Potential for renewable energy in Austria

(from Neubart, J., Kaltschmitt, M. 2000)

Study for the Association of Austrian Utilities VEÖ resp. BMWA, BMLFUW

Analysed technologies

ELECTRICITY	HEAT
• Hydro power • Solid biomass • Biogas • Wind • Photovoltaics	• Solar thermal • Heat from ambient • Hydro geothermal • Biomass

Definition of potentials

(from Neubart, J., Kaltschmitt, M. 2000)

Theoretical potential:

Theoretically physically useful energy within a given time horizon (e.g. the solar irradiation on the earth surface). Upper limit of the theoretical energy input.

Technical supply potential:

only technical and structural supply restrictions considered (e.g. the total possible energy that could be deliverd with PV-plants)

Technical demand potential

additional consideration of the demand side (e. g. the possible elctricity input in the current Austrian electricity grid taking into account daily and seasonal supply charaxteristics).

Definition of potentials

(from Neubart, J., Kaltschmitt, M. 2000)

Economic potential:

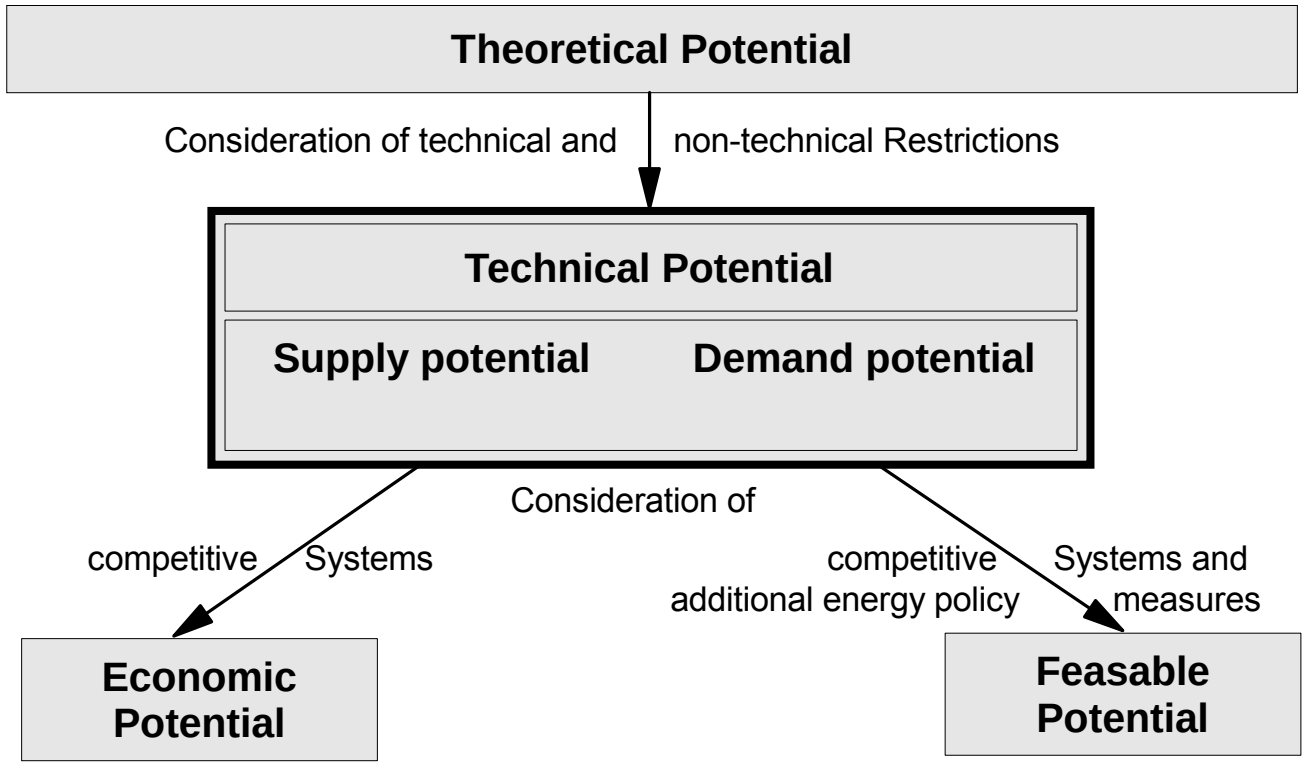
Part of the technical potential that can be used under economic conditions. This potential is mainly influenced by actual conventional energy prices, interest rates, depreciation time and capital resources.

Feasable potential:

This protential describes the realistcally expectable share of a renewable energy carrier. It is normally smaller than the economic potential because of numerous restrictions like limited production capacity, conventional technology still in use, legistic or administrative barriers et al.

Connection of the different potentials

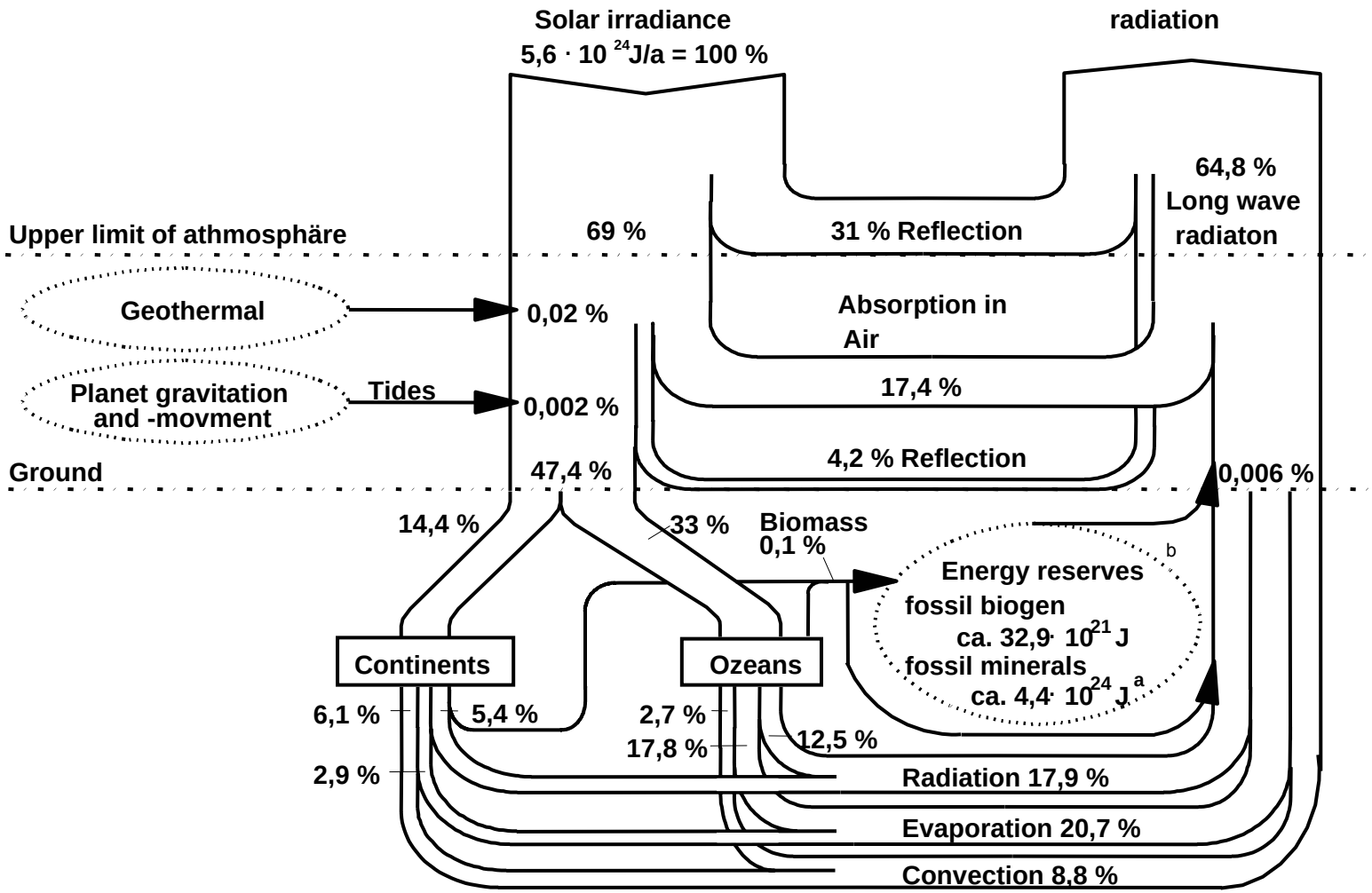
(from Kaltschmitt)



TUG

Institut für Wärmetechnik
TU Graz

World energy balance



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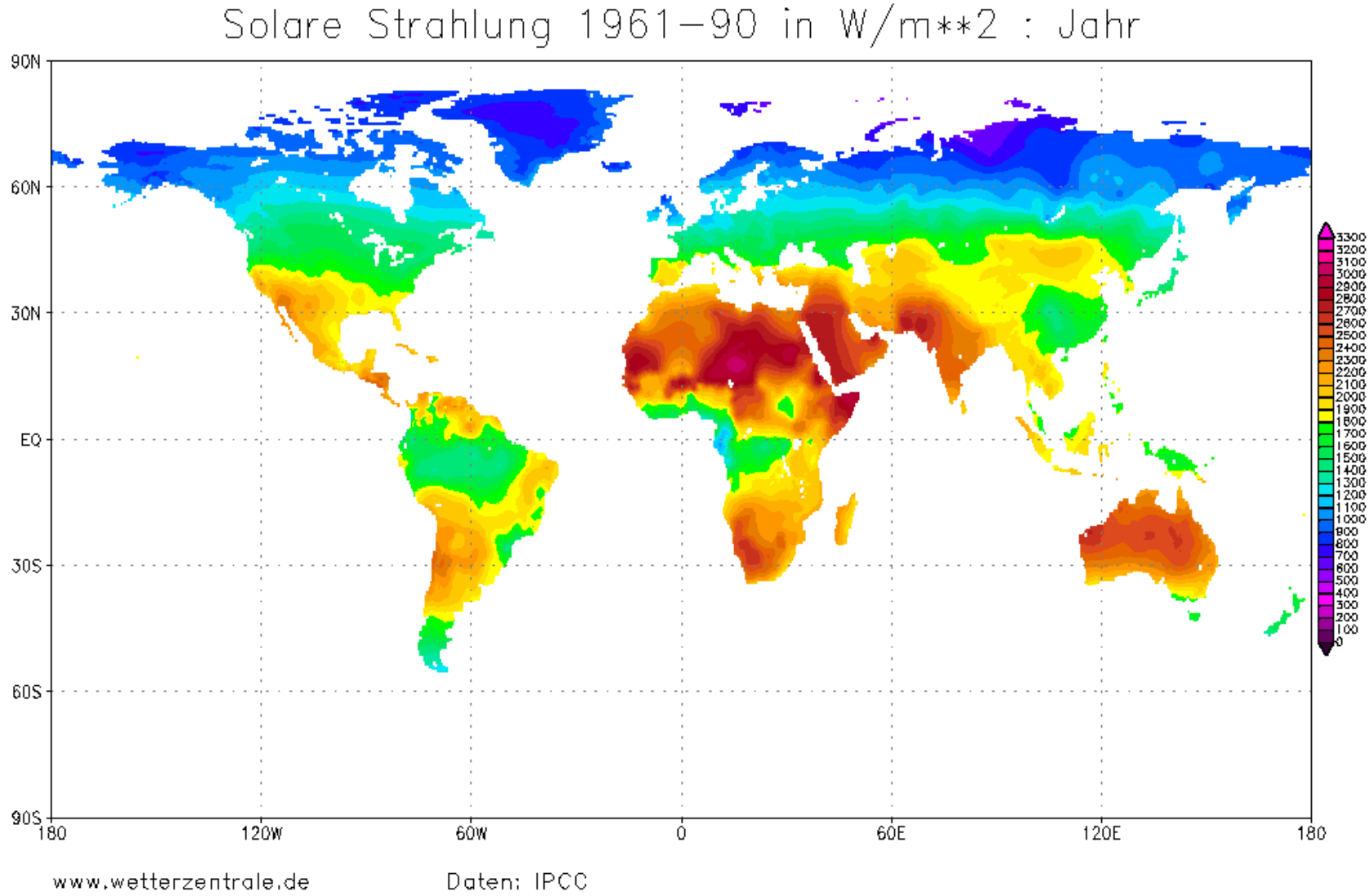
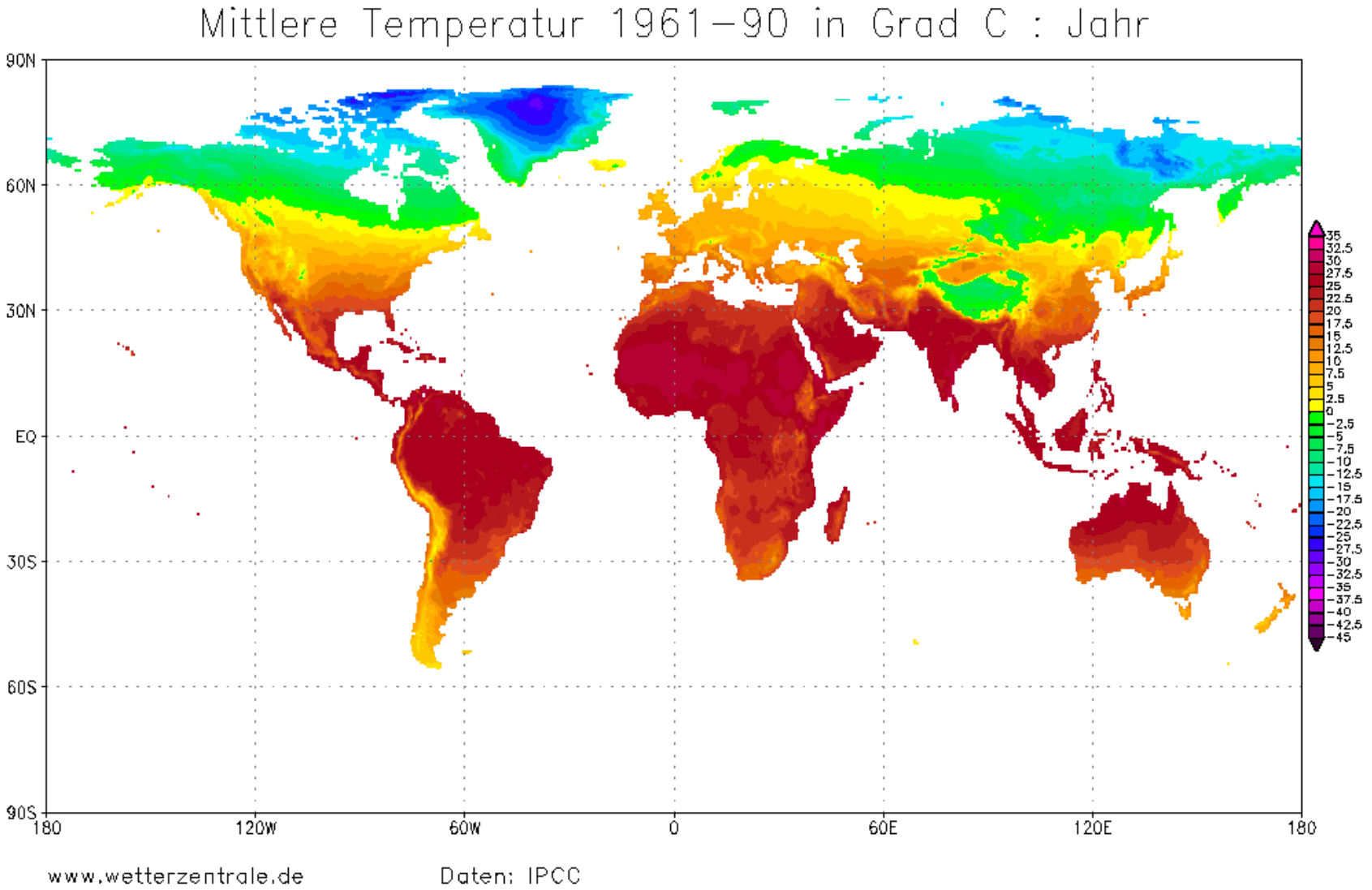
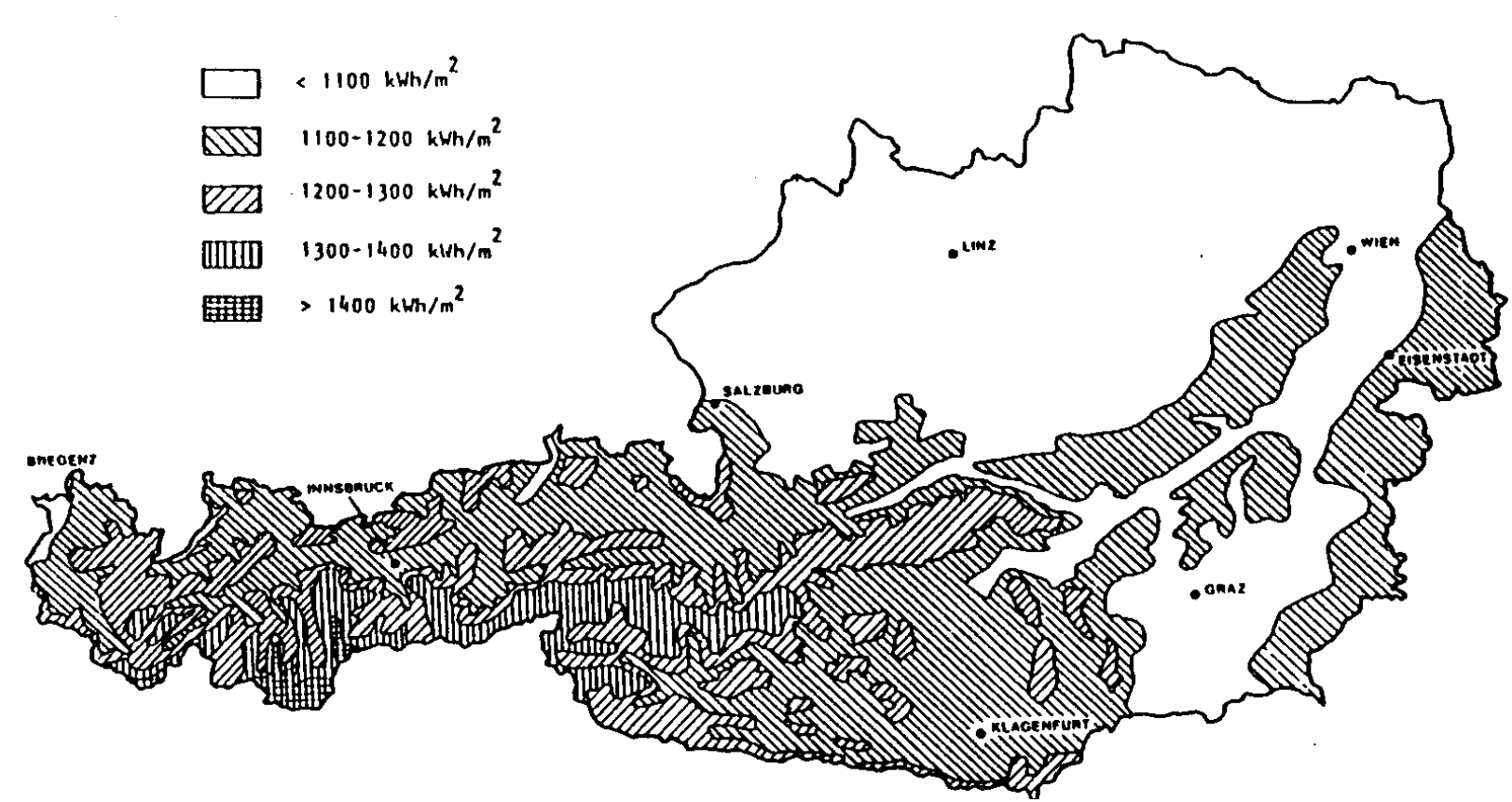
Mean world yearly global solar irradiance



Mean world ambient temperature



Yearly global solar irradiance in Austria



Theoretical Potential for direct use of solar energy (seasonal storage with 100 % efficiency available)

Average yield

Thermal collector	350 kWh/m²a
Photovoltaic	90 kWh/m²a

Required areas

Domestic hot water/space heating	264 km²
Process heat (η=60%)	247 km²
Mech. energy, EDV (PV)	349 km²
Vehicles (PV, η=50%)	1413 km²
Total	2273 km²

Area Austria	83859 km²

Example of the reduction of the potentials for solar energy use

Area available for solar energy use in Austria

• **Total Area**	**83858,6**	**[km²]**
• **Area with buildings**	**305,9**	**[km²]**
• **Suitable roof area (47 %)**	**143,8**	**[km²]**
• **Useful roof area (35 %)**	**107,1**	**[km²]**

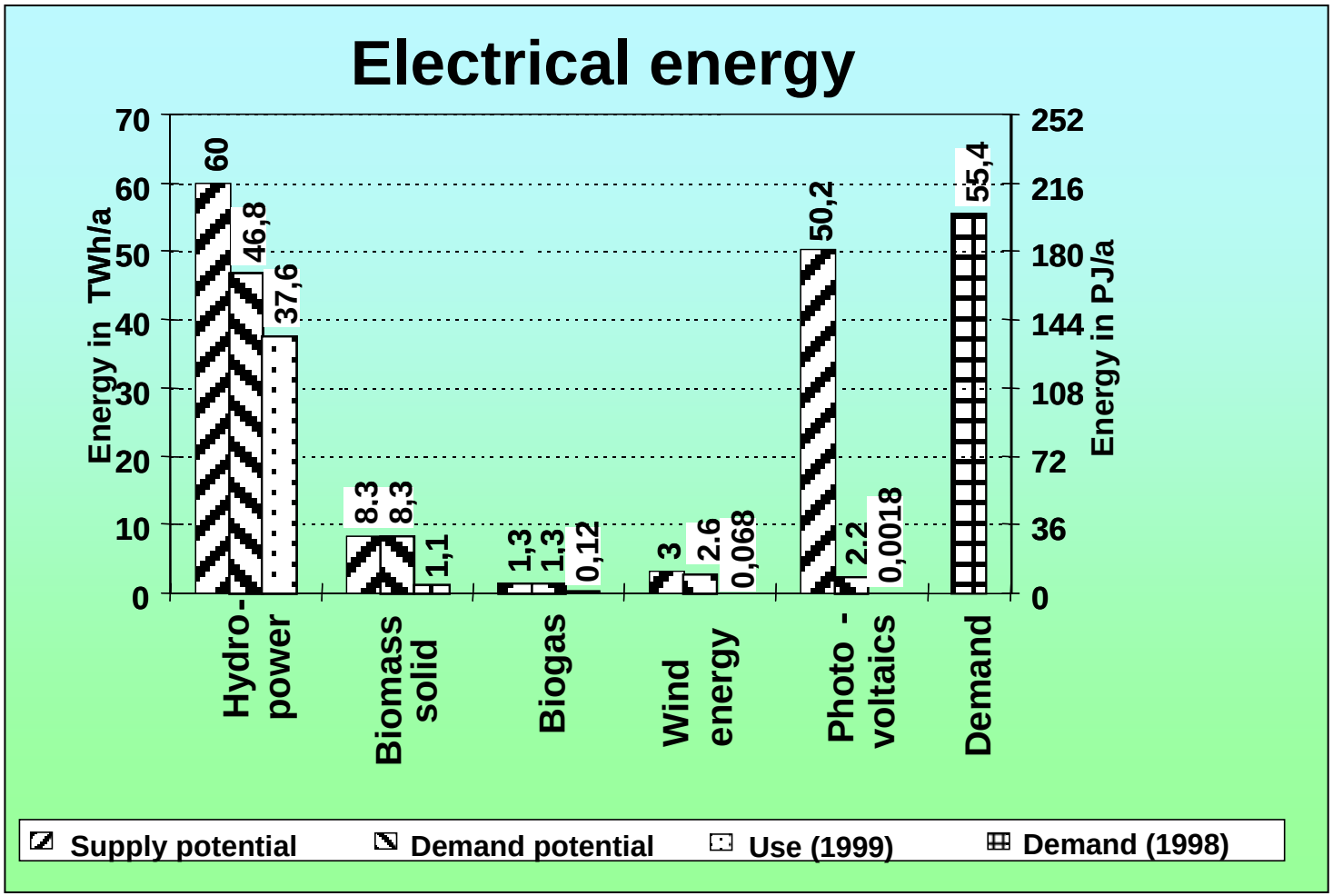
Theoretical and technical potentials of electricity production from river and storage hydro power in Austria

Rain potential	in TWh/a	252
„Abflussflächenpotenzial“	in TWh/a	150
„Abflusslinienpotenzial“	in TWh/a	118
Theoretical el-production potential	in TWh/a[a]	118
Technical supply potential and feasible building potential	in TWh/a	60

[A]equal to „Abflusslinienpotenzial“ (thereof about 25 % from overground influx from neighbouring countries)

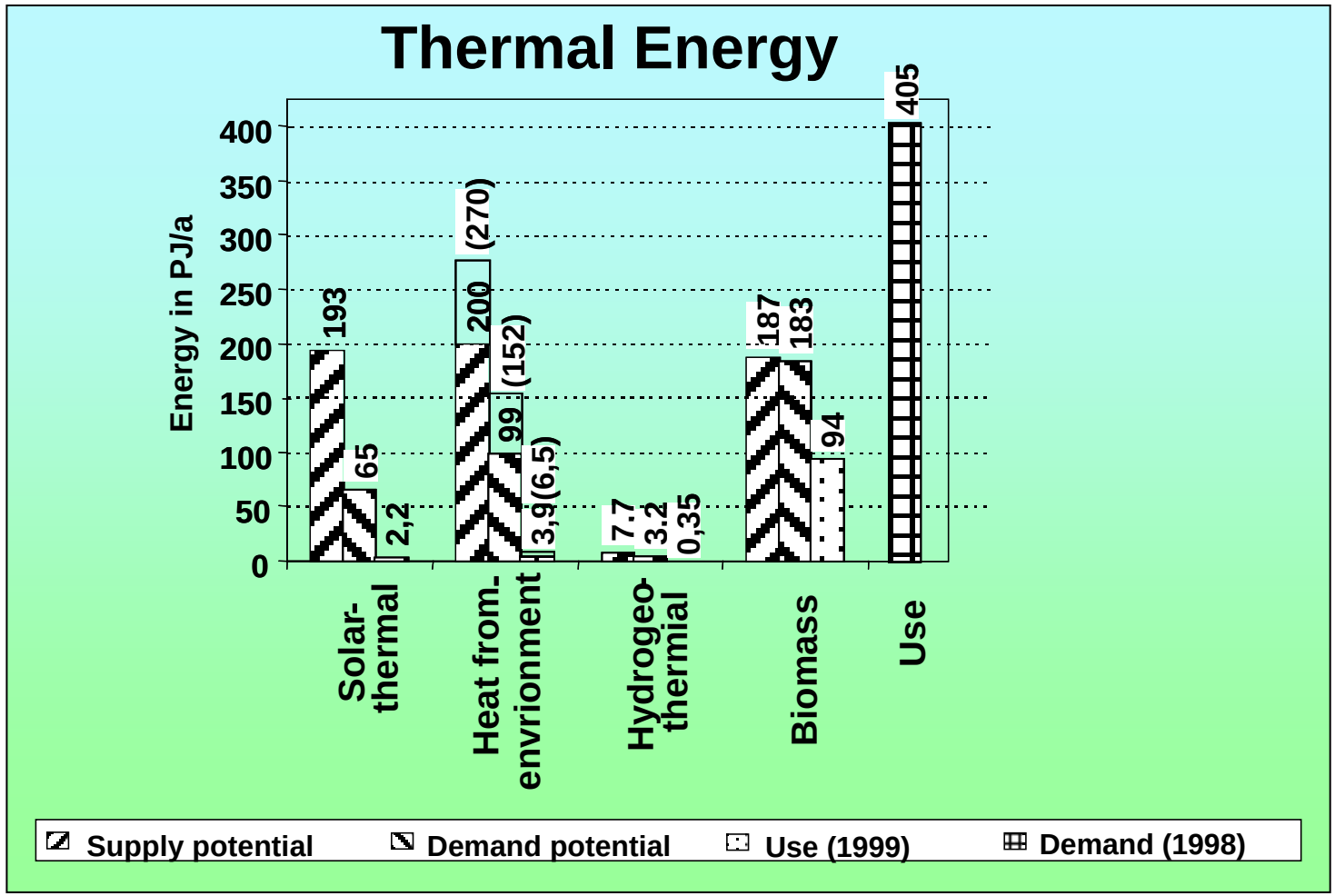
Potentials of renewables for electricity production in Austria

(from Neubart, J., Kaltschmitt, M. 2000)



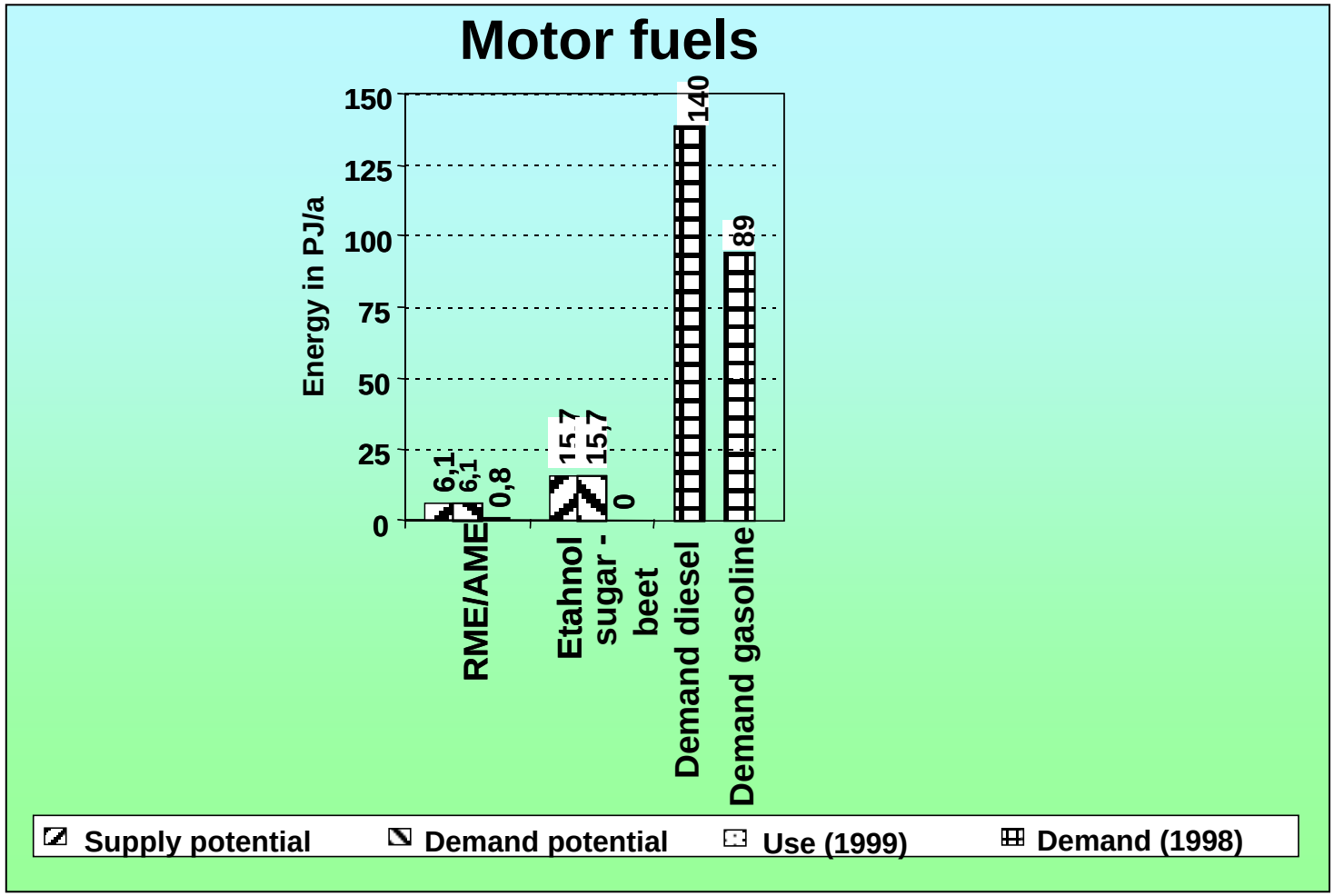
Potentials of renewables for heat use in Austria

(from Neubart, J., Kaltschmitt, M. 2000)



Potentials of renewables for motor fuels in Austria

(from Neubart, J., Kaltschmitt, M. 2000)



Definitions for costs and emissions

(from Neubart, J., Kaltschmitt, M. 2000)

Costs:

- Annuitiy (4,5 % rate, techn. life time)
- Operating costs
- Ev. demolition costs

Emissions:

- Life cycle analysis (EN ISO 14040
- Raw materials - production – operation – waste manag.
  (Prozess chain analysis)
- CO_2, $CO_{2\text{-equiv}}$ (CH_4 (21), N_20(310)), $SO_{2\text{-equiv}}$., NO_x

Tasks for heat delivery

(from Neubart, J., Kaltschmitt, M. 2000)

Space heating and domestic hot water:

SFH-I	5	kW heat load
SFH-II	8	kW heat load
SFH-III	18	kW heat load
MFH	60	kW heat load (6 appartements)

District heating networks

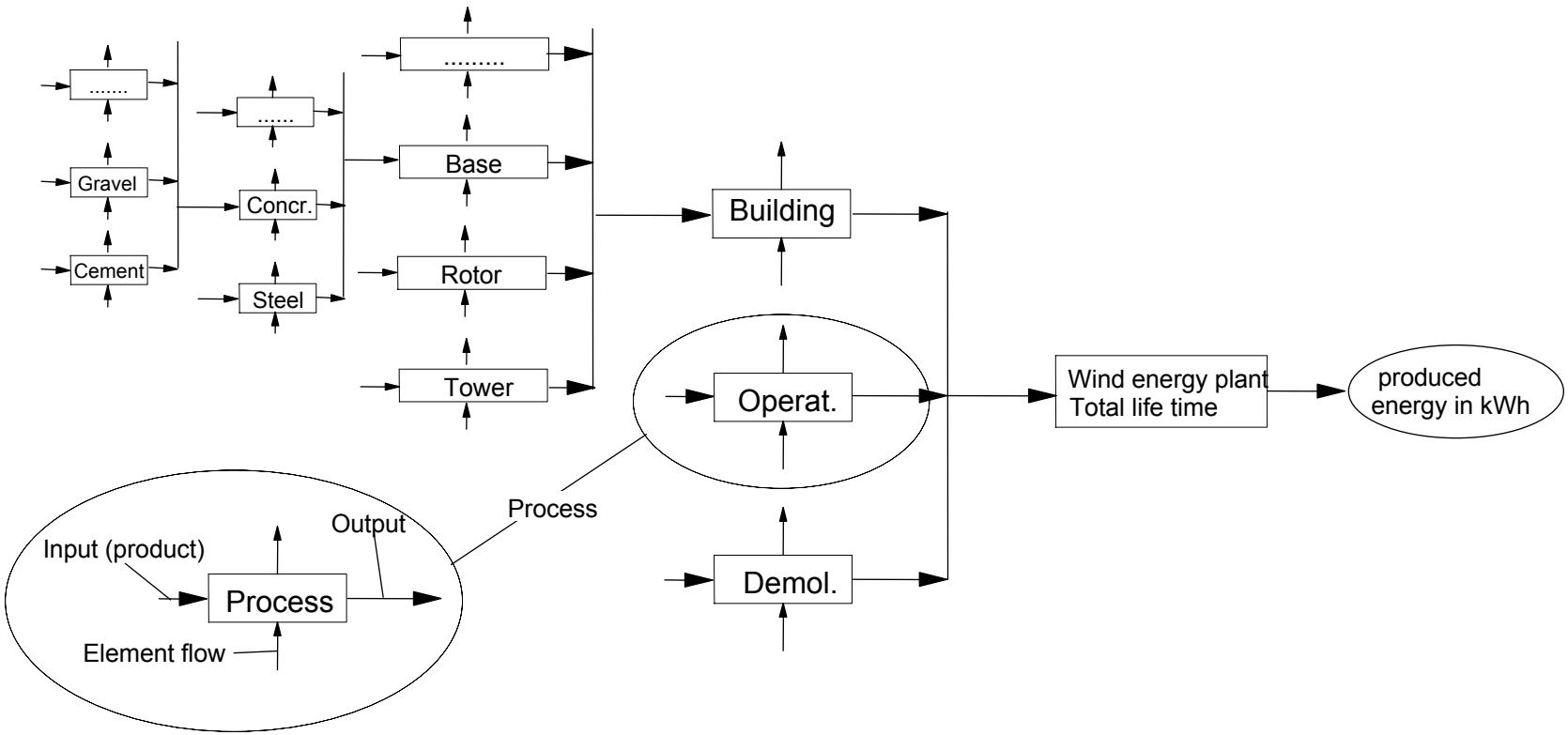
NW-I	1000 kW	2000 m
NW-II	3600 kW	6000 m
NW-III	7200 kW	2 * 6000 m

Electricity production technology

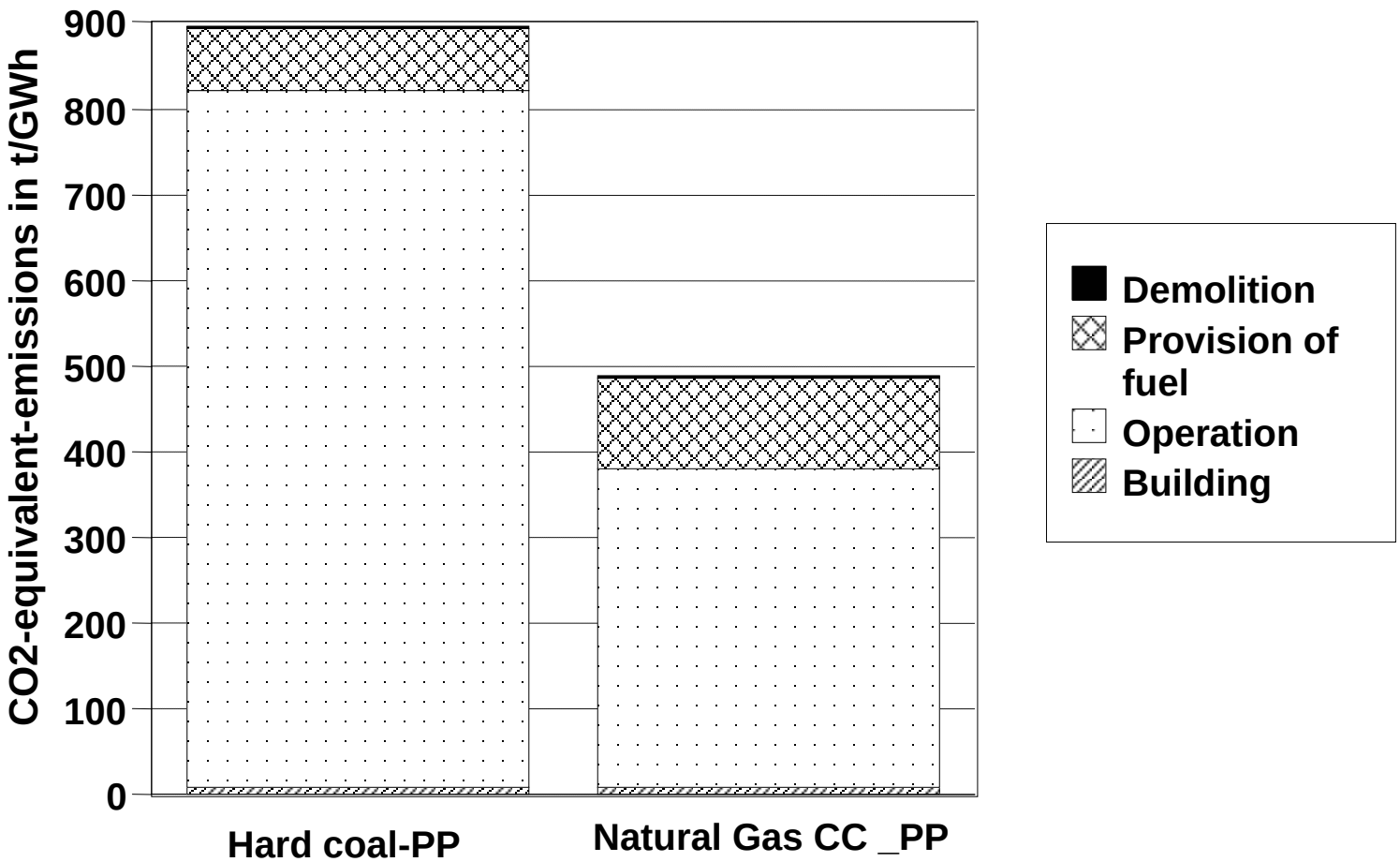
(from Neubart, J., Kaltschmitt, M. 2000)

Biomass I:	without heat use
Biomass II:	with maximum heat use CHP
Biogas I:	without heat use
Biogas II:	with maximum heat use CHP
Nat. gas CC:	combined gas/steam power plant with natural gas (without heat use)
Hard coal:	Steam plant (without heat use)

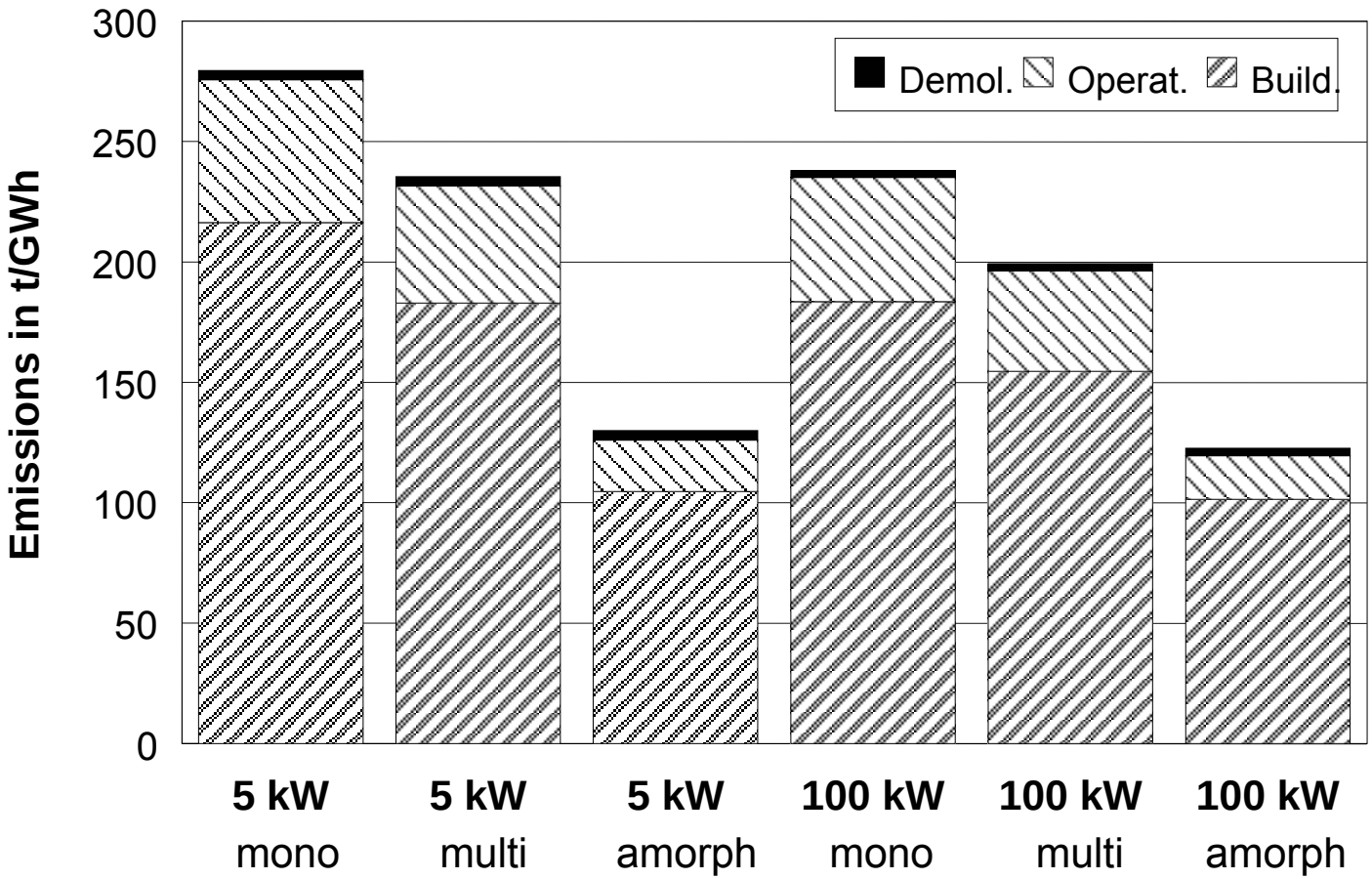
Principle of Life Cycle Analysis (LCA)



Contribution of building, operation, provision of fuels and demolition to total CO2-equivalent-emissions of electricity production from hard coal and natural gas

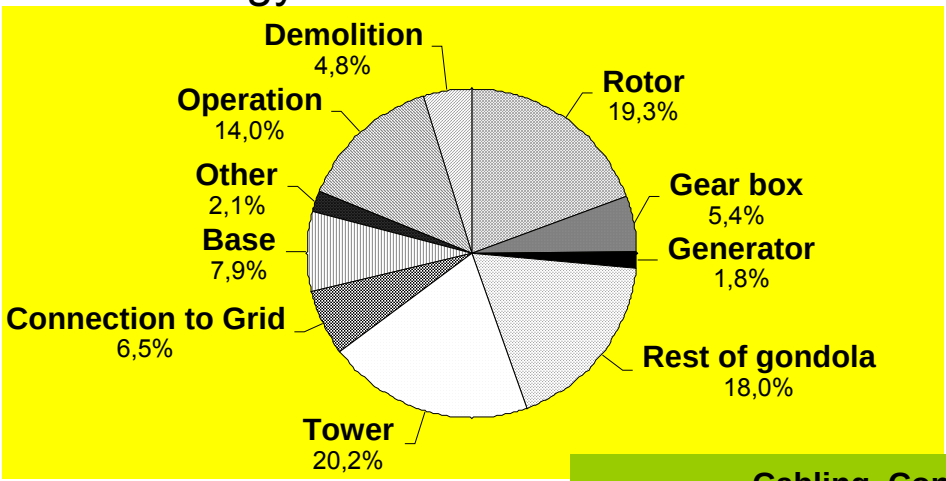


Contribution of building, operation and demolition to total CO2-equivalent-emission of photovoltaic plants

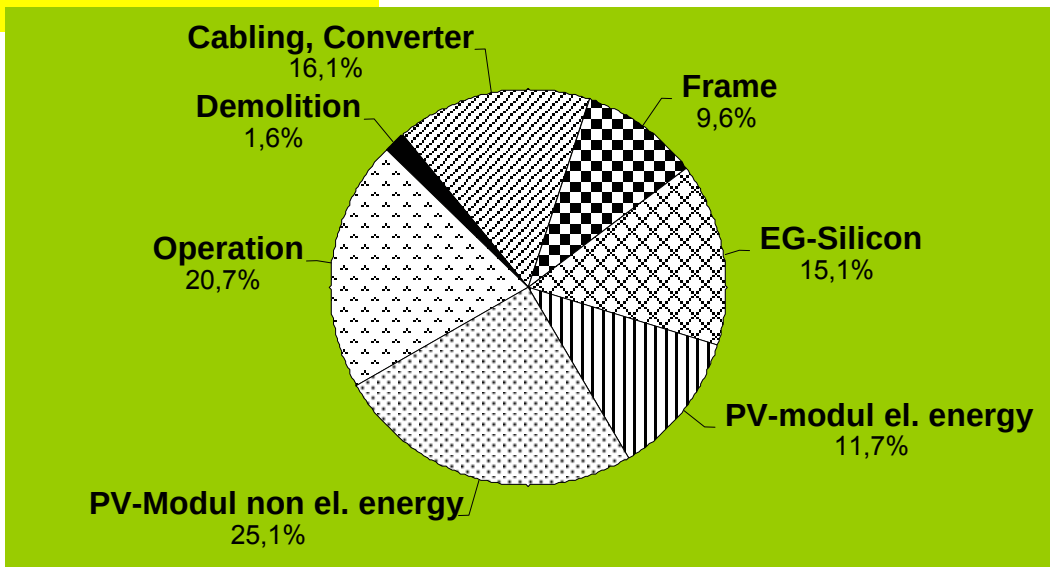


Distribution of CO2-equivalent-emission of an 1,5 MW-wind energy converter and a 5 kW-photovoltaic plant with monokristalline silicon-cells

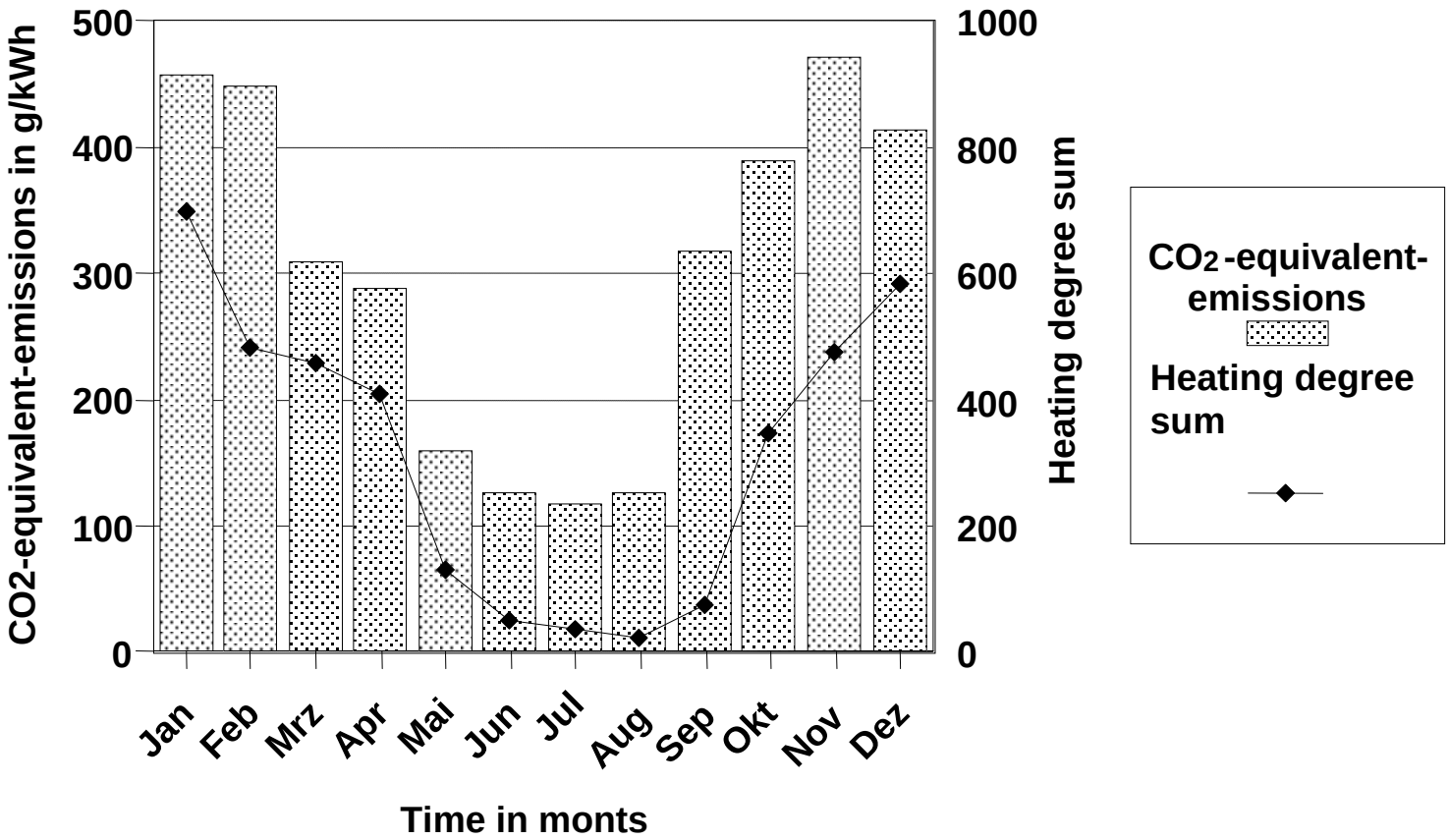
Wind energy converter



PV-plant

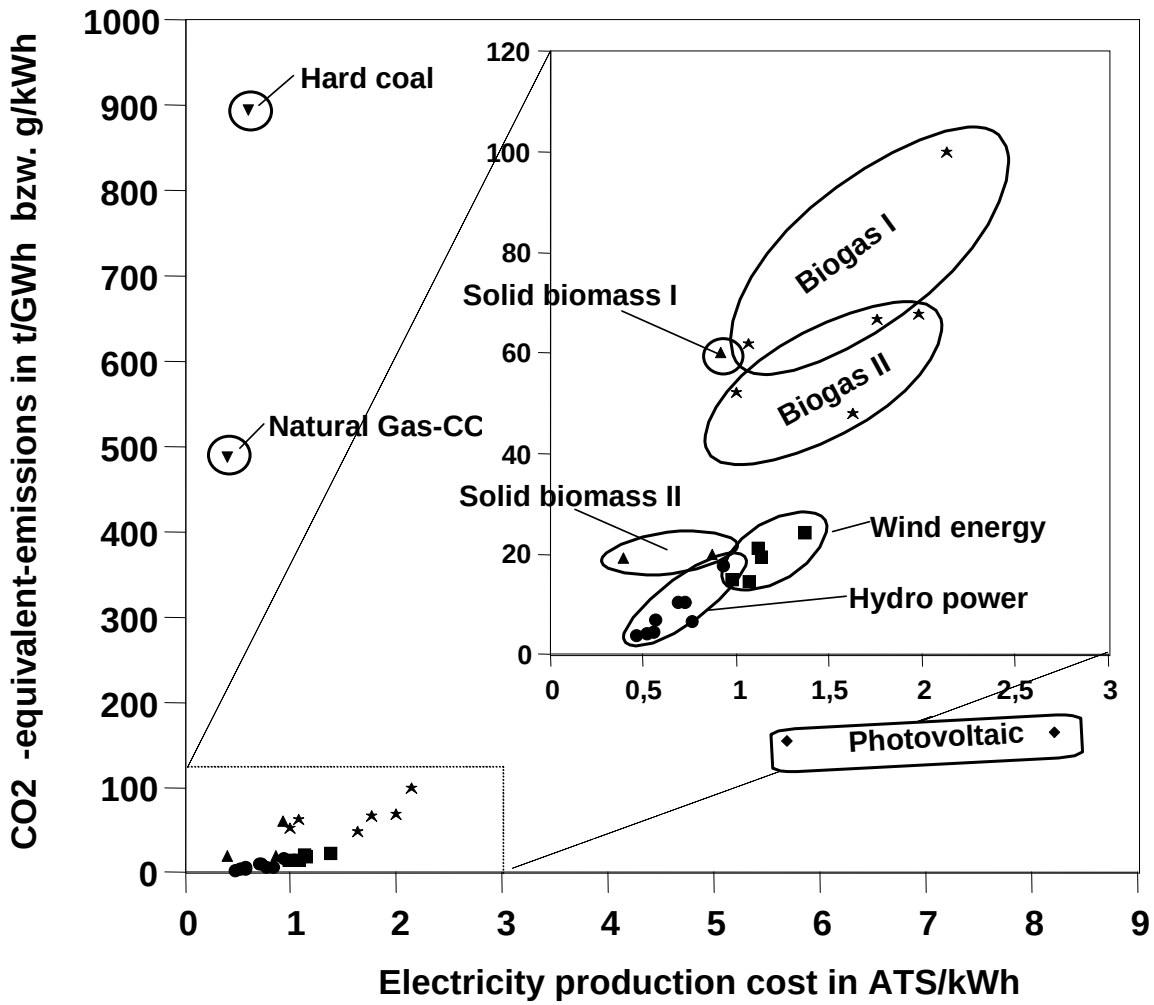


Specific CO2-equivalent-emissions of electricity production in Austria on low voltage level and monthly heating degree sums for 1997 (from /CEZ 1998/, /VEÖ 1998b/, /VDEW 1998/, /ÖSTAT 1998a/)



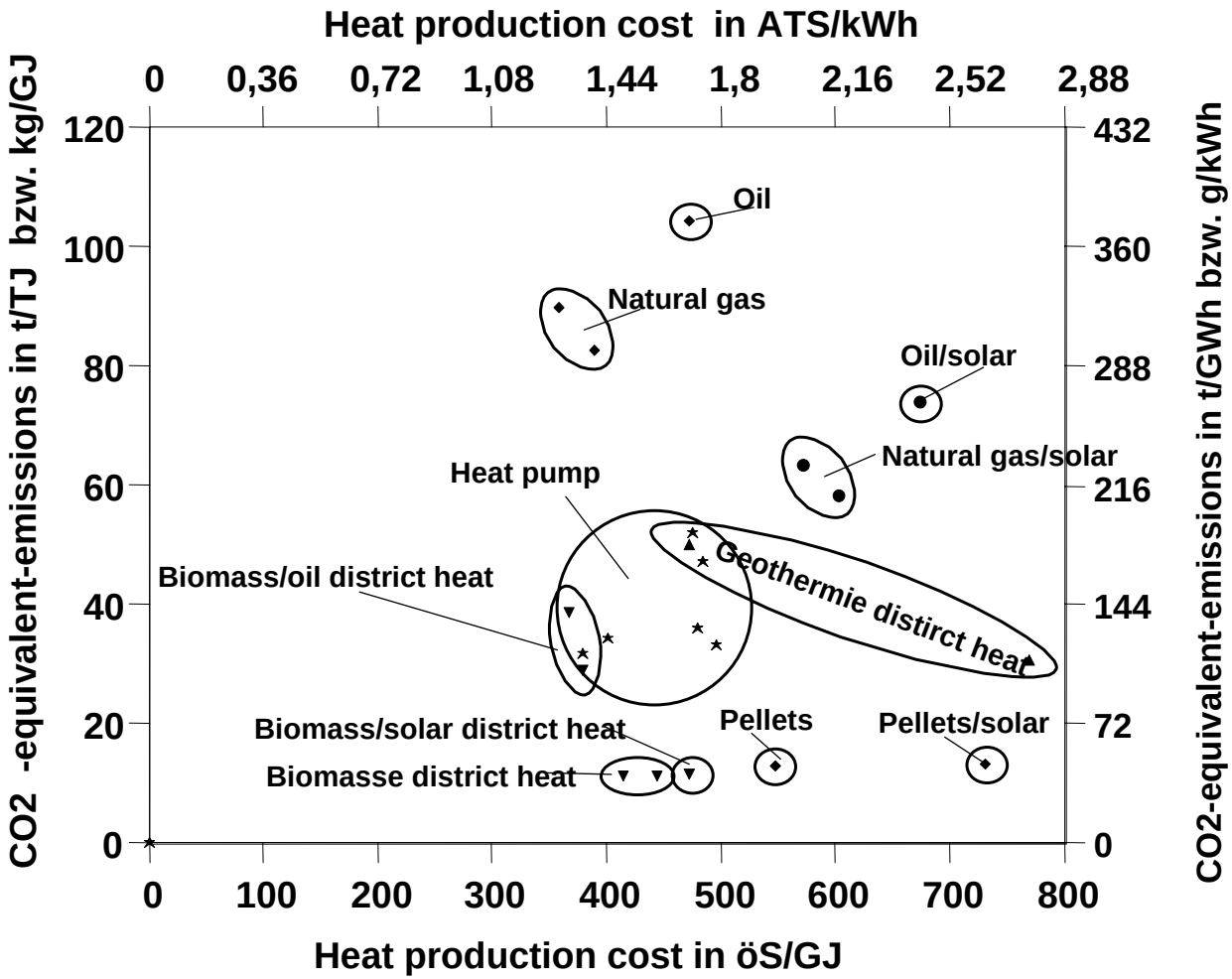
Costs and equivalent CO_2-emissions of electricity production

(nach Neubart, J., Kaltschmitt, M. 2000)



Costs and equivalent CO_2-emissions heat production, EFH-II

(from Neubart, J., Kaltschmitt, M. 2000)



Costs and equivalent CO_2-emissions of motor-fuels

(from Neubart, J., Kaltschmitt, M. 2000)