

Innovative Concepts for Energy Neutral Districts in 2050

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Energy neutral district

- Optimal use of all renewable energy sources in district
- No net energy import necessary on yearly base
- Not autarkic, energy exchange is essential
- Export of surplus energy to surrounding districts
- Import of energy in case of temporary shortage

Pilots in cities of Almere, Apeldoorn, Nijmegen and Tilburg

Energy Hub

- Meeting point of all energy flows in district
- Production, exchange, conversion, storage of energy
- Cars can 'refuel' biogas, liquid bio-fuel, electricity
- Biogas used for CHP, electricity for heat pumps
- Bi-directional heat and cold networks
- Compact (thermo-chemical) seasonal heat storage
- Energy management with PowerMatcher™ and HeatMatcher (supply and demand matching)

Energy Concepts

- Geo-Hub
- Bio-Hub
- Solar-Hub
- All-electric
- Conventional
- Hydrogen

				Degree of energy neutrality [%]					
				2020		2035		2050	
	ENERGY CONCEPTS	Individual or collective	Cooling	Transport					
				excl	incl	excl	incl	excl	incl
1	Waste Heat and/or Geothermy (Geo-Hubs)								
	High temperature waste heat utilization or geothermy	District heating	Compression cooling by PV or sorption cooling by solar	96	61	120	73	164	96
2	Waste Heat and/or Biomass (Bio-Hubs)								
	Moderate temperature waste heat utilization	District heating	Compression cooling by PV or sorption cooling by solar	93	60	119	72	163	95
3	All-Solar concepts (Solar-Hubs)								
	High temperature storage of solar heat	District heating	Compression cooling by PV or sorption cooling by solar	53	34	73	45	130	76
	Low temperature storage with ORC or heat pumps	District heating	Sorption cooling by solar	47	30	72	43	131	76
4	All-Electric concepts								
	Individual electric heat pumps, PV and solar collectors	Individual	Free cooling by ground heat exchanger	71	45	102	61	150	87
	Individual electric heat pumps and PV		73	47	106	64	157	92	
5	Conventional concepts with PV								
	Individual gas boilers with PV	Individual	Compression cooling by PV	36	23	64	38	112	65
	Individual gas boilers, solar collectors and PV		Compr. or sorpt. cooling by solar	38	24	65	40	114	67
6	Hydrogen concepts	Individual	Free cooling by ground heat exch	15	7	57	30	115	54

Conclusions

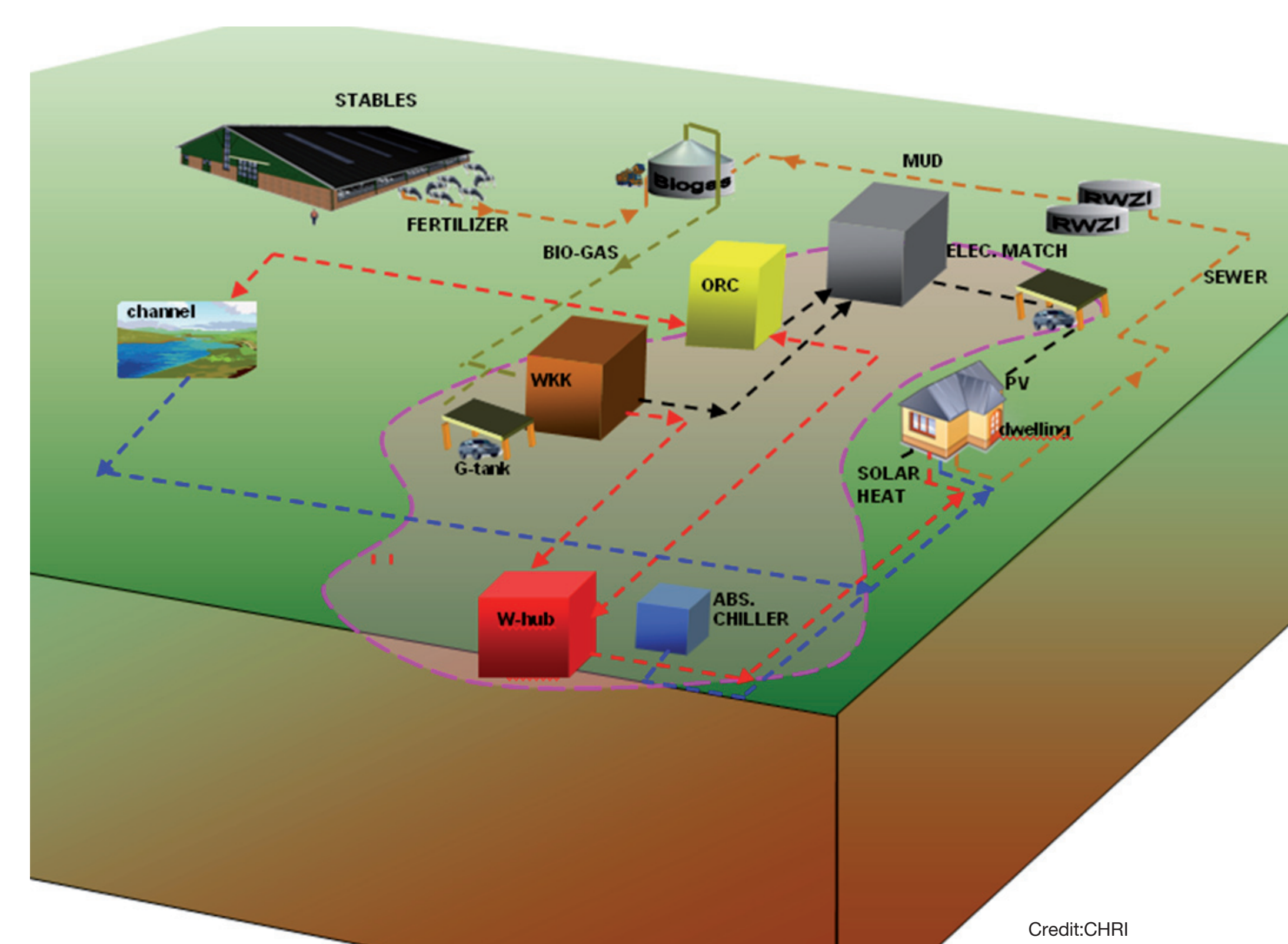
- In 2050, energy neutrality is possible for all concepts
- Extensive reduction of energy demand is crucial
- New and renovated buildings: passive house standard
- High-performance heat recovery from waste water
- Geo and Bio Hubs and All-electric: highest performance
- Transition can start using today's energy infrastructure
- If personal transport is included, energy neutrality within the district is not possible
- Next step: elaboration and evaluation of Energy Hubs



Credit: municipality of Apeldoorn

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Credit: CHRI

Residential buildings, small-scale industry and recreation in the Channel Zone of Apeldoorn and energy flows in the selected All-electric concept with small-scale district heating networks.