

Manure, Straw and Beet residues
joint methanization to LBG
complementary approach

Re, non verbis



YM-BGCo
YUZHEF-MYKOLAYIV
BIOGAS COMPANY



BIOMETHANE- LBG

YM-BGCo partners
with UTC



Jun'18

Aug'18



Agreement with Caterpillar

First MWh is
produced and sold



Dec'19

Jun'20



The production capacity
grows to 5.2 MWh / 90k m³
of BioGas per day

The annual EBITDA
reached 2.4 mEUR



2021

Jun'22



BioMethane station
purchased

YM-BGCo partners
with Sparrow Capital



Oct'22

Dec'22



Agreement with Airco
to construct BioLNG
production plant

Stage I. Capacity 3.2 MWe/h

Raw materials: Beet pulp, beet tails and pieces.

Daily biogas production – **36 000 m³**.



Raw materials: Beet pulp, beet tails and pieces, apple pulp, chicken manure.

Daily biogas production – **60 000 m³**.



Raw materials: Beet pulp, beet tails and pieces, apple pulp, chicken manure and straw.

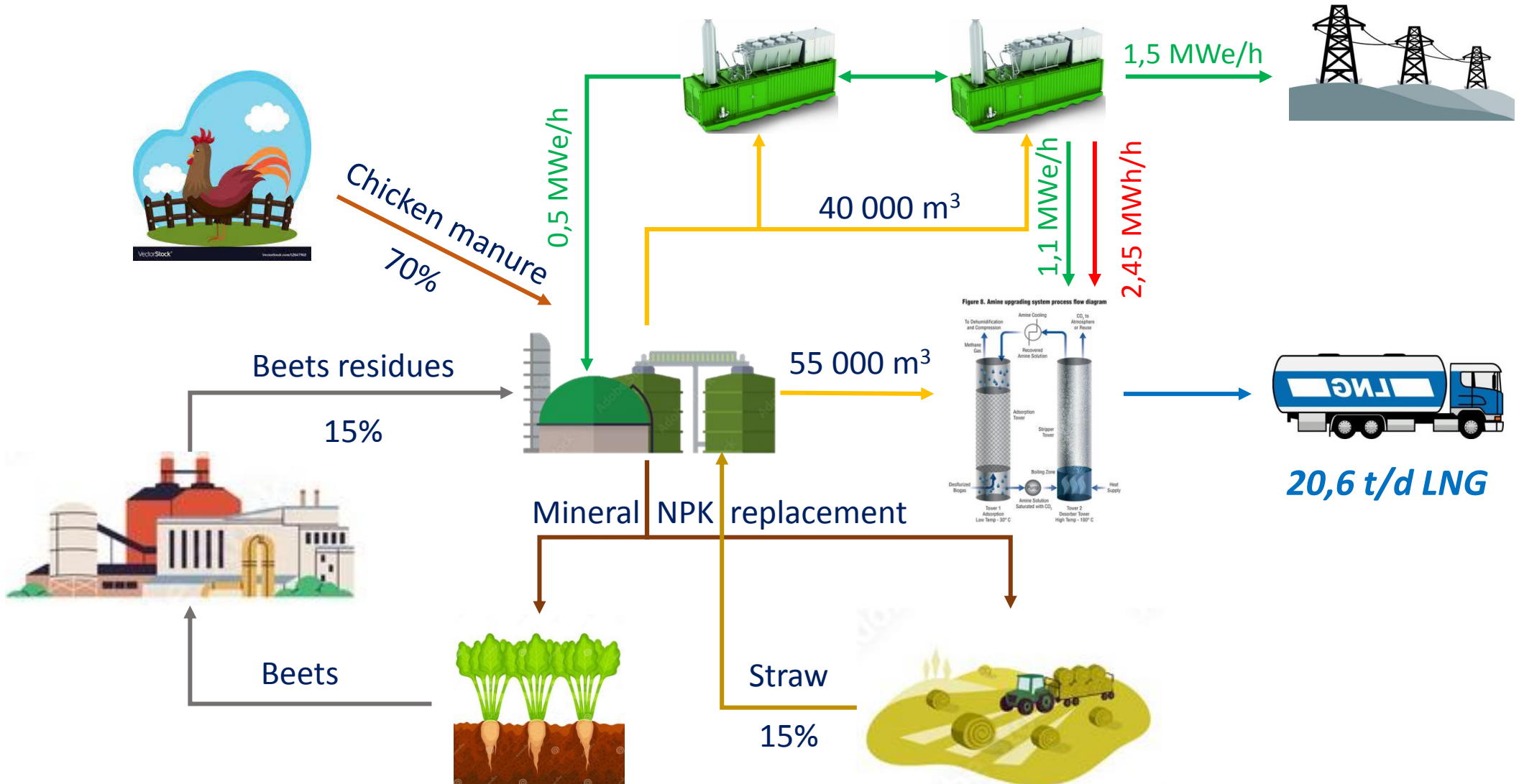
Daily biogas production – **110 000 m³**.





Technical characteristics of Yuzefa plant:

- Primary digesters volume – 17 000 m³
- Secondary digester – 4500 m³
- Organic loaded per day – 170 t (70% chicken manure)
- Organic load – 10 kg/m³/d
- Average conversion – 72% or 95 000 m³/day of dry biogas
 - 35 000 m³/d – to CHP
 - 55 000 m³/d – to upgrade and liquification
 - 5 000 m³/d – amine recovery heat
 - 1,6 MWe/h + 2,45 MWh/h self consumption



Biogas to Upgrade – 58% CH₄, 40,7% CO₂, H₂S – 1%, (N₂+O₂) – 0,3%

Dry Biogas to CHP – 58% CH₄, 40% CO₂, (N₂+O₂) – 0,3%, H₂S < 50 ppm

Off gas– 0,01% CH₄, 99 % CO₂, (N₂+O₂) – 1%, H₂S < 5 ppm

Methane to LNG – 99,5% CH₄, CO₂ < 50ppm, (N₂+O₂) < 0,5%, H₂S < 5ppm, H₂O < 0,5 ppm

BioLNG – -162,5 °C, storage capacity 100 t

CI Score - -92

Bio LNG quality advantage vs. LNG – no traces of aromatics

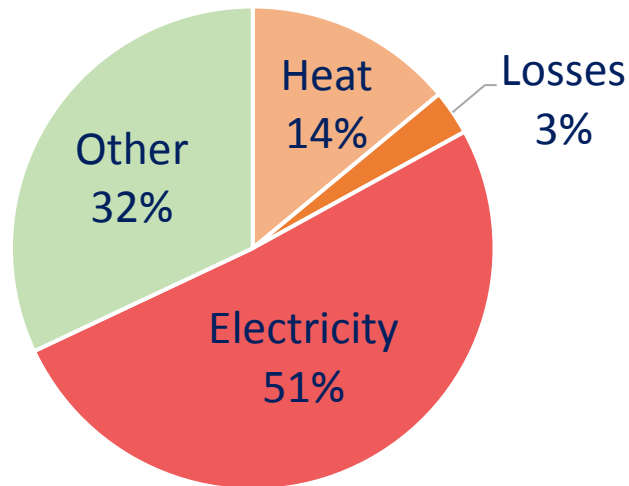
COMPARISON OF GAS PREPARATION UNITS AND TECHNOLOGIES FOR THE PREPARATION OF BIOGAS TO BIOMETHANE

Membrane

Enrichment up to >98% of CH₄
 Electricity: **0,4 kW/m³** (for LBG)
 Losses CH₄ – **0,6% (10 €)**
 Upgrade costs – **117 €/1000 m³**



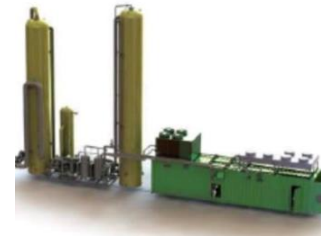
Operating costs



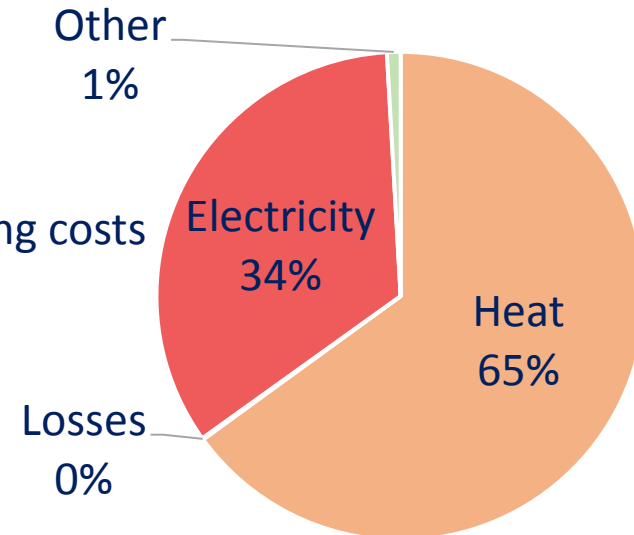
Heat Losses Electricity Other

Amine

Enrichment >99,5% of CH₄
 Electricity: **0,1 kW/m³**
 Heat: **0,75 kW/m³**
 Losses CH₄ – **0,1% (1 €)**
 Upgrade costs – **45 €/1000 m³**



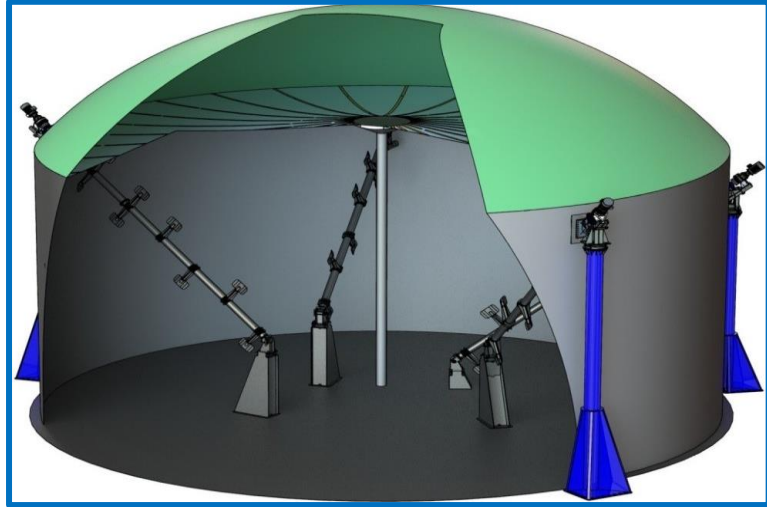
Operating costs



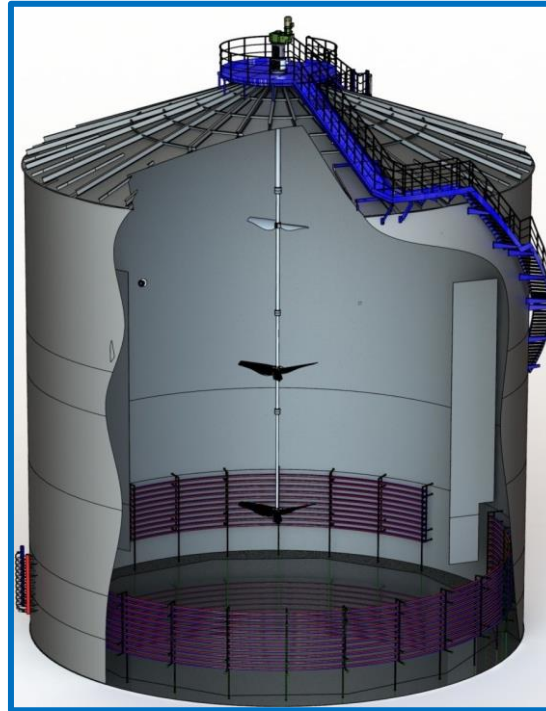
Heat Losses Electricity Other

I-CSTR as our expansion secret

Farm type reactor – 6500 m³



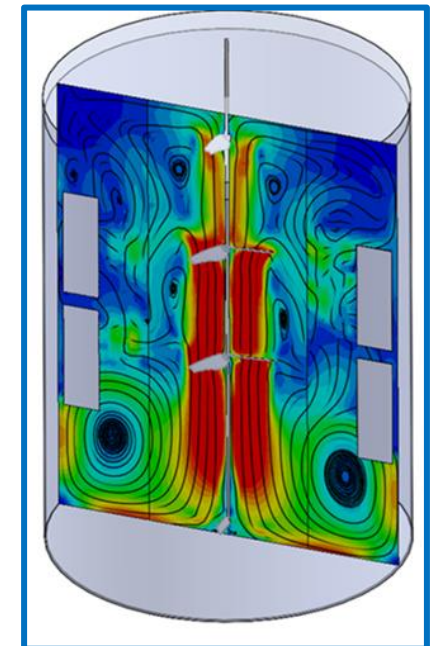
Dry matter content – **8-10%**
 Mechanical mixing – **80 kw/h**
 Local, homogeneity – **60%**
 «Jump through» organic - **20-25%**
 Organic conversion – **55-65%**
 Loading rate – **2,5-4,0 kg/m³/d**



I-CSTR type – 10 000 m³

Floating layer regulated
 Foam fighting system
 Low heat loss
 Minimum building space
 Low maintenance

Dry matter content - **12-15%**
 Vertical mixing – **22 - 37 kw/h**
 Homogeneity - **95%**
 «Jump through» organic - **10%**
 Organic conversion – **70-85%**
 Loading rate – **8-12 kg/m³/d**



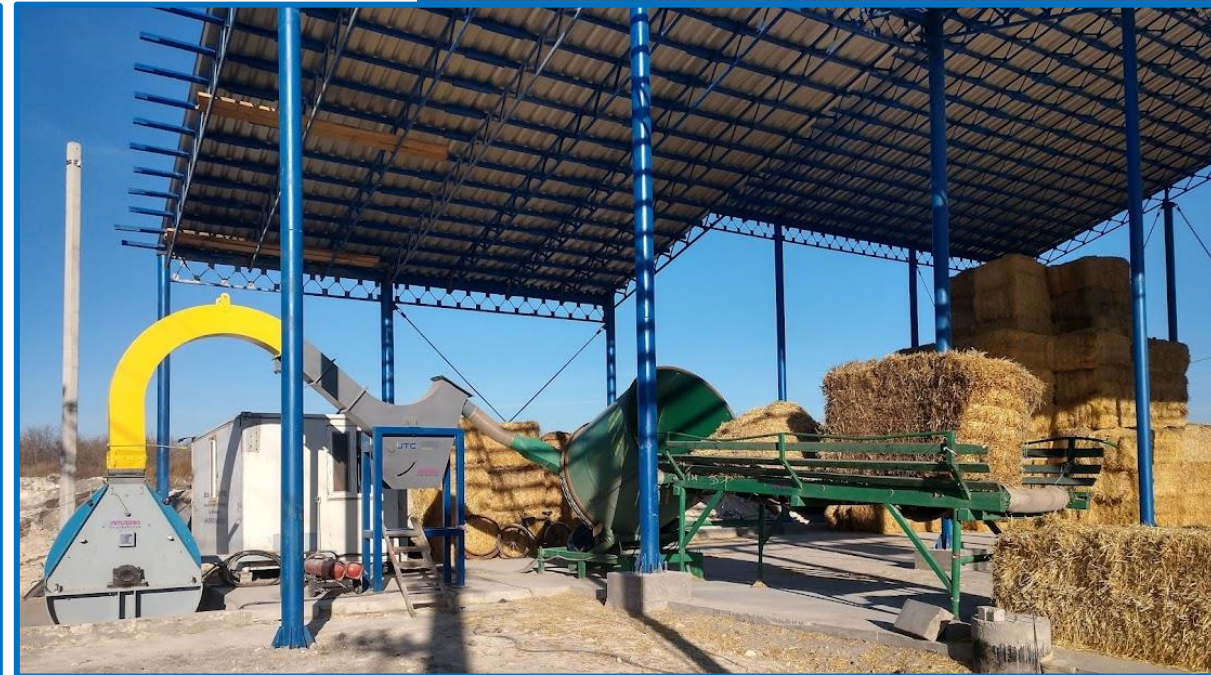
Straw conditioning: Size reduction

High dry matter of straw:

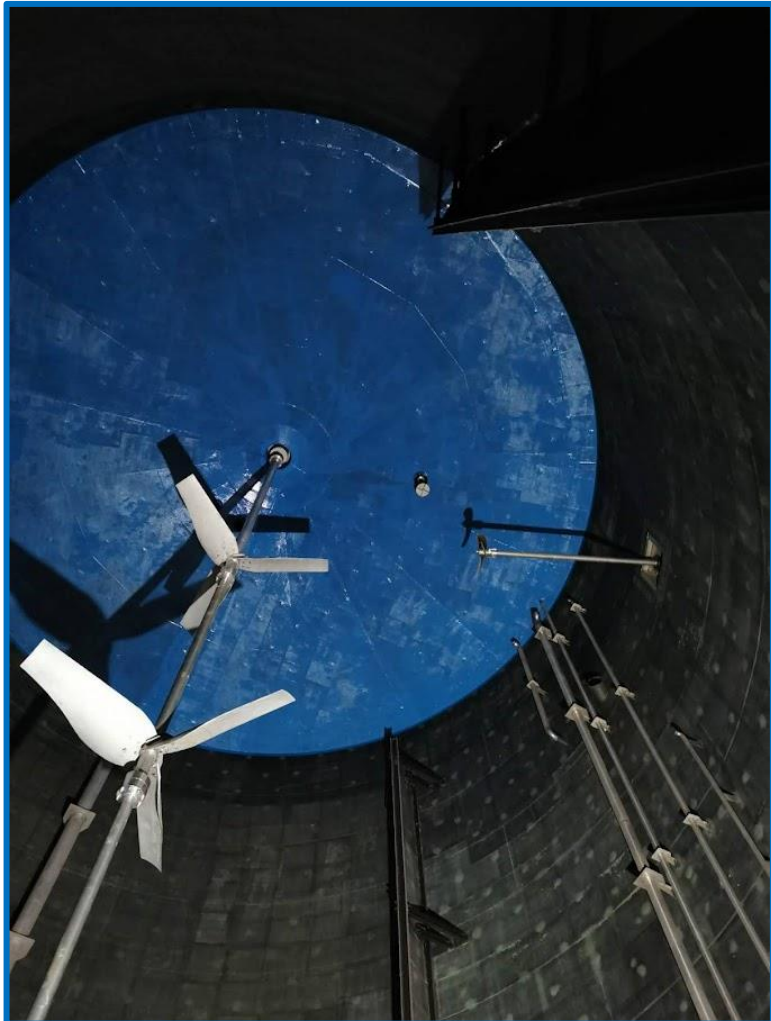
- ✓ ***key to low energy consumption shredding***
- ✓ ***Key to pneumatic transport of straw***

Straw size reduction only first step of straw conditioning

Physical or biological hydrolysis must follow



Wet fermentation in Hydrolyser



1. Smaller size I-CSTR
2. Special conditions and pH
3. Special mixing system
4. Hi Dry matter inside
5. Special menu needed
6. Special bottom shape
7. Can work as digester
8. Produce feed with High CH₄ content
9. Reduces retention time

Dry co-fermentation in clamp



1. Airless storage
2. Acid producing co – substrate
3. Controlled dry matter
4. Low pH
5. Easy to handle material

Chicken manure Carbon/Nitrogen (C/N) – 6-9

Agri wastes Carbon/Nitrogen (C/N) – 80 - 100

Optimal Carbo/Nitrogen (C/N) – 20-25

Optimal C/N ratio advantages:

- ✓ Optimal bacterial growth rate
- ✓ Deeper conversion of both feed types
- ✓ Higher biogas yield
- ✓ Lower ammonia concentration
- ✓ Lower wild methane and ammoniac escape



Corn cobs, grain hulls, husks and straw best co-feed to manure

Feeding systems of Yuzefa plant



Wet milling system, mixing and pumping



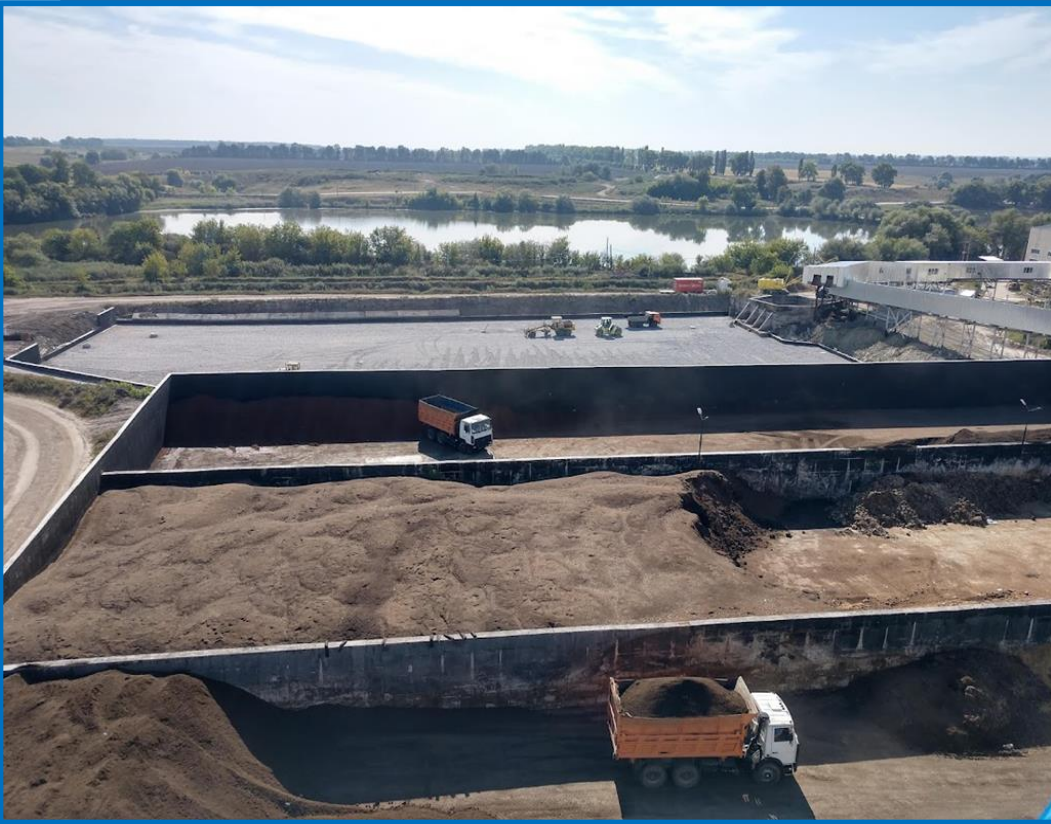
Dry milling system, mixing and pumping

Feed that needs no milling loaded directly on dosing table bunker

Feeding of straw

Dry milled straw and/or dry fermented straw are loaded through table to Hydrolyzer





Pumping station

Applicator - injector

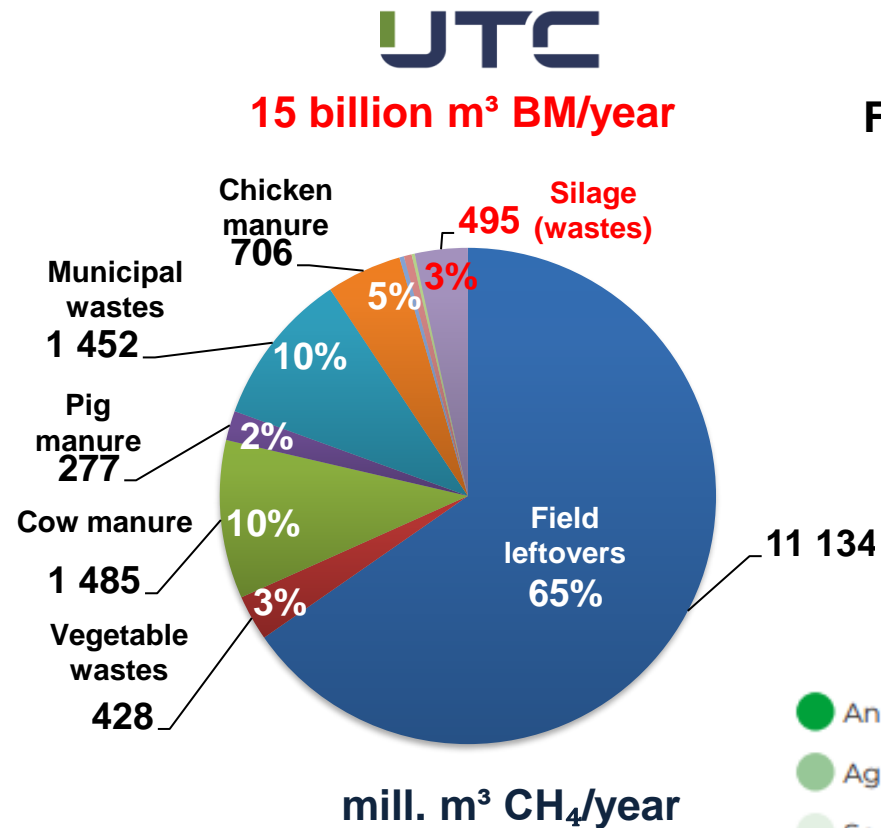
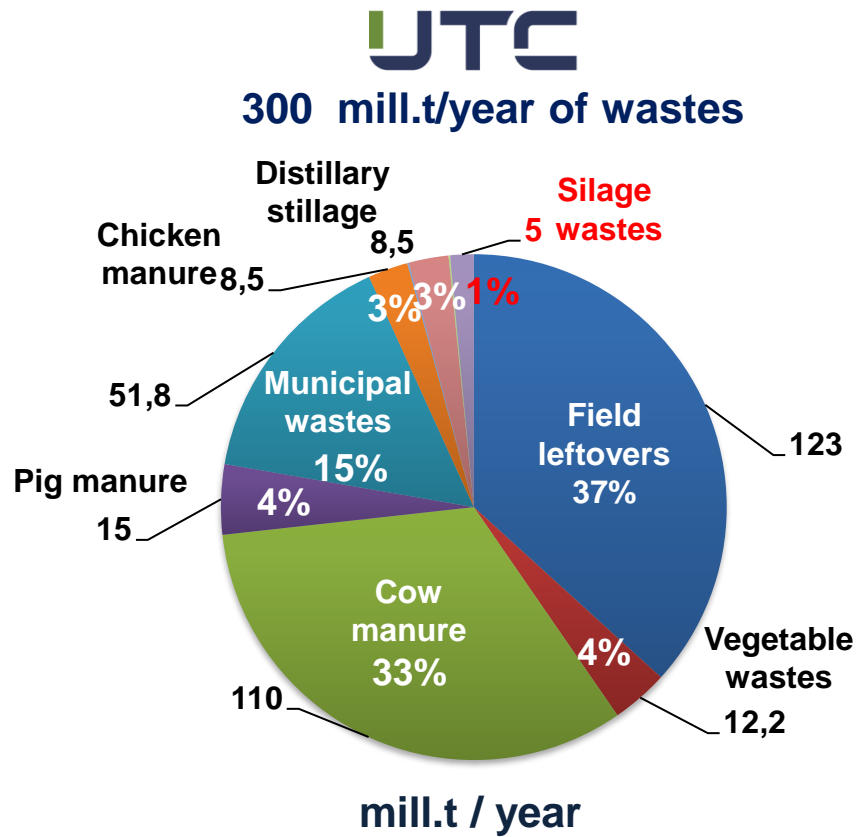
Hose transport



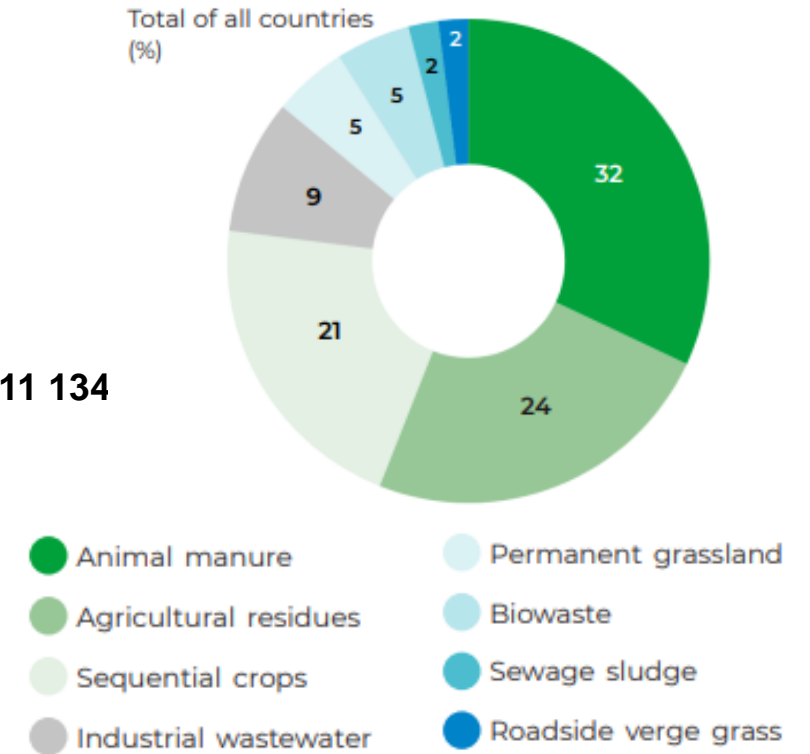
Pump it – don't drive it



Potential of Ukraine in biomass and biomethane volumes



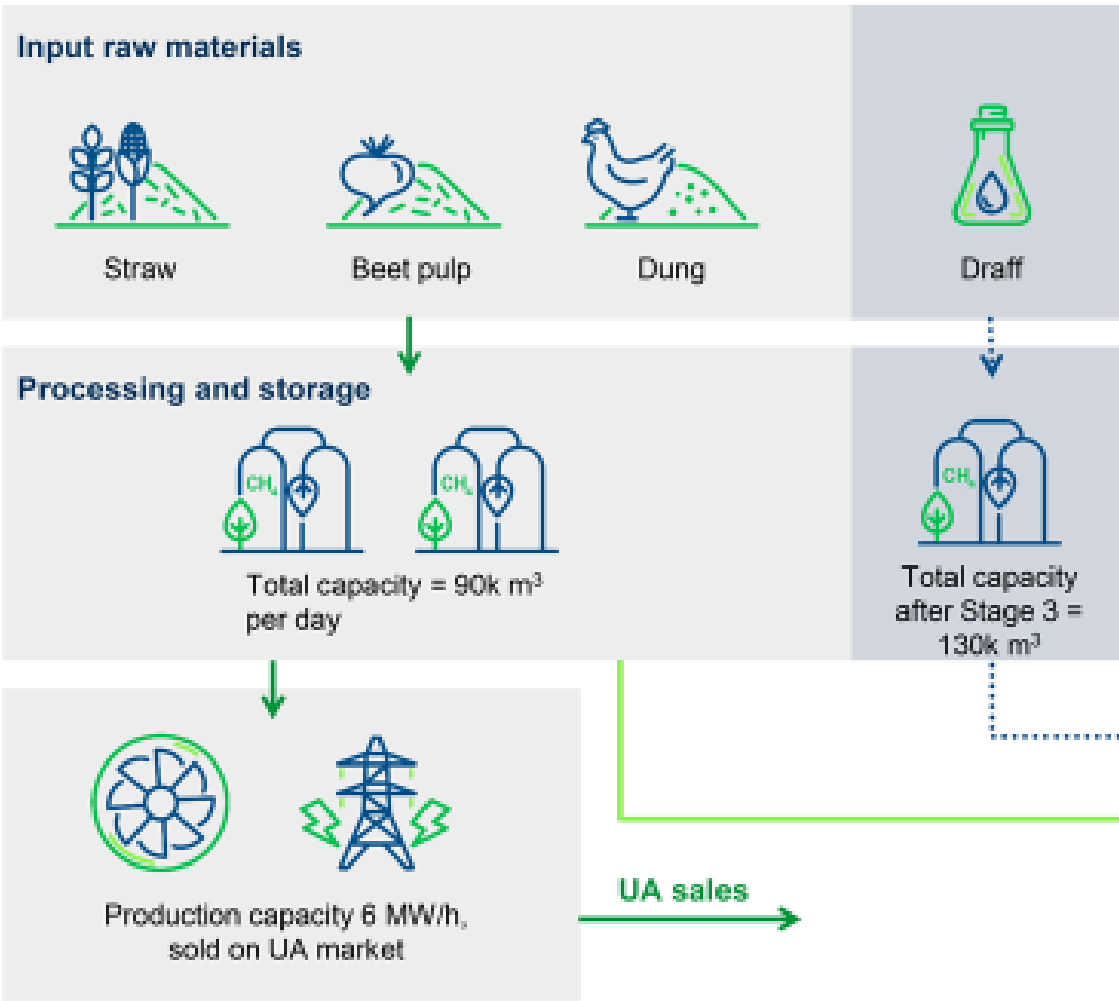
EBA
European Biogas Association
Feedstock potential (all countries)



Biomethane production potential calculations for Ukraine by “UTC” data

No	Biogas Raw materials	Quantity, practically t/year	Content OM, %	Content CH ₄ , %	Biogas dencity kg/m ³	Quantity OM, t/year	Conversion rate, %	Yield of biogas m ³ /t ODM	Yield biogas, m ³ /t	Yield of biogas, m ³ /t (literature)	Yield biomethane, thous.m ³ /year	% of yield balance	Content N, kg/t	Content P, kg/t	Content K, kg/t	C:N Ratio	Source and volume of waste production	Quantity, theoretically t/year
1	Straw of graincrops	10 560 000	65	52	1 314	6 864 000	60	456	297	250-340	2 265 120	16,34	6,40	1,00	3,00	150:1	Wheat, barley, rye, oats, millet	32 000 000
2	Corn Harvest residues	13 200 000	68	50	1 340	8 976 000	61	455	310	280-350	2 962 080	21,37	4,30	1,40	4,40	200:1	Corn grain	40 000 000
3	Harvest residues of oil agricultures	6 600 000	68	60	1 214	4 488 000	80	659	448	550-800	1 481 040	10,69	5,40	0,80	2,80	200:1	Sunflower	20 000 000
4	Harvest residues of technical crops	5 940 000	62	53	1 302	3 682 800	60	461	286	200-250	1 215 324	8,77	6,20	1,00	3,00	100:1	Soybeans, buckwheat, hops...	18 000 000
5	Bran and grain wastes	2 000 000	65	51	1 327	1 300 000	65	490	318	300-575	429 000	3,10	7,10	1,50	3,00	200:1	2% from grain	2 000 000
6	Leaves amd grass shavings	2 000 000	30	60	1 214	600 000	80	659	198	210-290	198 000	1,43	5,90	1,60	15,20	60:1	Wastes from cities and around woods	2 500 000
7	Green wood cleaning wastes	5 000 000	40	69	1 102	2 000 000	78	708	283	370	660 000	4,76	2,00	1,00	1,00	80:1	Sanitary wood cleaning	5 000 000
8	Pressed beet pulp	2 000 000	22	54	1 289	440 000	85	659	145	100-165	145 200	1,05	1,00	0,70	1,00	150:1	10 mln.t/year beets (1,4 mln.t of sugar)	2 000 000
9	Beet floating pulp	100 000	12	54	1 289	12 000	80	620	74	74	3 960	0,03	1,30	0,30	1,60	140:1	10 mln.t/year beets (1,4 mln.t of sugar)	2 000 000
10	Beet leaves	2 500 000	15	52	1 314	375 000	62	472	71	70	123 750	0,89	6,00	1,20	1,50	150:1	While harvested in field - 25-35% from beets	3 000 000
11	Beet tails	1 000 000	15	54	1 289	150 000	80	620	93	100	49 500	0,36	1,30	0,30	1,60	140:1	During beets processing	1 000 000
12	Apple pulp	300 000	35	50	1 340	105 000	55	411	144	70-140	34 650	0,25	1,00	0,50	0,50	35:1	At Apple juice production	1 200 000
13	Graip pulp	200 000	25	50	1 340	50 000	50	373	93	44	16 500	0,12	1,00	0,20	1,00	35:1	At wine materials production	1 000 000
14	Vegetable stores and storage wastes	1 000 000	15	51	1 327	150 000	75	565	85	110	49 500	0,36	9,00	0,24	1,40	20:1	Waste collected at vegetable sale points	1 000 000
15	Starch production wastes	500 000	20	56	1 264	100 000	75	593	119	123	33 000	0,24	6,10	0,30	2,00	28:1	Starch production plants	500 000
16	Melons wastes	1 000 000	15	50	1 340	150 000	60	448	67	100-110	49 500	0,36	9,00	0,24	1,40	20:1	Vegetable harvest wastes	1 000 000
17	Algae and river weeds wastes	2 000 000	12	59	1 227	240 000	70	571	68	80	79 200	0,57	2,00	1,00	2,00	19:1	River shaking and nuts weeds	3 000 000
18	Molasses after distillary stillage	500 000	10	66	1 139	50 000	70	614	61	50	16 500	0,12	9,60	1,10	3,70	100:1	3 200 thous. t molasses (6 mln.decal)	6 000 000
19	Grane stillage decantate	1 000 000	7	66	1 139	70 000	75	658	46	45	23 100	0,17	8,90	1,00	3,00	150:1	3 500 thous. t of grain (12 mln.decal)	2 000 000
20	Silage - wastes of feed leftovers	5 000 000	30	56	1 264	1 500 000	80	633	190	170-230	495 000	3,57	4,00	2,00	1,00	75:1	Feed wastes from 5 mln. Heads per year	5 000 000
21	Blood and slaughter house wastes	100 000	30	56	1 264	30 000	78	617	185	300	9 900	0,07	3,00	1,00	1,00	12:1	At sugar plant at processing	100 000
22	Manure of meat chicken	4 800 000	30	60	1 214	1 440 000	64	527	158	80-140	475 200	3,43	30,50	25,00	2,00	15:1	Meat production 1,6 mln. t/year	4 800 000
23	Manure of egg laying chicken	3 500 000	20	60	1 214	700 000	65	535	107	80-140	231 000	1,67	5,00	3,00	2,00	15:1	Eggs production 15 billion. pcs/year (0,25kg/head)	3 750 000
24	Manure COW, Goat, Sheep	30 000 000	15	58	1 239	4 500 000	60	484	73	20-30	1 485 000	10,71	5,00	1,00	1,00	15:1	Поголівя 5 млн. голів (40 кг/доб голову)	110 000 000
25	Manure pig	12 000 000	7	60	1 214	840 000	60	494	35	20-25	277 200	2,00	6,00	1,40	4,80	15:1	Поголівя 6 млн, м'яса 0,8 млн.t/year (10 кг/діб)	15 000 000
26	Animal husbandry wastes	100 000	25	45	1 402	25 000	64	456	114	110	8 250	0,06	3,00	1,00	1,00	15:1	organic farming 1 mln. Heads	100 000
27	Organic fraction of MSW	4 500 000	22	42	1 440	990 000	65	452	99	50-100	326 700	2,36	0,90	0,50	0,50	50:1	12 mln. t - 40% organic fraction of MSW	4 800 000
28	Municipal waste waters cleaning sludge	20 000 000	8	68	1 114	1 600 000	80	718	57	60	528 000	3,81	9,80	1,10	0,50	80:1	3,65 kg sludge per person (5% DM)	40 000 000
29	Local waste waters cleaning sludge keck	1 000 000	20	68	1 114	200 000	62	556	111	100	66 000	0,48	4,00	3,50	0,30	100:1	200 food production plants	1 000 000
30	Cellulose and card board plants scope	500 000	40	48	1 365	200 000	64	469	188	190	66 000	0,48	0,50	0,10	0,10	200:1	Card board and paper production	500 000
31	Sanitary wastes	100 000	75	45	1 402	75 000	76	542	407	400-461	24 750	0,18	3,00	2,00	2,00	25:1	Veterenarian milk wastes	150 000
32	Biodiesel and oil production wastes	300 000	30	60	1 214	90 000	85	700	210	256	29 700	0,21	10,00	1,20	1,20	100:1	Oil - fat production plants	350 000
33	Waste waters concentrate	1 000 000	1	70	1 089	10 000	78	716	7	8	3 300	0,02	7,00	3,50	0,30	75:1	Waste water of food production	1 000 000
	Total	140 300 000				42 002 800					13 860 924	100						329 750 000

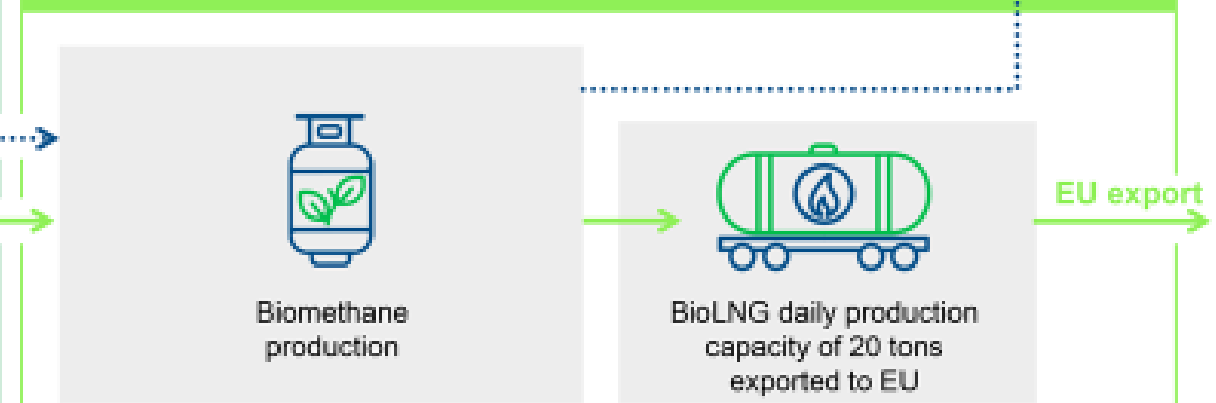
Stage 1 – Completed
Fully financed and active since 2019
Total invested funds 10m EUR



Stage 3 – Planned and requires financing.
Planned launch in autumn 2024
Total required funds 20m EUR. Required external financing 12.5m EUR



Stage 2 – In completion
Fully financed and installed. Planned launch in 2024
Total invested funds 5m EUR



- ❑ Wastes availability and low cost
- ❑ Large farm size and vertical integration
- ❑ Carbon and nitrogen wastes availability
- ❑ Digestate direct application available
- ❑ Developed Gas Transport Grid for EU export
- ❑ Supportive legislation on Biomethane
- ❑ Profit Tax exemption for industrial parks
- ❑ VAT exemption for imported from EU equipment

Other projects of Adverio and UTC in Ukraine

Astarta plant – 200 000 m³/d



Dionis biogas plant – 20 000 m³/d

