Global Potential of Power Crops

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Criteria of Potential Power Crops

- Efficient conversion of solar radiation to bio-mass, yield close to the potential maximum: 55 t for C-4 and 35 t dry matter/y/ha for C-3 plant species. The theoretical upper amonts to 250 t DM/y/ha.

- High dry matter contents for solid biofuels (gasification, combustion)

Power Crops 2

- Adequate sugar or starch contents of ethanol crops.
- High oil contents of oil plants.
- Convenient energy balance (output/input ratio), from the seed to the tank.
- Low-input, disease resistant and consistent to the environment

Table 1. Energy Crops for temperate Climates

- Cordgrass (*Spartina spp.*), Reed Canary Grass (*Phalaris arundinacea.*), Fibre and sweet sorghum (*Sorghum bicolor*), Rosin weed (*Silphium perfoliatum*), Giant knotweed (*Polygonum sachalinensis*), Safflower (*Carthamus tinctorius*), Hemp (*Cannabis sativa*), Soybean (*Glycine max*), Kenaf (*Hibiscus cannabinus*), Sugar beet (*Beta vulgaris*), Linseed (*Linum usitatissimum*), Sunflower (*Helianthus annuus*), Miscanthus (*Miscanthus x giganteus*), Switch grass (*Panicum virgatum*), Poplar (*Populus spp.),* Topinambur (*Helianthus tuberosus*), Rape (Brassica napus), Willow (*Salix spp.*)

Table 2. Energy Crops for Arid Climates

- Argan tree (Argania spinosa), Olive (*Olea europaea.*), Broom (*Ginestra*) (*Spartium junceum*), Poplar (*Populus* spp.), Cardoon (*Cynara cardunculus*), Rape (*Brassica napus*), Date palm (*Phoenix dactylifera*), Safflower (*Carthamus tinctorius*), Eucalyptus (*Eucalyptus spp.*), Salicornia (*Salicornia bigelovii*), Giant reed (*Arundo* do*nax*), Sesbania (*Sesbania spp.*), Groundnut (*Arachis* hypogaea), Soybean (*Glycine max*), Jojoba (*Simmondsia* chinensis), Sweet sorghum (*Sorghum bicolor*)

Table 3. Energy Crops for Tropical and Sub-Tropical Climates

- Aleman Grass (*Echinochloa polystachya*), Jatropha (*Jatropha curcas.*), Babassu palm (*Orbignya oleifera*), Jute (*Crocorus spp.*), Bamboo (*Bambusa spp.*), Leucaena (*Leucaena* l*eucoceohala*), Banana (*Musa x paradisiaca*), Neem tree (*Azadirachta indica*), Black locust (*Robinia* pseudoacacia), Oil palm (*Elaeis guineensis*), Brown beetle gras (*Leptochloa fusca*), Papaya (*Carica papaya.*)Cassava (*Manihot esculenta*), Rubber tree (*Acacia senegal*), Castor oil plant (*Ricinus communis*), Sisal (*Agave sisalana*), Coconut palm (*Cocos nucifera*), Sorghum (*Sorghum bicolor*), Eucalyptus (*Eucalyptus spp.*), Soybean (*Glycine max*), Sugar cane (*Saccharum officinarum*)

Perspectives of Biomass

- Annual primary biomass production: 220 billions DM, 4,500 EJ = 10 times of world primary energy consumption. Biomass used for food: 800 millions DM = 0.4% of primary biomass production.
- Annual food production corresponds to 140% of the needs of world population.
- The potential biomass productivity is the result of interactions between their genetic make up, the environments and the external inputs. The optimization of these 3 factors is the key issue for a successful introduction of power crops.

Perspectives of Biomass 2

- Biomass supplies 14% of the worldwide energy consumption (Nepal 90%, India 45%, China Brazil 28%) with conversion efficiency of less than10%. 10%.
- Large areas of surplus of agricultural in USA, EU, East Europe and USA could become significant biomass producing areas (> 200 millions ha). There is also a huge potential in Latin America.
- Micro algae have the potential to achieve high levels of photosynthetic efficiency. If laboratory production can be effectively scaled up to commercial quantities, levels of up to 80 t/ha/yr may be obtained.

Perspectives of Biomass 3

- The efficiency of photosynthetis is less than 1%. An increase in this efficiency (through plant breeding and genetic engineering) would have spectacular effects in biomass productivity: successful transformation of C4-mechanism (from maize) to C3-crops (rice). New achievement in accelerating cell division opens opportunities to speed up the growing seasons, resulting in several harvests per year and an overall increase in biomass.
- Developments in power and heat generation as well as car technologies are leading to significant reduction in biomass fuel consumption

Conclusions

- **Biomass is:**
  - Storable
  - Transportable
  - Convertible
  - Always with positive energy balance

Of all Options, Biomass represents the largest and most sustainable Alternative to substitute Fossil Fuels in a "Win-Win" Strategy

- Projection of Technical Energy Potential from Energy Crops grown by 2050

	Africa	China	Latin America	Industrialised	All regions
Available Area for Biomass Production in 2050 (Gha)	0.484	0.033	0.665	0.100	1.28
Maximum additional asset of Energy from Biomass (EJ/year)	145	21	200	30	396

Total (including traditional Biomass 45 EJ/year) IPPC 2001 **441**

Research Fields

- The biomass research activities are relatively new. There is still urgent need for research and actions in the fields:
  - Identification of non conventional power crops
  - Plant breeding and genetic engineering
  - Optimization of the whole chain from the seed to field margin (border), from field to tank and from tank to the wheel.
  - Improvement of biofuel conversion technologies and integration of solar and wind energy for improving the energy balances
  - Networking on biomsass and biofuels

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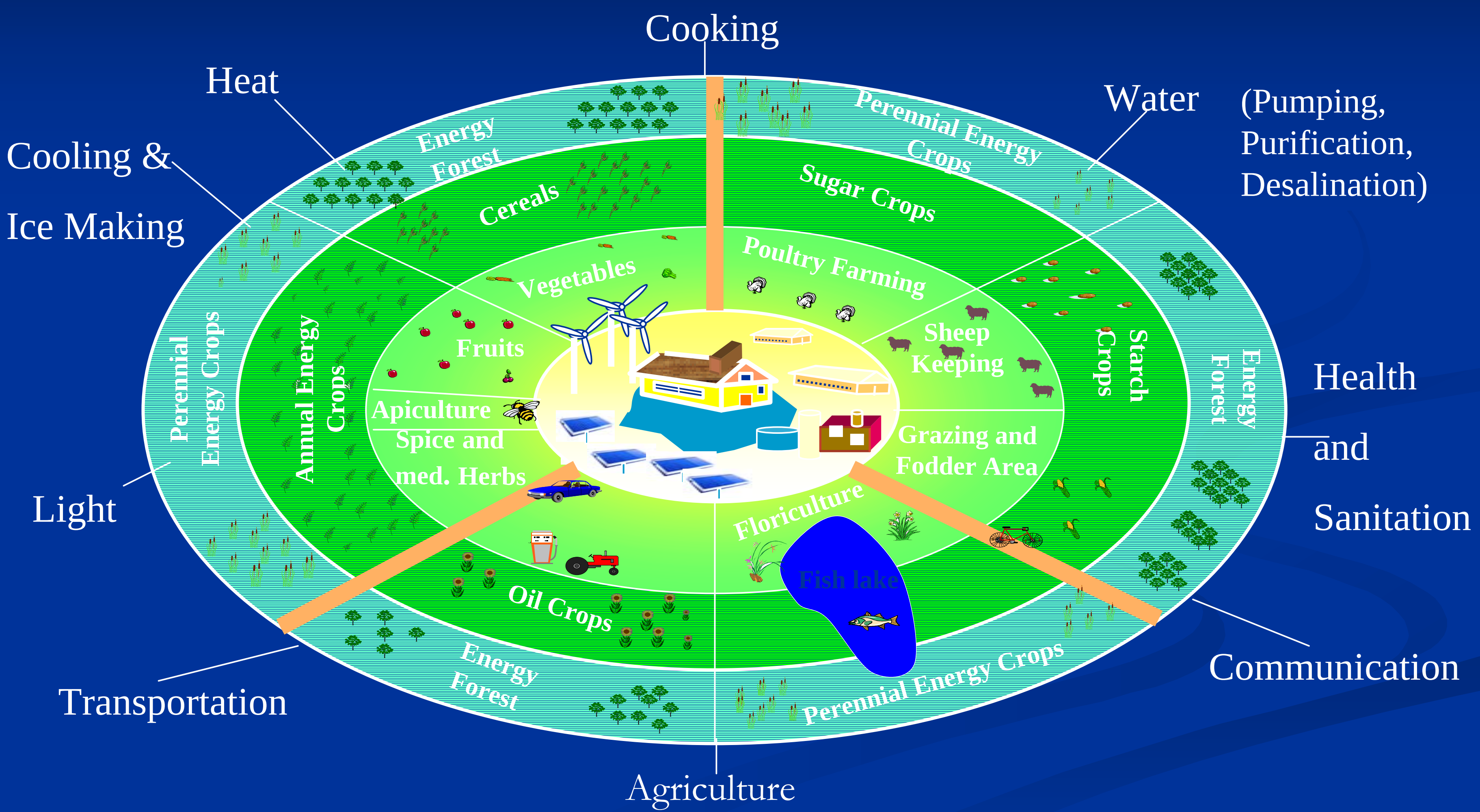
Cooking
Heat
Water
(Pumping,
Purification,
Desalination)
Cooling &
Ice Making
Health
and
Sanitation
Light
Communication
Transportation
Agriculture
Energy Forest
Perennial Energy Crops
Cereals
Sugar Crops
Vegetables
Poultry Farming
Fruits
Sheep Keeping
Starch Crops
Energy Forest
Perennial Energy Crops
Annual Energy Crops
Apiculture
Spice and med. Herbs
Grazing and Fodder Area
Floriculture
Fish lake
Oil Crops
Energy Forest
Perennial Energy Crops

ITER Spain

FAL-IFEED: The Sustainable Oil Fields

Thank You !