TÜBİTAK
MAM

TURKEY & BIOGAS

26 MAY 2010
COPENHAGEN

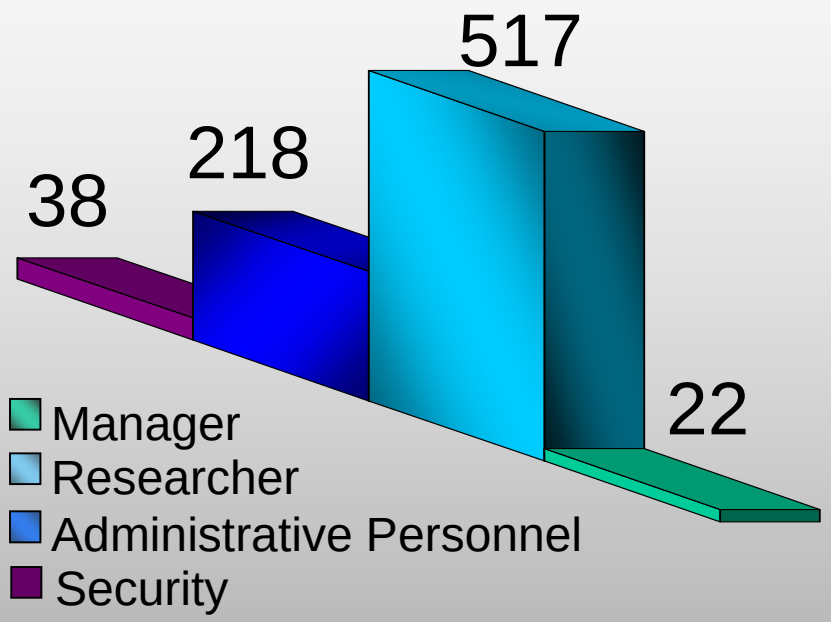
TÜBİTAK Marmara Research Center

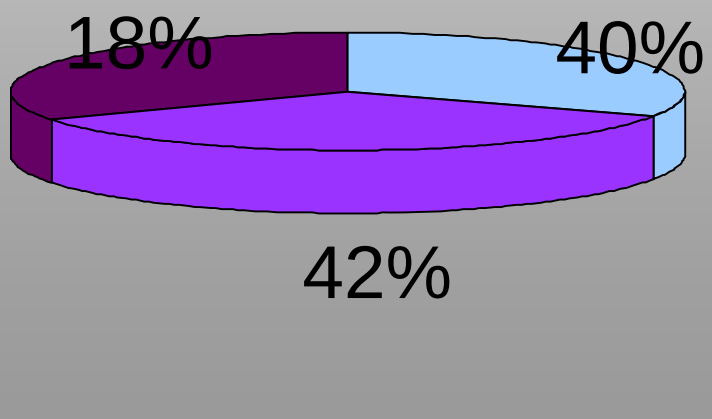
- Foundation of TÜBİTAK, 1963, Ankara
- Mission; Developing policies for science & technology, Funding and Research
- Foundation of Marmara Research Center, 1972, Gebze
- Area, 8.000 acres
- 7 institute

Organization & Personnel Profile

Total: 795 (Jan. 2010)

- TUBITAK MARMARA RESEARCH CENTER
  - CHEMISTRY INSTITUTE
  - ENVIRONMENT INSTITUTE
  - **ENERGY INSTITUTE**
  - FOOD INSTITUTE
  - MATERIALS INSTITUTE
  - GENETIC ENGINEERING & BIOTECHNOLOGY INSTITUTE
  - EARTH & MARINE SCIENCES INSTITUTE





Energy Institute

Management	**3**
Researcher	**95**
PhD	20
MSc	61
BSc	14
Technician	**28**
Support	**4**
Total	**130**

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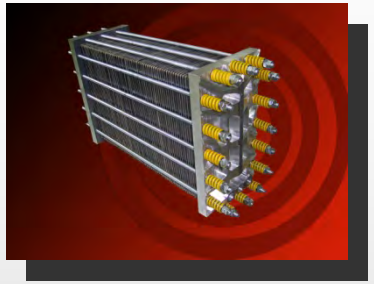
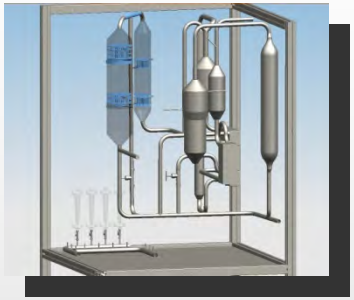
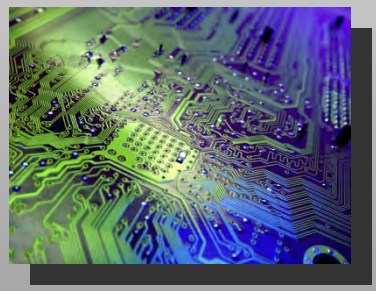
Energy Institute

Advanced Energy Technologies

- Fuel cell technologies
- Gas technologies
- Combustion and gasification technologies
- Fuel Technologies

Power Electronics and Control Technologies

- Power electronics technologies
- Vehicle technologies
- Battery technologies

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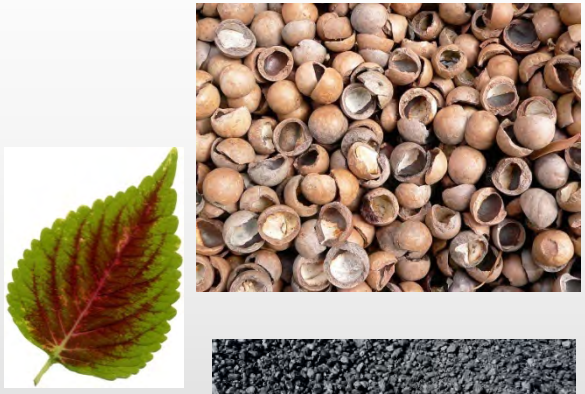
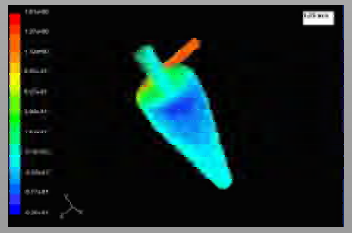
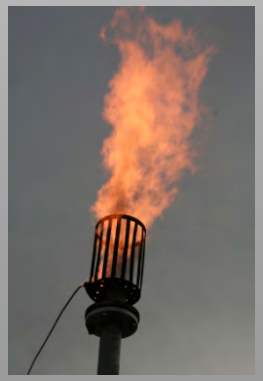
Combustion and Gasification Technologies

- Cold Fluidized Bed Modelling
- Bubbling Fluidized Bed Gasification (Laboratory Scale System)
- Circulating Fluidized Bed Gasification (Pilot Scale System)
- Gas cleaning technologies
- Pyrolysis technologies
- **Utilization of waste products for energy recovery and fuel production**
- **Biogas plant design**
- **Energy recovery from biomass**
- **Biogas production processes**
- **CHP applications**







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EU Projects

Ongoing projects

•**MC-WAP** (6th FP) Molten-Carbonate Fuel Cells For Water Borne Applications

•**MCFC-CONTEX** (7th FP) Effects of CONTaminants in biogenous fuels on MCFC catalyst and stack compo-nent degradation and lifetime and Extraction strategies

•**TYGRE** (7th FP) High Added Value Materials From Waste Tyre Gasification Residues,

Completed projects

•**EU-DEEP** (6th FP) The Birth of A European Distributed Energy Partnership That Will Help The Large-Scale Implementation of Distributed Energy Resources in Europe

•**NATURAL-HY** (6th FP) Preparing for the hydrogen economy by using the existing natural gas system as a catalyst.

•**HYPROSTORE** (6th FP) Improving of the S&T Research Capacity of TUBITAK MRC IE in the Fields of Hydrogen Technologies

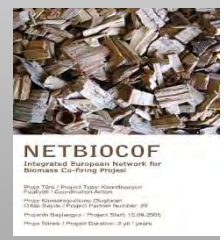
•**BIGPOWER** (6th FP) Improving of the S&T Research Capacity of TUBITAK MRC IE in the Fields of Integrated Biomass Gasification with Power Technologies

•**NETBIOCOF** (6th FP) Integrated European Network For Biomass Co-Firing

•**MOCAMI** (5th FP) Development and demonstration of a small-sized hybrid system with the combination of the MCFC technology and a microturbine

•**IRMATECH** (5th FP) Integrated Research on Materials, Clean and efficient energy Technologies and processes to enhance MCFC in a sustainable development

•**BIOCOGEN** (5th FP) Biomass Cogeneration Network Systems



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Turkey’s Biogas Plant Inventory

- Almost 180 million m^3 annually biogas produced from 20 running biogas plant
- Recently landfill gas extraction gained importance (total capacity 162,7 million m^3/year)
- The efficiency ratio is between 30-38% electricity and 80-85% overall depending on various parameters
- Investment cost: Gas engine, material dosaging unit and agitators are needed to be imported but the rest can be produced in Turkey
- Operating cost: Cheap in Turkey especially labour cost
- No upgrading plant yet
- The new renewable energy sources legislation is on the way.

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Turkey’s Biogas Plant Inventory

Our ongoing national project is supported by TUBITAK (ministry) which was aimed to be the forerunner in biogas market development

There are some issues still not clear such as how to make grid injection, which local permissions are needed for the plant and in which legislation digestate characteristics exist?

Moreover, local companies are interested in biogas market but it is still under development and there are no big demand in equipments

As the market grows, the more companies will become supplier to the biogas plants.

Turkey's Biogas Plant Inventory

Name of the company/place	Type of plant	Annual gas production (million m^3)
Ekolojik Energy Company	Landfill gas	2,2
Gaziantep M. Waste Treatment Plant		3
Adana M. Waste Treatment Plant		1,9
Kemerburgaz Landfill Area-Odayeri		51,6
Kemerburgaz Landfill Area-Komurcuoda		35
Cadirtepe Landfill		14
Mamak Landfill	Municipal Waste + Landfill gas	55
Eregli Sugar Plant	Waste water treatment	1
Yozgat and Afyon Sugar Plant		1,4
Kırsehir Sugar Plant		1,4
Eskisehir Sugar Plant		1,3
Burdur Sugar Plant		1,3
Bolpat Potato Production		1,2
Efes Beer Production		0,8
TekSut Milk Production		0,2
Mauri Yeast Production		0,65
Pakmaya Yeast Production		1,1
Fritolay (Pepsi CO)	Waste water treatment+organic waste	1,7
Cargill Turkey		0,7
Sütas Milk Production		3
Total Production		**178,45**

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Biogas Technologies Laboratory

Laboratory studies

- 300 litre batch model biogas reactor
- 5 pcs of 15 litre continous or batch biogas reactors

Some analysis

- Dry matter, organic dry matter
- Biogas component analysis (CH_4, H_2S, CO_2, H_2, S, N_2 and etc.)
- Heavy metal analysis
- Determination of biogas potential for susbrates
- Volatile fatty acids
- Kjeldahl nitrogen (C/N ratio)

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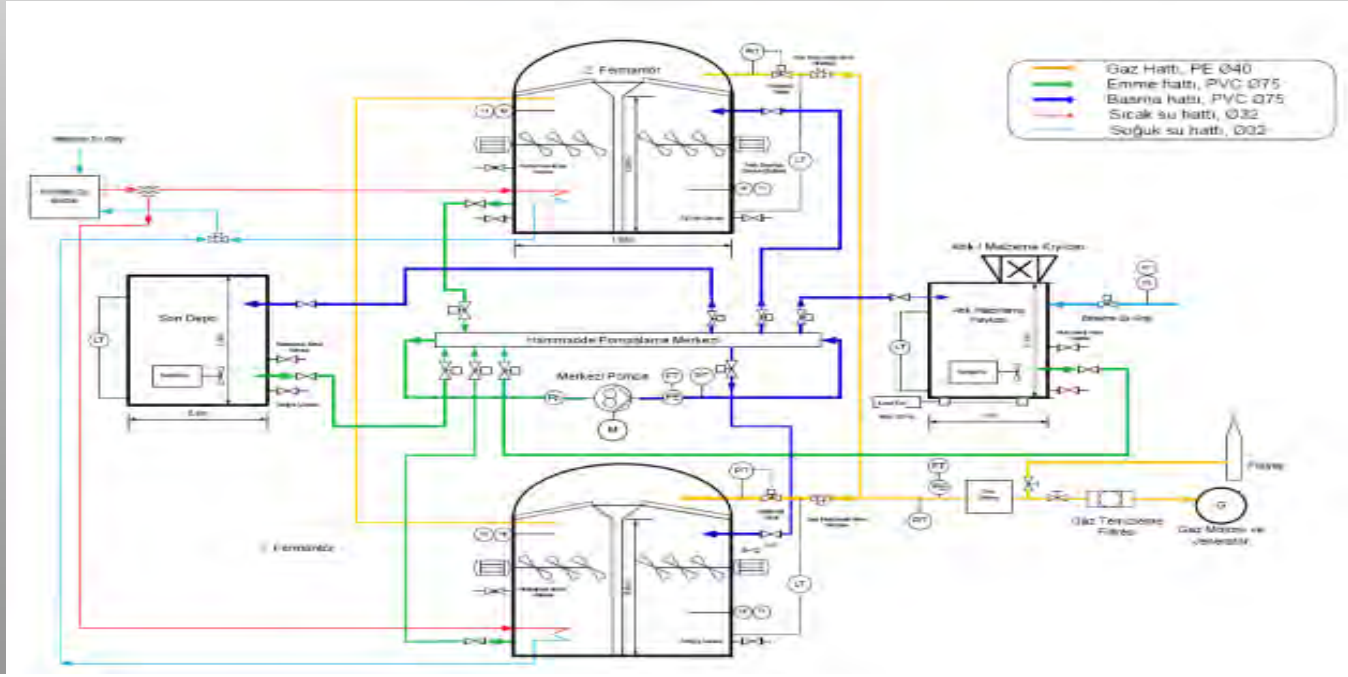
Biogas Technologies Laboratory

New Laboratory Facilities

2 off 2,4 m^3 fermentors to produce 3,5 Nm^3/day biogas (1:1000 scale)

Laboratory Instrument Infrastructure

- GC-FID (Gas Chromatography-Flame Ionization Detector)
- GC-TCD (Gas Chromatography-Thermal Conductivity Detector)
- Head Space Sampler
- Portable biogas analyzer
- Spectrometer



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Completed Project

“Exploitation of Agricultural Residues in Turkey” (AGRO-WASTE)
EU Life Projects, Project No:LIFE03 TCY / TR / 000061 (2004-2005)

The objective:
Determining and strengthen agricultural waste residues capacity of Turkey to exploit in a sustainable way to map the exploitable fraction of such residues across the country.

UNIVERSITY OF ÇUKUROVA (Turkey) (Leader)

TUBITAK MARMARA RESEARCH CENTER (Turkey) (Partner)

EXERGIA S.A. (Greece) (Partner)

CASELLA CRE ENERGY (United Kingdom) (Partner)

VTT TECHNICAL RESEARCH CENTRE OF FINLAND (Subcontractor)

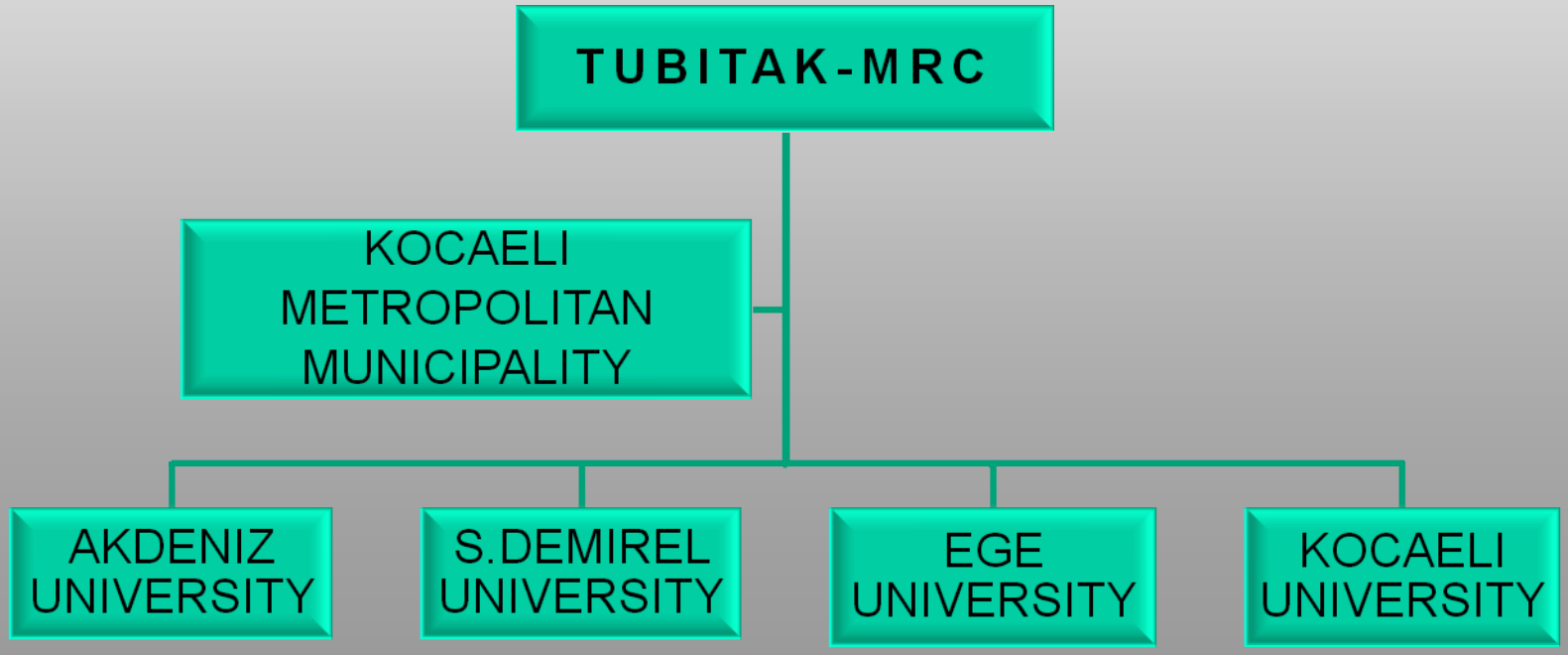
Turkey’s regional agricultural waste potential was determined as:

Annual field crops production and residues are **227 million GJ** (33,4% maize , 27,6% wheat and 18,1% cotton)

Annual fruit production and residues are **75 million GJ** (55,8% hazelnut and 25,9% olive)

TUBITAK MRC National Biogas Project

"THE PRODUCTION OF BIOGAS FROM AGRICULTURAL AND ANIMAL WASTES AND UTILIZATION OF OBTAINED GASES IN INTEGRATED ENERGY CONVERSION TECHNOLOGIES"



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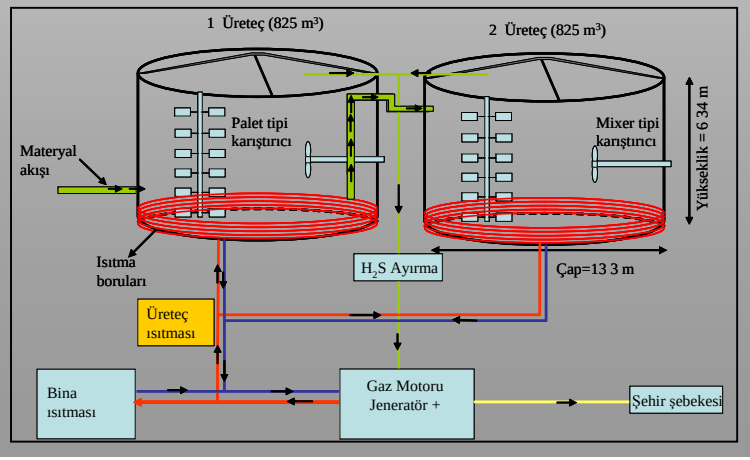
TUBITAK MRC National Biogas Project

Initially, literature was reviewed and then softwares, ADM1, FLUENT, IPSEpro and GAMBIT, were utilised during simultaneous laboratory trials . After all tasks done, the plant design were completed.



National Biogas Project

Biogas plant area during groundwork

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National Biogas Project

Construction phase

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National Biogas Project Hydrolic Test

After construction hydrolic test of the fermentors completed

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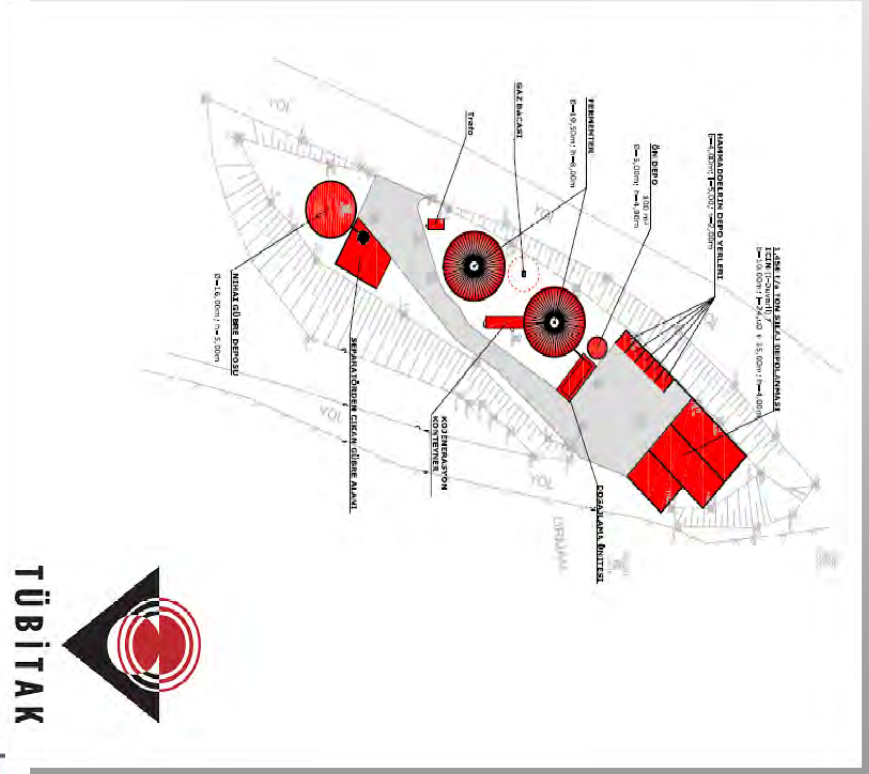
Layout of the plant



A view during the mechanical works phase

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National Biogas Project

Expectations from the project:

- Development of a pilot biogas plant utilizing various wastes
- Contribution to the development of biogas market and technologies in Turkey
- Gaining of experience on integration of biogas in internal combustion engines
- Contribution to the economy by utilizing fertilizers

Figures related to the waste amounts:

Material	Amount [ton/day]	Amount [ton/year]
Grass silage	16	5.900
Green vegetable wastes	5,6	2.050
Rumen waste	1,2	430
Poultry manure	5,4	1.950
Big cattle manure	1	350
Total	**29,2**	**10.680**

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National Biogas Project

Outputs:

- 350 kW electricity and 350 kW heat
- 11. 000 tonnes wastes will turn into energy
- 5.000 tonnes degistate as fertiliser
- Development of a new biogas market in Turkey
- A stable solution of environmental and health problems

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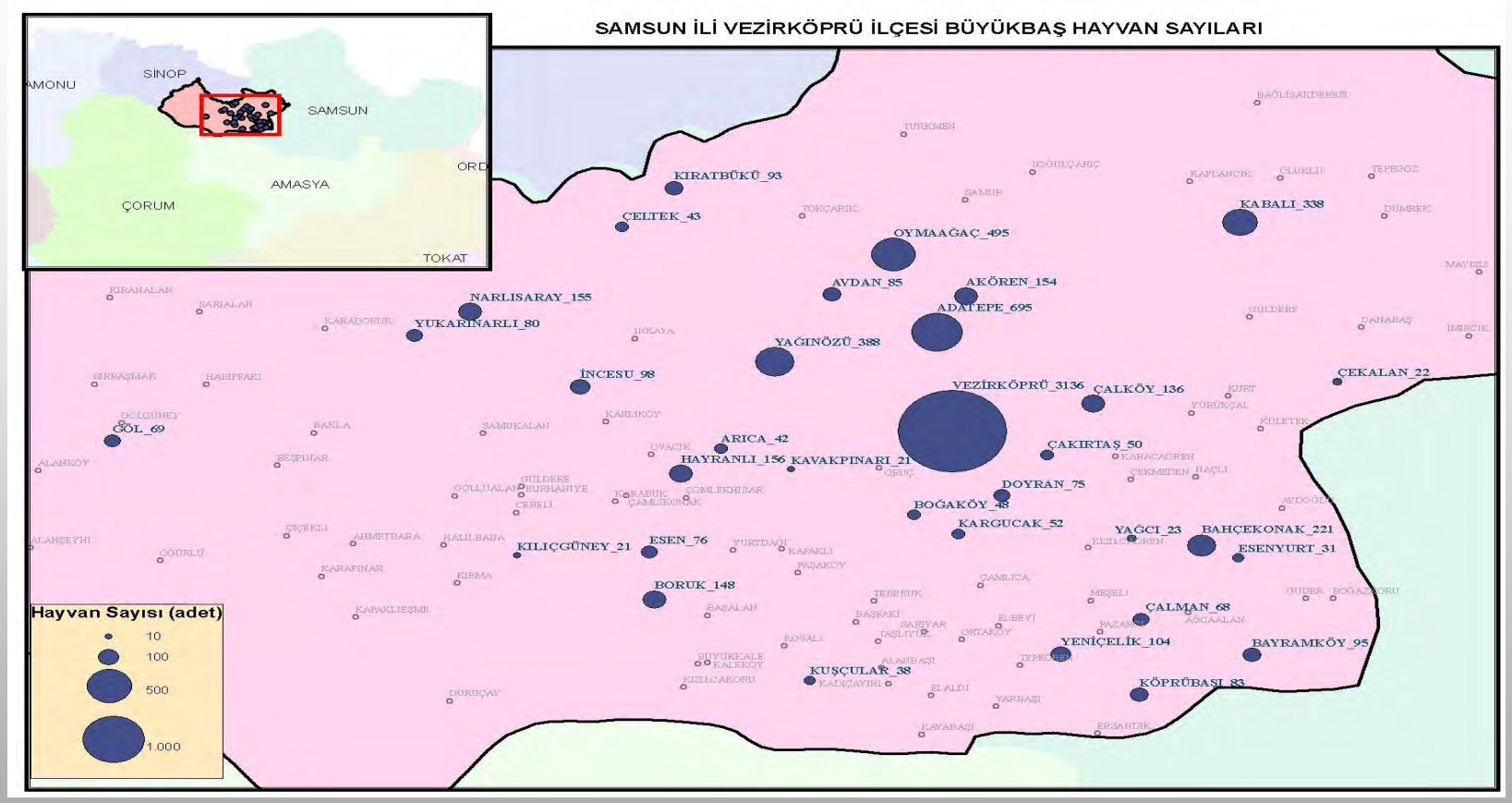
Potential Project-Samsun



Some figures are represented:

- 8.000 livestocks (mostly big cattle)
- Manure problem is the highest priority of local authorities
- 500 kWel. plant was planned to be constructed.

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Animal waste potential of Turkey

1- Biogas potential if ***all*** animal manure treated, (Optimistic scenario)

Animal kind	Animal Amount	Waste amount (ton/year)	Biogas production (m^3/ton)	Total capacity (kW)	Plant amount (500 kW capacity)
Big cattle	10.946.239	108.805.615	42	1.169.027	2.338
Small cattle	29.568.152	2.424.588	68	179.907	359
Poultry	244.285.376	7.084.275	82	45.785	91
TOTAL	----------	**118.314.480**	-	**1.394.719**	**2.788**

2- Biogas potential if ***some*** animal manure treated, (Realistic scenario)

Animal kind	Animal Amount	Waste amount (ton/year)	**Usage ratio (%)**	Real waste amount (ton/year)	Biogas production (m^3/ton)	Total capacity (kW)	Plant amount (500 kW capacity)
Big cattle	10.946.239	108.805.615	**65**	70.723.650	42	759.868	1520
Small cattle	29.568.152	2.424.588	**13**	315.196	68	178.109	356
Poultry	244.285.376	7.084.275	**99**	7.013.433	82	5.952	12
TOTAL	**284.799.767**	**118.314.478**	**---**	**78.052.279**	**---**	**943.929**	**1.888**

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Turkey’s Biogas Potential

Turkey has potential of 2.000 plants with each capacity of 500 kWel.

BUT!!!

New legislation on the way “Production via biomass including landfill gas” (10 years 14 €cent/kWh) (10 years 8 €cent/kWh)

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Task 37 Energy from Biogas and Landfill Gas

- In 1980s, there are many biogas plants constructed but some of them was succesfull. Now, there is a new trend in biogas.
- TUBITAK pay great attention to RES in Turkey which means this topic has governmental support.
- Each person involved in biogas market knows about the national project and look forward to seeing the plant running continously.
- We,as TUBITAK,focus on being the leadership of the technology therefore there are many other biogas technologies that we want to introduce to the Turkish market such as upgrading, natural gas grid injection, vehicle fuel usage, dry fermentation and so on.

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Task 37 Energy from Biogas and Landfill Gas

Feed-in-tariff was accepted at the Grand National Assembly (Turkish Parliament) Energy Commission waiting for approval by parliament

Scale of RES Feed-in tariff		
RES Plant type	First 10 years in operation (Euro cent/kWh)	Second 10 years in operation (Euro cent/kWh)
a. Hydroelectric power plant	7	-
b. On land wind turbine plant	8	-
c. Offshore wind power plant	12	
d. Geothermal power plant	9	-
e. Photovoltaic solar panel plant	25	20
f. Solar power plant	20	18
g. Plant running on biomass (including landfill gas)	**14**	**8**
h. Tide and wave energy power plant	16	

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THANK YOU

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