Environment Quality Authority

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Promoting Science & Technology

National Workshop on Climate Change

Jordan's Effort on Climate Change Mitigation

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Royal Scientific Society

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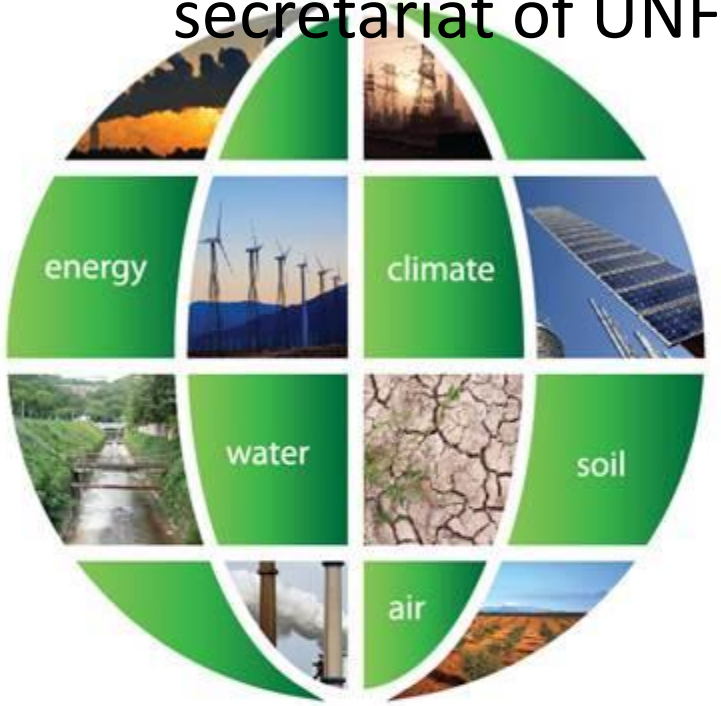
Jordan's Effort in Climate Change

- Jordan has ratified the UNFCCC in 1994.
- The Ministry of Environment is the national focal point for climate change issues.
- Jordan was the first Developing Country to submit its Initial National Communication (INC) to the secretariat of the UNFCCC in 1997.
- "Vulnerability and adaptation to climate change" project was carried out in the year 2000 as completion to INC
- A pilot Biogas facility at Russifa landfill was commissioned in May 2000
- Jordan has made an accession to Kyoto Protocol in 2003, Ministry of Environment is the DNA

Jordan's Effort in Climate Change

- Preparation of national reports on technology needs assessment (TNA) and technology transfer (TT), (2004-2005).
- National Capacity Self Assessment for Global Environmental Management (NCSA)- Biodiversity, Climate Change and Desertification was implemented in 2005
- Jordan's Second National Communication (SNC) to the UNFCCC was submitted in Dec 2009
- Adaptation to Climate Change to Sustain Jordan MDG's Achievements, a joint programme (JP)- 2010-2013
- TNC in 2014 and
- PMR world bank: RSS with RICARDO : 2015

Third NC completed in 2014, submitted to the secretariat of UNFCCC during Lima COP, 2014



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MINISTRY OF ENVIRONMENT

UNDP

الجمعية العلمية الملكية
Royal Scientific Society

Enabling Activities for the Preparation of

Jordan's Third National Communication

to the UNFCCC (TNC)

Climate Change Mitigation

What is Climate Change Mitigation?

- **Climate change mitigation** is a human intervention / action to reduce the sources or enhance the sinks of greenhouse gases to reduce the potential effects of global warming
- Mitigation is distinguished from adaptation to global warming, which involves acting to tolerate the effects of global warming.

Why do we need to mitigate GHGs?

- IPCC 4th assessment report: more evidences that CC is more likely attributed to anthropogenic emissions of GHGs
- The clear impacts of climate change
- Projections of catastrophic effects if the same trend of increase in GHGs will continue in the future
- Time is running out, tough GHG decisions should be taken

Mitigation in Jordan

- The highest percentage of GHG emission is from energy sector
- Power generation is the highest emitter
- Mitigation focus is on energy sector: power generation.
- Biogas collection from landfill sites and use for power generation
- Energy efficiency, renewable energy

Residential Sector

Low cost mitigation

- In OECD residential accounts for **35- 40 percent** of national CO2 emissions with appliances alone produce roughly 12 percent.

- Public policy instruments include: **Appliance standards, information (labeling), and building codes.**

Residential Sector

- In Jordan home appliances labeling GEF funded project was carried out, completed in 2014

- RSS with relevant ministries developed the green building codes and rating system. Due to their importance, high weight is given to energy and water efficiency (such as insulation).

Public Awareness

- Public awareness campaigns are used to influence the personal behaviors and result in reduction of GHG on the personal levels at homes, at the office and on the road.
- Public awareness campaigns have been done in Jordan by MoEnv in cooperation with Banks and cities through media (mainly newspapers) lectures in schools, etc.
- RSS conducted an awareness program on climate change (CC) for university students in 2014
- RSS developed a communication plan within TNC to raise awareness on CC

Mitigation on the personal level: Reducing your energy bill will help reduce GHG

At Home

- ✓ Use Energy efficient lighting: to energy efficient bulbs
- ✓Look for energy efficient appliances: labels
- ✓Proper and smart operation of home appliances
  - ✓ Refrigerators should not be placed near heat sources
  - ✓ Refrigerators condenser coil should be kept dust free to ensure smooth air flow,
  - ✓ Operate the washing machine at full load.
- ✓ Seal and insulate your home
  - ✓ Building new house: insulate the walls, water pipes.
  - ✓ Sealing air leaks around windows and doors.

Mitigation on the personal level: Reducing your energy bill will help reduce GHG

At Home

- ✓**Use solar energy to heat water**
- ✓ **Reduce "stand by" power waste**
  - Home appliances use electricity even when they are turned off. It is estimated that around **25 %** of the energy a television uses is consumed when it is not powered on. It is recommended then that you **unplug** your appliances when they are not in use
- ✓**Use water efficiently**

Mitigation on the personal level: Reducing your energy bill will help reduce GHG

At the Office

- ✓ Better management of energy use in office equipment
- ✓ Look for energy efficient office equipments
- ✓ Reduce, Reuse, Recycle
  - As using two-sided printing and copying; buying supplies made with recycled content

Mitigation on the personal level: Reducing your energy bill will help reduce GHG

On the Road

✓ **Buy smart: more fuel-efficient vehicles**

✓**Drive smart**

- **Go easy on the brakes and gas pedal**
- **Avoid speeding (a car's fuel economy drops sharply at speeds above 55 mph (around 88 Km/hr)**
- **Reduce time spent idling and try to avoid rush hours**
- **unload unnecessary items in your trunk to reduce weight.**

✓**Maintain your car and check your tires pressure regularly**

✓ **Avoid using your car when possible: Use public transportation, carpool, walk, or bike whenever possible**

Mitigation Assessment

The following part of the presentation is based on climate change mitigation analysis conducted within Jordan's TNC for the period 2007 to 2040. The TNC has been published and it is currently available at UNFCCC website

Why do Mitigation Assessment?

- To meet the principles and objectives of the UNFCCC. Under Article 4, all Parties are required to assess programs and measures that will mitigate climate change:

  Article 4, (b) of the UNFCCC: Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change;

Why do Mitigation Assessment?

- To provide policy makers with an evaluation of technologies and practices that can mitigate climate change and also contribute to national sustainable development objectives.
- To understand the costs of avoiding climate change.
- To identify potential project/programme investments.

Steps of Conducting Mitigation Assessment

- Development of Baseline Scenario (s)
- Development of Mitigation Scenario (s)

Baseline Scenario

- A baseline is a reasonable and consistent description of how a system might evolve into the future *in the absence of explicit new GHG mitigation policies.*
- The Baseline Scenario considered the likely evolution of activities that effect GHG sources and sinks including consideration of GDP and population growth, projections of the main GHG emitting activities and sinks up to the year 2040.

Cont'd Baseline Scenario

- The baseline scenario is constructed based on the trends, plans and policies prevailing in the country context
- The baseline scenario is constructed in close cooperation with the concerned institutions
- Development of scenarios required a projection of current levels to future levels of each kind of activity
- Relatively long time period (2006 – 2040)

National Overall Baseline Scenario

- The baseline scenario is constructed for each sector.
- The overall national baseline scenario is the combination of the baseline scenario for all sectors (energy, IP, waste, agriculture, LULUCF).

Baseline Scenario- Energy Sector

The energy sector baseline was constructed based on the **National Energy Strategy** and the following:

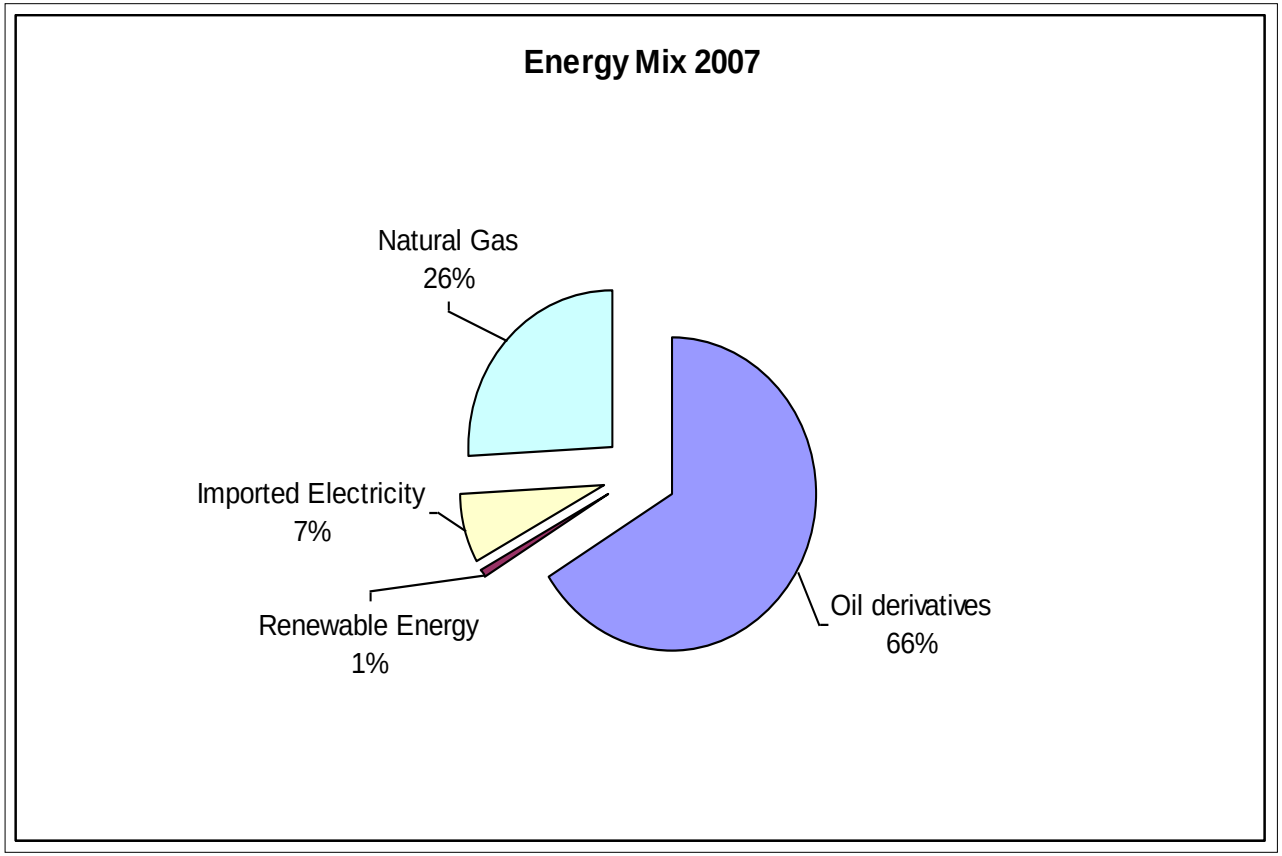
- The current situation in the energy sector.
- The government's efforts which are being made to achieve security of energy supply.
- The stated goals and policies, and
- The committed activities and projects

Energy Strategy (2007-2020)

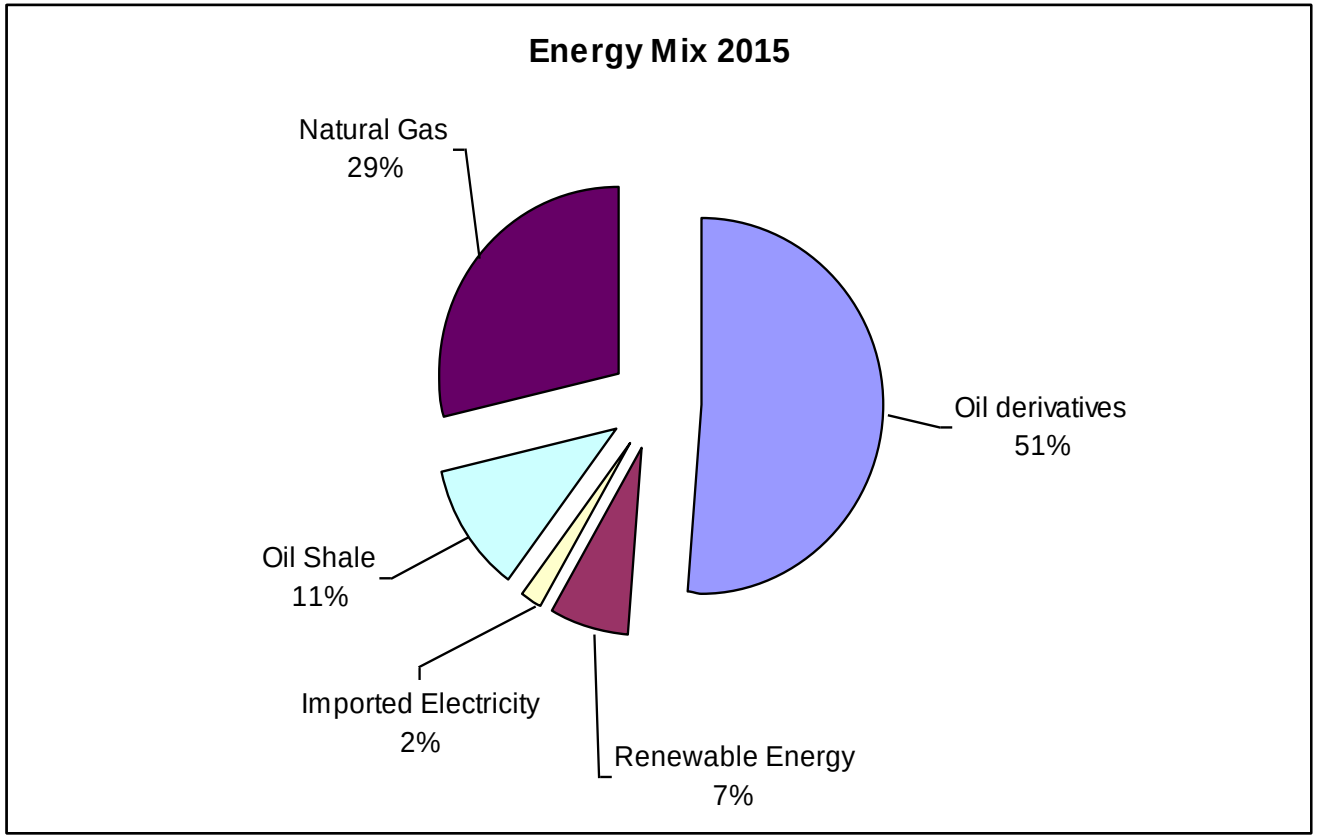
MAIN GOALS :

- Diversifying the energy resources.
- Increasing the share of local resources in the energy mix .
- Reducing the dependency on imported oil.
- Enhancing environment protection.

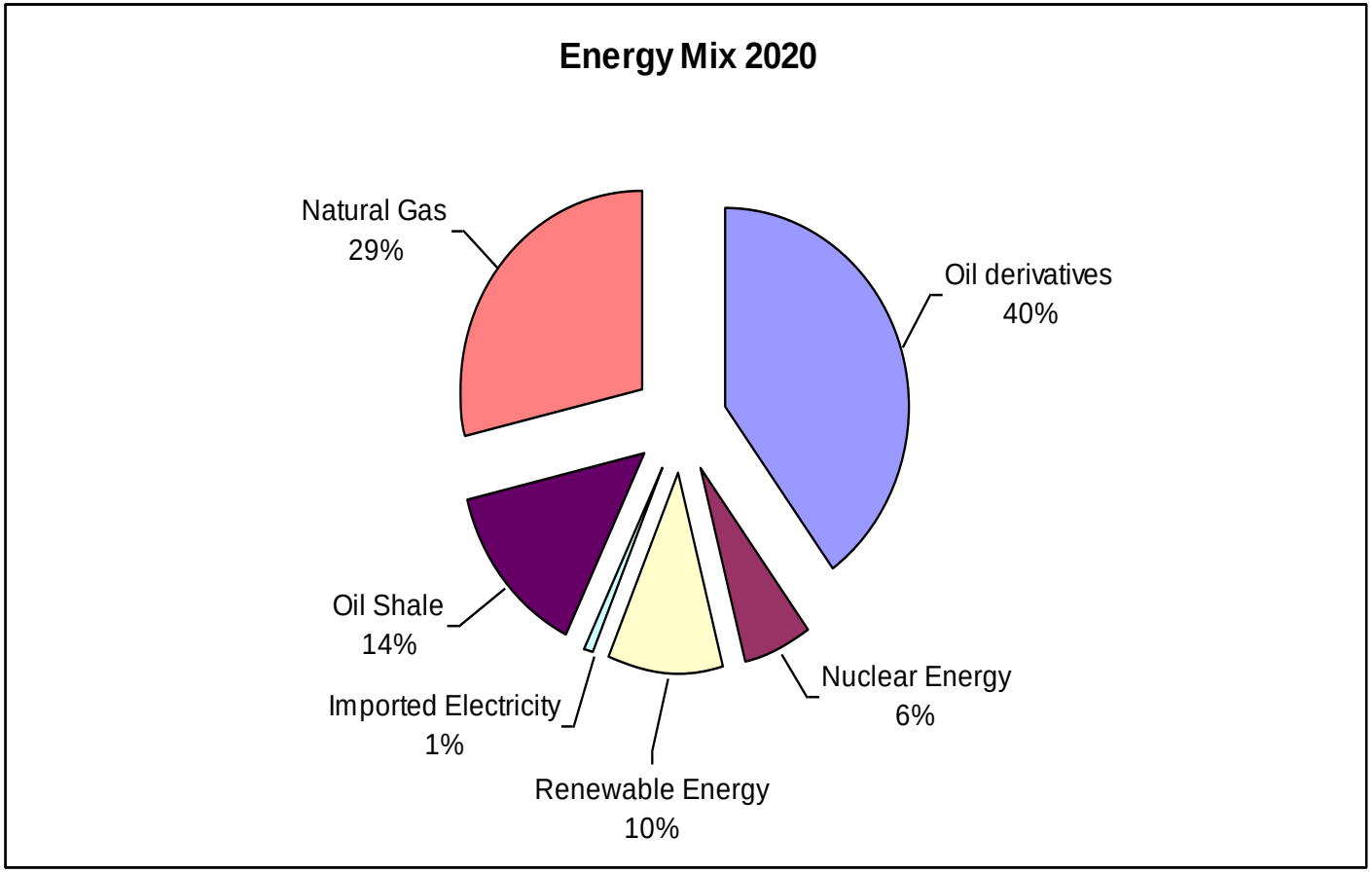
Energy Mix in Jordan - 2007



Planned Energy Mix for Jordan in 2015 according to the National Energy Strategy



Planned Energy Mix for Jordan in 2020 according to the National Energy Strategy



Significant Figures of Energy for 2013

−Primary energy consumption	8.2 MToe
−The imported crude oil and oil products	7.1 M tons
−Natural gas imported from Egypt	928 mcm
−Electricity generation	17287 Gwh
−The imported electricity	380 Gwh
−Cost of imported energy	4.1 Bn JD
−Imported energy bill	17% of GDP
−Per capita primary energy consumption	1249 kgoe
−Per capita of electricity consumption	2235 kwh
−Energy intensity	208 (kgoe/1000JD)

The Main Assumptions For The Energy Baseline Scenario Construction-1

Oil sector :

- The JPR will continue its work with the same capacity of production of 14 thousand tons per day.
- Implement the expansion of the Jordan Petroleum Refinery to be completed in 2021.
- Continuity to import 90% of the total need of crude oil form Saudi Arabia. And (10%) of crude oil from Iraq. This arrangements will continue until 2022.
- Constructing the Iraqi pipeline crude oil to export Iraqi crude oil through Aqaba port with a branch to supply JPR with 150 thousand barrels/day. The pipeline will be completed in the year 2022.
- The continuation of the policy of liberalization of prices of petroleum products, and pricing oil products on a monthly basis.

The Main Assumptions For The Baseline Scenario Construction-2

Natural gas :

- Continue to import certain amounts of natural gas from Egypt via the Arab Gas Pipeline, to reach 100 million cubic feet per day and at a steady rate until the year 2033.
- Start to import LNG through the port of Aqaba by the beginning of 2015, which can provide up to (715) million cf/day.
- Continue to produce 20 million CF of natural gas from the Risha gas field, at a constant rate until the year 2040.

Nuclear Energy :

- The nuclear power plant to generate electricity will be constructed with a capacity of (1000) MW to be in operation in 2023

The Main Assumptions For The Baseline Scenario Construction-3

Oil shale :

The oil shale will start to contribute to the generation of electricity in 2018:

- Constructing a direct burning power plant of oil shale with a capacity of (450 MW) to be in operation in 2018.
- Constructing a direct power plant of oil shale by Emarati and Chinese consortium, with a capacity of (600 MW). The first unit will start operation in 2018 and the second unit will start operation in 2020 with a capacity of (300) MW.

The Main Assumptions For The Baseline Scenario Construction-4

Renewable Energy (RE)

The following RE projects are considered within the baseline scenario:

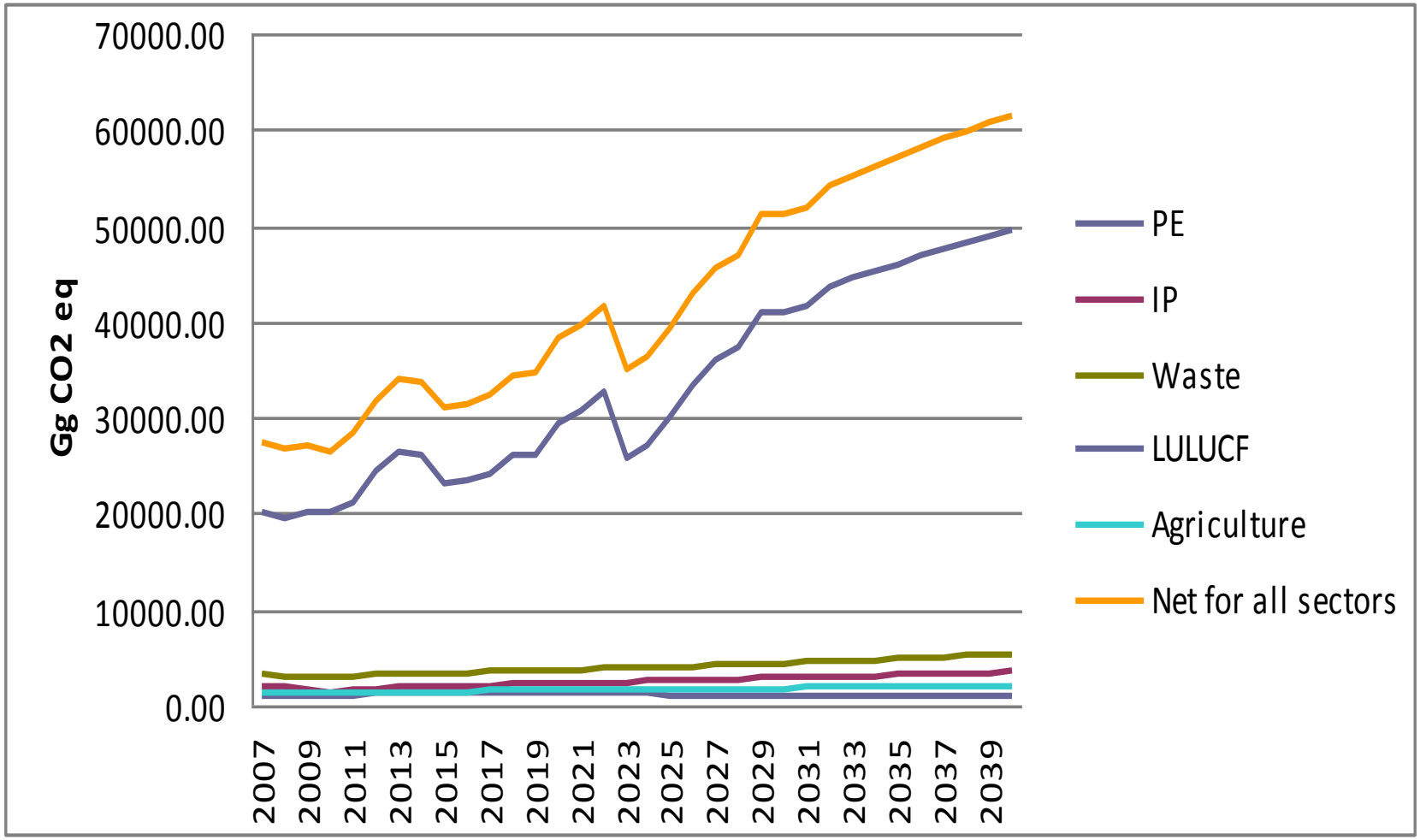
- 375 MW-Wind power to be constructed by the end of 2015.
- 285 MW-PV Solar to be constructed by the end of 2015.
- The capacity of PV solar self-generation in home, government institutions, banks, hotels and hospitals is considered to be (35) MW until 2015 and 125 MW by the 2020.
- Constructing a power plant for direct burning of solid waste with a capacity of (50 MW) by the year 2020.
- Bio–gas power plant with a capacity of (25 MW) will be built in Ghabawi area by 2020.

Methodology- Energy

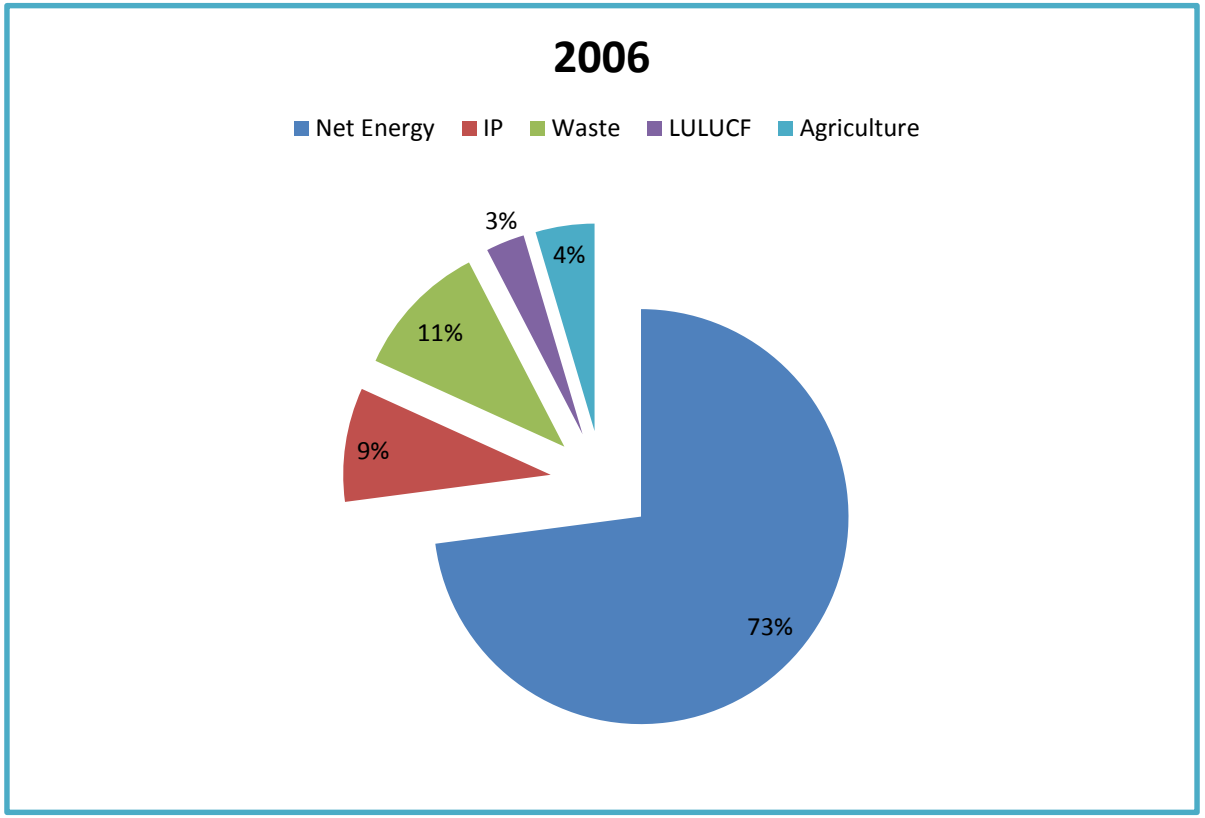
Energy and Power Evaluation program (ENPEP), with its different modules, e.g.:

- The DEMAND model is used for calculating the growth rate of oil product demand for any form of energy based on several macroeconomic variables
- The MAED module of ENPEP was used for projection of the electricity demand
- The BALANCE module and IMPACTs module were used to calculate the GHGs emissions for the period 2006-2040

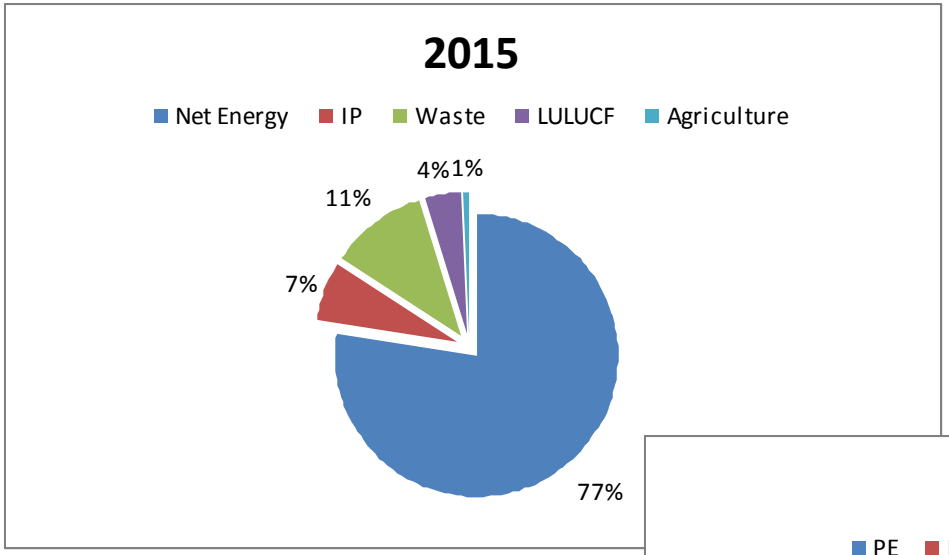
Emissions of Baseline Scenario for all Sectors

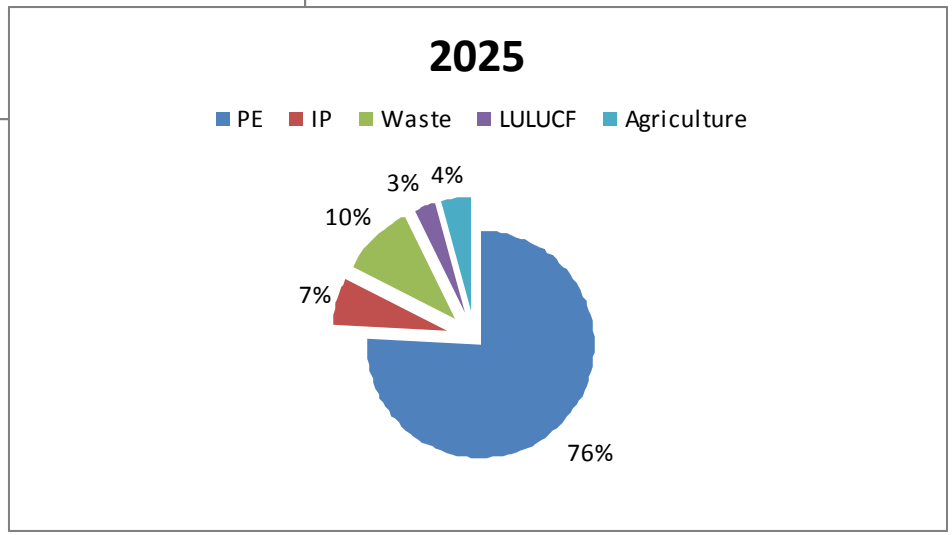


GHG emissions from different sectors Inventory of 2006- TNC

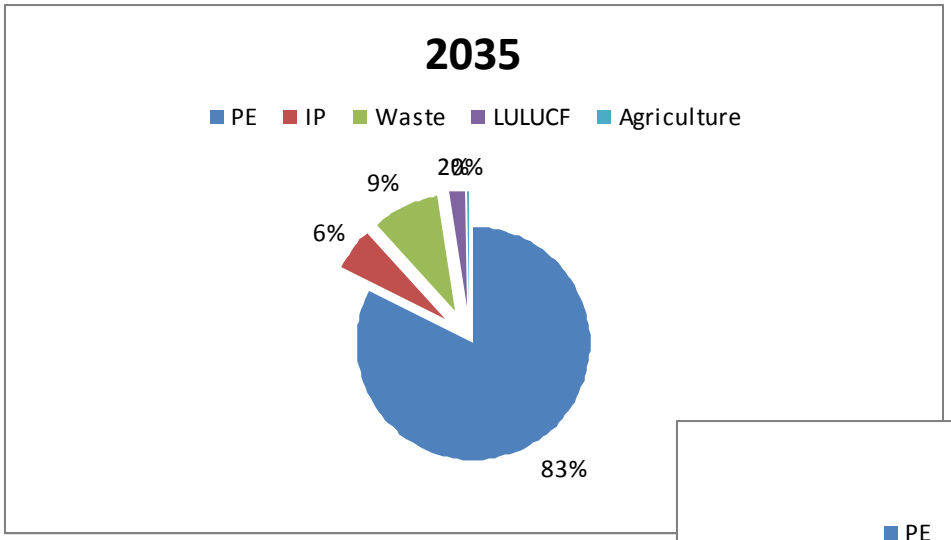


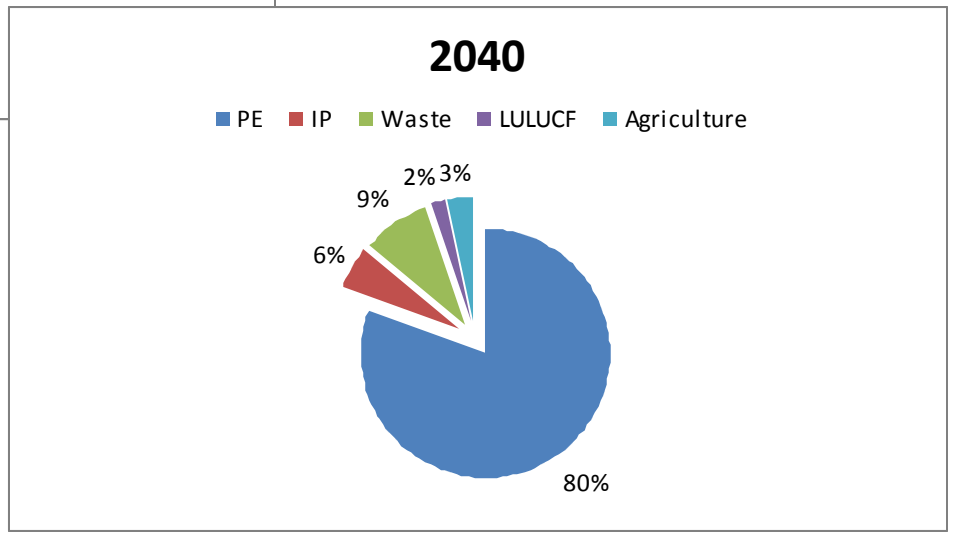
Emissions of Baseline Scenario for Selected Years





Emissions of Baseline Scenario for Selected Years





Mitigation Scenario-criteria to select mitigation options

Options identified based on set of criteria reflecting country-specific conditions:

- Potential for large impact on (GHGs)
- Consistency with national development goals
- Direct and indirect economic impacts
- Potential effectiveness of implementation policies
- Sustainability of an option
- Data availability for evaluation
- Other sector-specific criteria

Key Study Parameters

- Timeframe (2007-2040)
- Scope (Primary energy & energy demand ,RE, EE, Transport, agriculture, LULUCF, solid waste & wastewater, Industrial processes).
- Methodologies: ENPEP for Energy
- Discounted cash flow
- Discounted avoided GHG emissions
- Discount rate: 8%

Discounting C at 7% suggests it's better to save 1 ton C today than 2 tons C in 10 years, even though climate will be worse off

Identified Mitigation Projects

Mitigation Projects identified in the following sectors:

- Primary Energy and Energy Demand
- Renewable Energy (wind, PV, CSP, SWH, bio-solids)
- Energy Efficiency (industrial, commercial, residential)
- Transport
- Industrial processes- non energy
- Waste Sector (Solid waste & wastewater)
- Agriculture, LULUCF

Emission reduction and emission reduction unit cost for the (5) proposed primary energy mitigation projects

Project Name	Reduction Unit Cost (JD/t CO2eq)
Reduction of Loss in Electricity Transmission and Distribution (T&D): Main components- optimizing the utilization of the distribution generation, improving the system power factor, upgrade or replacing existing conductor and insulators with lower-resistance equipment	-40.74
Improving Combustion Efficiency in Rehab Power Plant: Improving boiler tuning, upgrading and replacing plant maintenance program and upgrading and replacing plant equipment, treating the fuel	-27.94
Combined Cycle Gas Turbine in Risha Plant	-19.48
Distribution Network of Natural Gas in Aqaba	-5.46
Demand Side Management: introducing actions to reduce overall energy consumption, including Variable Speed Drive Program	-21.31

Emission reduction and emission reduction unit cost for the (9) renewable energy mitigation projects

Project Name	Mitigation Cost (JD/ton)
150 MW Wind Farm	-45.7
100 MW Concentrated Solar Power (CSP)	6.14
Photo Voltaic (PV) 1-200 MW	-13.01
Photo Voltaic (PV) 2- 200 MW	-66.09
300 MW Concentrated Solar Power (CSP)	-61.98
Biogas Power Plant- 15 MW	58.01
Solar Water Heaters 1-30000 Houses	-104.83
Solar Water Heaters2-30000 Houses	-107.01
Solar Water Heaters 3-30000 Houses	-109.18

Emission reduction and emission reduction unit cost for (7) proposed energy efficiency mitigation projects

Project Name	Mitigation Cost (JD/ton)
Replacing High Thermal Mass with Low Thermal Mass (LTM) in Ceramic factories: for the "kiln cars"	-229.73
Returning un-returned condensate to the feed water tanks in Food Industry (to capture its heat)	-124.7
Insulating the un-insulated pipes, fittings and tanks in food industries	-254.09
Replacing the Fluorescent lamps fixtures with LED lamps fixtures in commercial buildings (100,000 unit)	-189.65
Insulating walls and roofs in 35000 new houses.	-274.77
Street Lighting: Replacing 125 W Mercury lamps with 70 W high Pressure Sodium lamps. (replace 200,000 lamp)	-132.44
Using Regenerative burners instead of conventional burners in Steel Reheating Industry.	-95.56

Emission reduction and emission reduction unit cost for transport mitigation projects

Project Name	Mitigation Cost (JD/ton)
Reduction by using hybrid cars for public passengers	200.77
Reduction by Amman – Zarqa Bus Rapid Transit (BRT)	215.66

Emission reduction and emission reduction unit cost for (5)municipal solid waste and (5) WWTP mitigation projects

Project Name	Mitigation Cost (JD/ton)
Biogas collection and utilization from Al-Dhulil domestic solid waste landfill	-3.7
Biogas collection and utilization from Al-Ekader domestic solid waste landfill	-0.2
Biogas collection and utilization from Al-Salt (Hamra) domestic solid waste landfill	-3.95
Biogas collection and utilization from Al-Karak domestic solid waste landfill	-3.95
Biogas collection and utilization from Maddaba domestic solid waste landfill	-0.2
Biogas generation by utilizing the sludge generated from Baqa'a tertiary domestic wastewater treatment plant	8.23

Cont'd: Emission reduction and emission reduction unit cost for municipal solid waste and WWTP mitigation projects

Biogas generation by utilizing the sludge generated from Madaba domestic wastewater treatment plant	7.32
Biogas generation by utilizing the sludge generated from Ramtha domestic wastewater treatment plant	15.47
Biogas generation by utilizing the sludge generated from Salt domestic wastewater treatment plant	8.49
Biogas generation by utilizing the sludge generated from Wadi Arab domestic wastewater treatment plant	13.81

Emission reduction and emission reduction unit cost for the industrial processes mitigation projects

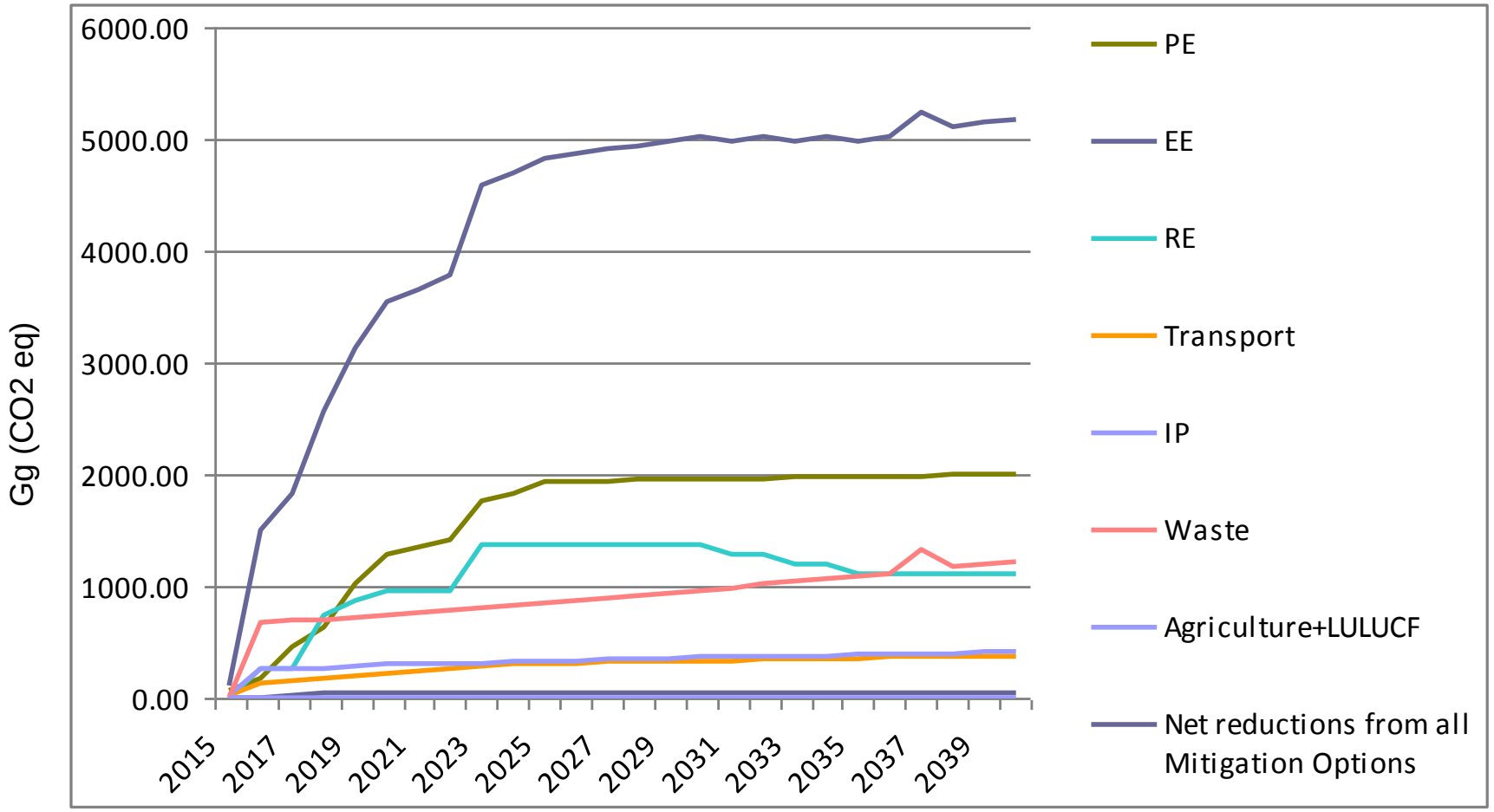
Project Name	Mitigation Cost (JD/ton)
Use of steel slag and/or fly ash to substitute the raw materials needed to produce clinker	-12.4
Increase the percentage of Pozzolana in CEM II cement	-23.9
Produce new cement product CEM IV with 45% of Pozzolana	-24
Use of biomass (MSW or/and Sewage Sludge) as alternative fuels (Gg/year)	-63.1
Catalytic Reduction of N_2O inside the Ammonia Burner of the Nitric Acid Plant	0.9

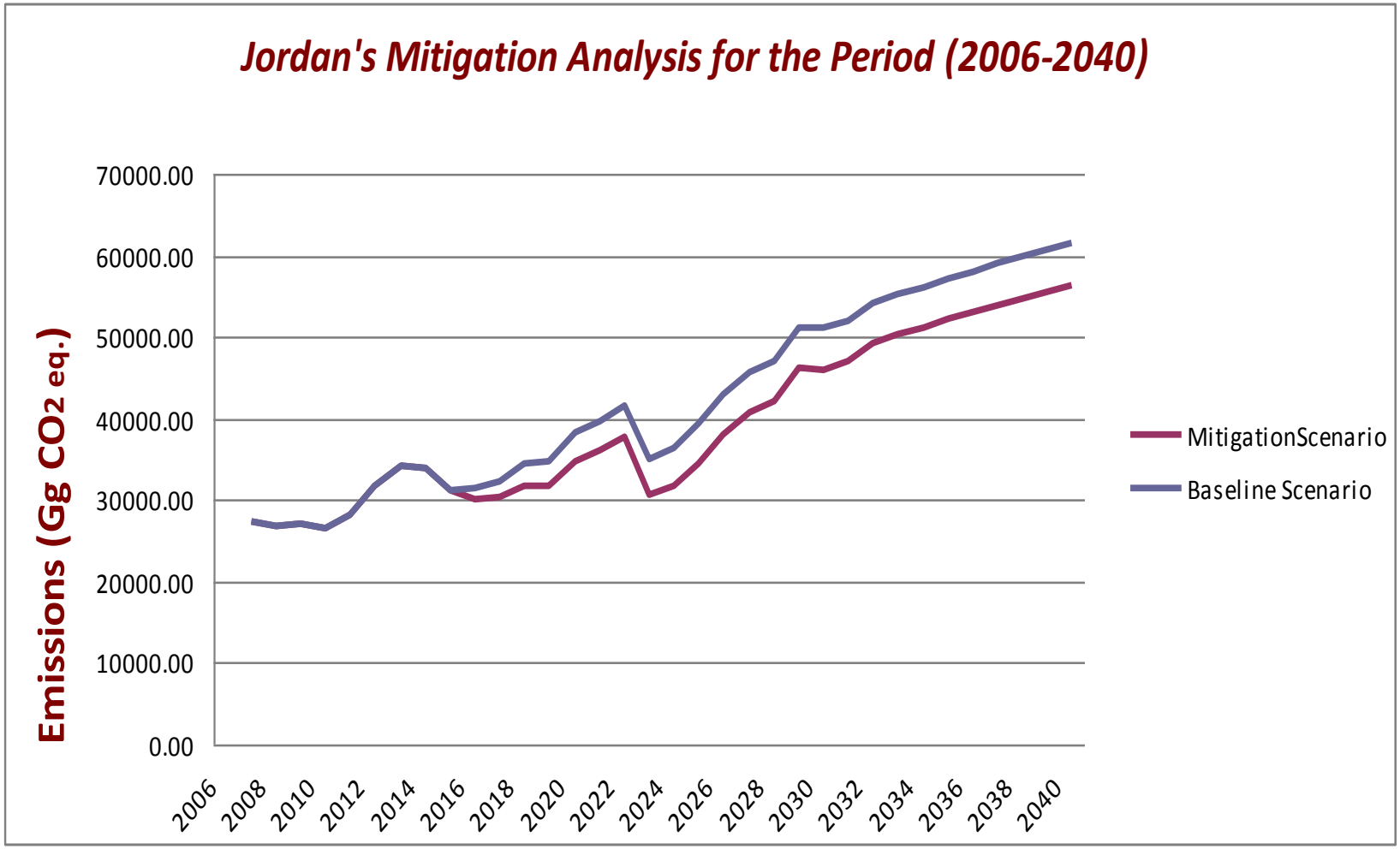
Emission reduction and emission reduction unit cost for Agriculture and LULUCF mitigation projects

Project Name	Mitigation Cost (JD/ton)
Forestry- Introduce new plantations in Urban Areas Reforestration to reverse the storm Alexa- 2014 adverse effect on urban trees (GAM)	56
Forestry- Introduce new plantations in Northern Area Reforestration to reverse the storm Alexa- 2014 adverse effect on urban trees (Ajloun and Jerash)	58
Rangeland1- restoration of Rangeland Areas : Plantation of perennial fodder shrubs in the Badia (Al Jafr and Al Husseinieh)	1356
Rangeland2- New Protected Rangeland Area As Natural Reserve: increase the protected area by another 100 000 du in the wide desert valleys south Badia	1922
Promoting for Climate-smart agricultural practices in the Jordan Valley: Minimal mechanical soil disturbance, Replacing 50 % of the Synthetic fertilizer by Compost	-1335

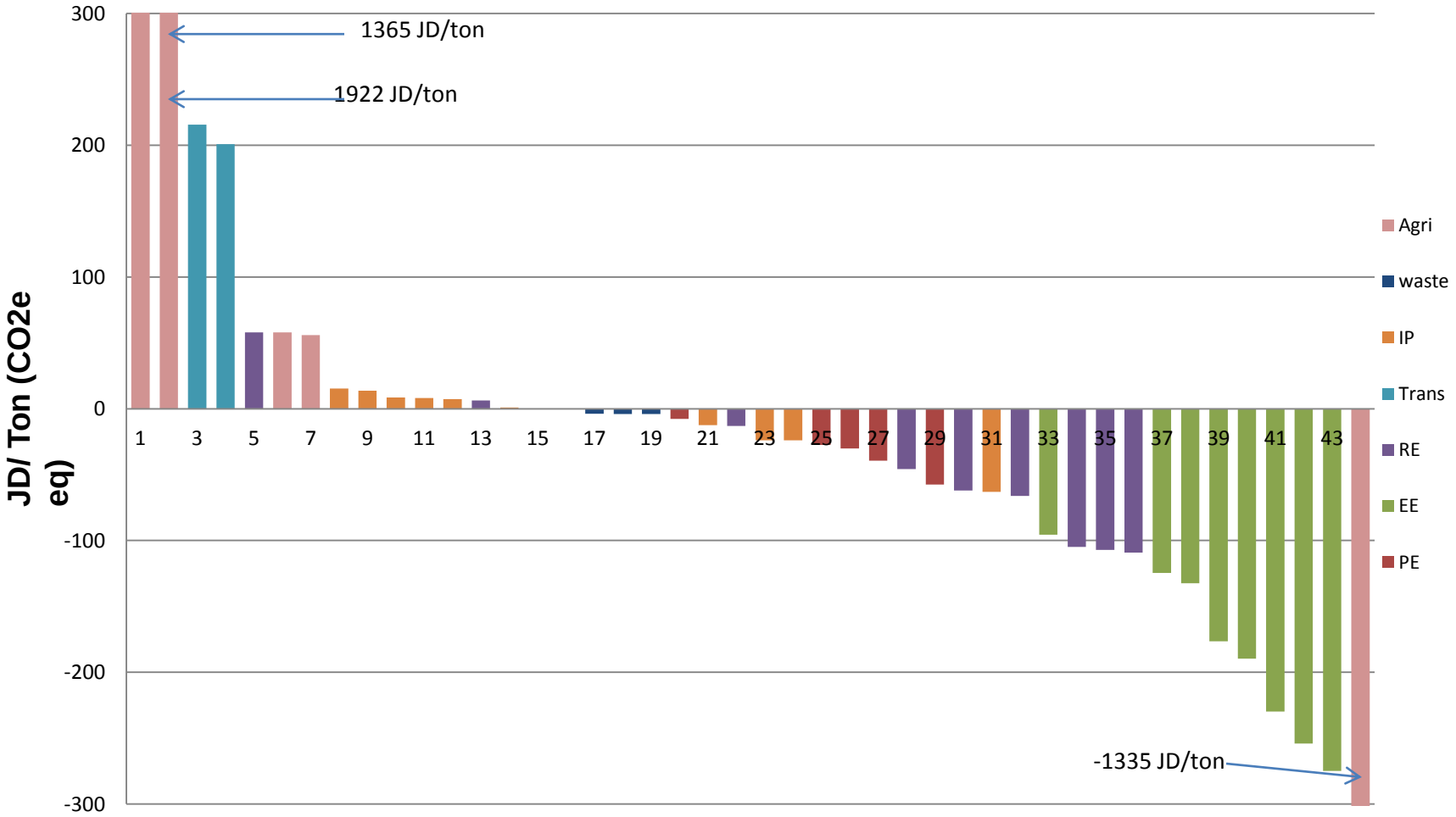
Overall Results of Climate Change Mitigation Analysis

Emission Reductions of Mitigation Measures

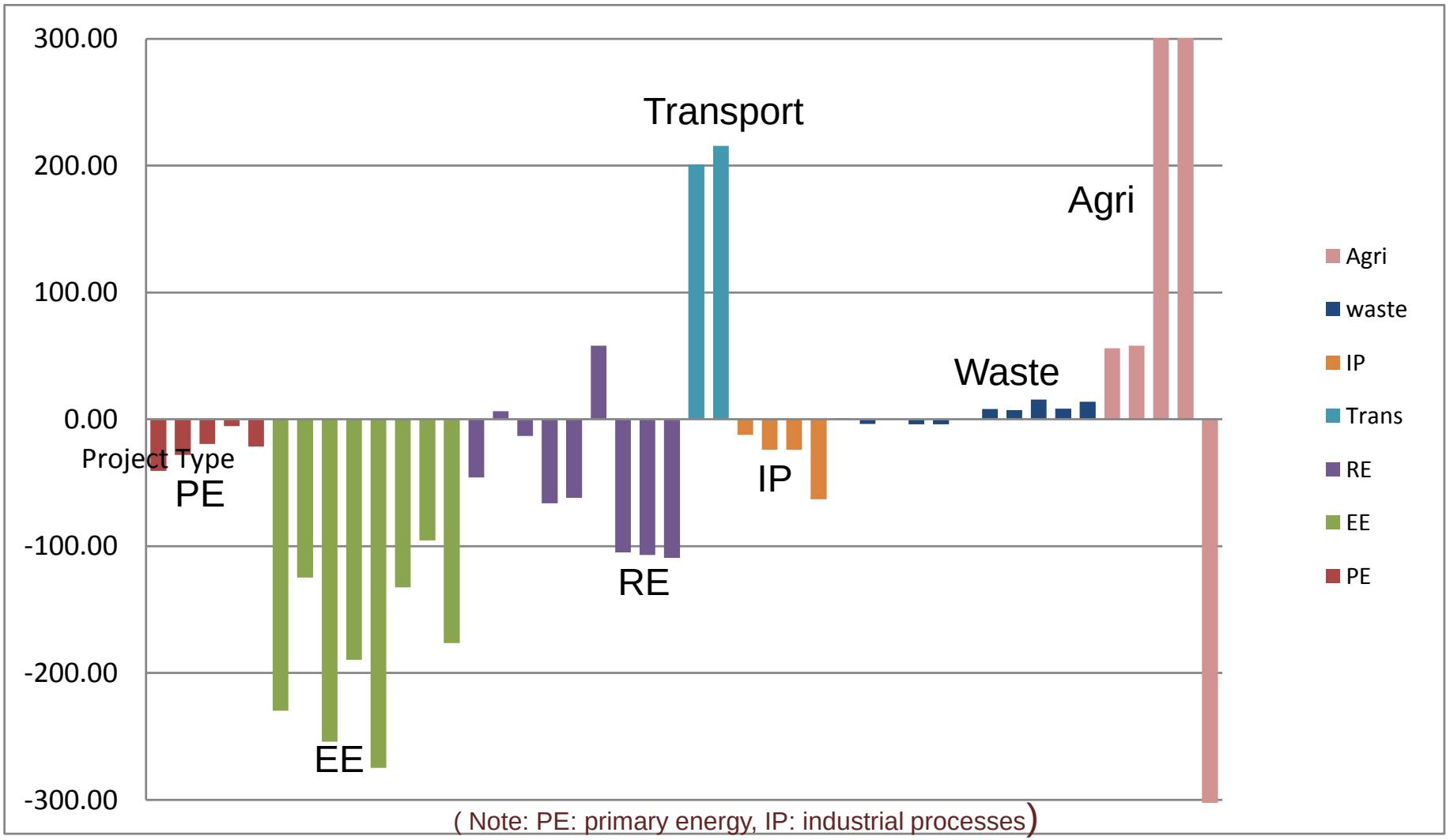



Jordan's Mitigation Analysis for the Period (2006-2040)
Emissions (Gg CO2 eq.)
70000.00
60000.00
50000.00
40000.00
30000.00
20000.00
10000.00
0.00
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
MitigationScenario
Baseline Scenario

Abatement Cost ranked from the highest reduction cost to the lowest



Abatement cost for all mitigation measures grouped according to sectors



(Note: PE: primary energy, IP: industrial processes)

Thank your for your kind attention