



**THE BRAUNSCHWEIG MODEL
- A Water-Nutrient-Energy Cycle -**

1. History and development
2. Wastewater Board
3. Braunschweig Model
4. Advantages of the wastewater reuse
5. Résumé and outlook



HISTORY AND DEVELOPMENT OF THE WASTEWATER BOARD



History of wastewater reuse in Braunschweig

- 1894 Initiation of the first infiltration fields
- 1954 Formation of the Sewage Board
- 1955 -1966 Extension of the 4 drainage areas approx. 3.000 ha
- 1955 - 1979 Sprinkler irrigation of mechanically pre-treated wastewater
- 1979 - 1991 Construction of the treatment plant in 4 stages
- 1985 - 1990 Modification of the infiltration fields
- 2000 Construction of the sludge digester
- 2006 Construction of the biogas plant
- 2015 - 2018 Construction of process water treatment and sludge disintegration

Sewer construction 1894



Infiltration fields 1960

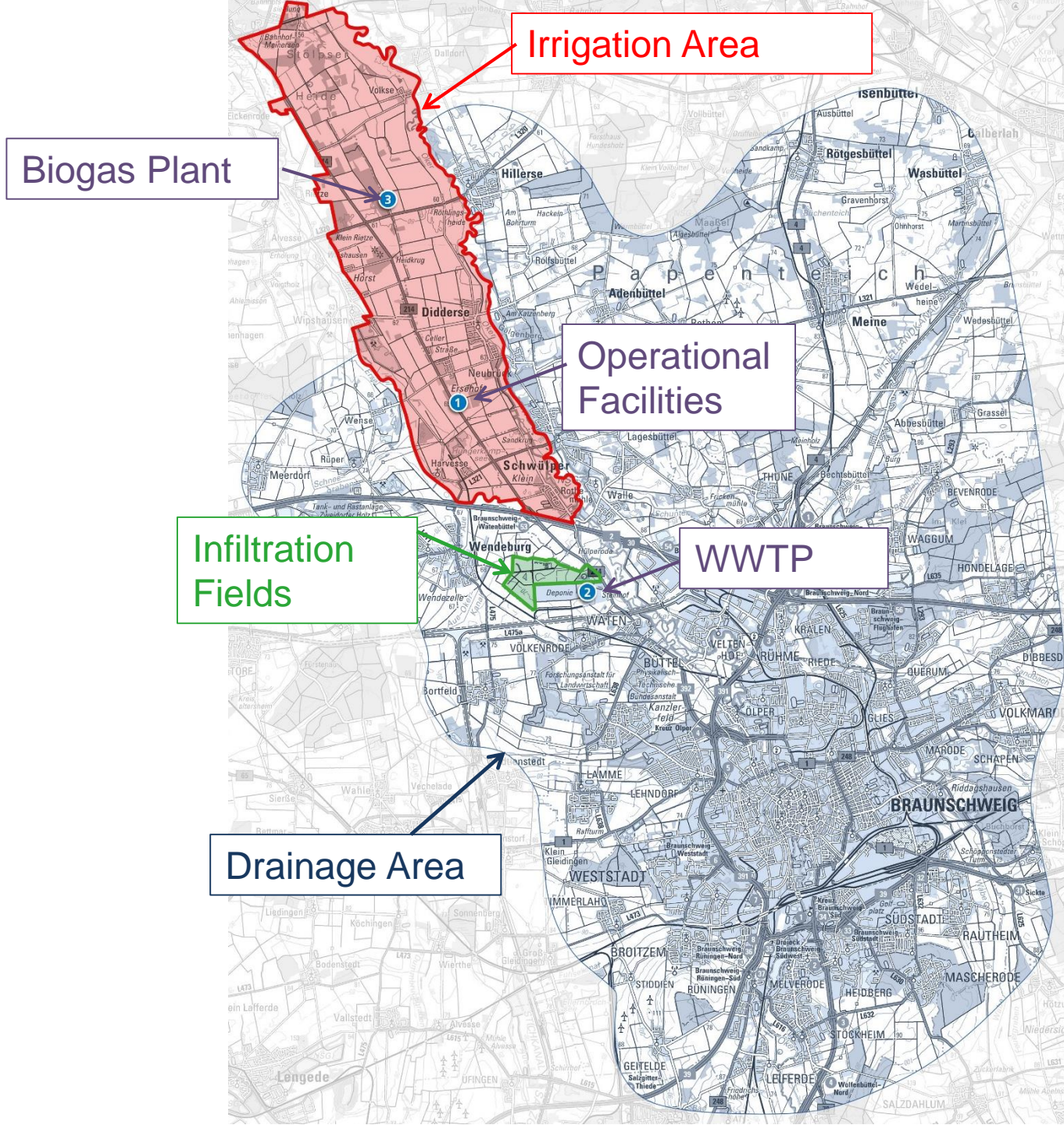


THE WASTEWATER BOARD



Operational facilities



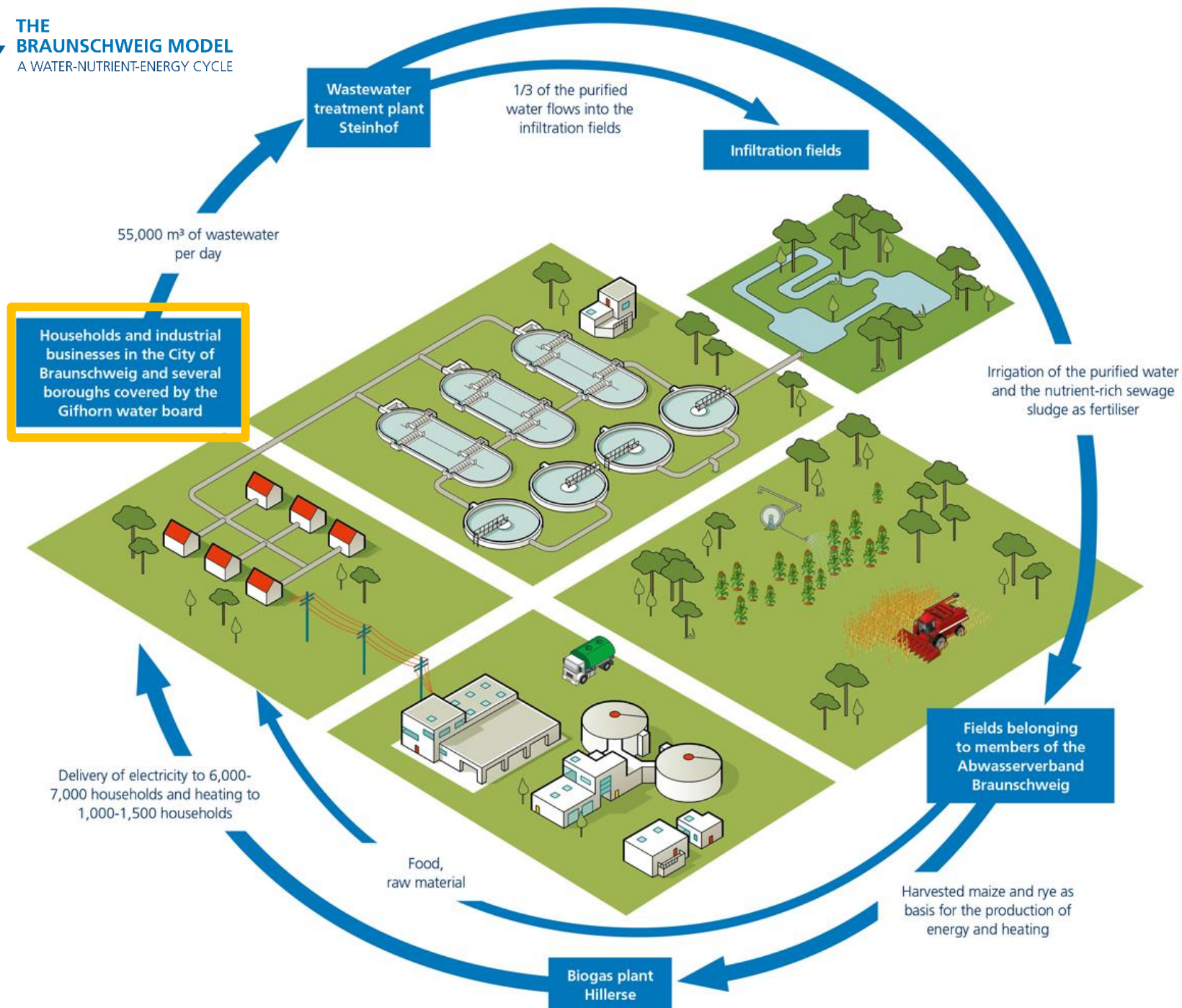




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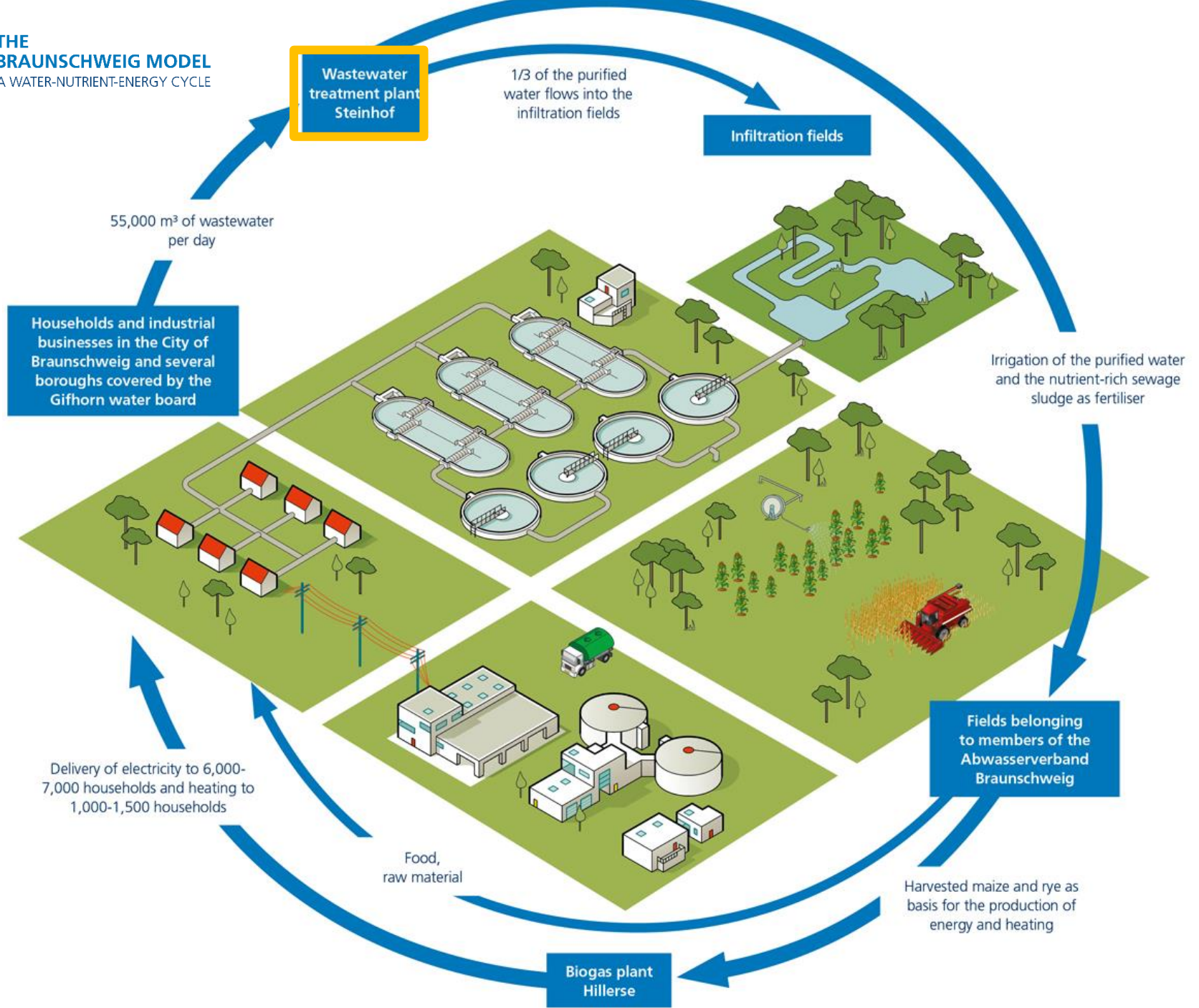
WASTEWATER TREATMENT PLANT



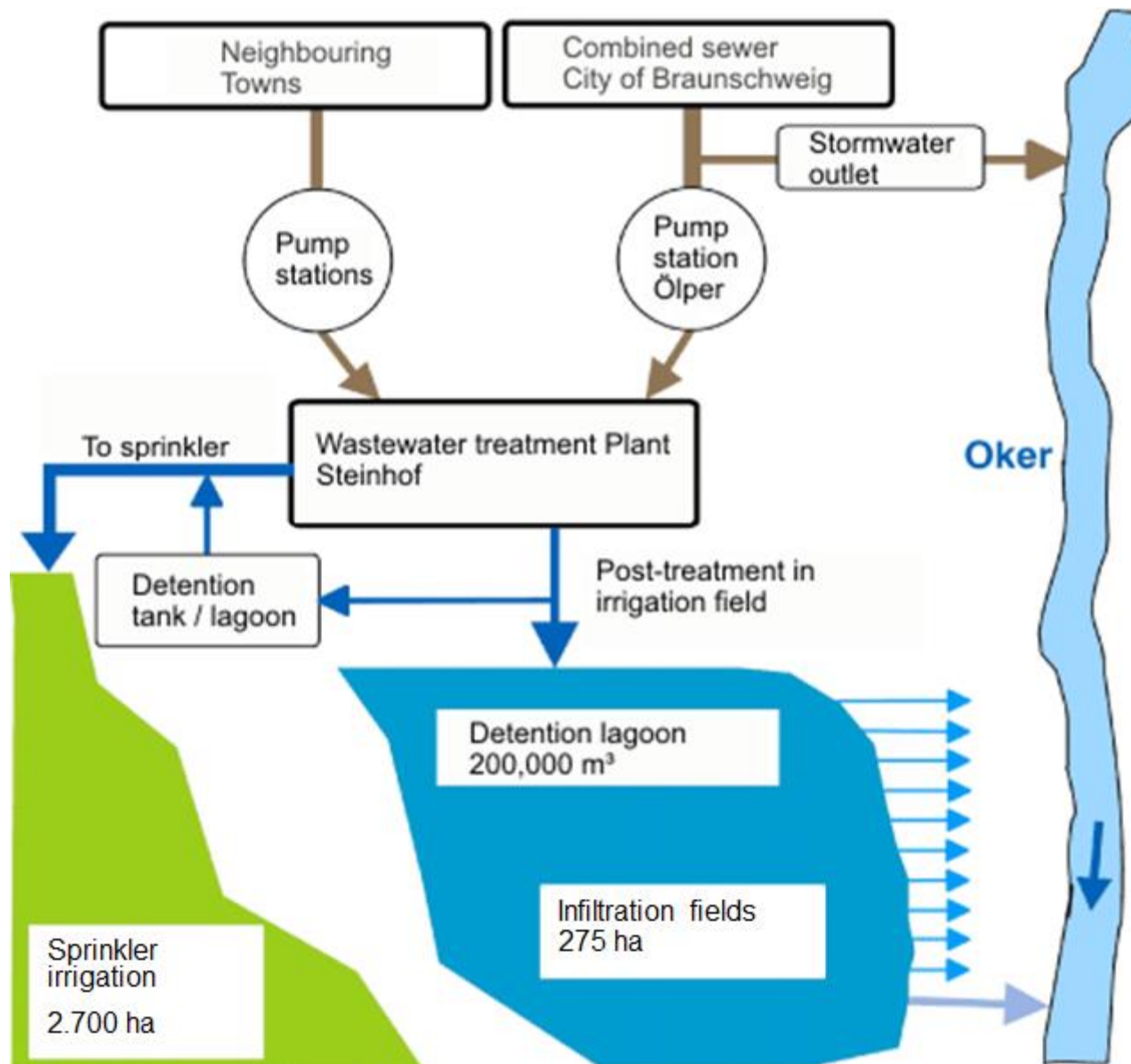


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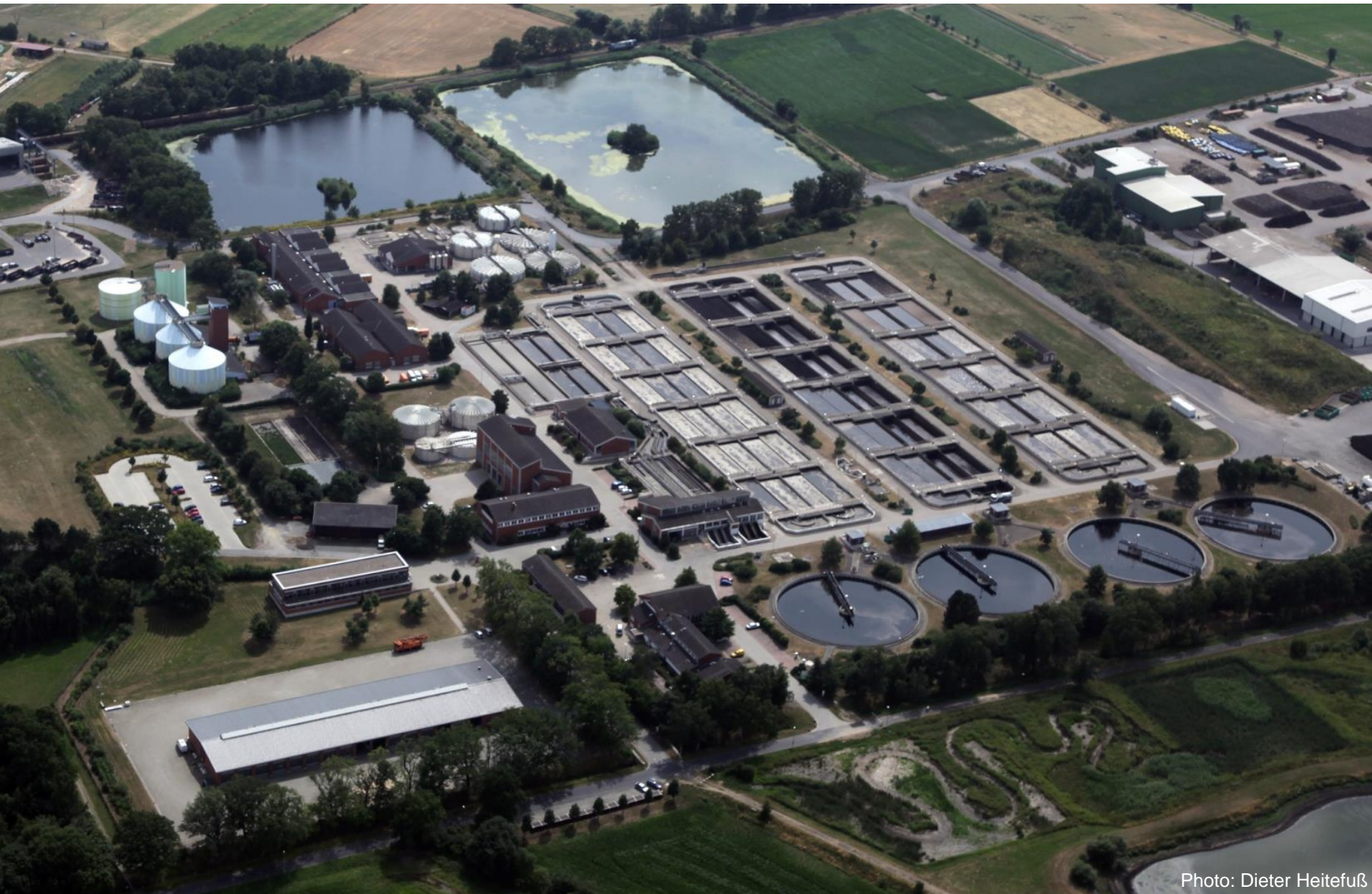
A WATER-NUTRIENT-ENERGY CYCLE



Concept for wastewater reuse



Wastewater treatment plant



Wastewater treatment plant

- Population equivalents: 385,000
- Flow: 55,000 m³/d
- Treatment process:
 - mechanical
 - biological
 - nutrient removal



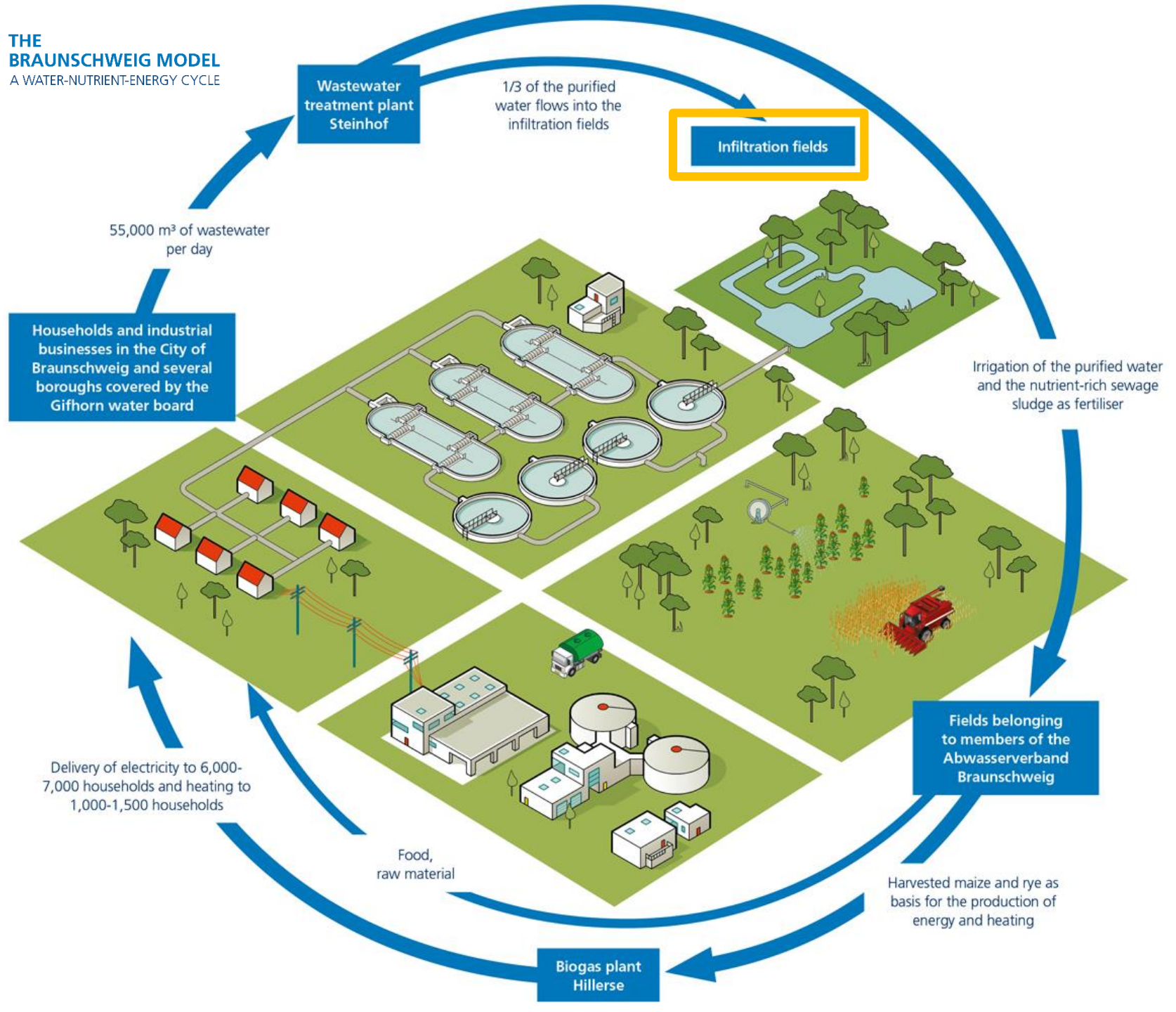
INFILTRATION FIELDS





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Infiltration fields



Size: 275 Hectare
This corresponds to an area
of 254 football fields.

Infiltration fields - Grey goose



Infiltration fields - Shelducks



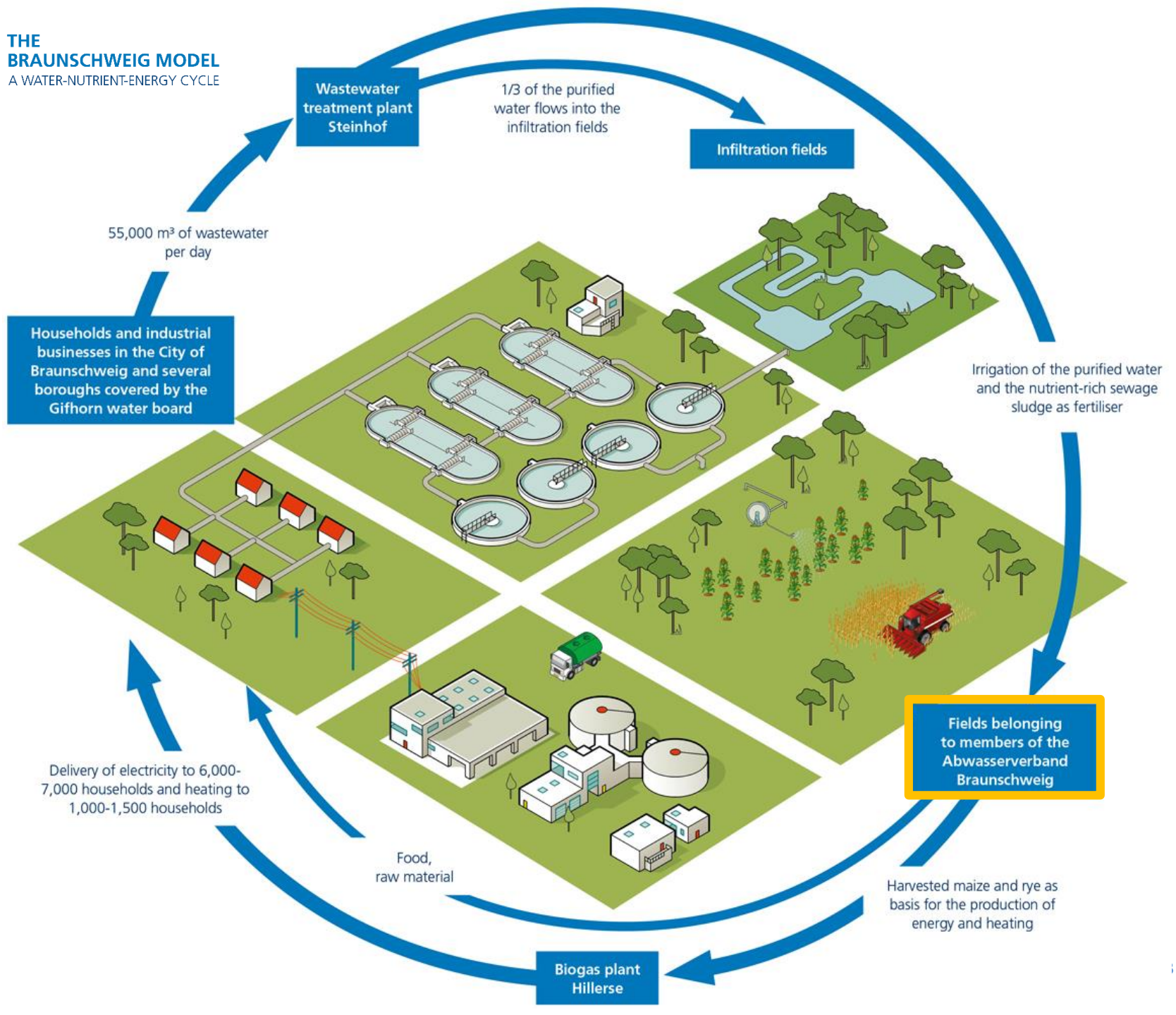
IRRIGATION





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Sprinkler irrigation

Sprinklers 1956 - 1974



Sprinkler irrigation

Sprinkling machines since 1974



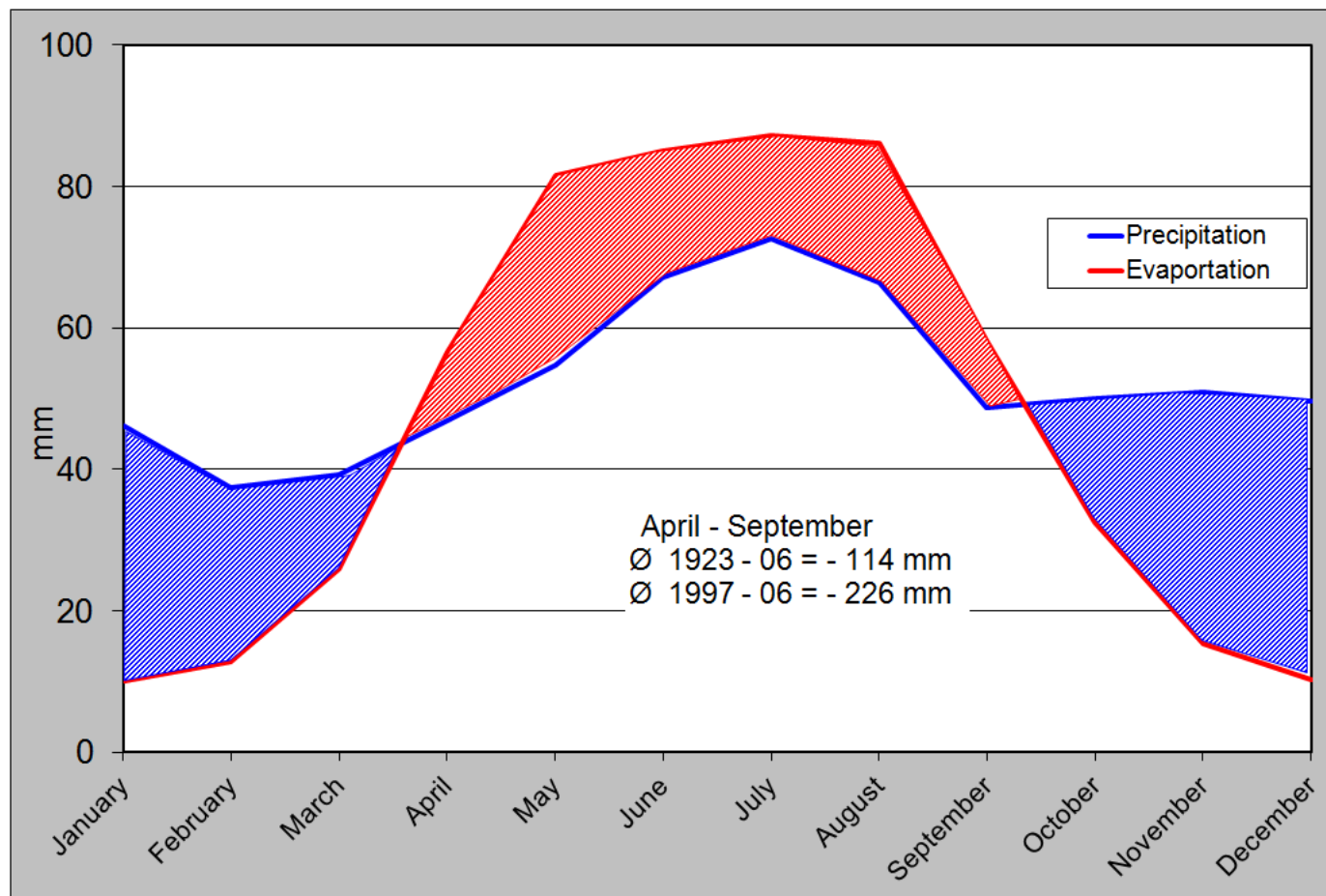
Irrigation



Necessity of irrigation and advantages of wastewater reuse in agriculture



Average water balance 1923 - 2014



Source: DWD, Station Braunschweig

Cultivation in the irrigation area

	1950	1970	1990	2010	2014
	%	%	%	%	%
Crop	42	39	60	40	39
Potatoes	26	20	6	4	4
Sugar-beets	6	16	25	17	17
Maize	0	2	2	32	38
Other	26	23	7	7	2

Relevance of wastewater reuse and its ingredients for resources conservation



Wastewater flow

Annual amount of treated water	21 Mio.m ³ /a
Hereof: reused by sprinkler irrigation	12 Mio.m ³ /a
artificial groundwater recharge	9 Mio.m ³ /a
Additional water demand for irrigation	
approx. 100 mm on 2,700 ha	3,6 Mio.m ³ /a
Total amount of water for artificial groundwater recharge	8,4 Mio.m ³ /a



Amount of sludge generated

Primary sludge and activated sludge	6,800 t TS/a*
Reduction by 30 % by digestion	2,050 t TS/a*
Anaerobic digested sludge	4,750 t TS/a*
hereof: ~ 60 % sprinkler irrigation in the „Sewage board-area“	2,750 t TS/a*
~ 40 % elsewhere reused in agriculture	2,000 t TS/a*

*total solids/year

Ø Nutrient load and nutrient demand (kg/ha)

	Load	Demand
Ammonium, nitrate	50	140
Phosphate P_2O_5	69	70
Potassium K	78	130
Magnesium MgO	38	45
Calcium CaO	318	380

Organic Substance 640 kg/ha



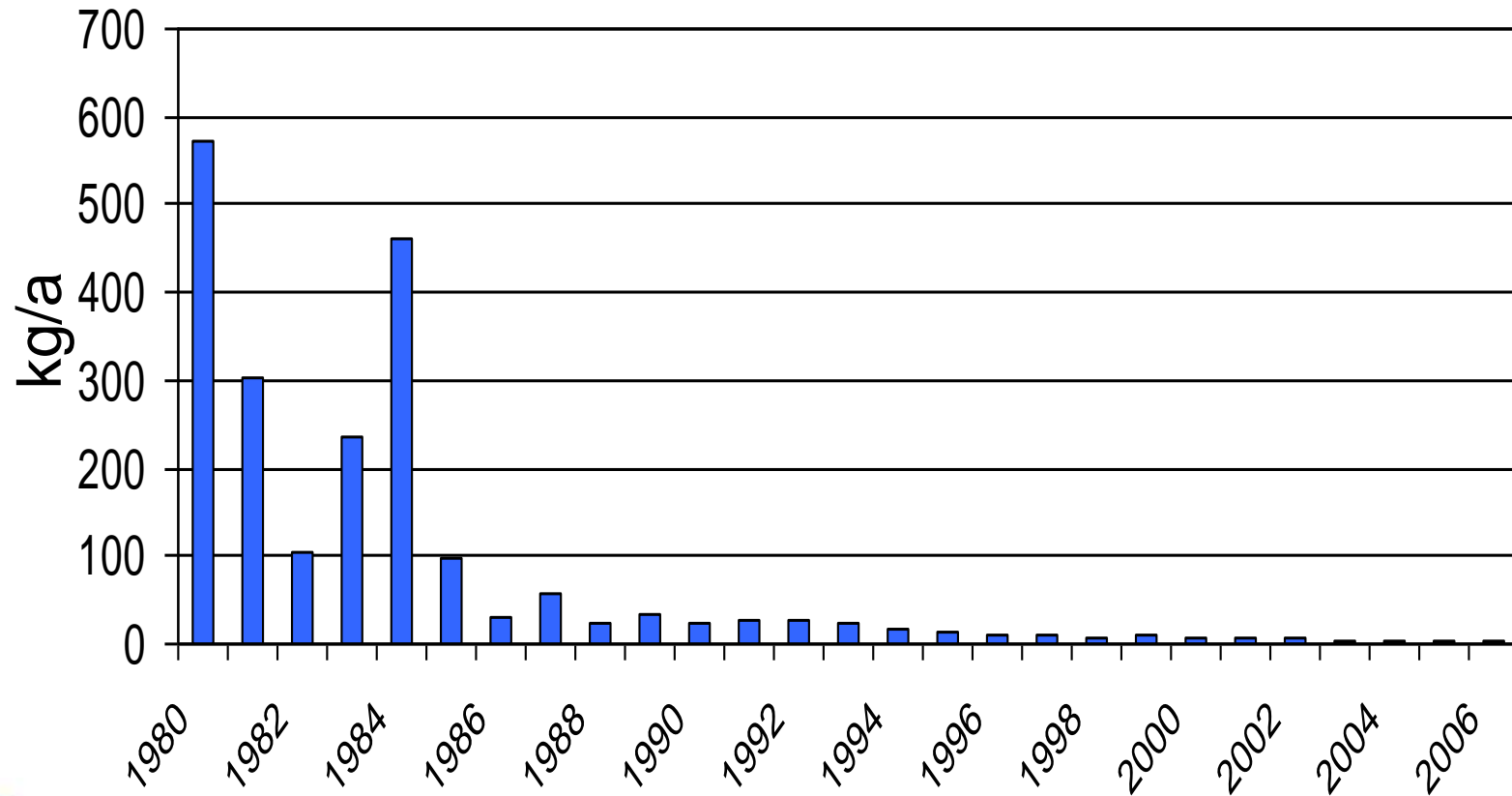
Arrangements for the protection of soil and groundwater



Indirect discharger monitoring in Braunschweig for 30 years

• Dry-cleaner	1
• Glass processing	7
• Breweries	2
• Chemical Companies	1
• Print shops	12
• Food industry	5
• Institutes and Laboratories	22
• Metal industry	5
• Garages, petrol stations etc.	242
• Hospitals	10
• Waste disposal sites	3
• Water treatment plants	13
• Restaurants	33
• Varnish production	8
• Other	13
• Sum Discharger	377

Cadmium-load in digested sludge

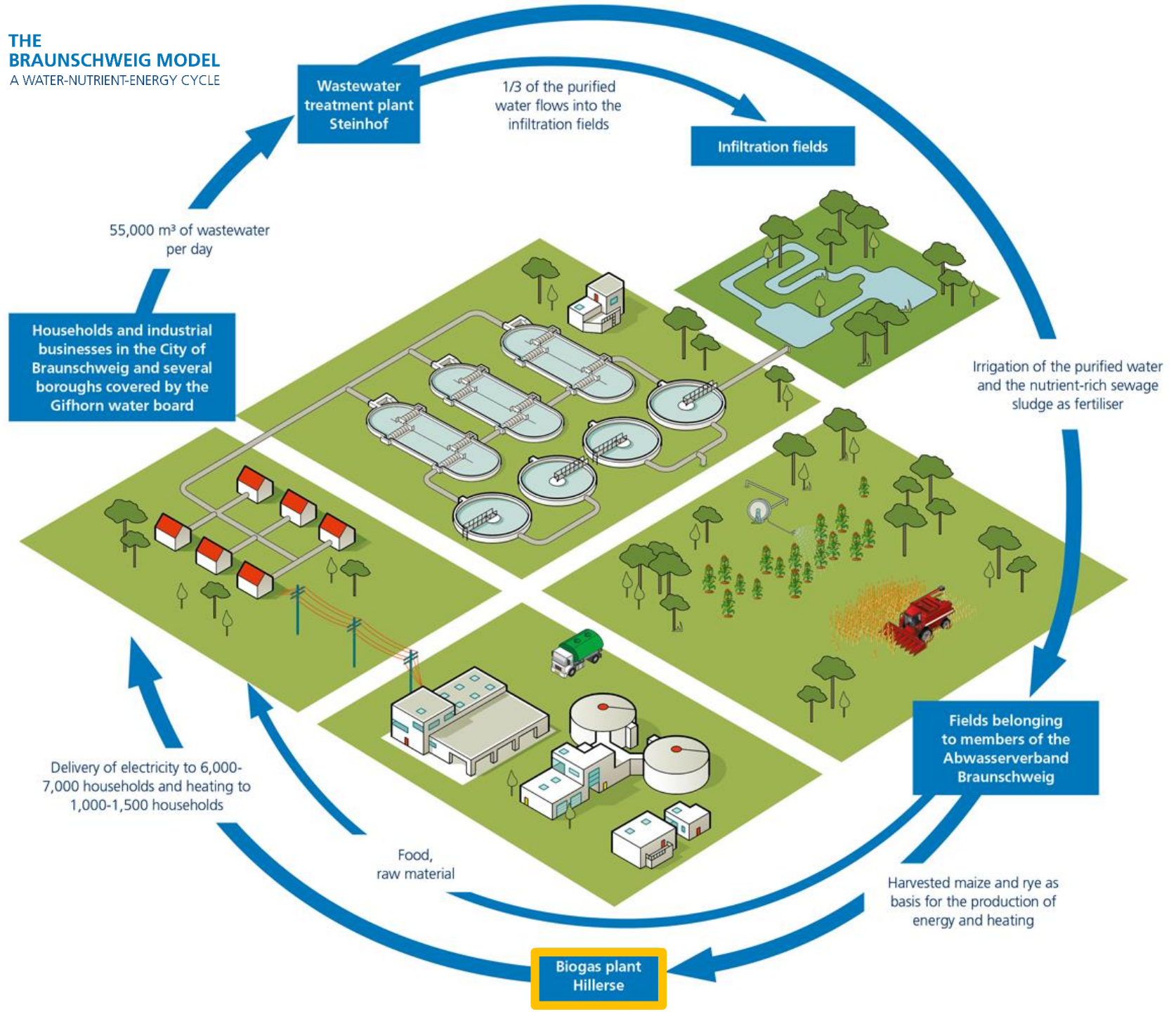


BIOGAS PLANT



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Biogas plant



Technical data

- Total capacity $2.5 \text{ MW}_{\text{el}}$
- $2 \times 1 \text{ MW}_{\text{el}}$ at Ölper (BS Energy)
- $0.5 \text{ MW}_{\text{el}}$ at Hillerse
- 20 km gas pipeline from Hillerse to powerplant Ölper



Demand for raw materials

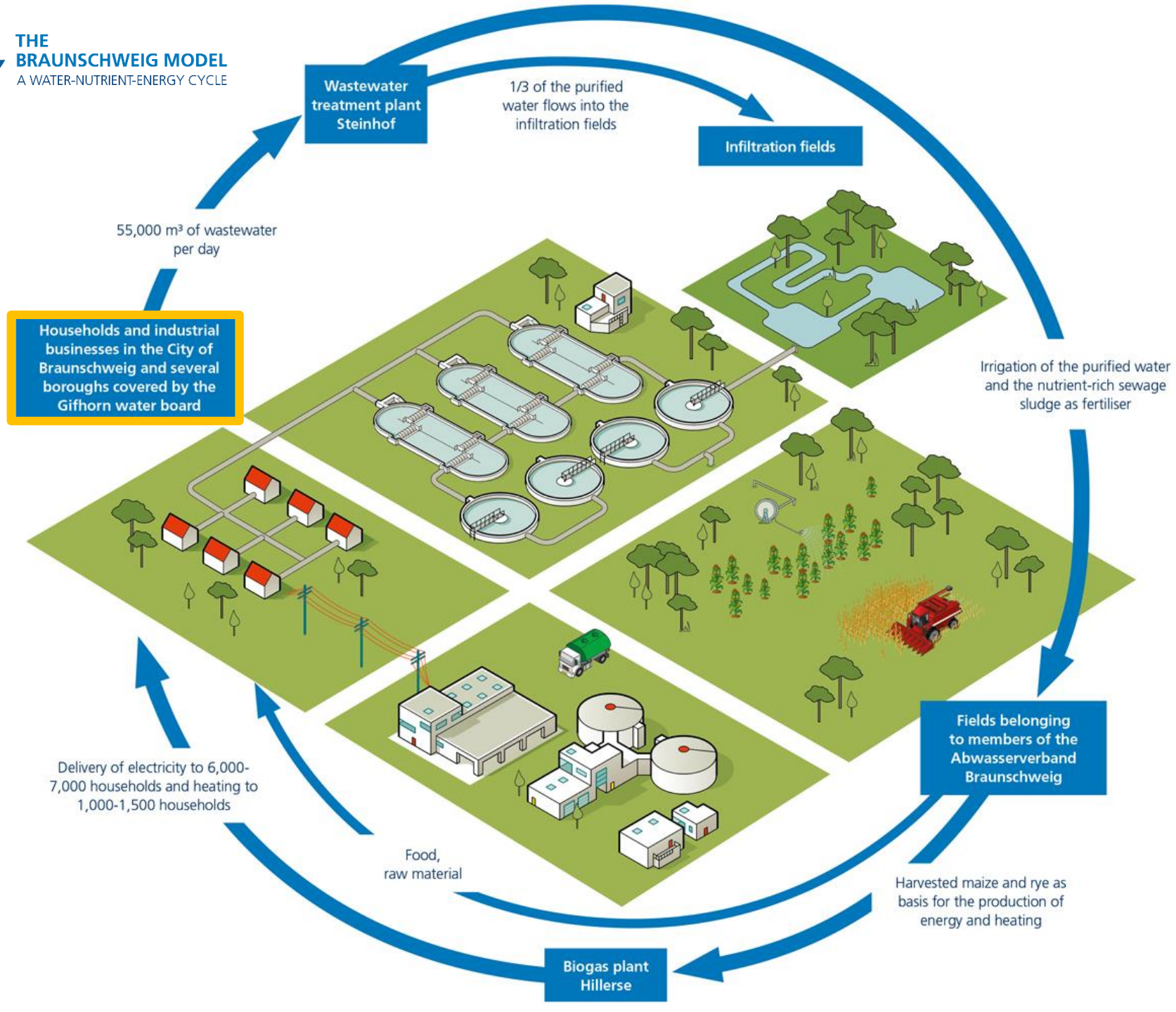
- Substrate per year 43,000 t (maize, rye)
- Agricultural crop land 1,000 ha
- Daily „feeding“ 101 t maize silage
16 t rye silage





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RÉSUMÉ AND OUTLOOK



The Braunschweig Model offers

- Sustainability through closed circles for water and nutrients
- Value chains of the plant production to electricity marketing
- Conservation of natural resources



- Water demand in agriculture will rise due to climate change
- The fertilizer legislation makes the use of plant nutrients from wastewater difficult
- The future of the agricultural utilization of sewage sludge is uncertain after the momentary political utterances





Thank you for your attention!

