EGE UNIVERSITY
SOLAR ENERGY INSTITUTE

Economic and Social Effect of Farm Scale Biogas Plants in Rural Areas

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E.U. SOLAR ENERGY INSTITUTE (SEI)

- Primary research institute dedicated to studies for renewable energy technologies in our country
- R&D studies, master and PhD programs are continued since 1978.

- Academic Staff: **21**
- Administrative and Technical Staff : **14**
- Continuing Students : **79**
- Grad Students : **202**
- Number of Complete Project**: 167**

Research Areas

- Solar architechture and Thermal Systems
- Photovoltaic
- Solar Photochemistry/ Optoelectronics / New Generation PV
- Biomass Energy
- Wind Energy
- Geothermal Energy and Heat pump
- Energy Efficiency and Management

EU-SEI VOCATIONAL EDUCATION STUDIES

Vocational Qualification İnstitution

Signing ceremony of a cooperation protocol to form the standards of vocation in the field of Renewable Energy Sources, 8 Haziran 2010

NAME of VOCATION:	LEVEL:
PHOTOVOLTAIC POWER SYSTEMS-ELECTRICAL TECHNICIAN	3,4,5
PHOTOVOLTAIC POWER SYSTEMS-MECHANICAL TECHNICIAN	3,4,5
WIND POWER SYSTEMS-ELECTRICAL TECHNICIAN	3,4,5
WIND POWER SYSTEMS-MECHANICAL TECHNICIAN	3,4,5
BIOGAS SYSTEMS -TECHNICAL STAFF	3,4,5
SOLAR THERMAL SYSTEMS -TECHNICAL STAFF	3,4,5

BIOMASS ENERGY

- An interdiciplinary approach and includes researchers from various professions such as agricultural, environmental, mechanical, chemical and electrical engineering, automotive, physic and biochemist.

- Since 2000, the biogas systems research studies has been concentrated.

SOLAR ENERGY INSTITUTE
LABORATORY SCALE BIOGAS SYSTEMS

SOLAR ENERGY INSTITUTE
PILOT PLANT BIOGAS SYSTEMS

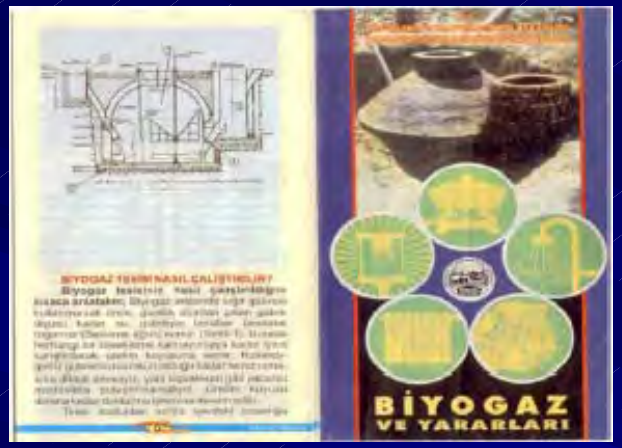
THE AIM

- High efficiency,
- Easy construction and operation
- Lowest operational and investment costs
- Usage of medium level control technology,
- Production of biogas systems by the domestic industry.

TECHNOLOGY APPLICATIONS

- At this subject, utility model certificate numbered “TR 2006 02900 Y” and named “Gas Purification Gasometer for Biogas Plants” was taken.
- In addition, one doctorate thesis was awarded the “Dr. Akın Cakmakcı University – Industry Cooperation Best Thesis and Setup” award given by the Turkish Technology Development Foundation.
- In 2010, a book titled “Biogas Technologies” has been published. Furthermore, the group services on biogas system design within protocols.

HISTORY of BIOGAS SYSTEMS FOR TURKEY



- First studies was began in Soil and Fertilizer Research Institute at 1957.
- At 1963, by Topraksu Research Institute under the Ministry of Agriculture,
  - 5 systems: constructed in Eskişehir Topraksu Research Institute
  - 2 systems: constructed in the village of Eskişehir
  - 1 system: constructed in Çorum
- After 1980, State Planning Organisation was worked with UNICEF.
- Within this study, 35 m^3 capacity of biogas systems was constructed in Muş-Alpaslan State Hatchery.
- In 1982, the responsibility of project was given to Topraksu Research Institute. 1000 biogas systems (6, 8, 12 and 50 m^3 capacity) were established by the annual interest rate of 16% of loans.

HISTORY of BIOGAS SYSTEMS FOR TURKEY

- Between 1984-1987 in Ankara and Erzurum biogas system studies by Eskişehir Rural Services Research Institute.
- Except some differences, India and China biogas systems was constructed.
- Failure causes of this systems:
  - The lack of organisation
  - The executive problem
  - Communications gap between projects
  - Technical problems (nonstable reactor temperature)
  - Deficiency of education for technical staff and farmer
- Biogas system projects have been increased under the leadership of the university since 2000.
- At 15/04/2007, 50 m^3 capacity biogas system has established by Ege University Solar Energy Institute, Biomass Energy Technology Researchers and a Cooperative of Aydın (ÖR-KOOP) in a farm.

50 m^3 CAPACITY BIOGAS SYSTEM

SYSTEM DESCRIPTION:

Location	: Pamukören-Kuyucak/AYDIN
Volume of reactor	: 60 m^3
Working volume of reactor	: 50 m^3
Reactor temperature	: 37 °C
Feeding Material	:% 10 TS Cattle manure+Water Mixture
Hydrolic retention time	: 20 day
Gasometer	: Gas Purification Gasometer **(TR 2006 02900 Y)**
Volume of gasometer	: 40 m^3
Operational pressure	: 300-700 mbar
Reactor heating	:Combi with biogas+ Cogeneration
Mixing	: Hydrolic
Mixing pump	: Q=35 m^3/h H= 30 mSS Rubber lobe pump

REACTOR AND GASOMETER

COGENERATION SYSTEM (47 kWe)

Development and Widespread of Biogas System for Rural Area

State Planning Organization Project

GUIDED TECHNOLOGY DEVELOPMENT PROJECT
PROJECT NO: 07/DPT/003

ORGANIZATIONS THAT SUPPORT THE PROJECT

IZMIR GOVERNORSHIP

IZMIR METROPOLITAN MUNICIPALITY

IZMIR MINISTRY OF AGRICULTURE

AIR CORPS SCHOOLS and TECHNICAL TRAINING CENTER COMMAND

TUBITAK-MRC ENERGY INSTITUTE

EBILTEM

IZMIR UNION of CHAMBER of MERCHANTS and CRAFTSMEN

AEGEAN REGION CHAMBER of INDUSTRY

IZMIR CHAMBER of COMMERCE

CHAMBER OF MECHANICAL ENGINEERS IZMIR BRANCH

S. S. TIRE MILK COOPERATIVE

Professional Associations
Cooperatives
Biggest Private Companies

HAY-KOOP

OR-KOOP

AYGAZ CORPORATION

EGESAN CORPORATION

CAMLI FEED, FATTENING IND. and COM. CORPORATION

MAVIGOK BIOGAS SYSTEMS CORPORATION

GULSAN SOLAR COLLEKTORS LIMITTED COMPANY

GULEZ INSTALATION LIMITTED COMPANY

LOCATION of the ESTABLISHED BIOGAS SYSTEM

- 1200 polls in İzmir
- Selected 12 towns of Izmir

POTANTIAL BIOGAS SYSTEMS FOR IZMIR

	VOLUME OF REACTOR					
	2–5 m^3	5–25 m^3	25–50 m^3	50–100 m^3	100–500 m^3	500m^3<
Aliağa	411	195	17	5	-	-
Balçova	17	6	-	-	1	-
Bayındır	1132	1329	207	75	21	-
Bergama	2805	1973	110	20	6	1
Beydağ	690	420	31	7	-	-
Bornova	94	111	15	2	2	-
Buca	154	143	15	8	2	-
Çeşme	51	30	9	2	-	-
Çiğli	29	36	12	1	-	-
Dikili	370	209	22	8	2	-
Foça	133	147	28	14	6	-
Gaziemir	11	9	-	-	-	-
Güzelbahçe	14	7	-	-	-	1
Karaburun	31	20	2	1	-	-
Karşıyaka	59	23	5	1	-	-
Kemalpaşa	484	402	106	50	29	3
Kınık	767	337	13	5	1	-
Kiraz	2442	1362	99	18	5	-
Konak	7	3	-	-	-	-
Menderes	814	556	59	6	5	-
Menemen	551	501	74	24	13	-
Merkez	42	25	4	-	1	-
Ödemiş	3828	3139	518	200	87	-
Seferihisar	149	140	17	4	2	-
Selçuk	147	143	15	5	2	-
Tire	1833	1414	257	83	37	1
Torbalı	602	435	64	42	15	2
Urla	209	125	23	7	2	-
TOTAL	17876	13240	1722	588	239	8

FOR ANIMAL WASTES

Source: İzmir Ministry of Agriculture

INCOME OF BIOGAS SYSTEMS FOR IZMIR

	Biyogaz (m^3)	Biyogaz Karşılığı(12 kg LPG tüp)	Biyogazın Getirisi (TL)	Fermente Gübre (ton)	Fermente Güb. Getirisi (TL)
Aliağa	1.794.398	**88.361**	3.534.068	4.486	2.664.682
Balçova	108.799	**5.358**	214.280	272	161.567
Bayındır	15.417.635	**759.202**	30.365.032	38.544	22.895.188
Bergama	15.904.236	**783.163**	31.323.392	39.761	23.617.790
Beydağ	3.613.710	**177.948**	7.117.202	9.034	5.366.360
Bornova	1.121.420	**55.221**	2.208.637	2.804	1.665.309
Buca	1.571.439	**77.381**	3.094.949	3.929	2.333.587
Çeşme	383.793	**18.899**	755.881	959	569.933
Çiğli	457.272	**22.517**	900.597	1.143	679.049
Dikili	2.247.886	**110.691**	4.427.212	5.620	3.338.111
Foça	2.208.151	**108.735**	4.348.953	5.520	3.279.104
Gaziemir	45.412	**2.236**	89.439	114	67.437
Güzelbahçe	320.406	**15.778**	631.039	801	475.803
Karaburun	194.892	**9.597**	383.841	487	289.415
Karşıyaka	285.716	**14.069**	562.718	714	424.288
Kemalpaşa	9.770.799	**481.138**	19.243.588	24.427	14.509.636
Kınık	2.972.268	**146.362**	5.853.882	7.431	4.413.818
Kiraz	11.991.879	**590.509**	23.618.006	29.980	17.807.941
Konak	22.391	**1.103**	44.098	56	33.250
Menderes	5.130.592	**252.643**	10.104.701	12.826	7.618.929
Menemen	6.018.646	**296.373**	11.853.723	15.047	8.937.689
Merkez	366.133	**18.029**	721.099	915	543.707
Odemiş	41.847.326	**2.060.664**	82.418.308	104.618	62.143.279
Seferihisar	1.438.672	**70.844**	2.833.465	3.597	2.136.428
Selçuk	1.395.468	**68.716**	2.748.374	3.489	2.072.270
Tire	18.543.799	**913.142**	36.522.012	46.359	27.537.541
Torbalı	8.928.157	**439.644**	17.584.005	22.320	13.258.313
Urla	1.620.004	**79.773**	3.190.599	4.050	2.405.706
TOPLAM	155.721.299	**7.668.094**	306.693.098	389.303	231.246.129

FOR AGRICULTURAL WASTES

- 1 % of wastes of wheat, barley, rye, oat, cotton and silage were only taken into account. And the wastes of poulty and goat also added in calculations.

- The availability of wastes:
  - Animal wastes: 75 %
  - Goat: 13 %
  - Poulty: 99 %

- Income of biogas systems will be increased more than 10 times (approximately 4 milliard).

INVESTMENT COSTS AND PAY BACK TIMES

1-Partly Automatic Systems

Reactor Volume (m^3)	Investment Cost (TL)	Payback time (Yıl)
5	12.000	2,56
20	49.071	2,63
30	58.201	2,01
40	73.828	1,90
50	84.621	1,73
60	95.742	1,62
70	106.606	1,54
80	115.826	1,46
90	126.899	1,41
100	136.907	1,37

Partly Automatic Systems:
Loading and discharging of material with rubber lobe pump

Automatic Control:
Reactor temperature
Mixing
Gas purification

Manual Control:
Transportation of feeding material
Valves control

Usage of biogas: combi, hot water tank, cooking and modified generator

INVESTMENT COSTS AND PAY BACK TIMES

2-Partly Automatic and Cogeneration systems

Reactor Volume (m^3)	Investment Cost (TL)	Payback time (Yıl)
20	79.071	4,89
30	89.201	3,41
40	105.828	2,96
50	117.621	2,58
60	129.742	2,33
70	141.606	2,16
80	151.826	2,01
90	163.899	1,92
100	174.907	1,83

Beside the electrical energy the waste heat could be also used.
Although the system efficiency could increase to 95 %, the payback time of small capacities biogas system could also rise.

INVESTMENT COSTS AND PAY BACK TIMES

3-Full Automatic and Cogeneration systems

Reactor Volume (m^3)	Investment Cost (TL)	Payback time (Yıl)
20	153.071	14,30
30	165.801	7,99
40	185.028	6,15
50	199.421	5,03
60	214.142	4,35
70	228.606	3,89
80	241.426	3,53
90	256.099	3,29
100	269.707	3,08

High investment cost
But easy operation
If the system capacity could rise, the availibility of system would be economically.

Widespread of Biogas Systems

- The solution consists on;
  - To develop available systems and applications,
  - Continious support for the users,
  - Education for implementers,
  - Advertise and support activities,
  - Support to special technicians,
  - Financial support to investments (From government agency).

Widespread of Biogas Systems

- To universalize biogas in Turkey;
  - The Ministry of Finance should subsidise and provide appropriate credits,
  - The Ministry of Energy and Natural Sources should bind legally that the electrical energy from biogas wires up and be used,
  - The Ministry of Agriculture and Rural Affairs should prepare courses about biogas systems and utilization and advertising activities,
  - The Ministry of National Education should integrate the biogas systems in curriculum,
  - The Ministry of Health should perform the pilot applications,
  - The Ministry of Environment should be supportive.

Widespreading Studies

- Status of districts, roads and transportation-communication facilities should be analysed.

- All steps of a biogas system, such as building, operating and maintenance, the avaibility of reach for the parts for system should be investigated.

- Regional ethnic and social-economic situation should be researched.

- Market investigation should be carried out about exist and using products.

Widespreading Studies

- Feasibility analyse should be done and application procedure should be determined.

- Pilot applications should be started to chose the best system for biogas production.

- Courses and presentations for end users, technicians, engineers, consultants and financial facilities, should be prepared.

- Visual and audial introduction about systems should be performed.

POSSIBLE PROBLEM DURING WIDESPREAD IN TURKEY

- *Environmetal problems:*
  - Pyschologically, the studies of human and pig wastes wouldn't be interiorize by the society,
  - Difficulty of the change in life style (For example, cooking method or usage of manure)
  - The usage of cattle manure and agricultural wastes inside of classical method (peaple having lower income in rural area)

POSSIBLE PROBLEM DURING WIDESPREAD IN TURKEY

- *Technical problems:*
  - Narrowness and expensiveness of building material
  - Only usage of animal and agricultural wastes for feeding material inside all organic material
  - The disorder and problems in biogas production
  - The difficulty of purification and usage of biogas
- People having lower income

SOCIAL EFFECTS

Biogas systems allows the development of rural living standards.

It leads to increase the income of local installation and construction workers

Reduces the migration from rural area

Leads to reduce the social pressure on farmers, which arise from waste and environmental problems .

Causes the strengthening of family relations

It can be used instead of non-commercial fuels, therefore reduce the cut of forests and time spending for collection of firewood and agricultural waste.

CONCLUSION

- After the economical and technical analysis, Solar Energy Institute was established 13 of farm scale biogas plants for rural area in İzmir and Aydın.
- Thus the biogas plants have been universalized
- It beeing in İZAYDAŞ is becoming an important and good central biogas plant example in Turkey.
- We would like to educate the farmer, technician and society with Vocational Qualification Institution.

Thank you for your attention