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Technical Assistance for Developed Analytical Basis for
Formulating Strategies and Actions towards
Low Carbon Development

Waste Sector

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GHGs caused by Waste Sector

- Turkey's total GHG emissions in 2016 was 496 Mt of CO_2 equivalent (**3.3 % , 16.2 Mt $CO_{2\text{-eq}}$ caused by waste sector compared to 16.9 Mt $CO_{2\text{-eq}}$ in 2015**).
- Main sources of waste sector based GHG emissions are solid waste disposal and wastewater discharge and treatment. In 2016, "solid waste disposal" accounted for 72.2% (compared to 73.8% in 2015) and "wastewater discharge and treatment" accounted for 27.6% of the waste sector based GHG emissions.
- The major GHG emissions from the waste sector are landfill methane (CH_4) and, secondarily, wastewater CH_4 and nitrous oxide (N_2O).
- 87 % from methane (CH4) and 83 % of this methane is from landfills.

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Status of Municipal Waste in Turkey

- The annual generation of municipal waste, mainly from households but including similar wastes from such sources as commerce, offices and public institutions in Turkey has reached 395 kg per person in 2016 (TUIK).

- This is significantly lower than the EU's generation rate of 480 kg in the same year (EUROSTAT) but much higher than Turkey's own generation rate in 1994 (308 kg/person).

- 28 432 313 tonnes out of 31 583 553 tonnes collected municipal waste was sent to sanitary landfills or waste dump sites according to 2016 TUIK data.

- 83 sanitary landfills are existent at the end of 2016 (compared to 2 in 1994 and 32 in 2007) receiving 61.2% of the total municipal waste collected and serving 59 out of 81 provinces.

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Status of Municipal Waste in Turkey

- Supported by YEKDEM mechanism, landfill gas collection and electricity generation facilities have become popular particularly in the last 5 years. (200 MWe installed capacity and 1.5 million MWh annual production capacity including other biological recovery for energy facilities).

- 8 biological waste recovery facilities (6 composting, 2 biomethanisation) for source-segregated municipal waste; 6 MBT (1 composting, 4 biomethanisation, 1 biodrying) for mixed municipal waste and 1 co-incineration plant for mixed municipal waste.

- Despite all these positive developments in waste management, there are still more than 800 dump sites (unmanaged landfills) in Turkey and about 29% of the municipal waste was disposed to these sites in 2016 .

- According to 2016 data, about 2.2 million tonnes of packaging waste was collected out of 4.2 million tonnes generated. Big portion of this amount is from municipal packaging waste which would be sent to landfills if not collected separately.

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Mitigation – Barriers

- Lack of policy and economic instruments on waste management in Turkey: Landfill taxes, bans, Pay as you throw (PAYT schemes) .

- Reluctance of local governments to waste management: transfer to private sector, not in my backyard.

- Weak monitoring and auditing on implementation: Implementation of source separation and dual collection (recyclables and organic) is weak. There is no or limited sanctions and penalties for incompatibility. Auditing is generally limited to heavy industries focusing on hazardous waste. Personnel of auditing authority is mainly assigned for licensing.

- Coordination of different ministries, governmental organisations and NGOs is needed. For example waste pickers problem cannot be solved without the inclusion of Ministry of Labour and Social Security. Non-existence of sufficient infrastructural and institutional coordination for LCD management.

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Mitigation – Barriers

- Insufficient human resource for complicated waste management projects: WtE projects involve sophisticated technologies which require skilled staff and regular maintenance.

- Inefficient use of donor funds. Lack of financing specific to waste sector as waste sector financing could be more risky and less prestigious compared to other projects like renewable energy.

- Inadequate internal financing source for waste management: Revenue from environmental cleaning tax is EUR 10-20 /year compared to EUR 50-200 /year in the EU. No separate fee is applied for waste management. Huge amount of municipality funds is allocated to waste collection in Turkey as collection period is at least once a day in most regions.

- Vulnerable secondary material market to economic crisis.

- Existence of waste pickers.

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Mitigation – Barriers

- Inadequate waste data: Collected waste data is not generally long term and not robust enough to use for project evaluation and investment feasibility studies. No regional data and LCA study available.

- Insufficient waste management capacity: Biological waste recovery capacity in Turkey is too low at a level around 1.5 million tonnes. Established in only 12 cities out of 81 cities of Turkey. Besides, 22 cities do not have sanitary landfills and are still depending on uncontrolled dump sites.

- Drawbacks of landfill gas capturing projects: Theoretical gas production and the real capturing of gas do not coincide.

- Low calorific value of municipal waste in Turkey (53% compared to 29% EU avg.).

- Low level of awareness in waste management sector related to climate change mitigation; not clear policy and legal framework to national and external stakeholders.

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Mitigation – Opportunities

- Successful transposition of waste part of EC *acquis* into national legislation and strong national waste legislation in Turkey.

- Presence of NGOs and authorised institutions in the field of waste management in Turkey.

- Multiple income opportunity for integrated waste management in Turkey:
  - sales of electricity at the guaranteed feed-in-tariff of 13.3 US$ cent / kWh to the National Grid (YEKDEM);
  - gate fees for non-municipal waste;
  - sales of the resulting heat/steam to neighbour commercial buildings;
  - sales of the recycled waste won back as raw material such as packaging waste and non-recycled waste used as refuse derived fuel by companies from the heavy industry;
  - sales of the generated carbon credits in the global voluntary carbon market.

- Long term leasing of the landfills.

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Mitigation – Opportunities

- External donor support, particularly from the European Union.

- Loans provided by international financial institutions: World Bank, the European Investment Bank (EIB), European Bank for Reconstruction and Development (EBRD), International Finance Corporation (IFC), or within the framework of inter-governmental agreements such as the German Investment and Development Bank (KfW) or Japan Bank for International Cooperation (JBIC). For ex: TurSEFF, NØW.

- Presence of secondary material market for various recyclables, huge raw material potential of the market and extensive experience on trade of recyclables.

- Job creating potential of waste management particularly recycling. Business potential for SMEs.

- Awareness raising on reducing food waste: Around 90 million tonnes of food waste are generated in the EU each year. 53% of this amount comes from households.

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Mitigation – Opportunities

- Increasing thermal substitution rate with co-processing: the average substitution rate across the EU amounts to about 39%. In Turkey, the thermal substitution rate is around 3%.

- To become widespread of existent technologies: Various waste management technologies such as mechanical biological treatment, biomethanisation for solid waste and wastewater sludge, biodrying and composting have been already introduced in Turkey. There is lower cost of early mover externalities and adaptation period for streamlining these technologies compared to totally new technologies (Gasification and pyrolysis, later also plasma pyrolysis).

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Future

- Submitted on 30 September 2015, Intended National Determined Contribution (INDC) of Turkey includes below plans and policies to be implemented for waste sector:

• Sending solid wastes to managed landfill sites;
• Reuse, recycle and use of other processes to recover secondary raw materials to utilize as energy source or to remove wastes;
• Recovering energy from waste by using processes such as material recycling of wastes, bio-drying, bio-methanisation, composting, advanced thermal processes or incineration;
• Recovery of methane gas from landfill gas from managed and unmanaged landfill sites;
• Utilization of industrial wastes as an alternative raw material or alternative fuel in other industrial sectors, through industrial symbiosis approach;
• Conducting relevant studies to utilize wastes generated from breeding farms and poultry farms;
• Rehabilitation of unmanaged waste sites and ensuring wastes to be deposited at managed landfill sites.

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Future

- National Waste Management and Action Plan (2016 – 2023)
  - Increase material recycling rate of municipal waste (mainly packaging) from 5.4 % in 2014 to 12 % in 2023;
  - Increase biological treatment recovery rate of municipal waste from 0.2% in 2014 to 4% in 2023;
  - Increase mechanical biological treatment recovery rate of municipal waste from 5.4 % in 2014 to 11% in 2023;
  - Increase thermal treatment recovery rate of municipal waste from 0.3 % in 2014 to 8 % in 2023;
  - Decrease landfilling rate of municipal waste from 88.7 % in 2014 to 65 % in 2023.

- Wastewater Treatment Action Plan (2015 - 2023)
  - 100% of the municipal population served by the wastewater treatment and sewerage system until the end of 2023; (WWTP 75%, sewerage 89.7% in 2016)
  - Construction and commissioning of 1418 new wastewater treatment plants until 2023.

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Future

- 10th National Development Plan (2014- 2018)
  - Ratio of municipal population served with wastewater treatment plant to total municipal population is planned to be 85% until the end of 2018 ; (75% in 2016)
  - Ratio of municipal population benefiting from sanitary landfill is planned to be 80% until the end of 2018. (61.8% sanitary landfilling, 9.8 % recovery facilities in 2016)

- National Climate Change Strategy (2010 – 2023)
  - 104 sanitary landfill facilities will be constructed and 76% of municipal waste will be disposed at these facilities by the end of 2012. (83 landfills in 2016)

- National Climate Change Action Plan (2011 – 2023)
  - Reduce the quantity of biodegradable wastes sent to landfill sites, taking year 2005 as a basis, by 75% in weight till 2015, by 50% till 2018 and by 35% till 2025. (Target is from Regulation on Sanitary Landfill of Wastes (2010))

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Future

- In Turkish waste legislation, policies and strategy papers; there are no direct targets or obligation for GHG emissions mitigation. Below actions may contribute to reduction:

  - reducing amounts of both solid waste and wastewater;
  - diverting waste away from landfills; increasing biological recovery of waste which replaces landfilling;
  - capturing or flaring methane from landfills and wastewater;
  - rehabilitation of old dumpsites;
  - better source separation and collection of municipal waste;
  - increasing the use of nitrogen removal technologies in wastewater treatment.

- Rough estimate: 10.4 Mt CO_2-eq caused by waste sector by 2023. % 36 reduction compared to latest data (16.2 Mt CO_2-eq from 2016) and %7 reduction compared to 1990 data.

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Waste sector: actions suggested based on preliminary screening

Sub-Sector	Suggested actions for Waste sector	Selection Criteria		
		Including in National Climate Change Action Plan (NCCAP)	Cost Effectiveness (EUR/tCO2e)	Mitigation Potential (MtCO2)
Solid Waste	Methane utilization for energy production at waste disposal and treatment facilities	√	24 to 77	2.9 to 5.1
	Improving recycle rate	√	?	?
	Rehabilitation of uncontrolled waste disposal sites	√	?	?
Wastewater	Improving WWTP technology		?	?
	Increasing use of biogas from WWTP		?	?

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Future - Cost

- Cost of rehabilitation of old dumpsites is around EUR 350 million and establishing necessary landfill is around EUR 205 million.

- Potential landfill gas to energy plant cost would be around EUR 140 million.

- Biological recovery methods has cost of around EUR 750 million and other recovery methods like thermal processes has huge cost more than EUR 1 billion.

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Future - Cost

Gerekli Tesisler	Gerekli Kapasite Ton/Gün	Birim Yatırım Maliyeti (€/Ton)		Tesis Bazında Yatırım Aralığı (Milyon €)	
MGT	12.509	25	50	114,1 €	228,3 €
Biyolojik Prosesler	4.050	75	200	110,9 €	295,6 €
Mekanik Biyolojik Prosesler	7.250	100	150	264,6 €	396,9 €
Termal Prosesler	8.046	300	450	881,0 €	1321,6 €
Düzenli Depolama	67.732	15	25	370,8 €	618,1 €
GEREKEN TOPLAM YATIRIM MİKTARI (€)				**1.741,5 €**	**2.860,5 €**

Source: MoEU

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Emission Sources

- **Collection & Transport:** CO_2 from fuel consumption (Direct)
- **Mechanical Pre Treatment:** CO_2 from fuel consumption (Direct), Purchased electricity consumption (Indirect)
- **Recycling & Recovery:** CO_2 from fuel consumption (Direct), Purchased electricity consumption (Indirect), Difference between virgin raw material production emissions and material emissions (Avoided)
- **Biological Treatment (composting):** CO_2 from fuel consumption, Process emissions (CH_4) (Direct), Purchased electricity consumption (Indirect), Difference between use of chemical fertilizer and compost spreading (Avoided)
- **Biological Treatment (anaerobic digestion):** CO_2 from fuel consumption, Process emissions (CH_4) (Direct), Purchased electricity consumption (Indirect), Difference between biogas recovery emissions and substituted energy production emissions (avoided)
- **Landfill:** CO_2 from fuel consumption, CH_4 emissions (direct), Purchased electricity consumption (Indirect), Difference between biogas recovery emissions and substituted energy production emissions (avoided)
- **Thermal treatment:** CO_2 from fuel consumption, Process emissions (CH_4, N_2O) (Direct), Purchased electricity consumption (Indirect), Difference between energy from thermal process (power and heat) and substituted energy production emissions, difference between virgin raw material production emissions and material recovery emissions (bottom ashes, slags) (avoided)

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Thank you for your attention!

http://www.lowcarbonturkey.org/