



GLOBAL PRIMARY ENERGY SUPPLY 2008 & SUSTAINABLE INCREASE POTENTIALS FOR 2020

World primary energy demand increases by 36% between 2008 and 2035, or 1.2% per year on average.

Demand > 600 EJ 2020 (492 EJ 2008). Biggest potentials to increase energy supply are in solar energy.

Due to emissions of green house gas emissions, the use of fossil fuels should not be allowed to increase. It will.

Sustainable bio-energy potentials are and will be relatively small:

Cultivation of energy crops depends mainly on global food demand and productivity increases. Surplus areas would/should be used for food production. Increasing environmental and nature protection standards will further reduce energy crop potentials. You can't count on using degraded land for energy crop production. Quality of lands is very variable. It is not possible to estimate the potential.

Forest areas decline globally. Number of plantations increase. Raw wood consumption in some African, Asian and European countries already exceeds the sustainable potential. Despite raw wood excess in some countries like Russia, North America or Brazil, it is a big economic and ecologic challenge to mobilize this potential. Forest energy is mainly local energy.

Climate change will have an increasing influence on biotopes, which can severely influence yields.

After 2020 solar power, wind energy, geothermal energy and ocean energy, possibly also nuclear energy still has increase potentials. See Figure 1. Global demand of Primary energy 2008-2050. See Also Table 1. Primary Energy Supply 2008 + increase potentials for renewable and nuclear energy.

GLOBAL DEMAND OF PRIMARY ENERGY 2008 - 2050

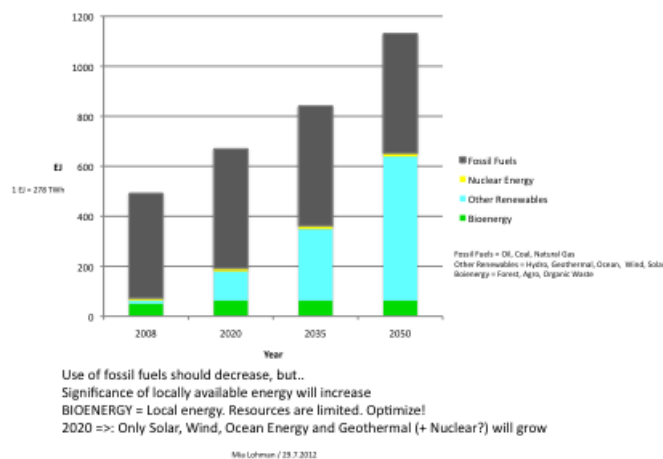


Figure 1. Global demand of Primary Energy 2008-2050





Table 1. World Primary Energy Supply 2008 + increase potentials for renewable and nuclear energy

Source	P. Energy EJ (%)	Electricity EJ (%)	¹ Increase 2020, EJ	Remarks
Oil	170 (34,6)	4 (5,5)	0	Use likely to increase 1%/a.
Coal	140 (28,4)	29,8 (41,1)	0	Use likely to increase 0,5%/a
Natural Gas	109 (22,1)	15,5 (21,4)	0	Use likely to increase 2,1 %/a
Fossils total	419 (85,1)	49,3 (68,0)	0	Should decrease, will increase
Nuclear	9,8 (2,0)	9,8 (13,6)	1,85²	Short & long-term safety issues
Forest Energy	43,8 (8,9)		11,2	Technical potential ≈29-57 EJ/a
- Fuel wood	33,7 (6,9)		2,8	95% of wood use in developing countries
- Charcoal	3,5 (0,71)			Depends of forest industry success
- Black liquor	0,5 (0,1)		0,3	
- Wood Industry residues	2,5 (0,51)		0,3	
- Recovered wood	3 (0,61)			
- Forest residues	0,5 (0,1)		7,8	Not enough long term information
Energy from agriculture	5 (1,02)		1,5	Land use, food supply issues
- Energy crops	1,5 (0,3)		0	Potential +4,5 EJ/a
- Agricultural by-products	2 (0,41)		1	Long-term consequences?
- Animal by-products	1,5 (0,3)		0,5	
Organic Waste	1,5 (0,3)		?	Use of biogas likely to increase
- Municipal Solid Waste and Landfill gas	1,5 (0,3)			
Bio-energy Total	50,3 (10,2)	0,82 (1,1)	12,7	Too high estimate?
Hydropower	11,6 (2,3)	11,6 (15,9)	1,4	Technical potentials up to 52 EJ/a
Wind power	0,8 (0,2)	0,79 (1,1)	84	Technical potential up to 580 EJ/a
Geothermal energy	0,4 (0,1)	0,23 (0,3)	1,8	Technical potentials 10 – 312 EJ/a
Solar Energy	0,05 (0,1)	0,05 (0,07)	9,3	Huge potential ->67->1575++ EJ/a
Ocean power	0,002 (0,002)	0,04 (0,005)	7	Theoretically up to 331 EJ/a
Renewables (-Bio) Total	12,85 (2,7)	12,71 (17,4)	103,5	
Renewable Energy Total	63,15 (12,9)	13,53 (18,5)	116,2	
Primary energy supply total	492 (100)			
Electricity use total		72,5 (100)		
Increase potential total			118,05	

¹ Potential to sustainably increase supply of energy

² Expected plant shutdowns are not included in figure. Sustainability of nuclear power is very controversial

$$\text{Energy [EJ]} = \text{Energy [TWh]} * 3,6 * 10^{-3}$$

Primary Energy supply 2008: 492 EJ = 136,7*10³ TWh, Electricity supply 2008: 20133 TWh = 72,48 EJ

Technical potentials do not necessarily take environmental social, and other parameters into account





SOURCES

Table 1. World Primary Energy Supply 2008 + increase potentials for renewable and nuclear energy

IPCC: Special Report on Renewable Energy Sources and Climate Change Mitigation. 2011, Summary for Policymakers. A Report of Working Group III of the IPCC and Technical Summary Downloadable from www.ipcc.org

http://www.iea.org/media/bioenergyandbiofuels/02_Thran.pdf Bioenergy Potential Assessment State of the Art, Dr. Daniela Thrän, Ulrike Seyfert, Jens Ponitka 15. September 2010

http://www.iea.org/work/2010/feedstock/02_Thran.pdf DBFZ Report Nr. 7 Final Report

Global and Regional Spatial Distribution of Biomass Potentials – Status quo and options for specification – Daniela Thrän / Katja Bunzel / Ulrike Seyfert / Vanessa Zeller / Marcel Buchhorn (DBFZ), Klaus Müller / Bettina Matzdorf / Nadin Gaasch / Kristian Klöckner / Inga Möller / Anja Starick / Juliane Brandes (ZALF), Kurt Günther / Markus Thum (DLR), Jürgen Zeddies / Nicole Schönleber / Wilhelm Gamer (ILB), Jörg Schweinle / Holger Weimar (vTI)

http://www.energyblueprint.info/fileadmin/media/documents/2010/Global_biomass_potentials_report_DBFZ.pdf

Deutsches BiomasseForschungsZentrum, gemeinnützige GmbH German Biomass Research Centre

Report, Global Biomass Potentials, Investigation and assessment of data Remote sensing in biomass potential research Country-specific energy crop potentials, Thilo Seidenberger Daniela Thrän Ruth Offermann Ulrike Seyfert Marcel Buchhorn, Jürgen Zeddies

<http://www.metla.fi/tapahtumat/2009/gloener/Metsabiomassansaatavuusenergiatuotantoon.pdf> potentials

<http://www.metla.fi/tapahtumat/2009/gloener/Pahkala-MTT-6-3.pdf> potentials

<http://www.metla.fi/tapahtumat/2009/gloener/SEKKibioskenaariot.pdf> potentials

Bioenergian kestävä tuotanto ja käyttö maailmanlaajuisesti - Muu biomassassa ja globaali potentiaali, Martti Flyktman, VTT

<http://www.iaea.org/Publications/Reports/ntr2011.pdf> Nuclear technology review 2011

<http://www.iea.org/weo/docs/weo2010/factsheets.pdf> WORLD ENERGY OUTLOOK 2010 FACTSHEET What does the global energy outlook to 2035 look like?

http://www.iea.org/papers/2010/Hydropower_Essentials.pdf Renewable Energy Essentials: Hydropower

www.iwea.com/index.cfm/page/iwec_09?twfId=121&download... GLOBAL WIND ENERGY, Steve Sawyer, IWEA Conference - Dublin March 26, 2009

http://www.exxonmobil.com/Corporate/files/news_pub_eo.pdf 2012 The Outlook for Energy: A View to 2040

