European Bank
for Reconstruction and Development

أمانة عمّان الكبرى

Circular economy-zero waste anaerobic digestion plant in Greater Amman Municipality

G. Iliopoulos, M. Dimitropoulou, V. Stergiou, M. Chionidis, G. Giannakis

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ENGINEERING & ENVIRONMENTAL CONSULTANTS

EPTA Environmental Consultants – Engineers
Athens, Greece
www.epta.gr

Mostaqbal Engineering & Environmental Consultants
Amman, Jordan
www.mostaqbal.jo

Scope of the project - Contents

To assess the viability of an AD Plant in Amman from a technical, financial, environmental, legal, and regulatory perspective.

Presentation's Contents:

- *Biowaste Separate Collection*
- *Anaerobic Digestion Plant*
- *AD Plant Site*
- *Regulatory and Legal Issues*
- *Financial Analysis*
- *Benefits*

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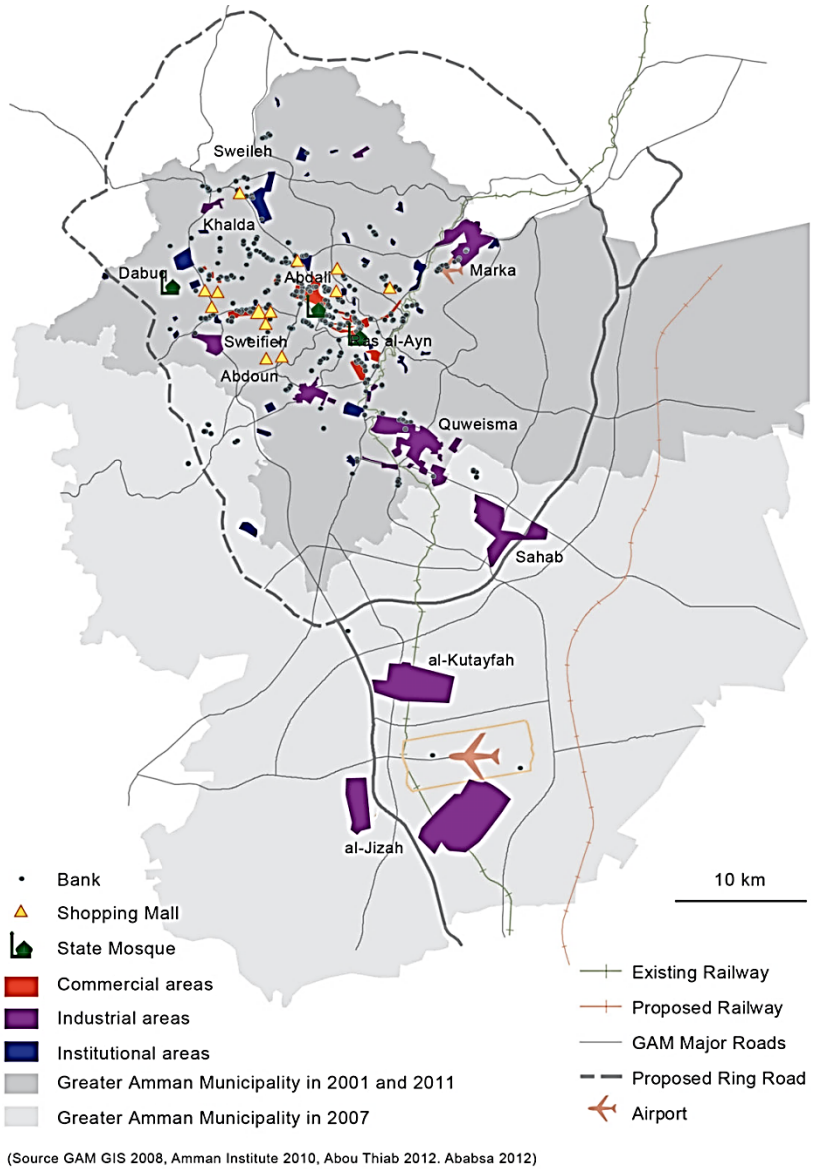
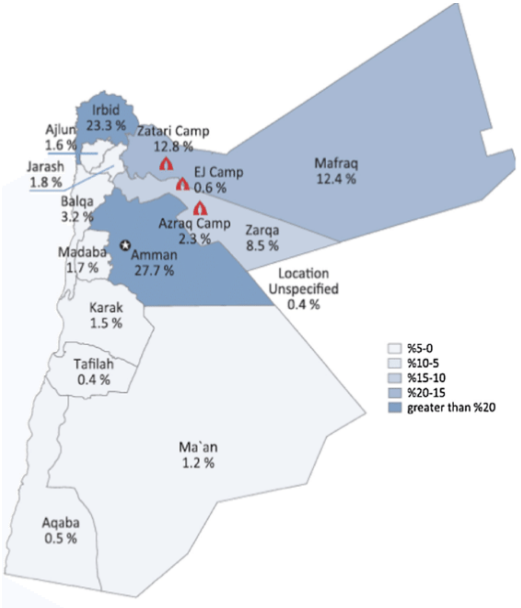


(Source GAM GIS 2008, Amman Institute 2010, Abou Thiab 2012. Ababsa 2012)

Large biowaste producers:

- **Hotels – restaurants**
- **Supermarkets - Markets**
- **Municipal Green waste**
- **Army camps**
- **Airport**



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Other large bio waste producers :

- **Food processing Industries**

  olive sector (olive mills), breweries, dairy industry, wineries, etc.

- **Farms & slaughterhouses**

  agricultural waste

  manure from livestock farms

  slaughterhouse waste

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Collection Option A

- hotels, supermarkets, refugee camps, etc.

+ Leads to **Public Awareness**

+ Easier **Expansion** to **Residential Areas** afterwards

+ **Stability of** Biowaste **Quantity & Quality** (from households)

+ **Centrally** located

+Organic waste **diversion from landfill**

- **Small quantities** (unless expansion to households)

- **Stakeholders engagement** to participate /need for development of incentives

Collection Option B

- Food processing industries, olive sector, etc.

+ **Large biowaste Quantities produced**

+ **High calorific potential**

+ **High biogas generation**

+Easy to organize

+Prevent illegal disposal

- **Large transportation distances** /potential need for TS

- **Stakeholders engagement** to participate via regulations & permitting

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Incentives for promoting separate collection

Target Group	Description of Incentives
Residents	- *Provision of equipment free of charge* - *Free use of soil improver* - *Provision of loyalty vouchers for discounts on selected municipal services*
Hotels & Restaurants	- *Provision of equipment free of charge* - *Provision of discount on municipal fees for SWM* - *Green Business Nomination to the participants in the programme* - *Provision of a free of charge manual and training programme for waste prevention and cost minimization*
Supermarkets	- *Provision of equipment free of charge* - *Provision of discount on municipal fees for SWM* - *Green Business Nomination to the participants in the programme*
University & Army Campuses	- *Provision of equipment free of charge* - *Free use of soil improver*
Industries	- *Zero Gate Fee for the treatment of their waste produced by AD plant* - *Provision of optional transportation of their waste to AD plant with very low cost* - *Compliance with the legislation*
Local Community	- *Development of Circular Economy Zero Waste AD Park open to the public including an integrated Community Recycling and Environmental Education Center* - *Provision of soil improver for the citizens' personal use, free of charge* - *Provision of bins in households of the local community for internal use, free of charge* - *Plantation of large public areas of the local community with the use of the produced by AD plant soil improver (wet and dry)* - *Provision of environmental training in the schools of the area*

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- The AD plant development in **two phases:**
  - Phase 1: **30,000 tn/year** of incoming organic waste **mainly municipal/GAM** managed biowaste sources
  - Phase 2: upgrade unit up to **60,000 tn/year** of incoming organic waste municipal/GAM managed & non-municipal/private sources

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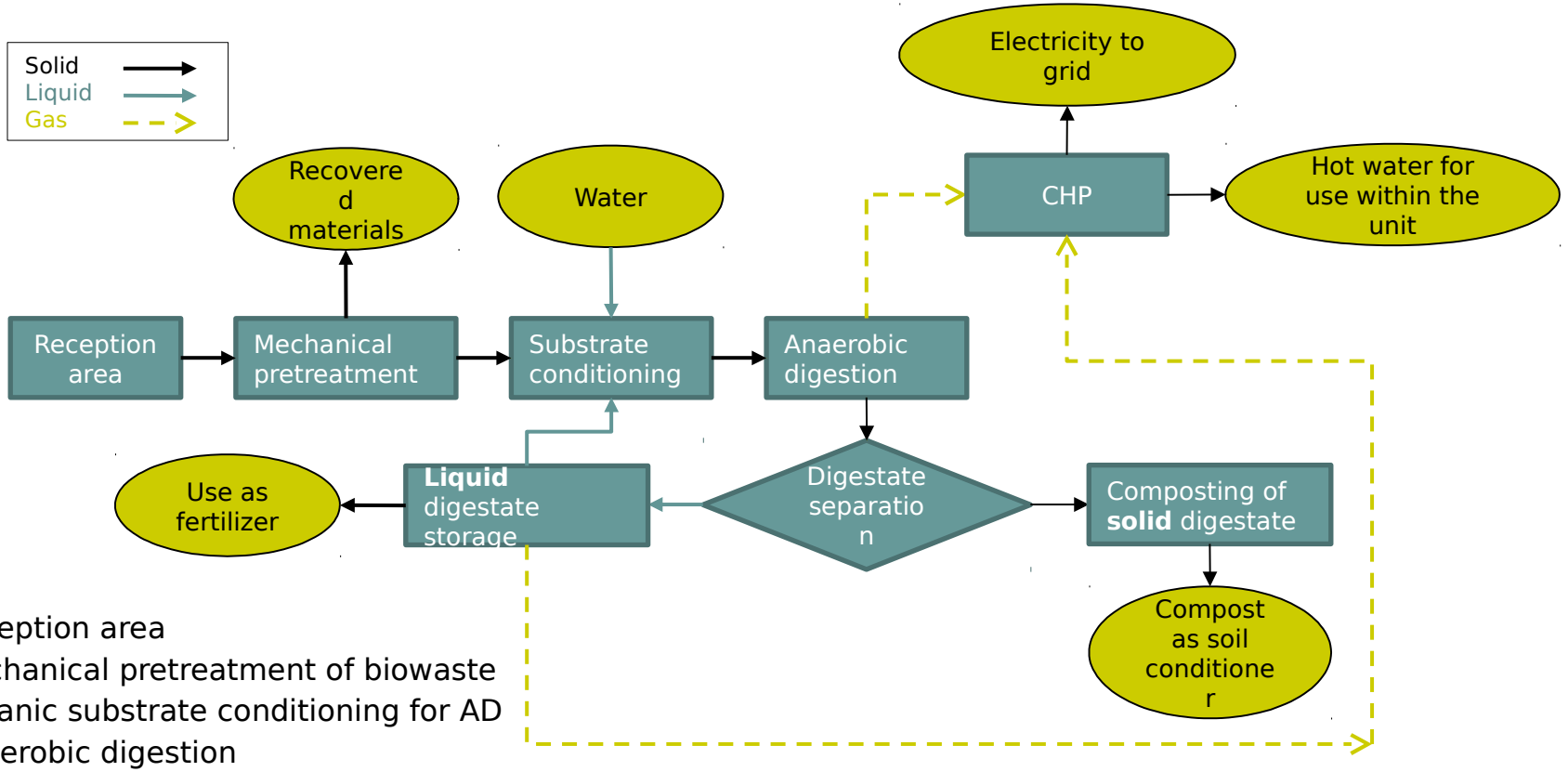

- Reception area
- Mechanical pretreatment of biowaste
- Organic substrate conditioning for AD
- Anaerobic digestion
- Digestate separation
- Liquid digestate storage
- Solid digestate composting and maturing
- Biogas treatment
- CHP system and flare

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- **Key design parameters regarding the AD technology**

➢ ***AD system (wet/ dry)***

Mainly depends on the type of feedstock

	Wet	Dry
Feedstock flexibility	✓	
Lower water demand		✓
Higher biogas production rate	✓	


Wet/low solids AD:~TS 15-25%


Dry/high solids AD:~TS >30%

- **Key design parameters regarding the AD technology**

  - ***Process flow (continuous / batch)***

Mainly depends on the type of feedstock and level of facility automation

	Continuous	Batch
Flexibility on feedstock fluctuations (quantity)		✓
Feedstock flexibility	✓	
Automation & better process monitoring and control	✓	
Biogas production rate	✓	

Feeding dry batch AD

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- Al Sha’er TS is located on the highway & there is an EIA study approved
- Subject to **due diligence** & **regulatory review**
- Site **Criteria** shall be based on **EU standards** (UK Environmental Permitting Regulations, etc.)
- Assessment of **potential risks:**
  - Availability of required space
  - Proximity to sensitive receptors
  - Regulatory approval (authority engagement)

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	Site characteristics to be investigated	
1	**Area/space**	
		needed 10,000 -15,000 m2 *
2	**Topography**	
		not steep terrain, etc.
3	**Geology-Hydrology**	
		geological/ groundwater characteristics
		>50 from wells-boreholes for supply of water for domestic -food production purposes or/and for human consumption
		>10m from watercourses
		Soil strength, check for significant local hydrogeological characteristics (underground caves, swampy ground etc.)
4	**Road Access-Driving distance**	
		road quality/type (highway, etc)
		Traffic
5	**Environmental factors**	
		>500m from Site of Special Scientific Interest
		other local environmental land restrictions
		endangered or rare flora/fauna in the area
6	**Cultural factors**	
		cultural heritage sites (Ayn Ghazal archaeological site, etc)
7	**Social factors**	
		potential objectors or unwilling landowners
8	**Land uses/activities**	
	Proximity to sensitive receptors	>250m from building used by the public, residencies, etc
		Visual impact - Status of surrounding properties
	Proximity to project collection area	
	Proximity to grid connection	
	Proximity to demand for electrical energy	
	Access to water supply	

**considering high rate of compost disposal and small storage area requirement*

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AD Plant Site - Key points

- Careful identification of Risks related to site selection:
  - space availability
  - proximity to sensitive receptors
    - *public/ stakeholder engagement*
  - energy connection issues
    - *proximity to grid connection*
    - *agreement with **JEPCO** (Jordanian Electric Power Company)*
    - *license from **EMRC** (Electricity & Mining Regulatory Commission)*
  - regulatory approvals
    - *authority engagement*

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		PHASE A CAPEX *(30,000 tn/y)* (JOD)	PHASE B UPGRADE CAPEX *(additional 30,000 tn/y)* (JOD)	PHASE A & B TOTAL CAPEX *(60,000 tn/y)* (JOD)
	AD PLANT CAPEX	7,530,388	1,476,000	9,006,388
	COLLECTION EQUIPMENT CAPEX	1,201,423	270,862	1,472,285
	TOTAL AD Plant & Collection CAPEX	**8,731,811**	**1,746,862**	**10,478,673**
	VAT (16%)	1,397,090	279,498	1,676,588
	TOTAL AD Plant & Collection CAPEX (*incl. VAT)*	**10,128,901**	**2,026,360**	**12,155,261**
	LAND ACQUISITION	**300,000**		**300,000**
	TOTAL CAPEX (AD Plant & Collection & Land)	**10,428,901**	**2,026,360**	**12,455,261**

1 JOD = 1.25502 EUR

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1 JOD = 1.25502 EUR

(FIXED PRICES AT BASE YEAR - in JOD)

Financial Analysis Outputs (Discounted Cash Flow (DCF) method)

	Financial parameters	Non Discounted value (JOD)	Discounted value (JOD)
1	Time Horizon (Reference period)	30	
2	Discount Rate	4%	
3	Capital Expenditures (CAPEX)	12,455,261	11,099,350
4	Residual value	706,515	217,832
5	Revenues (discounted)		20,824,501
6	Operating costs (discounted)		11,518,441
7	Net Revenues = Revenues + Residual value - Operating costs (discounted)		9,523,893
8	Net Present Value (NPV)		- 1,575,457

NPV<0 which implies that the project requires financial support (EU financial support) as the revenues generated will not cover the costs.

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AD Plant Site - Benefits

1st Circular Economy and Zero Waste Park in Jordan, open to the public including an integrated **Community Recycling and Environmental Education Center** (schools, universities, etc).

Environment

- Organic waste diversion from landfills
- Minimize leachates' production from landfills & dumpsites
- Improving of the cleansing and smell
- Clean energy production from renewable energy source (biomass)
- Prevention of illegal waste disposal
- Development of Circular Economy approach by GAM, since the organic matter returns to soil, improving soil condition, especially in degraded terrestrial ecosystems prone to desertification.

Local Community

- Soil Improver available to local community, free of charge, to be applied to soil, improving soil characteristics and enhancing plant growth.
- Community Recycling and Environmental Education Center: except of its functionality as a center for treating separate collection of MSW recyclable streams, can also perform as a center for environmental education - accessible by the local communities (students etc.) for demonstration of proper SWM and separate collection of MSW.
- Digestate (solid and liquid) used for landscape uses in areas owned by GAM

Above can contribute to the transformation of the local community from passive consumers into **active citizens**.

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Thank you for your attention!

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