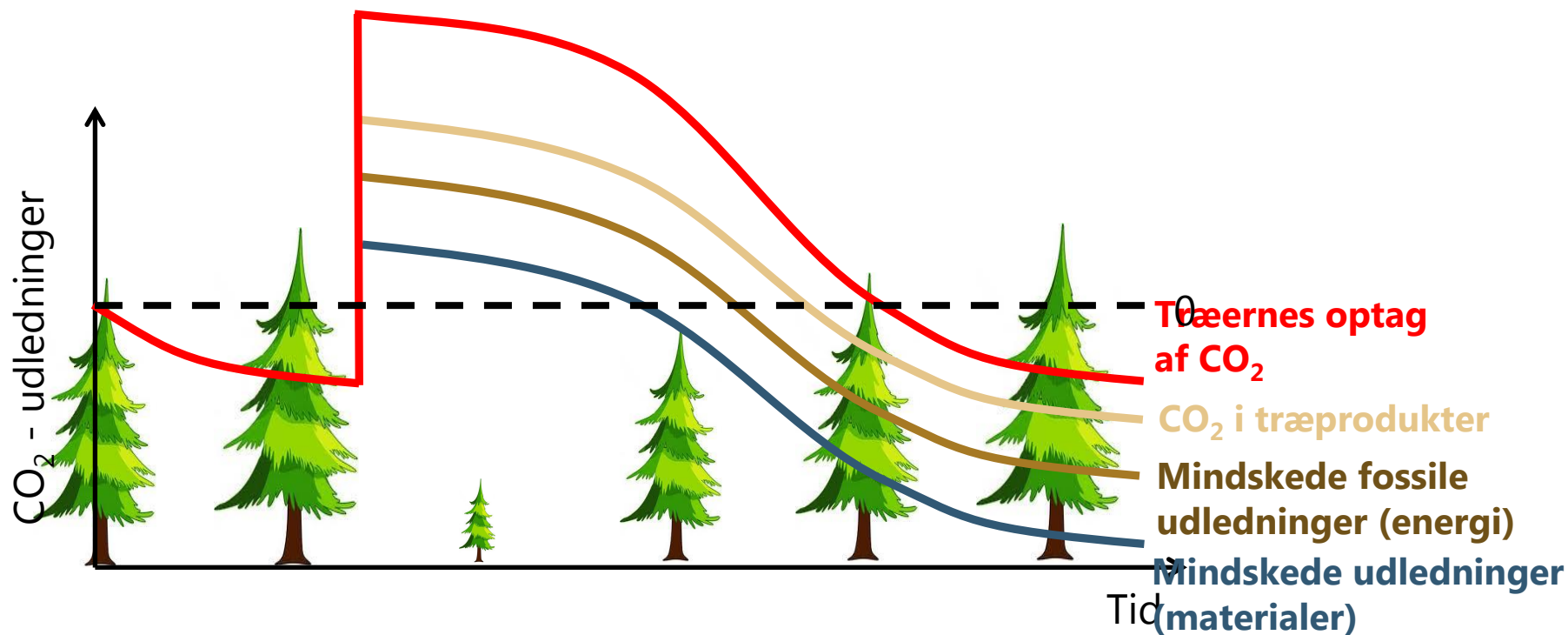
At bruge skoven eller lade være?

Urørt skov

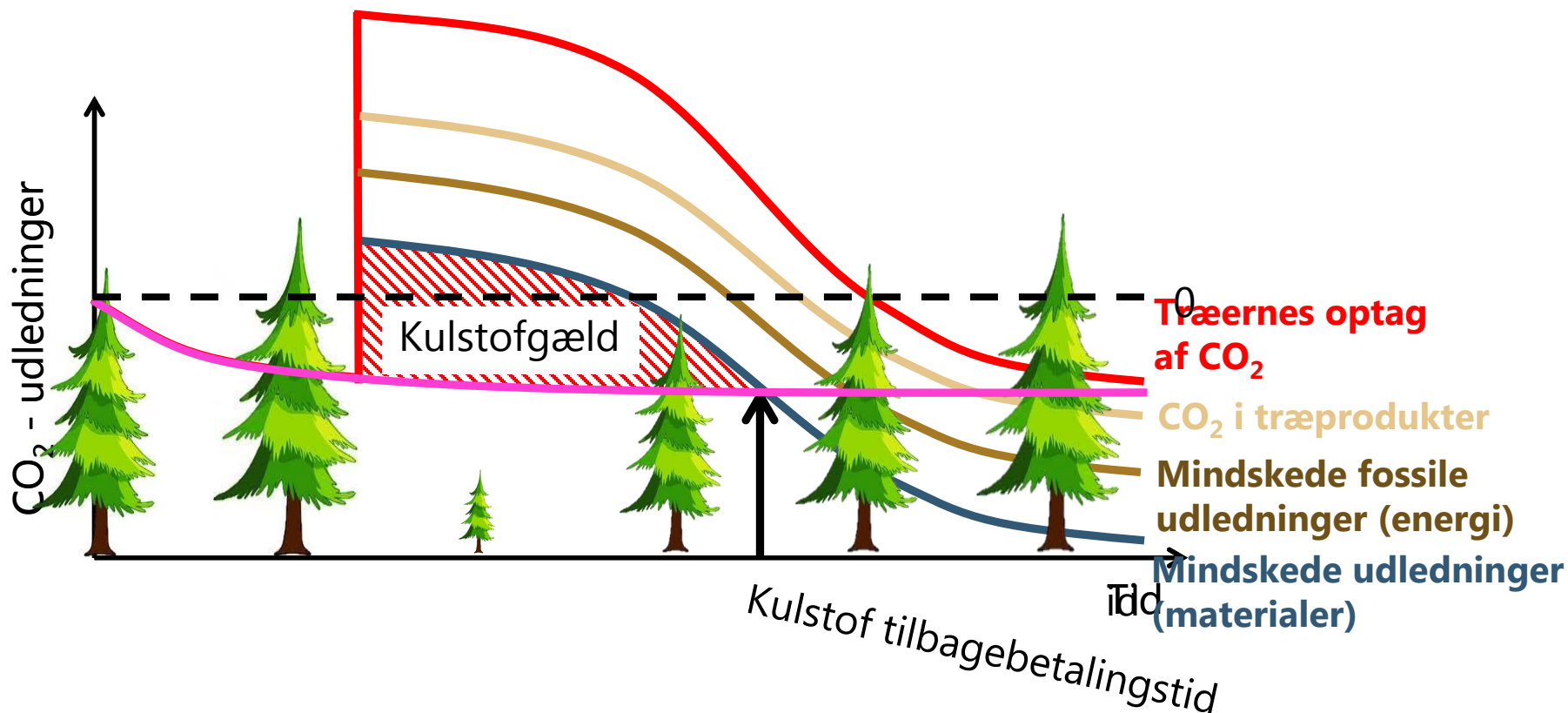


At bruge skoven eller lade være?

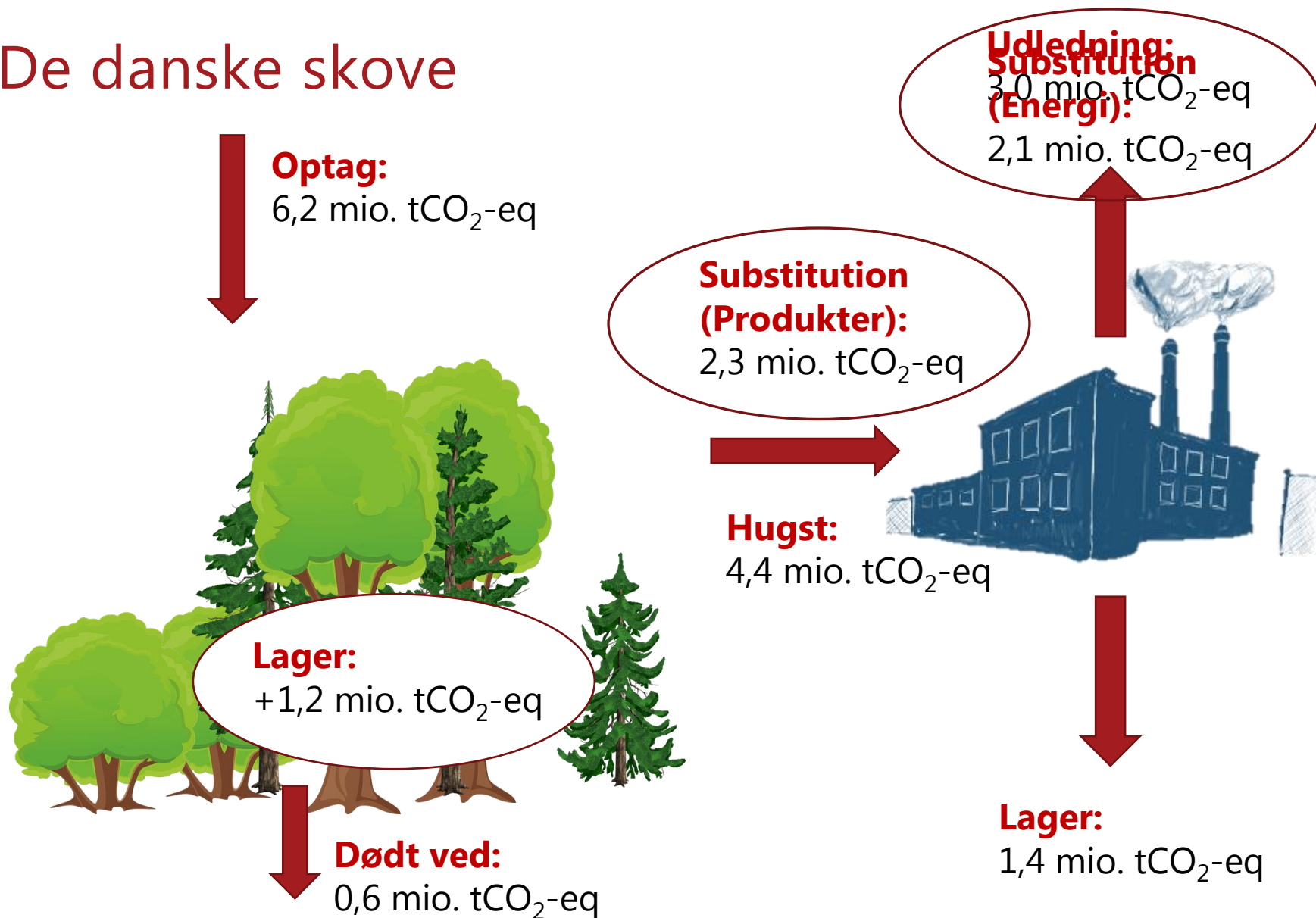
Dyrket skov



At bruge skoven eller lade være?



De danske skove



Konklusioner

- Skovene indeholder *store* mængder kulstof
- Den langt største del af kulstoffet er lagret i skovjorden der er en "*langsom*" pulje
- Klimaforandringerne løses *ikke ved skovtilplantning*
- Skovbruget kan bidrage ved at producere produkter til en *grøn omstilling*.

