Biomass in Austria & European Policies

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What is Biomass?

- Is a product from photosynthesis
  - Counted as annual biomass per unit area
- Annual biomass varies from year to year
  - See tree rings on the right
- And from place to place
  - Particular conditions vary

http://www.detectingdesign.com/images/Dendrochronology/TreeRings3.jpg

What is Biomass according to EU definition?

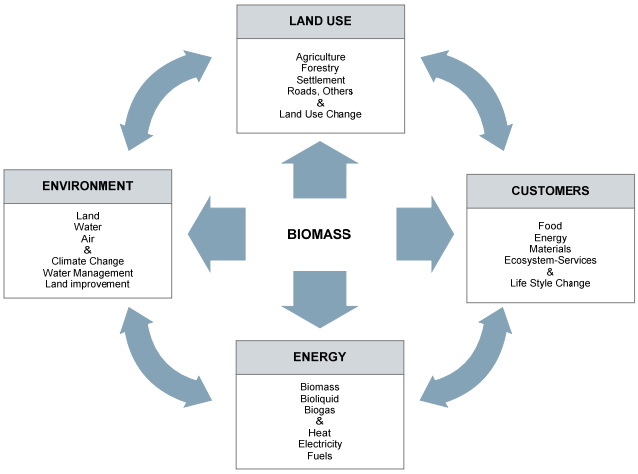
Biomass is derived from different types of organic matter: energy plants (oilseeds, plants containing sugar) and forestry, agricultural or urban waste including wood and household waste. Biomass can be used for heating, for producing electricity and for transport biofuels.

- Source: European Comission 2008, Renewables make the difference

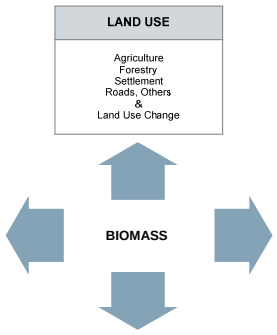
Presentation has four parts

- Biomass and Land Use (Producer perspective)
  - Explanation on biomass and factors of influence
- Biomass and Customers (Consumer perspective)
  - Austrian biomass policy
  - Benefits of biomass use as promoted by Austrian biomass association
- How important can biomass become? (Energy perspective)
  - Future role of biomass in European and global energy and resource demand
- Biomass and its role in climate change and global/regional environment

Biomass interaction in four interconnected fields



Part 1: Biomass and Land Use



Biomass and Land Use

- In many European countries decline of agriculture
  - More food is imported
  - Agricultural work does not provide sufficient income
- Forestry has longer time scales than agriculture
  - Less annual work and less annual income
  - Even forest management is getting less intensive
- New land use energy forest emerged
  - In between agriculture and forestry
    - After 10 years of growth, forest is harvested
    - Combines element of agriculture and forestry

What is biomass from land use point of view

- Unmanaged wilderness
  - Increase in developed countries when previous forest or agricultural land is no longer used
  - Connected to decline in working population of primary sector
  - From economic viewpoint understandable
  - Impairs a lot of risks to the provision of known services
- Marginal unused land became an important issue in most OECD countries
  - Biomass and bio-energy became an answer to this problem
    - assumingly solve the problem and put it into a favorable light
- If transport from remote areas is considered biomass is less favorable energy alternative
  - Did not find studies to cite this

Variations of biomass in altitude: Jugoviz observation 1908

- Growth of pinus cembra
  - Stand alone fertilized 1080m (1)
  - Stand alone stormfree 1650m (2)
  - In mixed forest stand 1350m (3)
  - Stand exposed to storm in group 1650m (4)
  - Stand exposed to storm alone 1650m (5)
  - Stand exposed to storm close to timberline 1900m (6)

J. Liebig 1855 defined factors of minimum

- Basic conditions at a location
  - Water
  - Sunshine/Temperature
  - Topology/Relief/Exposure to Weather
  - Soils
  - Minerals
- One factor is always in minimum and limits the production of biomass
  - Perhaps even two or more factors limit biomass growth
  - Land improvement is possible by inputs compensating the deficiencies
    - Irrigation against water scarcity
    - Fertilizer against lacking minerals
    - Wind protection fences to protect against erosion
    - Others

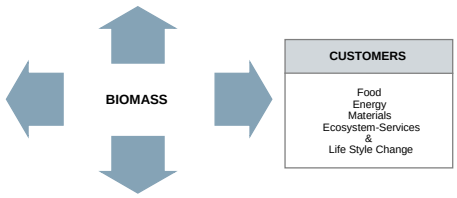
Available inputs to increase biomass

- Contributed resources in agriculture and forestry
  - Imported natural resources
    - Fertilizers
    - Pestizides
    - Energy
  - Human resources
    - Working hours available in agriculture
    - In Japan the labor input is less than 10% of what was usual 40 years ago

Biomass also expresses low value products of agriculture and forestry

- Previously term biomass was not used
  - Everything was used as no imports were possible
    - No “mass” remained
  - Quality aspects of cultivars are not an issue here
- A lot of waste is turned into a positive product
  - Avoiding waste should be better
  - The energy used to produce the organic waste cannot be regained by producing energy from waste
  - Studies to quantify this are needed
- Life Cycle Assessment LCA and Life Cycle Impact Assessment LCIA are well developed tools.
  - Alternatives to biomass use have to be regarded simultanously
  - Learn about resource performance of other options

Part 2: Customers, examples from Austria



Biomass and Customers (i)

- Biomass and Customers
- In rich countries oversupply of food
  - Some 50% of food produced will become waste
  - Food waste can be used as biogas and bio-liquids
  - Large portion of food is imported and does not relate to own land use
- There is limited supply of energy
  - Demand of energy sector is further growing
  - Food waste energy content can compensate for a certain – however limited – amount

Recycled food waste in Bruck

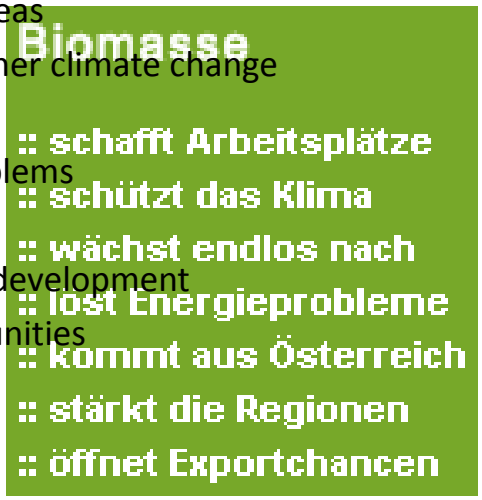
Biomass and Customers (ii)

- Materials
  - Wood is a building and storage material
  - Tatami mats and other rice residual products
  - In general biomass products have an image of “healthy”
- Ecosystem services
  - High demand of biomass helps also other purposes
    - Better land management
    - Water purification
    - Soil erosion protection
    - Less flood risk
  - Biomass rich areas can hold water longer in landscape
    - Intensification of organic processes and microbial life

Biomass is supposed to….

- Create jobs in rural areas
- Can protect from further climate change
- Is infinitely renewable
- Can solve energy problems
- Comes from Austria
- Strengthens regional development
- Opens export opportunities

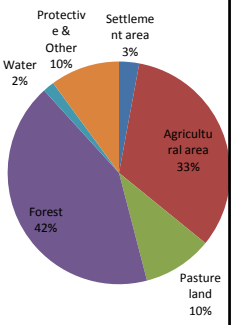
Even if only half of this is true one should think more about biomass and analyze the connection to rural areas



Source: www.biomasseverband.at

Create jobs in rural areas (i)

- The forest area is growing in Austria
  - Forest contains most biomass per ha
  - Grows at the expense of marginal agricultural land
  - In remote areas forestation is perhaps not profitable
- Maximum biomass production
  - Mixture between agriculture and forestry
  - Biomass harvested after 10 years
    - Special arrangement of forest plantation
    - Less labor than in agriculture



Create jobs in rural areas (ii)

- Dialogue within region
  - Cities use their surroundings again more intensively
  - Rural areas become to some extend reintegrated via energy policy
  - No competition with the competitive food production market
  - Shares in biomass business are not yet balanced out

Create jobs in rural areas (iii)

- New fields of technology opened
  - Biomass electricity plant for some 100,000 people operates in Vienna since 2006
  - Distance heating systems based on biomass is used for some 25,000 people
  - Majority of installations are small scale biomass units for schools, public buildings and villages with 100 to 1000 inhabitants
- Financial support has to be available
  - to be competitive to other energy sources

Biomass can protect from further climate change ?

- EU Directive on Energy End-use Efficiency and Energy Services
  - National Energy Efficiency Action Plans
    - obligation to make national energy efficiency action plans.
    - The first plans were due by the end of June 2007
    - How the countries will realize a 9% reduction in final energy consumption until 2016?
      - http://www.inforse.dk/europe/Vision2050.htm

Biomass can protect from further climate change: RES Initiative

- In 2010 Austria is supposed to get 24% of all energy from renewable
  - Biomass is one out of five major sources for renewable energy systems (RES)
    - Wind
    - Geothermal
    - Solar
    - Photovoltaic
- In 2040 Austria should supply 34% of energy from renewable

Biomass can protect from further climate change

- In rural areas it was the main energy source.
  - Could again become the main energy source
  - Fuel wood is consumed close to the place where it was growing
- In cities the use of biomass has to remain limited at current consumption levels
  - Vienna has the largest biomass plant that can however only contribute to 5% of the needed energy
  - Problem with supply of cheap wood
    - Comes today from Slovakia and Hungary
    - Additional transport costs

Biomass is infinitely renewable?

- Globally, we have a reduction of biomass
  - Deforestation processes are considered to be responsible for climate change with 18%
  - CO2 stored in forests gets released after cutting
  - Avoiding further deforestation globally is more productive than afforest land in Austria
  - From local point of view, potential for more biomass can be used
  - There is already today a shortage of affordable (cheap) biomass in Austria -> limits the use of biomass

Example A: The Biomass Electricity Plant Vienna

Biomass Electricity Plant Vienna

Inside Biomass Electricity Plant Vienna

Example B: Energiepark Bruck (zero emission village)

- In Bruck efforts were done to demonstrate zero emissions
  - Regardless the costs
    - Support from provincial government of Lower Austria
    - Several research projects are centered in Bruck
  - More than 5000 inhabitants have negative CO2 balance
    - Use of renewable energy technics at maximum
      - Biomass is just one option out of several
      - Is embedded in overall concept
    - Wind electricity generation and export of energy
    - Cooperation with leading universities TU Wien and BOKU

Example B: Energiepark Bruck (Biomass heating plant)

Biomasse Fernwärme Bruck an der Leitha

Der Mensch versucht seit langem, die Sonnenwärme des Sommers für kalte Wintemächte zu speichern. Der Einsatz von Holz macht das möglich! Holz ist bei der Verbrennung CO2-neutral, d.h. es wird nur soviel CO2 abgegeben, wie während des Wachstums eines Baumes wieder gebunden wird.

BIO-MASSE FERNWÄRME

BLFW - Fernwärme Bruck an der Leitha GmbH

Aus Gründen des Umweltschutzes sowie zur Verringerung der Abhängigkeit von fossilen Rohstoffen wurde das Biomasse Fernheizwerk Bruck an der Leitha von engagierten Landwirten aus der Region in Kooperation mit der EVN AG errichet. Die Inbetriebnahme erfolgte im Oktober 1999.

Versorgt werden neben privaten Haushalten vor allem zentrale öffentliche Gebäude. Ein Grundsatzbeschluss der Stadtgemeinde Bruck/Leitha stellt sicher, dass auch zukünftig alle öffentliche Gebäude sowie neue Siedlungsgebiete entlang der Fernwärme-Leitung an die Biomasse-Fernwärme angeschlossen werden.

Das Biomasse Fernheizwerk versorgt derzeit 1/3 aller Haushalte von Bruck/Leitha.

Investitionsvolumen	rd. €7 Mio (incl. Netzerweiterung)
Heizzentrale	Biomassekessel 1: 4.500 kW Biomassekessel 2: 1.500 kW Gaskessel (Ausfallreserve): 4.000 kW
Leitungsnetz	Länge im Endausbau: ca. 9 km
Brennstoff	Waldhackgut und Strauchschnitt aus der Region, sowie Rinde und Sägenebenprodukte
Brennstofflager	5.000 m3
Biomasseeinsatz Endausbau	ca. 6.000 to pro Jahr
Kunden	rd. 800 Haushalte (das entspricht 1/3 des Wärmebedarfes aller Brucker Haushalte)

Biomass heating plant Bruck

Zero emission village Bruck

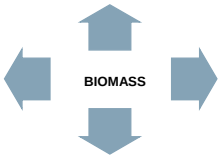
Biomass widely from own forest

Important is that biomass comes from
Local sources

Conclusion Austria

- Several advanced biomass demonstration projects available
  - Biomass already gained higher prestige
- System solution for biomass in Austria alone is difficult to obtain
- Austria gained know how as an early investor
  - Is now able to sell know how to other countries
  - Developed technologies for efficient biomass combustion

Part 3: Biomass and Energy

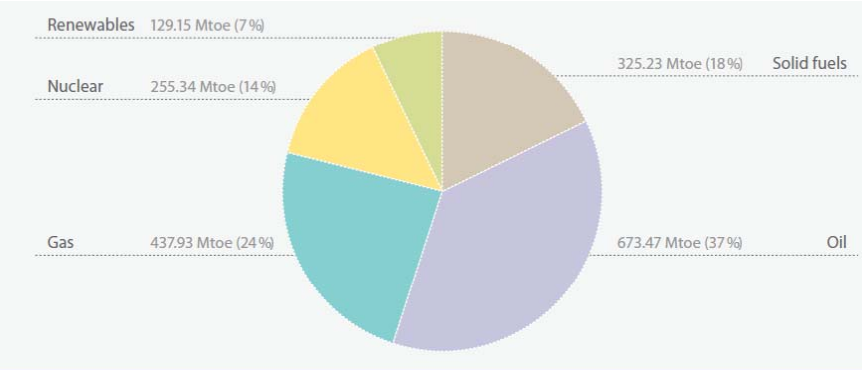


ENERGY
Biomass Bioliquid Biogas & Heat Electricity Fuels

Biomass and Energy

- Is still an emerging field
  - Biomass, bioliquids and biogas need separate technologies
    - Large efficiency gains can be expected
  - New technologies to fit
    - Biomass combustion
      - Heat generation usually tailored for demand structure of village, city
    - Biomass conversion
      - Electricity, see Vienna biomass power plant
      - Fuels, here biomass is not yet used, but in principle possible
      - Innovative technologies split wood cellulose into sugar
        - » Energy is reconverted to food (for animals at current stage)

Europe has 7% share in renewables

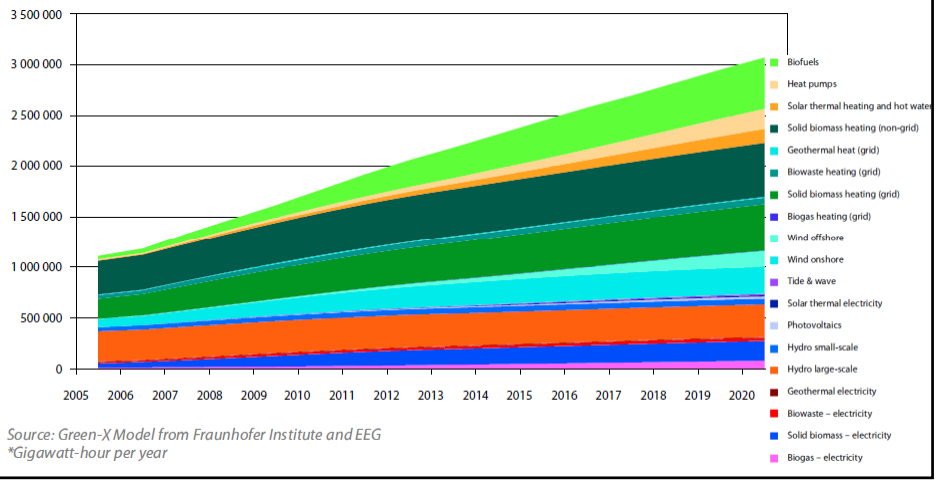


EU-27, ENERGY MIX IN 2006 (GROSS INLAND CONSUMPTION IN MTOE AND PERCENT)

Source: Eurostat 2008, in Europe"s Energy Position Present and Future, 2008

Europe aims 20% renewables by 2020

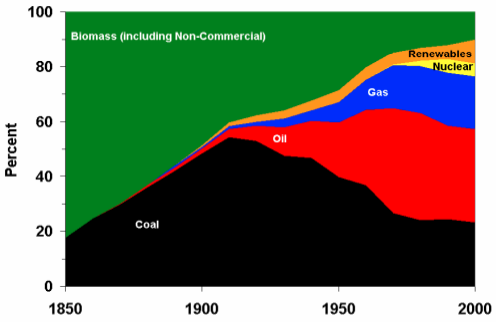
- Renewable energies are set to produce increasing amounts of electricity over coming years – with projections showing that renewable electricity output could roughly triple between 2004 and 2020.



Source: Green-X Model from Fraunhofer Institute and EEG
**Gigawatt-hour per year*

Biomass became gradually less important

- 200 years ago, all energy consumed was biomass
  - This share gradually reduced to some 5% today
- Now there are different problems
  - There is not enough biomass to satisfy energy demands
  - Technologies are not yet ready for efficient biomass use
  - Harvesting requires large labor input and other energy is still too cheap



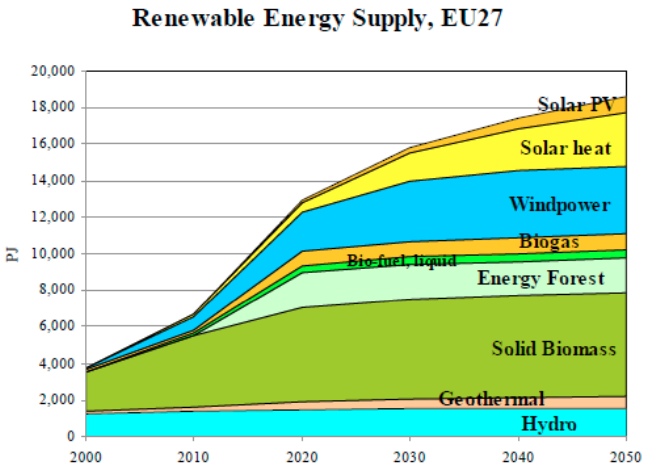
Source: N. Nakicenovik, IIASA, TU Wien, R. Haas, TU Wien 2005

Even other energy interest

Own Picture from IAEA head office Vienna UN-City

Expected growth of Renewable Energy Systems (RES)

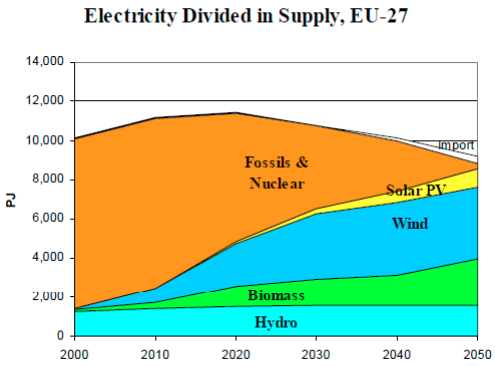
- Potential of RES
  - 4 x more in 2050
  - Biomass 2x of today
    - Relatively smaller as compared to others
  - Energy forest ready to be harvested in 2020
    - Not yet ready for use
    - Programs started recently



http://www.inforse.dk/europe/pdfs/SEN62-visionarticle.pdf

Biomass can solve electricity problems?

- Actually only contribute
  - To cut down fossil and nuclear energy uses
- Use 7% of agricultural land in Europe for solid biomass
- Additionally another 7% for liquid biomass



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New EU Directives in favor of biomass

L 114/64 EN Official Journal of the European Union 27.4.2006

DIRECTIVE 2006/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 5 April 2006

on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC

(Text with EEA relevance)

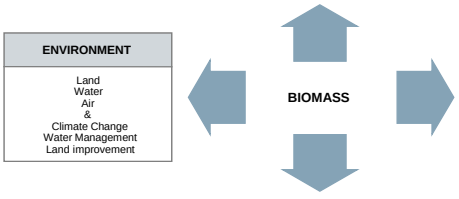
Japanese text of EC Directive, “Energy from renewable sources"

EC 指令において、「再生可能資源エネルギー」とは、再生可能な非化石資源からのエネルギー、つまり、風、太陽、地熱、エアロサーマル、熱水、海洋エネルギー、水力、バイオマス、埋立地ガス、下水処理場ガスおよびバイオガスからのエネルギーを意味する。

ここで「エアロサーマルエネルギー」とは、外気において熱の形で貯蔵されるエネルギーを意味する。「地熱エネルギー」は、固体地球の表面下に熱の形で貯蔵されるエネルギーを意味する。「熱水エネルギー」は、地表水の中に熱の形で貯蔵されるエネルギーを意味する。「バイオマス」とは、農業（植物性および動物性物質を含む）、林業および漁業と水産養殖を含む関連した産業からの生物起源の生産物、廃棄物および残留物の生物分解可能な部分、ならびに産業および一般廃棄物の生物分解可能な部分を意味する。バイオガスとは、バイオ燃料または木ガスとして使用されるために、バイオマスや廃棄物の生物分解可能な部分から生産される燃料ガスで、天然ガス品質に精製できるものを意味する。

再生可能資源エネルギーの使用についての国別全体目標が存在する。各加盟国は 2020 年におけるエネルギーの最終総消費に対する再生可能資源エネルギーのシェアがその年の再生可能資源エネルギーシェアの国別全体目標に少なくとも達するようにするべきである。これらの義務的な国別目標は、2020 年の欧州共同体の最終総エネルギー消費に対する再生可能資源エネルギーの少なくとも 20%のシェアという目標と一致している。各々の加盟国は、エネルギー効率とエネルギー節減を推進し、促すものとする。

Part 4: Biomass and Environment

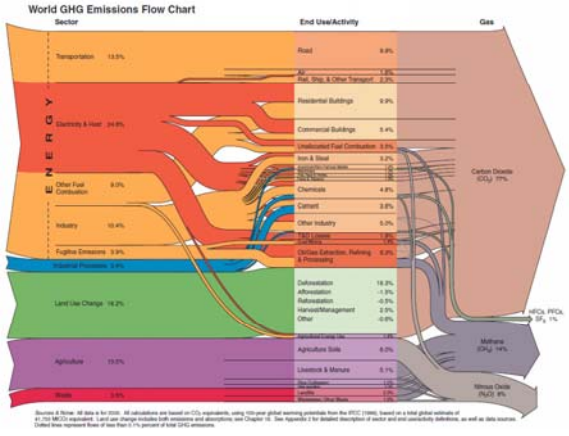


Biomass and Environment

- Climate change
  - Biomass is CO2 effective
    - Means of mitigation to climate change
      - Some 18% of GHG effect due to land conversions and depletion of CO2 stocks
    - Economically important
      - Instead of buying certificates from foreign countries
      - Measures inside the country and due to multiplication effects more income

Biomass is infinitely renewable?

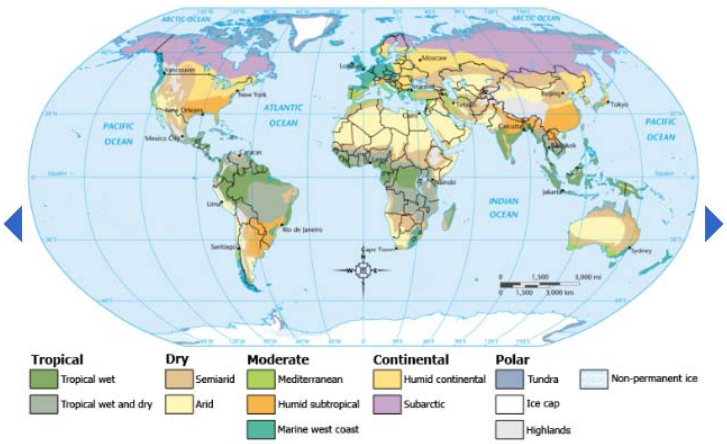
- Only if we stabilize total energy consumtion
  - Efficiency gains
  - Less per caput energy use



Source, http://pdf.wri.org/world_greenhouse_gas_emissions_flowchart.pdf

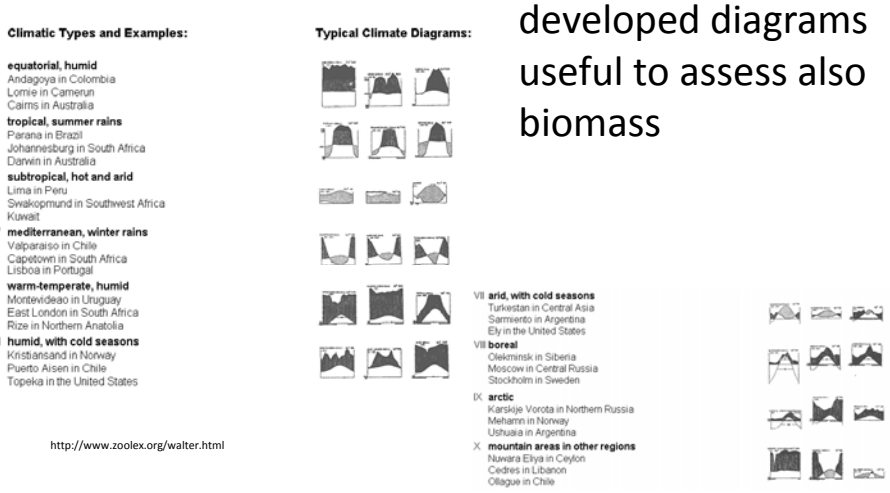
Variations of biomass in latitude

- Correlates widely with climate zones



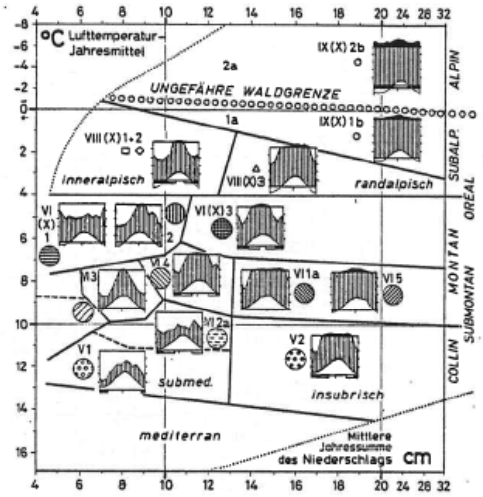
Walter Lieth schemes to assess biomass in climate zones

- Walter and Lieth developed diagrams useful to assess also biomass



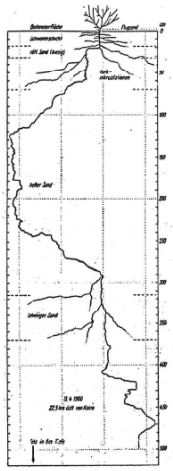
http://www.zoolex.org/walter.html

Biomass potential varies upon conditions



How much biomass can be used

- In case of a desert plant depicted
  - Hardly anything can be used for biomass production
- A certain percentage will be useful biomass
- Biomass became attractive in developed countries with declining agriculture
  - To alter request after timber
  - As an alternative on former agricultural soils



Wurzelsystem der Wüstenpflanze Pituranthos tortosus in dem Boden eines Trockentals der Ägyptischen Wüste. Nach KAUSCH (aus WALTER 1964)

Other global and regional environment issues

- Water management
  - Biomass improves water holding capacity
    - Slows run off processes
    - Improves local climate by gradual release of water to atmosphere
    - Purifies water
      - Plant sewage treatment plant in remote areas
      - Many applications
- Land improvement
  - More biomass will be positive for greenhouse gas reduction
  - Better local climate by evapotranspiration of green leaves

Final Remarks

- In each of the four areas a lot of inside research has to be undertaken
  - trade offs are possible
  - Optimizing in one field is not necessarily connected with
- Biomass is a policy driven subject
  - Originally the domain of primary sector it became much wider involving secondary and tertiary sectors
  - Reflects the development in society and life styles
  - Many interests are involved
- Economic circumstances decisive
  - A shortage in food supply would reverse the trend away from food towards biomass