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Developing a method of accounting for the material use of biomass/biochar and its positive side benefits within the company carbon footprint: A case study at Hochschule Geisenheim University

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- Zeitbudget
  - 15 Min, 5 min für Fragen
    - Max 8 Folien
- Ablauf
  - Vorstellung HGU/FACE
  - E-Mgmt
  - Biomass potential HGU
  - Carbon balance
  - Carbon surplus potential

„Developing a method of accounting for the material use of biomass/biochar and its positive side benefits within the company carbon footprint“

FACEING COMPENSATION - A CASE STUDY AT THE HOCHSCHULE GEISENHEIM UNIVERSITY

Carbon Footprint reduction through carbonization of biomass and energy management

Agenda

- What is „FACEing Compensation“?
  - Project & Goals
- CO_2 balance
  - Energy demand, biomass emergence
- Approach to improve
  - Carbon sequestration
  - Side effects of material use of biochar

Compensation Team

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Biogeochemistry, FACE & Biochar research

Department for Soil Science and Plant Nutrition

Head of WG Climate Change Research for Special Crops

Georg Ardissone (M. Sc.)

Sustainable Energies (SENCE)

Department for Soil Science and Plant Nutrition

WG Climate Change Research for Special Crops

FACE facility at HGU

Own pictures, https://www.dwm-aktuell.de/face2face-anlage-ersten-ergebnissen, Google Maps

FACEING COMPENSATION

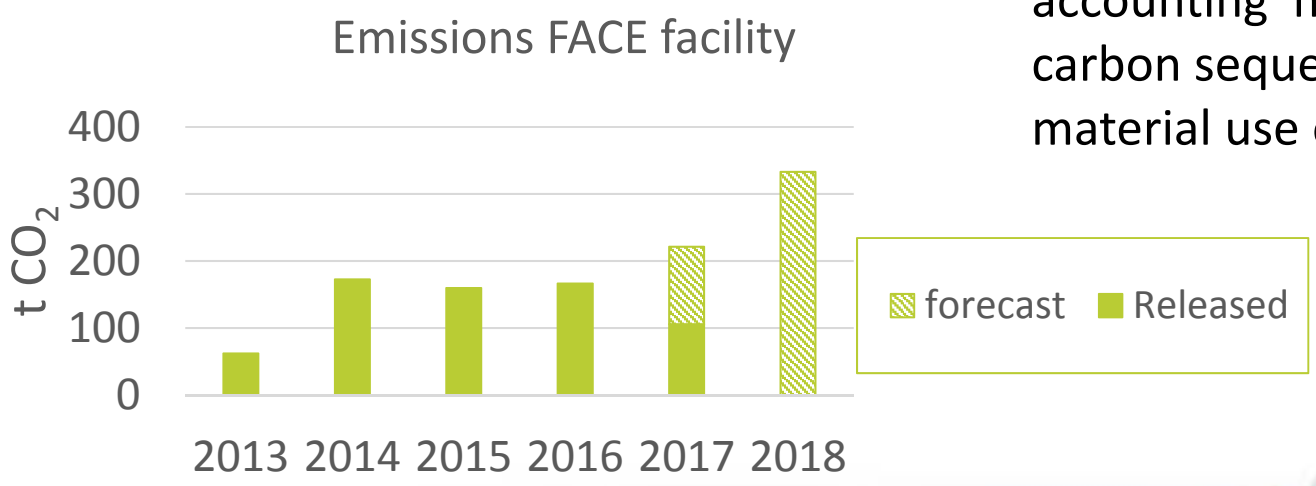
Projects goals:

To compensate the FACE facility's CO_2 emissions

- To reduce the HGU's carbon footprint by energy management
- To evaluate the CO_2 compensation potential trough biochar

Approach:

- To quantify the biomass potential of HGU sites
- To evaluate renewable energy potentials (including pyrolysis)
- To develop a suitable accounting model that respects carbon sequestration and material use of biochar



HGU's CO_2 balance

(t)

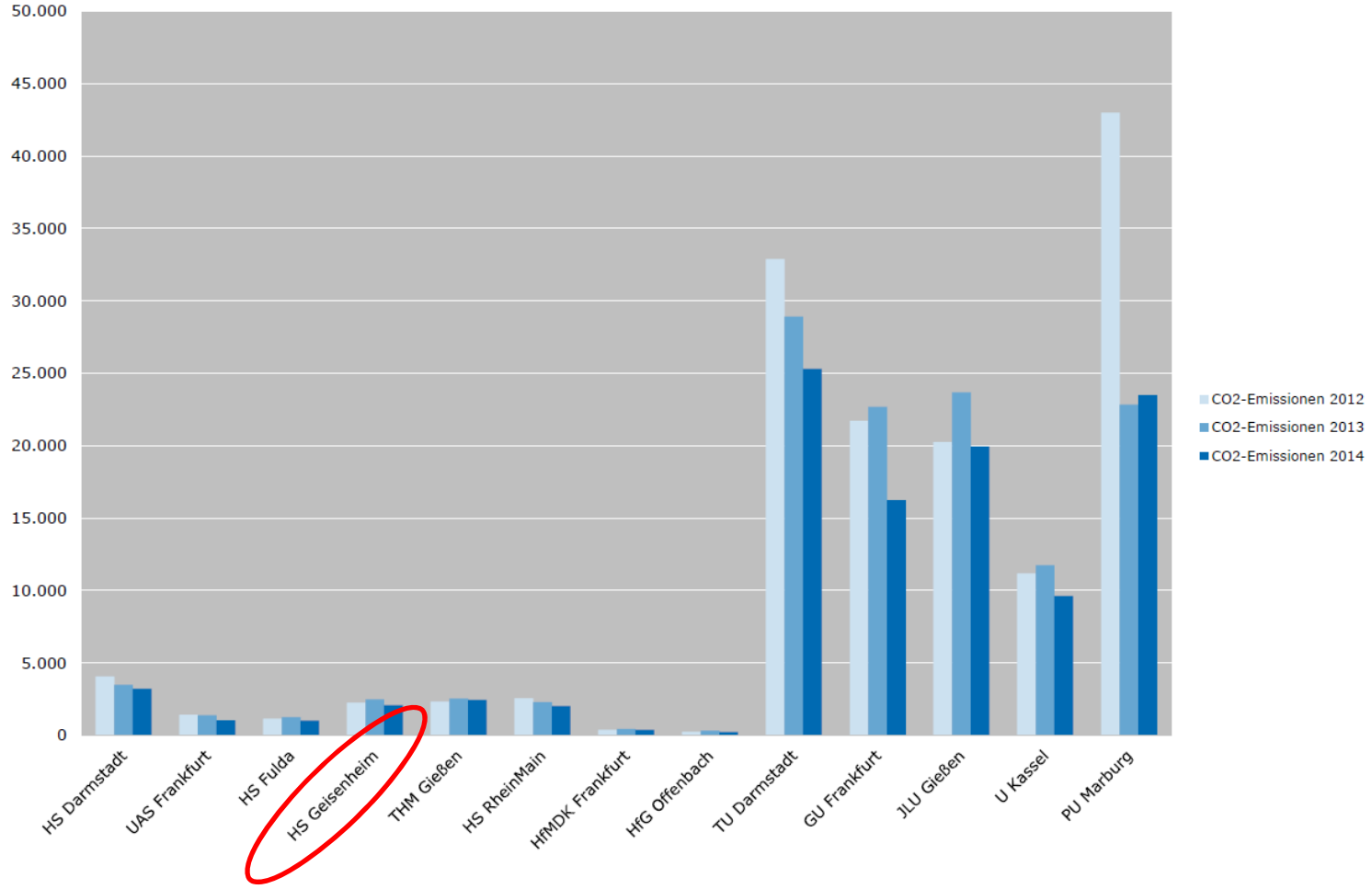


Abb. 18 CO_2-Emissionen

Source: HIS-HE CO_2 Bilanzen Hessen 2014

HGU's CO_2 balance

(kg/ person)

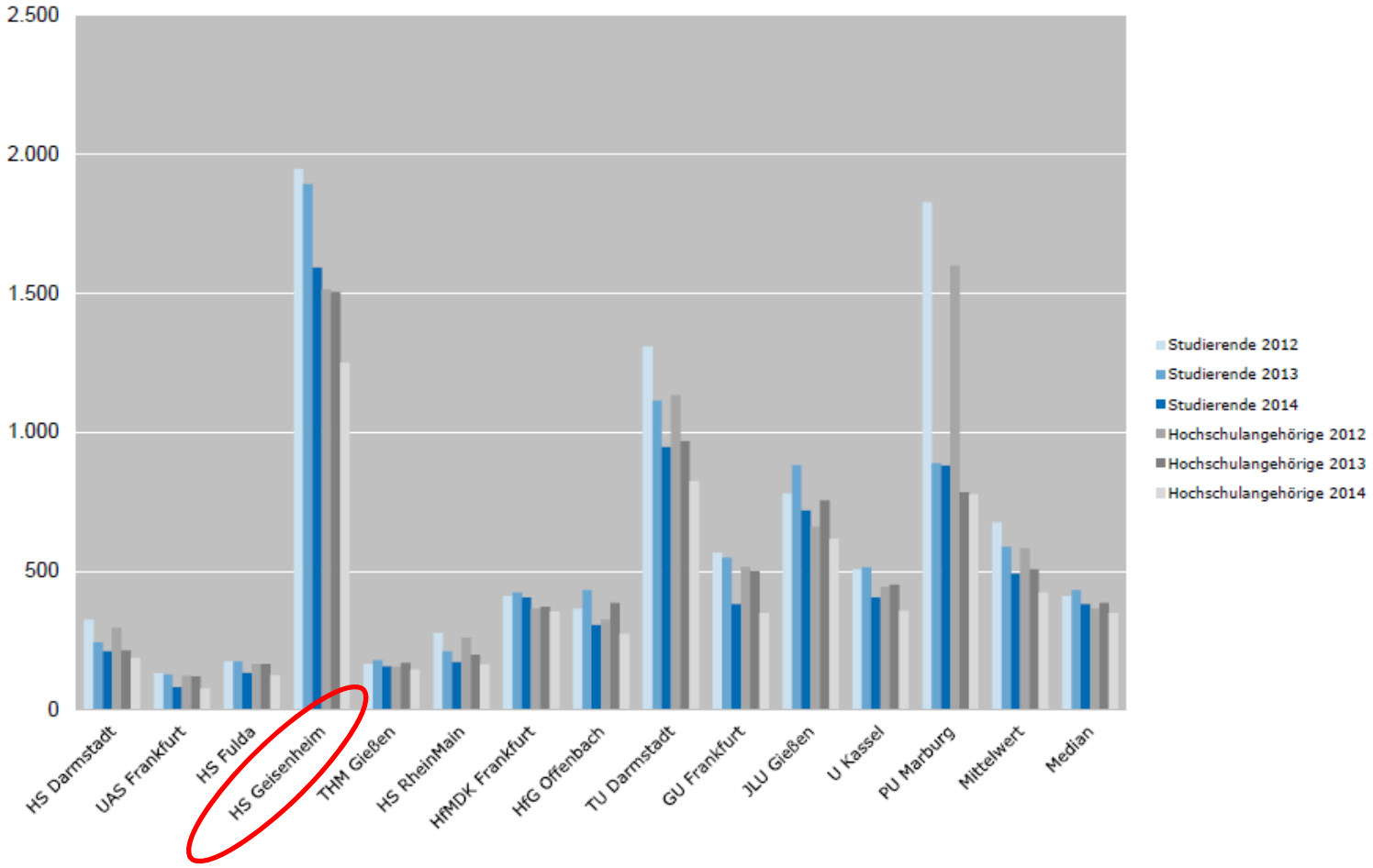
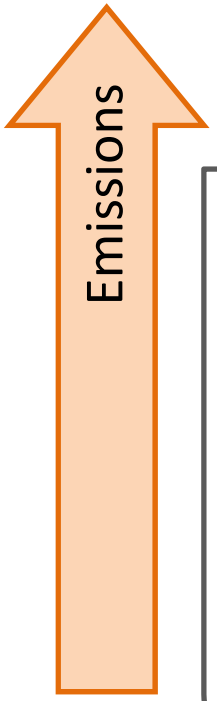


Abb. 20 Kennwerte für spezifische CO_2-Emission [Bezugsgröße: Studierende bzw. Hochschulangehörige]

HIS-HE CO_2 Bilanzen Hessen 2014

Balance



Indirect

- Thermal & electrical energy demand of greenhouses

Direct

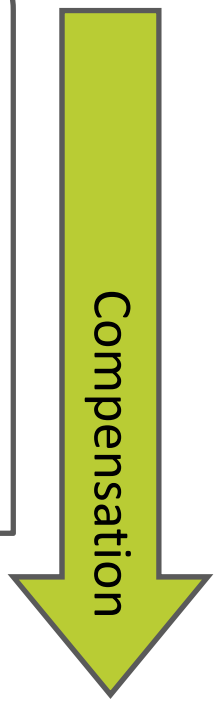
- CO_2 emissions from FACE

Energy mgmt

- Renewable Energies
- Domestic production

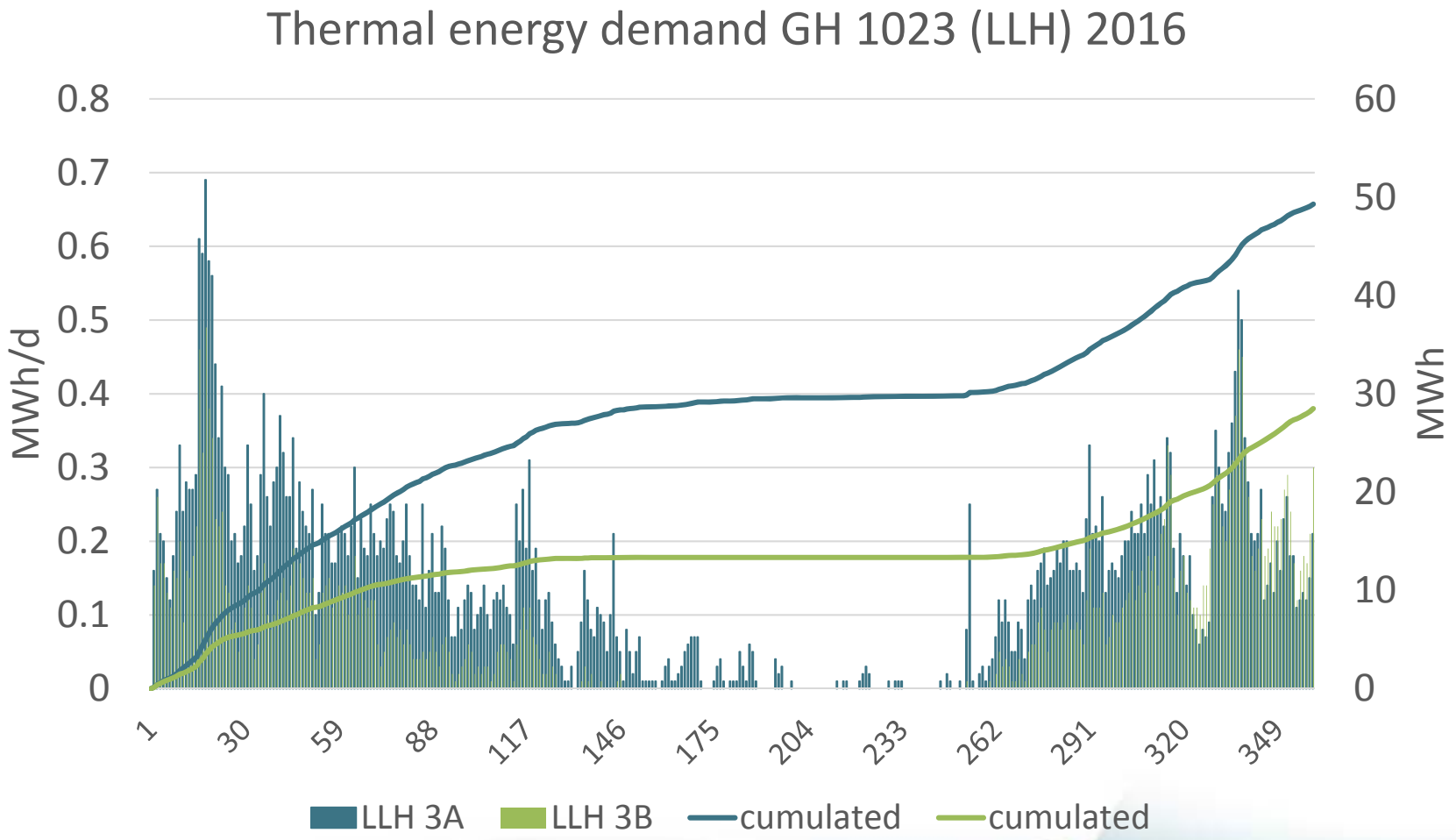
Material use

- Biomass carbonisation
- Accounting of positive side effects

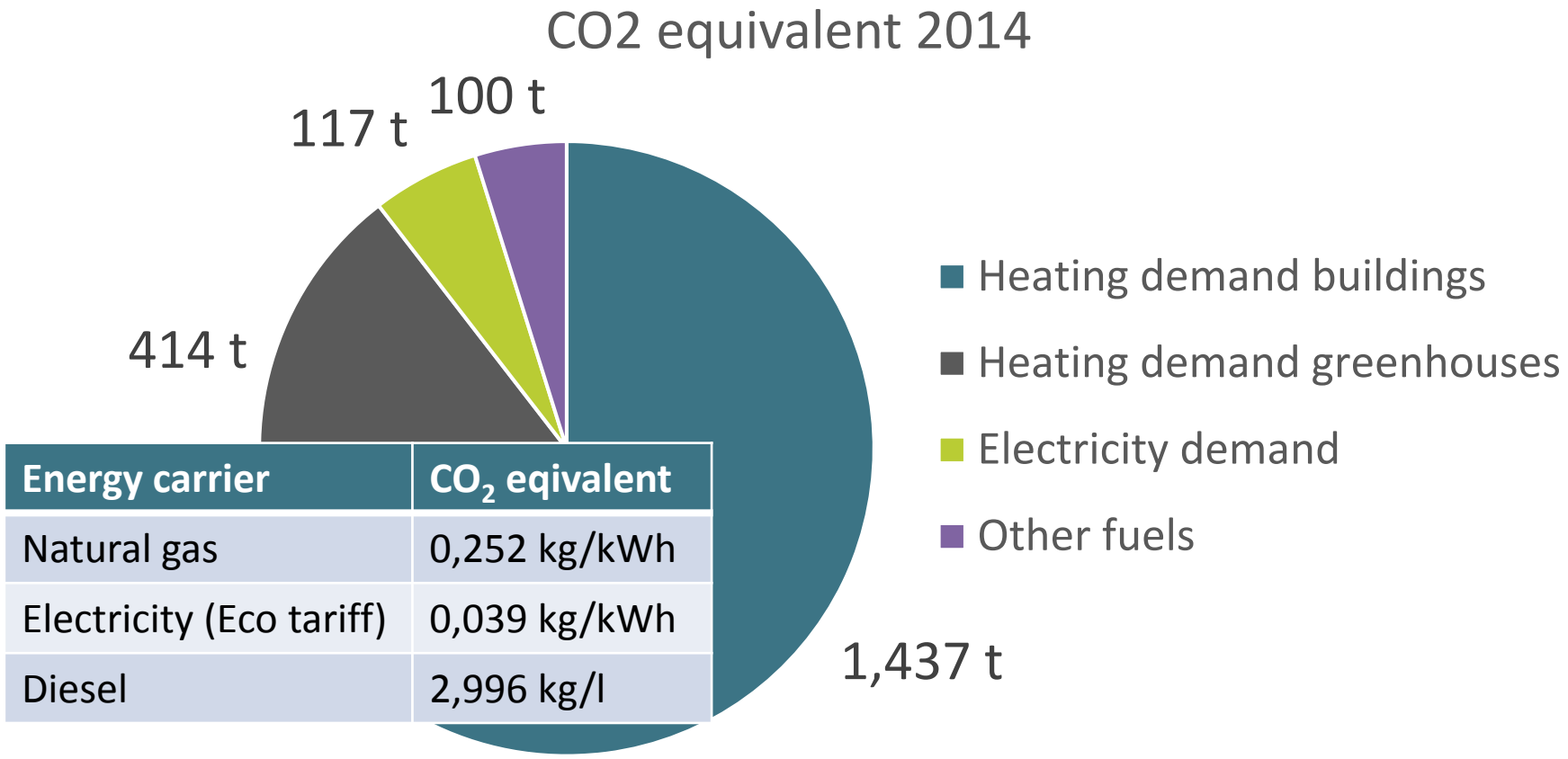


Das ist eine Folie um die Überleitung zur nächsten Seite ein bisschen sanfter zu gestalten, kommt bei Zeitknappheit raus

greenhouse heating demand curve



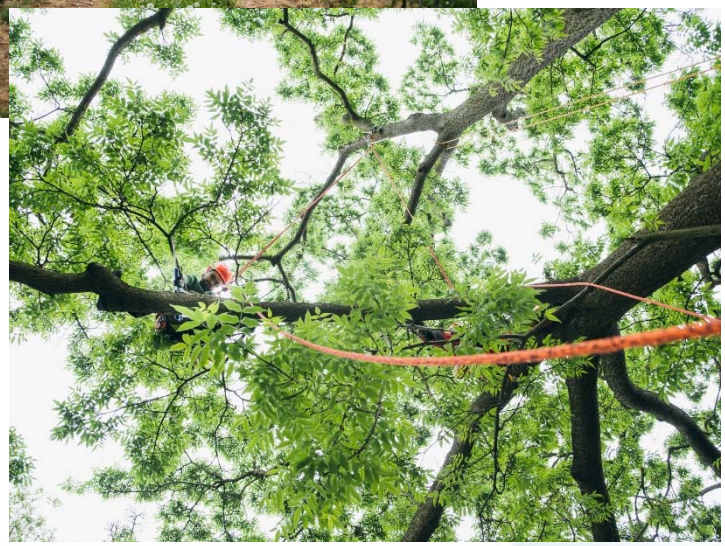
Carbon Balance HGU



Energy carrier	CO_2 eqivalent
Natural gas	0,252 kg/kWh
Electricity (Eco tariff)	0,039 kg/kWh
Diesel	2,996 kg/l

Total: 2.068 t

Biomass potential



Cultivation areas

- Grapevine: 24 ha
- Breeding: 10 ha
- Fruit orchards: 10 ha
  - Apple, Cherry, Pear
- Parks: 5 ha

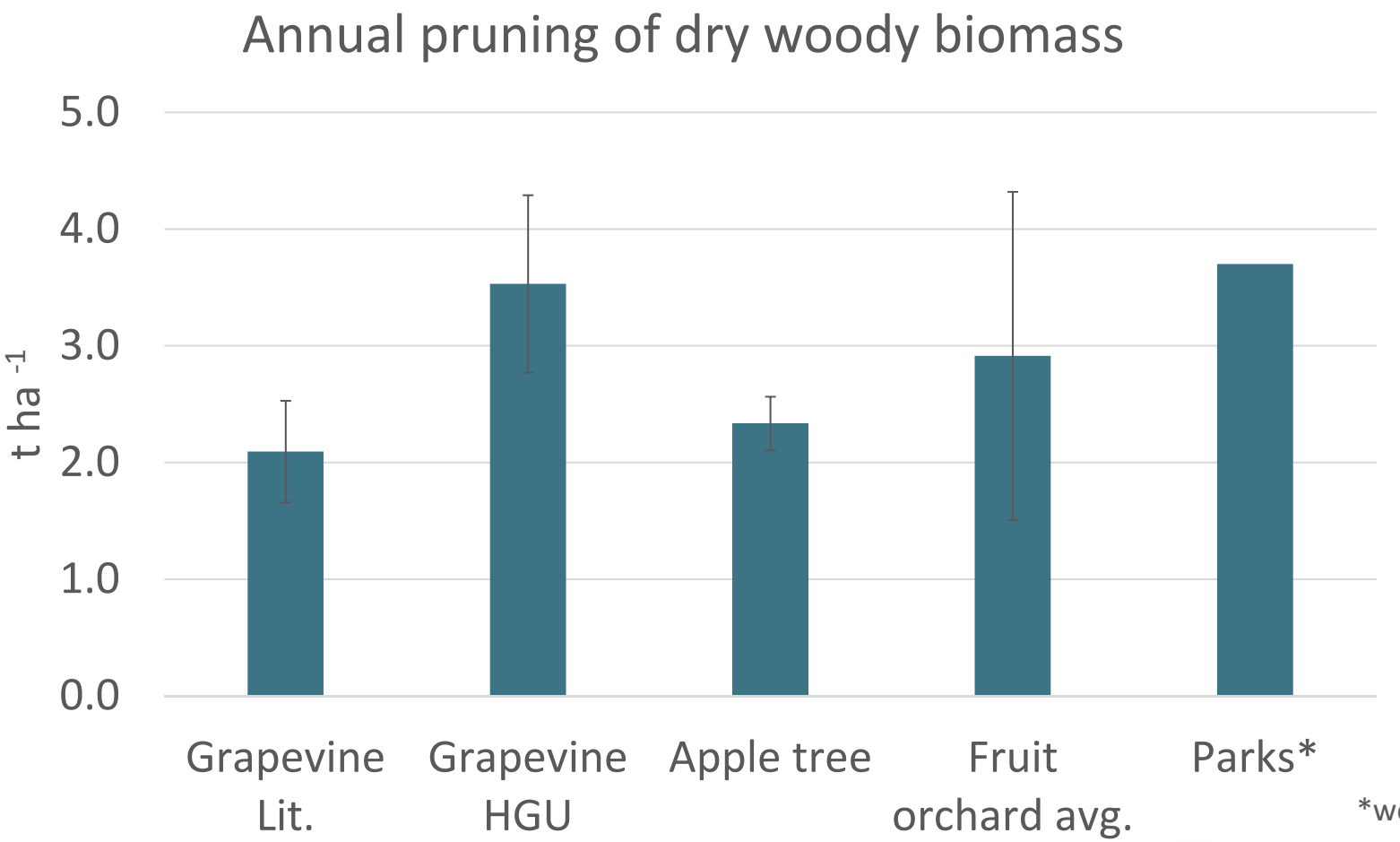
Type of biomass

- Woody/leafy

Seasonality

- Regular prunings
- Perennials with different standing times

Biomass accounting



*wood and leaf

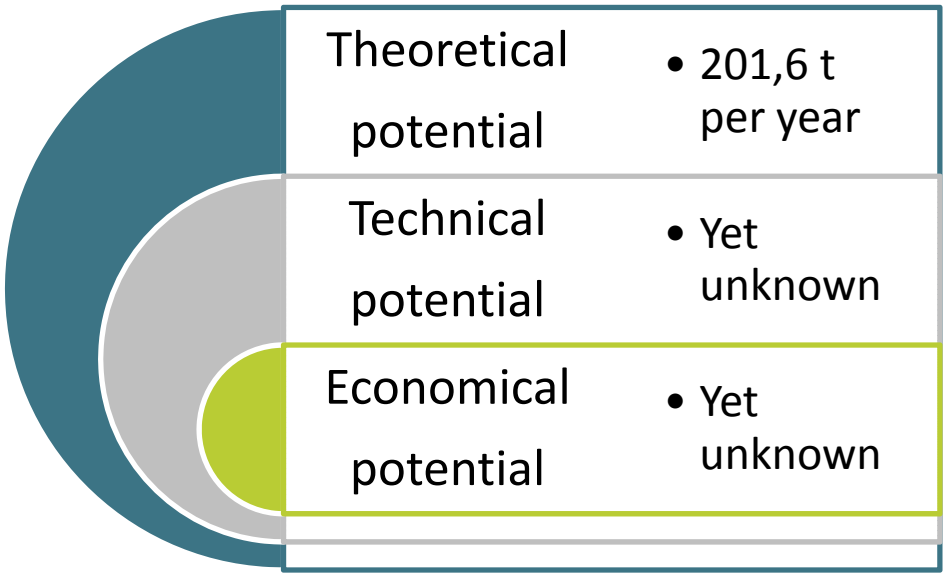
Sources: HGU (Blank 2016), Duca 2016, Jäger et al. 2016, Velazquez-Mari et al. 2013, Grella et al. 2013)

Biomass accounting

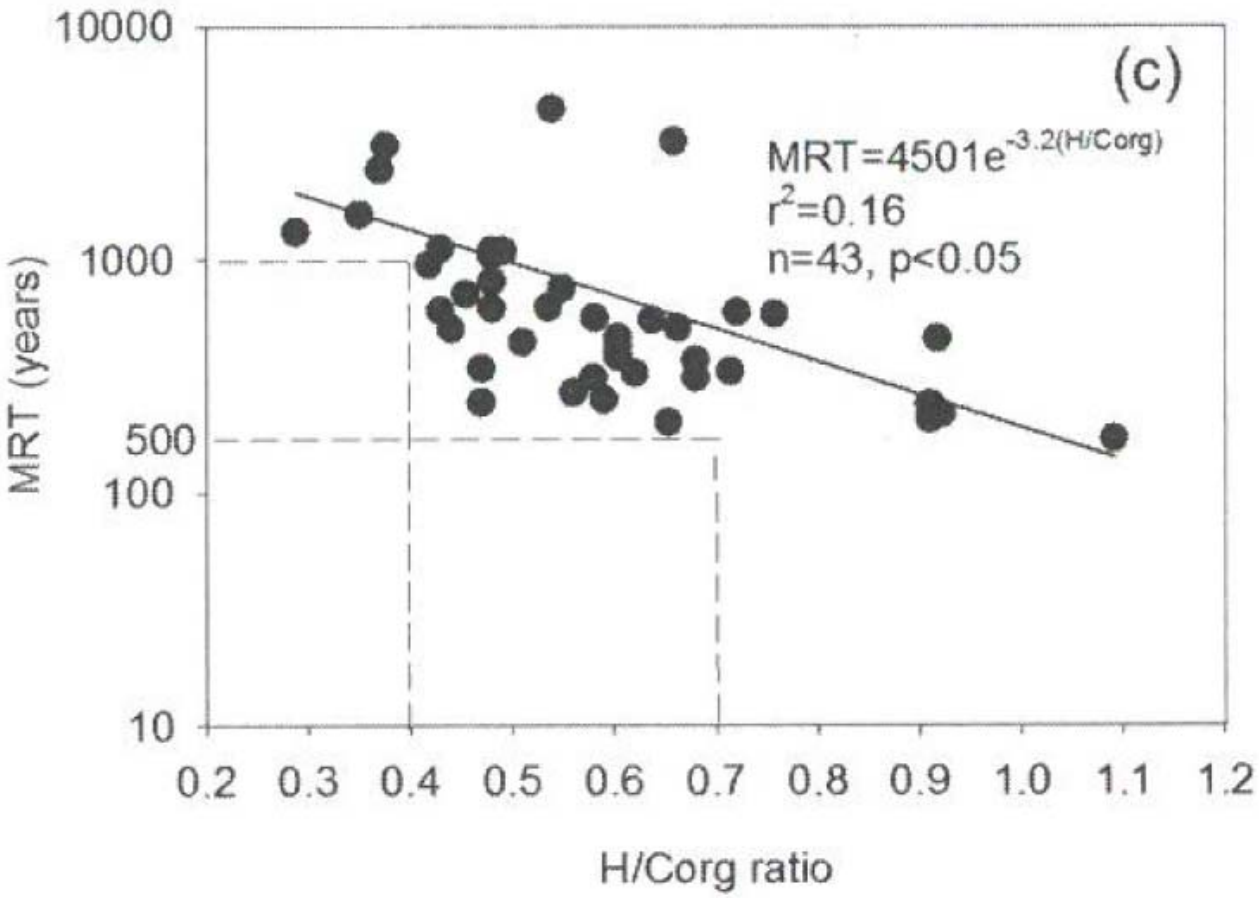
Cultivation area	Area (ha)	Pruning (t y^{-1})	Clearing cycle (y)	Clearing BM (t $^{-cycle}$)	Clearing BM (t y^{-1})	Annual emergence (t)
Vinyard	24	3,53	30	13,5	11,17	95,89
Orchards	10	2,91	10	25	27,78	56,92
grapevine breeding	12	1,77	15	10	8,57	29,75
Parks*	5	3,70	--	--	--	18,50
					dry biomass (t)	**201,06**

Sources: HGU, Duca 2016, Jäger et al. 2016, Velazquez-Mari et al. 2013, Grella et al. 2013

Biomass accounting

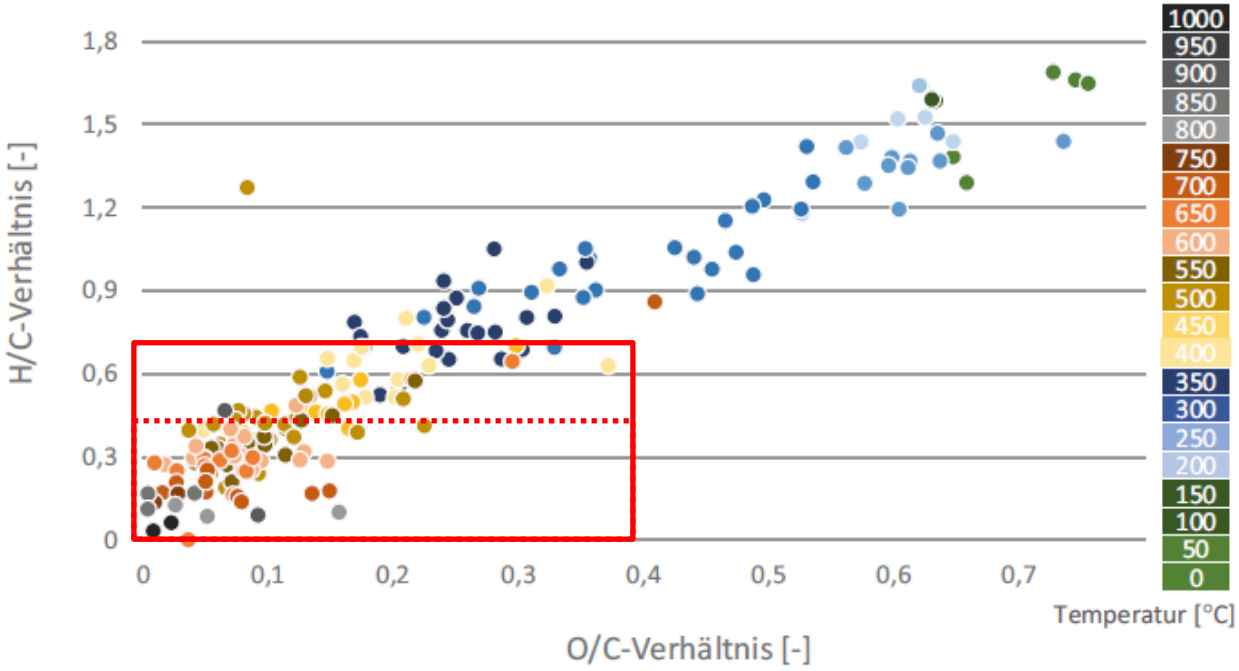


Physical aspects



Source: Lehmann et al. 2015

Physical aspects



— European Biochar Certificate threshold

⋯ Own required threshold

Source: Quicker, Weber 2016

Biomass conversion paths

	Kon-Tiki	Pyreg	TCR
Type of Biomass	Grapewood		
Input Biomass (dm)	201,06		
Biochar yield	25,0%		
C-Content	82,2%		
H/C ratio	0,14		
t C per year	41,3		
t CO_2 eq.	**151,6**		
Comment	No energy extraction		

Sources: Conrelissen et al. 2016; Eurofins 2017; https://www.biochar-journal.org/en/ct/39-Kon-Tiki-the-democratization-of-biochar-production

Biomass conversion paths

	Kon-Tiki	Pyreg	TCR
Type of Biomass	Grapewood	Wood chips	
Input Biomass (dm)	201,06	201,06	
Biochar yield	25,0%	24,0%	
C-Content	82,2%	77,4%	
H/C ratio	0,14	0,21	
t C per year	41,3	37,3	
t CO_2 eq.	**151,6**	**137,1**	
Comment	No energy extraction	Heat extraction	

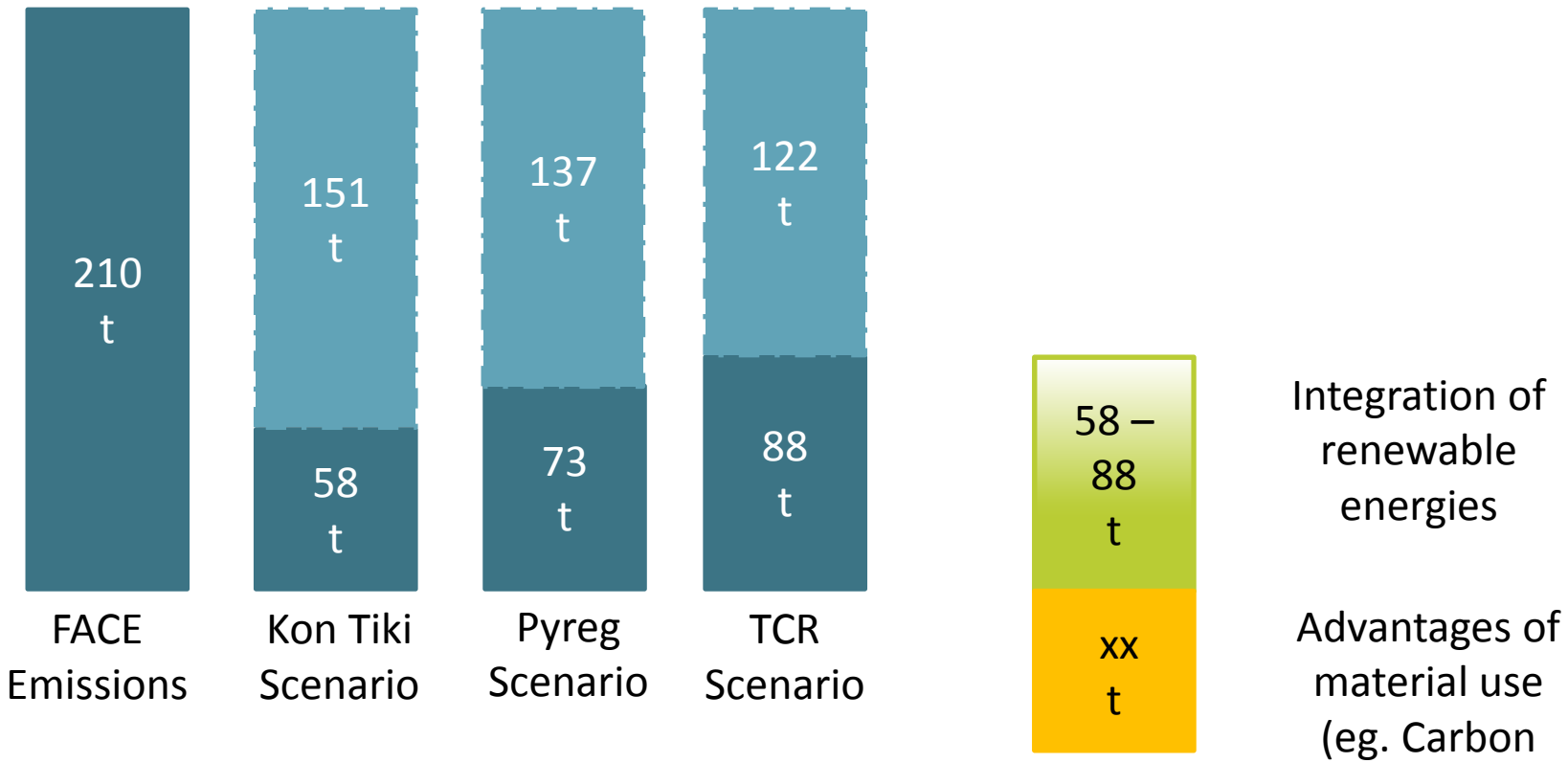
Sources: HGU; Pyreg; Jäger et al. 2016; Quicker, Weber 2016

Biomass conversion paths

	Kon-Tiki	Pyreg	TCR
Type of Biomass	Grapewood	unknown	Grape prunings
Input Biomass (dm)	201,06	201,06	201,06
Biochar yield	25,0%	24,0%	23,4%
C-Content	82,2%	77,4%	70,8%
H/C ratio	0,14	0,21	0,17
t C per year	41,3	37,3	33,3
t CO_2 eq.	**151,6**	**137,1**	**122,2**
Comment	No energy extraction	Heat extraction	Heat and electricity extr.

Sources: Jäger et al. 2016; https://susteentechnologiesgmbh-public.sharepoint.com/

Compensation „gap“



Conclusion:

Carbonization is one, but not the only measure!

Material and energy streams need appropriate management!

We (and I especially) have to hurry!

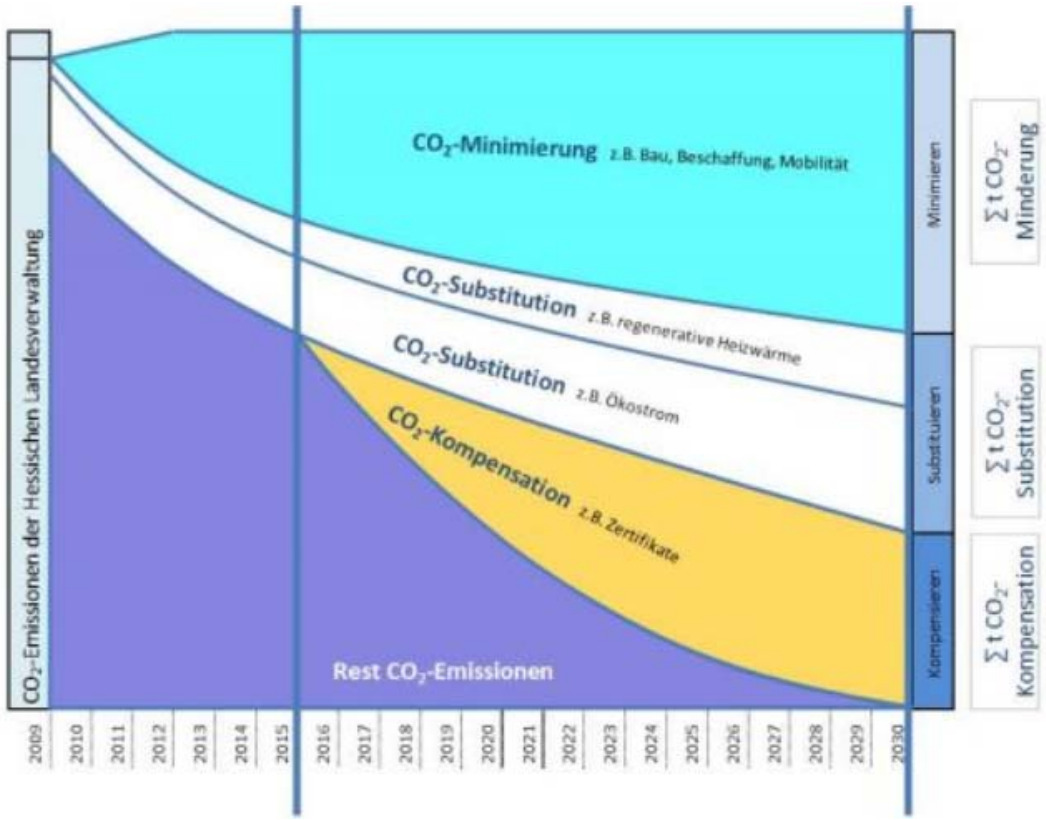
Thank you for your attention!

Your questions please!

Backup

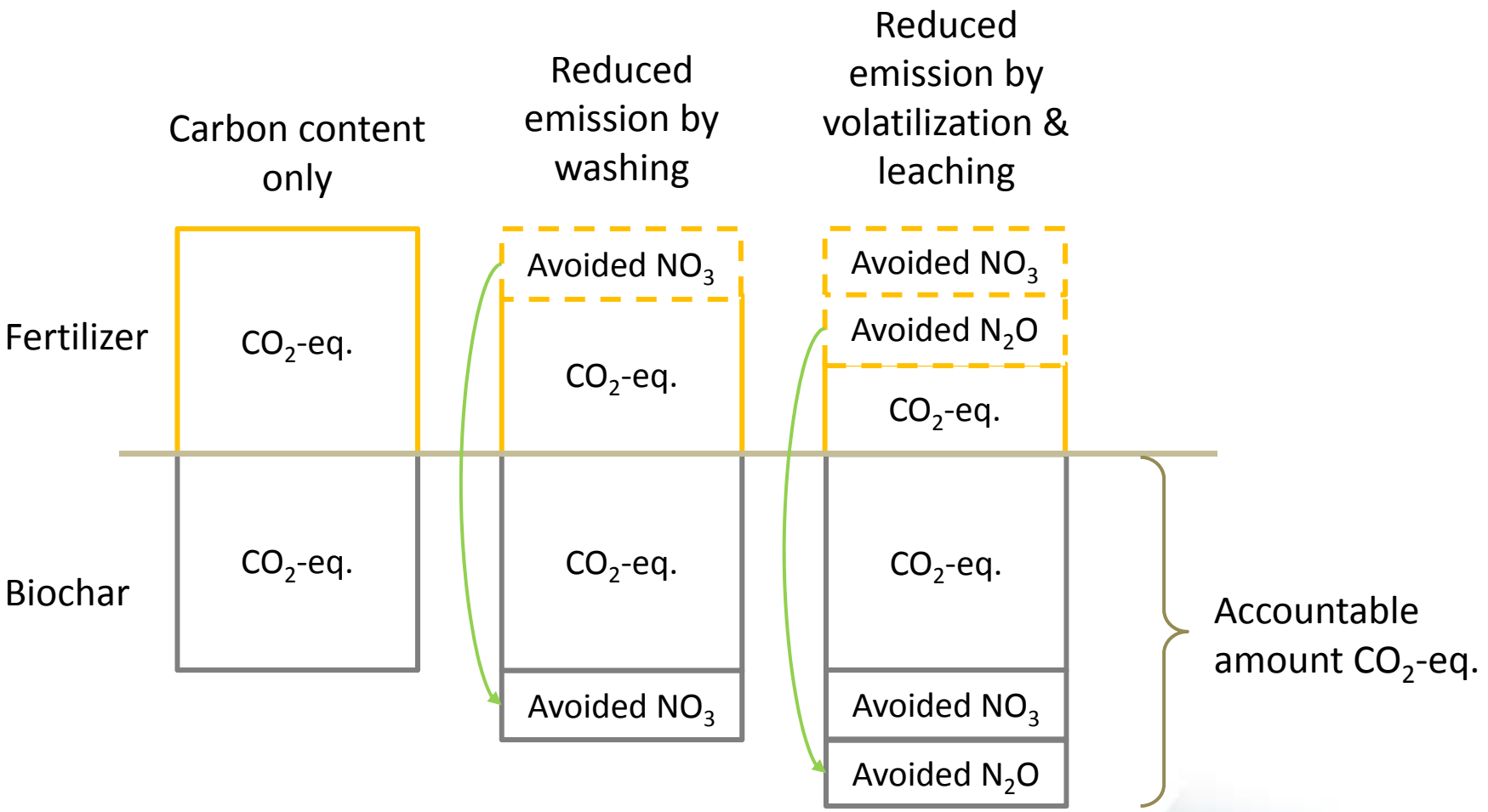
Tree pillars of the CO2-neutral Hesse administration

- Minimizing
- Substitution
- Compensation



http://co2.hessen-nachhaltig.de/de/projektstrategie.html

Approach to improve carbon balance



Resume

- Only consideration of high temperature pyrolysis techniques
- Small to medium scale sized
  - depending on demand and supply
- Stabilization and increase of carbon content of the soil
  - Persistence >100 years,
- Hard to evaluate
  - Improved hygenization of the biomass