Impact of bark beetle outbreaks on carbon sequestration in Slovak forests.

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Introduction

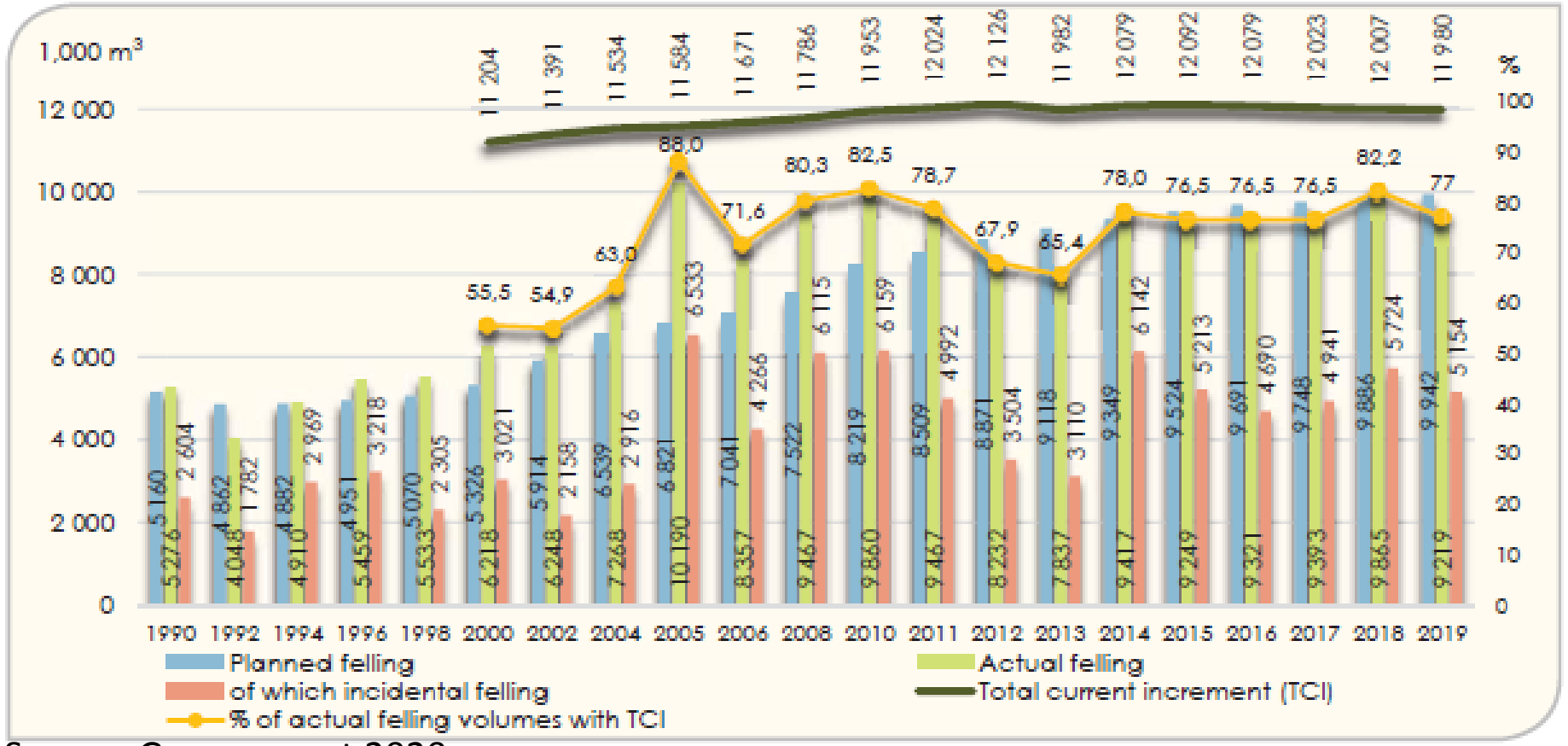
Current situation

- Almost all harvests in spruce stands are sanitary felling (85% in 2013-2019; 92% in 2019)
- Sanitary felling due to bark-beetle outbreaks in 2019: 3.35 mil. m^3 (76.8% of total harvests in spruce stands)
- Harvests of spruce wood (4.36 mil. m^3) exceeds its increment (3.48 mil. m^3) – total growing stock of spruce stands decreases in Slovakia

Aim of the study

- To compare the development of carbon stock changes in living biomass of Slovak forests and specifically in spruce stands under planned and realized forest management until 2050
- To assess the influence of sanitary felling in spruce stands on their future development

Total current increment (TCI) and felling (planned/actual/sanitary) in 1000 m^3

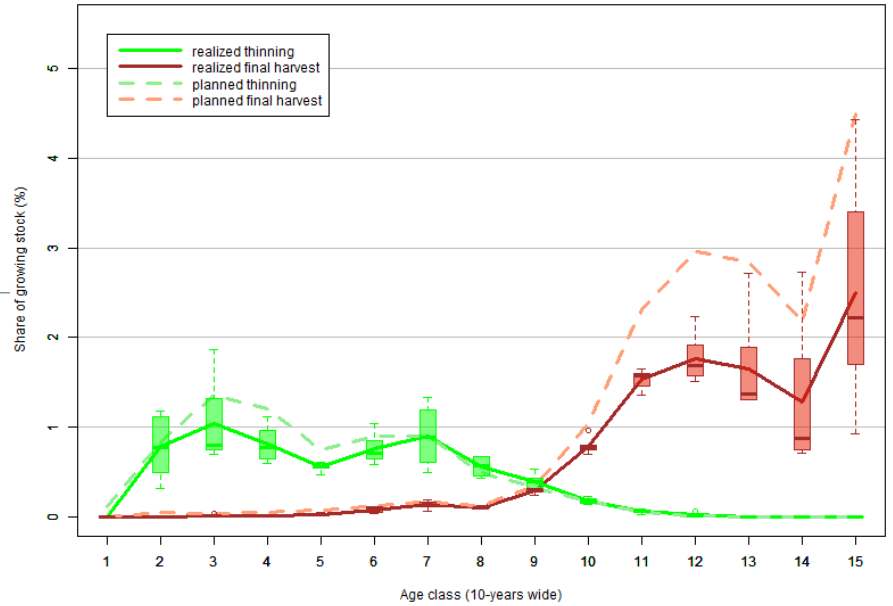


Source: Green report 2020

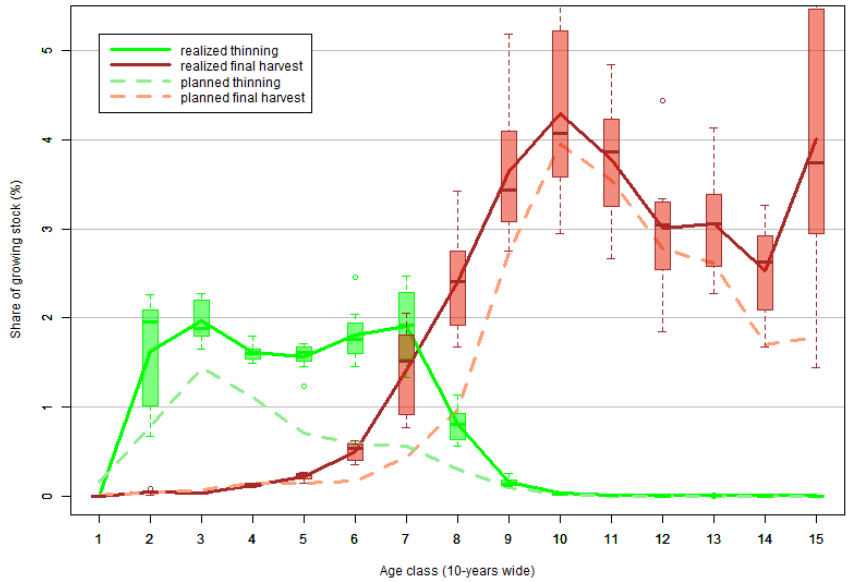
Planned versus realized management

- In spruce stands, real harvesting rates (in % of growing stock) is considerably higher (by 0.5 – 2% of total growing stock) than planned rates
- In broadleaved stands, real rates are lower than planned rates (by 1 – 2% of growing stock)

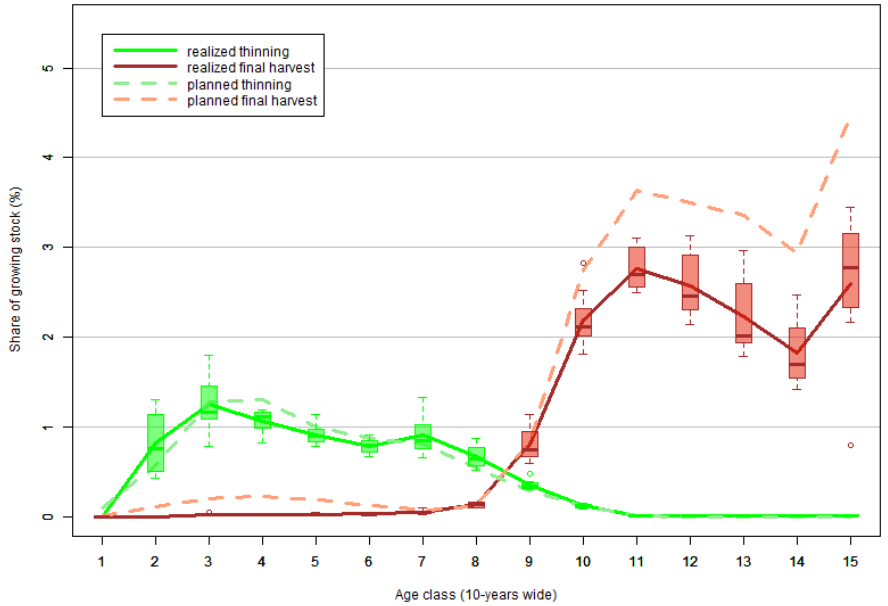
Oaks



Spruce



Beech



Modeling approach

Future development of forest age structure, growing stocks, wood increments and harvested volumes for main tree species in Slovakia

Yield tables (spruce, fir, pine, beech and oak)

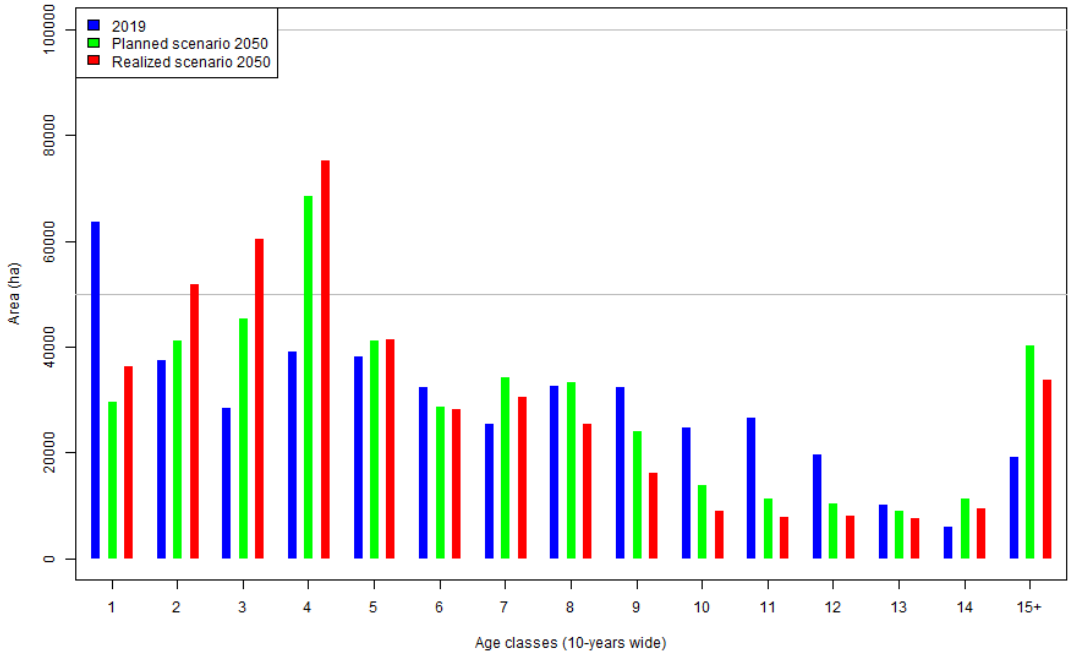
FCarbon model (https://web.nlcsk.org/?page_id=17445)

2 scenarios of forest management: planned and realized, applied through planned and real harvesting rates (ratio of harvested volume to volume available for harvesting)

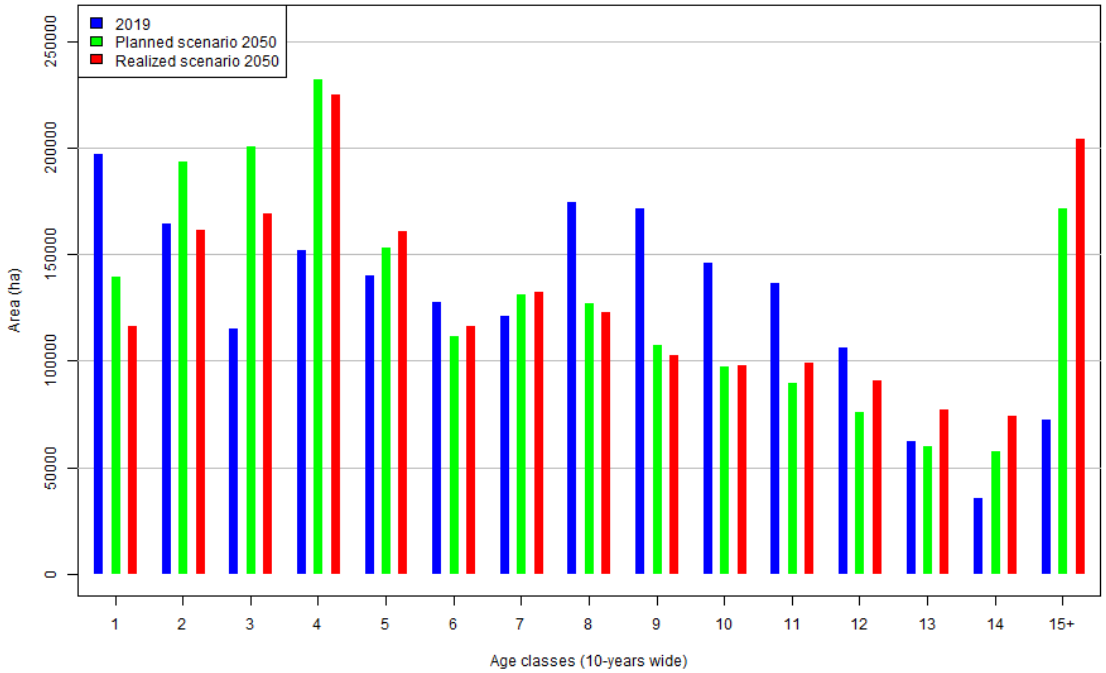
Initial state 2019, simulation step 1 year, reference period 2013 - 2019

Carbon stock changes as well as CO_2 emissions/removals calculated according to IPCC 2006 GL, using the Gain _Loss method, compatible with Slovak National GHG Inventory

Results - projected development of stand characteristics



Age structure of spruce stands



Age structure of all forest stands

Spruce forests – current annual increment (mil. m^3, change in %)

Management	Ref. period	2020	2030	2040	2050
Planned	3.72	3.68 (-1.08%)	3.48 (-6.45%)	3.23 (-13.17%)	2.81 (-24.46%)
Realized		3.65 (-1.88%)	3.23 (-13.17%)	2.98 (-19.89%)	2.60 (-30.11%)

All forests – current annual increment (mil. m^3, change in %)

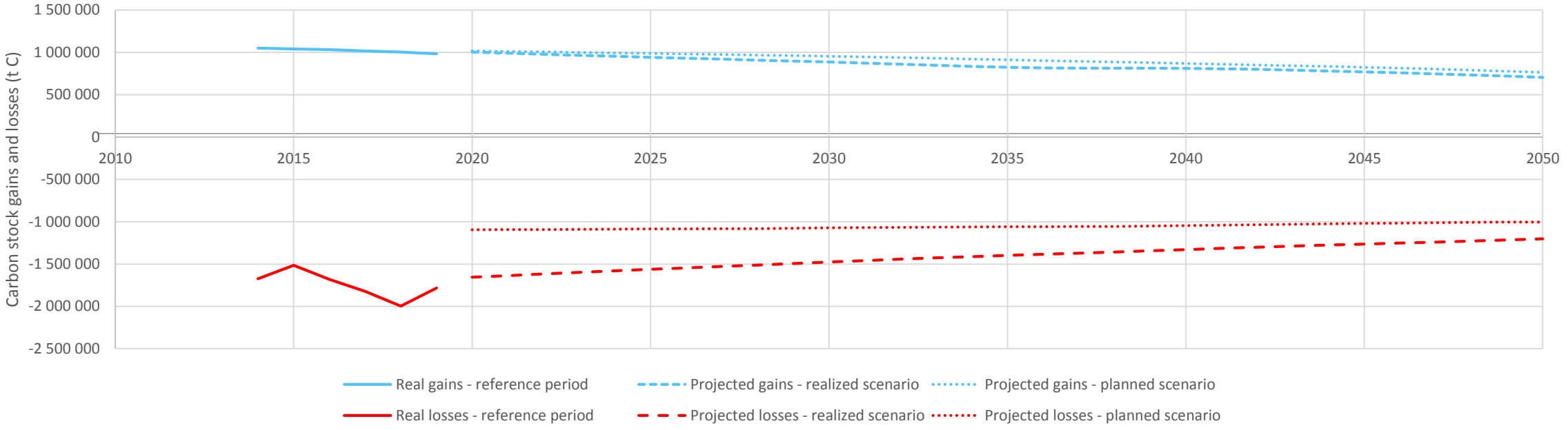
Management	Ref. period	2020	2030	2040	2050
Planned	12.04	12.14 (0.83%)	11.35 (-5.73%)	10.28 (-14.62%)	10.46 (-13.12%)
Realized		12.14 (0.83%)	11.39 (-5.40%)	10.46 (-13.12%)	10.56 (-12.29%)

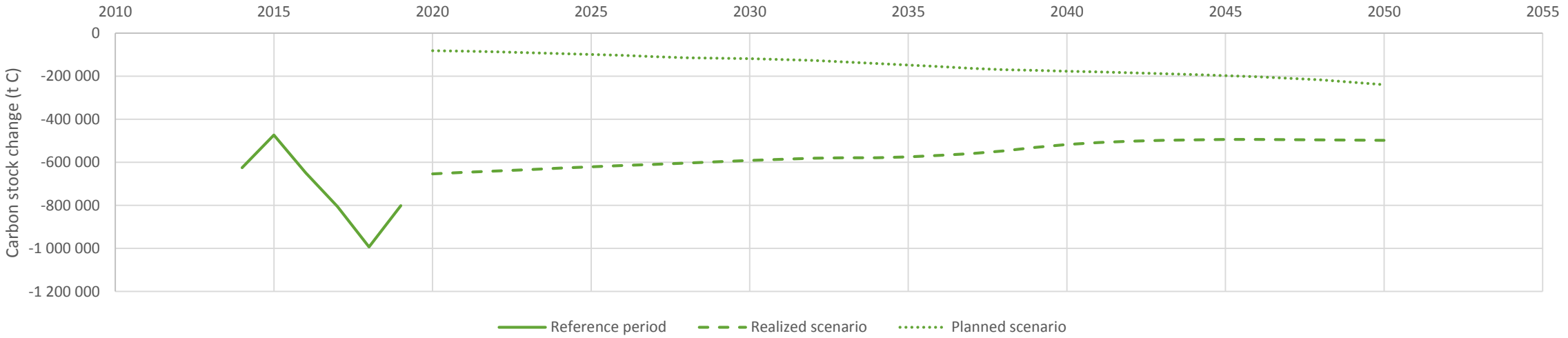
Spruce forests – harvests (mil. m^3, change in %)

Management	Ref. period	2020	2030	2040	2050
Planned	2.95	2.87 (-2.71%)	2.81 (-4.75%)	2.74 (-7.12%)	2.66 (-9.83%)
Realized	4.55	4.32 (-5.05%)	3.85 (-15.38%)	3.48 (-23.52%)	3.18 (-30.11%)

All forests – harvests (mil. m^3, change in %)

Management	Ref. period	2020	2030	2040	2050
Planned	9.68	9.69 (0.10%)	9.79 (1.14%)	9.97 (3.00%)	9.52 (-1.65%)
Realized	9.39	9.15 (-2.56%)	9.06 (-3.51%)	8.95 (-4.69%)	8.69 (-7.45%)


1 500 000
1 000 000
500 000
0
-500 000
-1 000 000
-1 500 000
-2 000 000
-2 500 000
Carbon stock gains and losses (t C)
2010
2015
2020
2025
2030
2035
2040
2045
2050
Real gains - reference period
Projected gains - realized scenario
Projected gains - planned scenario
Real losses - reference period
Projected losses - realized scenario
Projected losses - planned scenario


2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
0
-200 000
-400 000
-600 000
-800 000
-1 000 000
-1 200 000
Carbon stock change (t C)
Reference period
Realized scenario
Planned scenario

The effect of sanitary felling in spruce forests on forest management

Sanitary felling due to the bark beetles and other injurious agents increased total harvested volume in spruce forests to ~150% of planned harvests. With expected changes in age structure of spruce forests, this will decrease to ~120% in 2050 (supposing constant level of sanitary felling)

Carbon stock change in spruce forests is negative (more carbon is released than sequestrated) and it will be until 2050 due to the decrease of total area of spruce forests

The total area of spruce forests in Slovakia is expected to decrease (even without influence of natural disturbances) – conversion of spruce forest to more stabile mixed stands

Current level of sanitary felling in spruce forests is one of the reasons which led to lower total harvests compared to total planned harvests in all forests

Carbon stock change in spruce stands, strongly influenced by bark-beetle outbreaks, equals to emissions ~2000 kt CO_2 per year

Thank you for your attention

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