Potentials for realizing negative carbon emissions using forest biomass and subsequent biochar recycling - FOREBIOM

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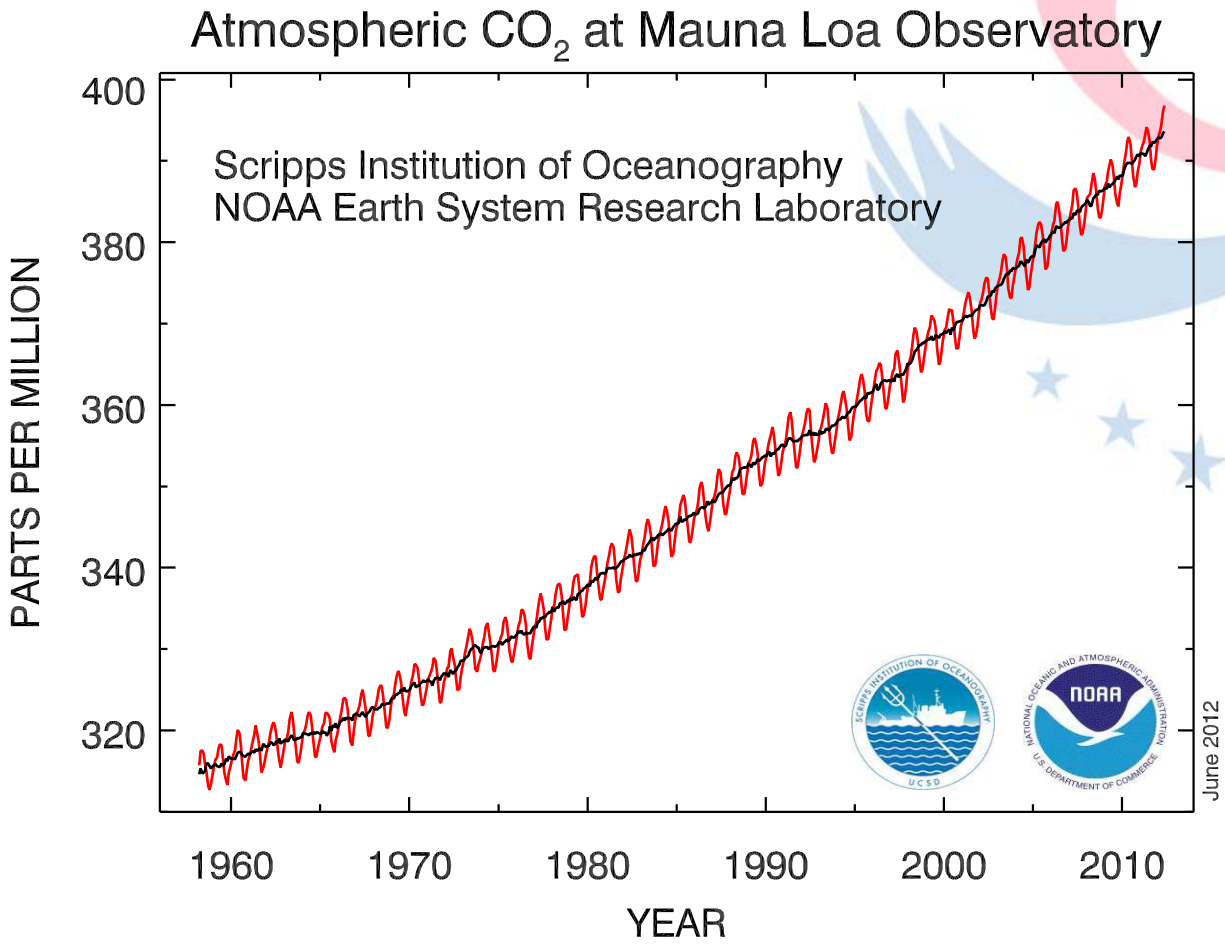
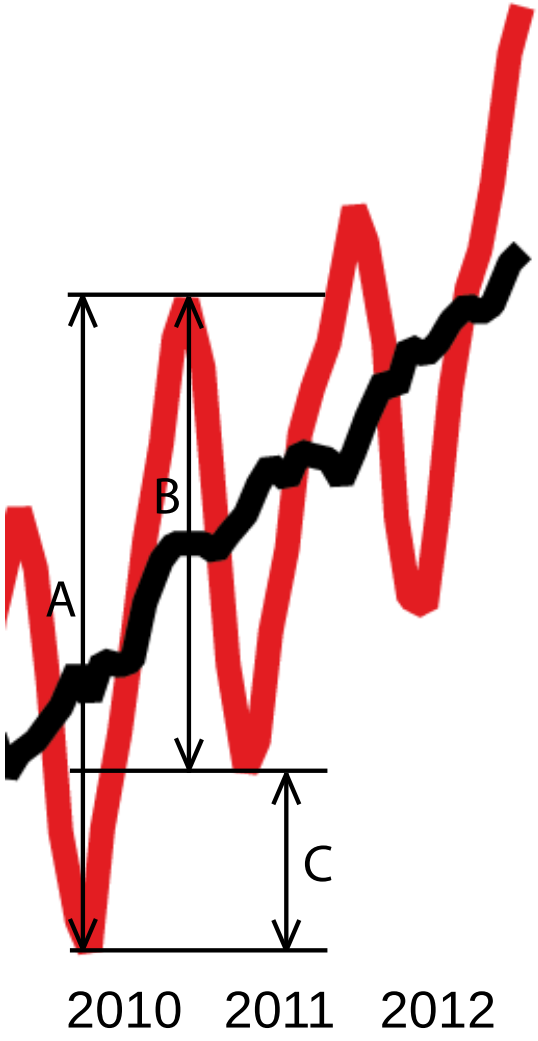
General background

- Increasing demands on Energy, renewable sources, decarbonization…
- Forests play an important role in all member countries (source for raw materials, social and cultural value)
  - 65% forest cover in South Korea
  - 48% forest cover in Austria
  - 26% forest cover in Turkey, but 17.1% gain between 1990 and 2010
- 2010 IUFRO commitment to the “important role of forests for future generations”
  - Forest Bioenergy as one of the six key thematic areas for future development
  - Taskforce “Forest Bioenergy”

The grand problem





Vegetational fingerprint

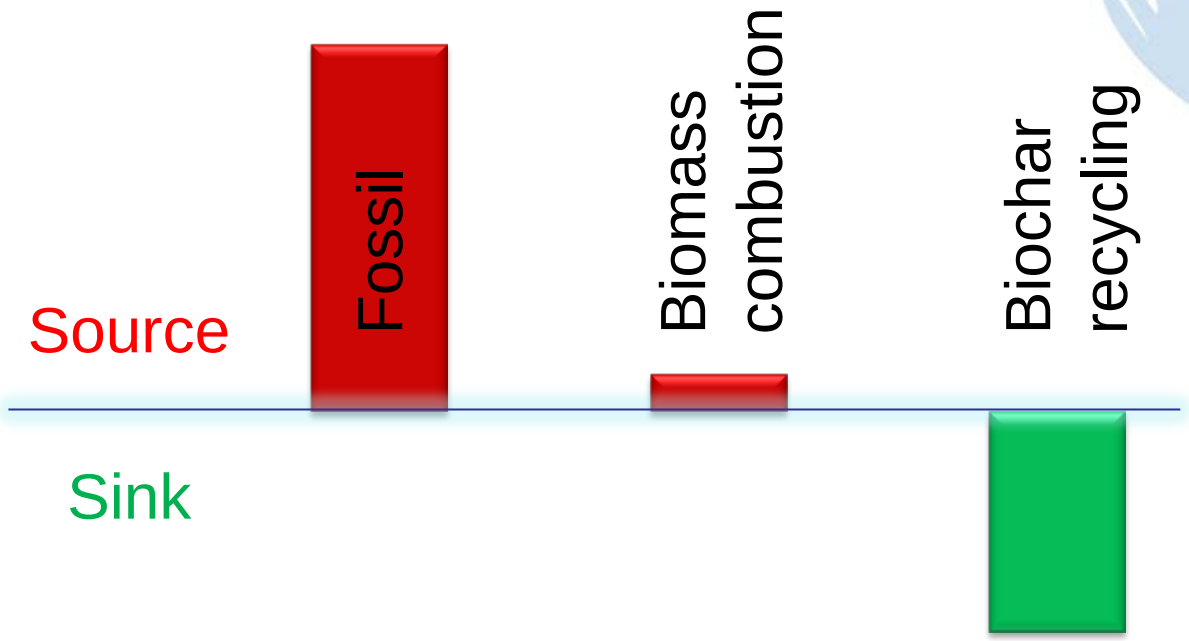
- Annual variations of atmospheric CO_2 indicates importance of vegetation in carbon sequestration
  - Sequestration of northern hemisphere causes a significant reduction (B) during vegetation period
  - Surplus of atmospheric CO_2 (C) causes steady increase in concentrations
- Forests are by far the most important terrestrial C sink

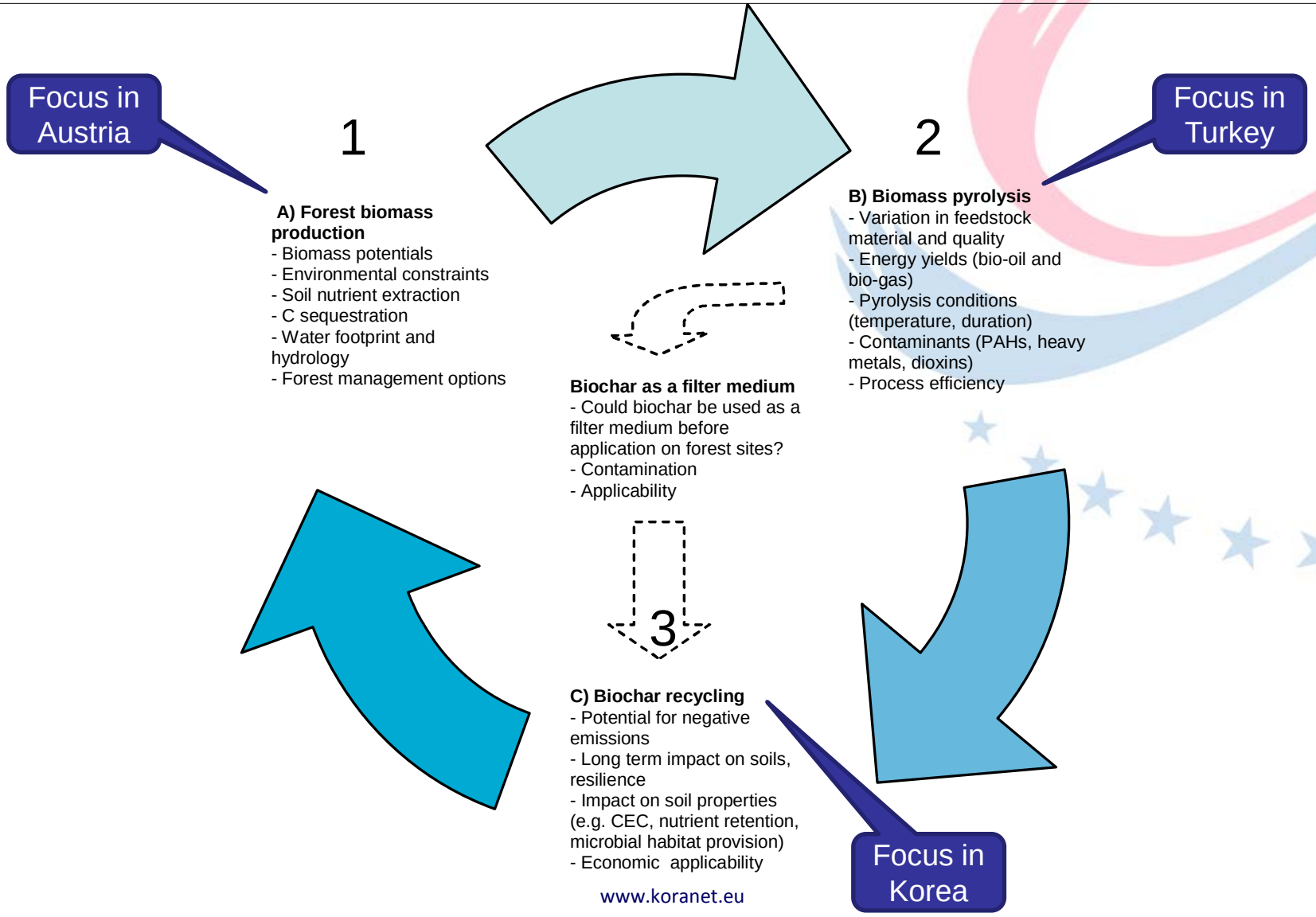
Three arguments for the proposed approach

1. Substitution of fossil fuels with renewable resources (biomass)
   - No additional CO_2 emissions
   - Local added value, „green jobs“, valorization of rural areas, Independent of global price fluctuations, higher resilience of energy provision systems
2. C fixation during pyrolysis of woody biomass
   - Charcoal (biochar) remains in the reactor – carbon compartments
   - Pyrolysis oil/gas can be used as source for energy (compatible to existing infrastructure)
3. Recycling of biochar as a soil amendment
   - Significantly increases soil properties and fertility
   - Consequently increases productivity and therefore CO_2 sequestration

1. **Forest biomass production**
2. **Biomass pyrolysis**
3. **Biochar recycling**

CO_2 emission scenarios




Focus in Austria
1
A) Forest biomass production
- Biomass potentials
- Environmental constraints
- Soil nutrient extraction
- C sequestration
- Water footprint and hydrology
- Forest management options
2
Focus in Turkey
B) Biomass pyrolysis
- Variation in feedstock material and quality
- Energy yields (bio-oil and bio-gas)
- Pyrolysis conditions (temperature, duration)
- Contaminants (PAHs, heavy metals, dioxins)
- Process efficiency
Biochar as a filter medium
- Could biochar be used as a filter medium before application on forest sites?
- Contamination
- Applicability
3
C) Biochar recycling
- Potential for negative emissions
- Long term impact on soils, resilience
- Impact on soil properties (e.g. CEC, nutrient retention, microbial habitat provision)
- Economic applicability
Focus in Korea

Learning from ancient practices

Oxisol | Terra Preta

Source: Bruno Glaser

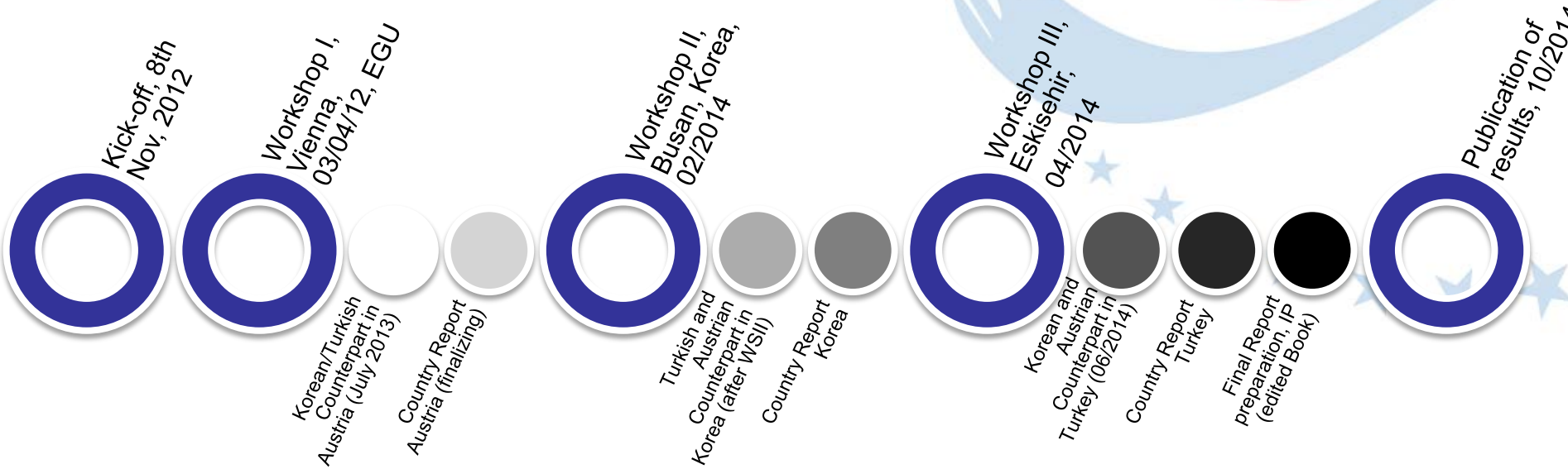
Objectives

- Combination of current state-of-the-art knowledge of each of the three steps
- Organization of scientific workshop series with keynote lectures and posters
- Supporting small-scale laboratory experiments with involvement of scientific mobility for early-stage researchers
- Publication of country case reports (in cooperation with IUFRO)
- Summary report (edited book, Interdisciplinary Perspectives series)
- Establishment of an on-line dossier (further reading, reports, project information…)
- Desicion support system focussing on criteria for the steps

The challenges

- Forest Biomass production
  - Biomass availability (sustainable amounts, demand of other industries, harvesting costs, problems of mobilization)
  - Ecological impacts (nutrient extraction, biodiversity loss, hydrological aspects, soil biogeochemical implications)
- Biomass pyrolysis
  - Optimal pyrolysis conditions (temperature, time, water content)
  - Feedstock material (physical and chemical composition of different plant species)
  - Contamination (PAHs, VOCs, dioxins…)
  - Costs (expected to decrease as a consequence of technological progress and proliferation)
- Biochar recycling
  - (Long-term) Recalcitrance of biochar against decomposition
  - Sudden change of soil chemical properties (pH, N limitation…)
  - Increasing rates of hetherotrophic soil respiration

Project Milestones



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