Solar Progress
Targeting “%100 Renewable Transformation”
Quo Vadis...?
REST ARE THE COUNTRIES WHOSE POPULATION IS PROJECTED TO DECREASE BETWEEN 2015 AND 2050. ABSOLUTE DIFFERENCE IS NEGATIVE.

<table>
<thead>
<tr>
<th>Country</th>
<th>2015</th>
<th>2030</th>
<th>2050</th>
<th>2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uzbekistan</td>
<td>29.9</td>
<td>34.4</td>
<td>37.1</td>
<td></td>
</tr>
<tr>
<td>Turkey</td>
<td>78.7</td>
<td>87.7</td>
<td>95.8</td>
<td></td>
</tr>
<tr>
<td>Tajikistan</td>
<td>8.4</td>
<td>11.1</td>
<td>14.3</td>
<td></td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>5.9</td>
<td>7.1</td>
<td>8.2</td>
<td></td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>17.6</td>
<td>20.0</td>
<td>22.4</td>
<td></td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>9.7</td>
<td>10.7</td>
<td>11.0</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1. Population of the world and major areas, 2015, 2030, 2050 and 2100, according to the medium-variant projection**

<table>
<thead>
<tr>
<th>Major area</th>
<th>Population (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2015</td>
</tr>
<tr>
<td>World</td>
<td>7349</td>
</tr>
<tr>
<td>Africa</td>
<td>1186</td>
</tr>
<tr>
<td>Asia</td>
<td>4393</td>
</tr>
<tr>
<td>Europe</td>
<td>738</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>634</td>
</tr>
<tr>
<td>Northern America</td>
<td>358</td>
</tr>
<tr>
<td>Oceania</td>
<td>39</td>
</tr>
</tbody>
</table>

Figure 2. Urban and rural population of the world, 1950–2050

A majority of the world’s population lives in urban areas

Urban and rural population as proportion of total population, by major areas, 1956–2050

Turkiye

73% → 84%

Turkiye
Challenge: bridge supply limitations with 24-hour demand for electricity worldwide.

1970s: Photo from space - glow from electric lights at night.

Image Credit: NASA
Challenge: bridge supply limitations with 24-hour demand for electricity worldwide

2005: Photo from space - glow from electric lights at night.

- Streamline electricity grid for efficiency
- Develop wind and solar storage systems for peak use.
- Continue “clean coal” technology advancements
- Increase use of natural gas
- ENERGY EFFICIENCY
Global urban population growth is propelled by the growth of cities of all sizes.

- 662 cities
- 50% of world population
Turkiye
131.3 million TOE
336.3 million TCO2e
85.6% fossil fuel

Need for low-carbon economy

86% from fossil fuels
Least developed areas, High carbon dependency
Least developed, highly fuel dependent areas

The world’s fastest growing cities are in Africa and Asia

Designing future’s cities as
• energy efficient,
• multi-comfort,
• environmental friendly
• Zero Carbon is crucial
World demand for energy by 2040

Future Global Energy Demand
The world will require 56 percent more energy in 2040 than in 2010.
Factors driving growth of Carbon Emissions

- Energy Efficiency
- Renewables

Diagram showing annual change in carbon emissions with a focus on GDP, energy intensity, and fuel mix.
Energy Policy

Energy security and sustainable energy supply are among the main policy concerns of .......

... attributes significant importance to;

• Encouraging the energy production from renewable sources in a secure, economic and cost effective manner,
• Expanding the utilization of promising renewable resources
• Increasing the diversification of energy resources,
• Taking significant steps to increase energy efficiency,
• Reducing greenhouse gas emissions,
• Making use of waste products and protecting the environment,
• Developing the related mechanical and/or electro-mechanical manufacturing sector.
Energy Performance of Buildings Regulation, 2010

All new buildings will be nearly zero-energy buildings (nZEB) as of 31st December 2020 (public buildings-as of 31st December 2018)
REPUBLIC OF TURKEY
INTENDED NATIONALLY DETERMINED CONTRIBUTION

Plans and policies to be implemented for this INDC

Buildings and Urban Transformation
- Constructing new residential buildings and service buildings as energy efficient in accordance with the Energy Performance of Buildings Regulations
- Creating Energy Performance Certificates for new and existing buildings so as to control energy consumption and greenhouse gas emissions and to reduce energy consumption per square meter
- Reducing the consumption of primary energy sources of new and existing buildings by means of design, technological equipment, building materials, development of channels that promote the use of renewable energy sources (loans, tax reduction, etc.)
- Dissemination of Green Building, passive energy, zero-energy house design in order to minimize the energy demand and to ensure local production of energy
Plans and policies to be implemented for this INDC

**Industry**
- Reducing emission intensity with the implementation of National Strategy and Action Plan on Energy Efficiency
- Increasing energy efficiency in industrial installations and providing financial support to energy efficiency projects
- Making studies to increase use of waste as an alternative fuel at the appropriate sectors

**Agriculture**
- Fuel savings by land consolidation in agricultural areas
- Rehabilitation of grazing lands
- Controlling the use of fertilizers and implementing modern agricultural practices
- Supporting the minimum tillage methods
Plans and policies to be implemented for this INDC

Energy
- Increasing capacity of production of electricity from solar power to 10 GW until 2030
- Increasing capacity of production of electricity from wind power to 16 GW until 2030
- Tapping the full hydroelectric potential
- Commissioning of a nuclear power plant until 2030
- Reducing electricity transmission and distribution losses to 15 percent at 2030
- Rehabilitation of public electricity generation power plants
- Establishment of micro-generation, co-generation systems and production on site at electricity production
Plans and policies to be implemented for this INDC

Transport
- Ensuring balanced utilization of transport modes in freight and passenger transport by reducing the share of road transport and increasing the share of maritime and rail transport
- Enhancing combined transport
- Implementing sustainable transport approaches in urban areas
- Promoting alternative fuels and clean vehicles
- Realizing high speed railway projects
- Increasing urban railway systems
- Achieving fuel savings by tunnel projects
- Scraping of old vehicles from traffic
- Implementing green port and green airport projects to ensure energy efficiency
- Implementing special consumption tax exemptions for maritime transport
Plans and policies to be implemented for this INDC

**Waste**
- 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-methanization, 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.
Up to 21 percent reduction in GHG emissions from the BAU level by 2030 will enable Turkey to step on low-carbon development pathways compatible with the long-term objective of limiting the increase in global temperature below 2°C.

20% reduction in GHG emissions in the EU compared to 1990 levels by 2020 and reveals commitment to reducing GHG emissions by 40% by 2030, 80-95% by 2050. 20% of the EU energy consumption from renewable sources of energy and 20% reduction in primary energy consumption by increasing energy efficiency by 2020 and raised to 27% by 2030.
Ukraine defines ambitious, but at the same time substantiated and fair target with regard to the level of GHG emissions. It will not exceed 60% of 1990 GHG emissions level in 2030.

Limiting anthropogenic greenhouse gases in Russia to 70-75% of 1990 levels by the year 2030 might be a long-term indicator, subject to the maximum possible account of absorbing capacity of forests.

By 2030 the Republic of Azerbaijan targets 35% reduction in the level of greenhouse gas emissions compared to 1990/base year as its contribution to the global climate change efforts. The use of alternative and renewable energy sources stated.

The Republic of Kazakhstan wishes to communicate the following Intended Nationally Determined Contributions (INDC), and intends to achieve an economy-wide target of 15%-25% reduction in greenhouse gas emissions by 2030 compared to 1990.
(INTENDED) NATIONALLY DETERMINED CONTRIBUTION
IN OUR REGION

The Republic of Moldova intends to achieve an economy-wide unconditional target of reducing its greenhouse gas emissions by **64-67 percent below its 1990 level in 2030** and to make best efforts to reduce its emissions by 67 per cent. The reduction commitment expressed above could be increased up to 78 per cent below 1990 level conditional to, a global agreement addressing important topics including low-cost financial resources, technology transfer, and technical cooperation, accessible to all at a scale commensurate to the challenge of global climate change.

Montenegro’s contribution to the international effort to avoid dangerous climate change is expressed in **30 % emission reduction by 2030 compared to the 1990 base year**.

Kyrgyz Republic will reduce GHG emissions in the range of 11.49 -13.75% below BAU in 2030. Additionally, under the international support Kyrgyz Republic could implement the mitigation measures to achieve total reduction in the range of 29.00 - 30.89% below BAU in 2030.
SOLAR
23,000 per year

2009 World energy use 16 TWy per year

© R. Perez et al.
WORLD ENERGY
2015 Use 26 18.5 TWy/y

RENEWABLES
Solar 12 23,000 TWy/y
Wind 3 75-130 TWy/y
Waves 4 0.2-2 TWy/y
OTEC 5 3-11 TWy/y
Biomass 5 2-6 TWy/y
Hydro 7 3-4 TWy/y
Geotherm. 6,22,23 0.2-3++ TWy/y
Tidal 2 0.3 TWy/y

FINITE
Nat. Gas 9,21 220 TWy
Petroleum 9,21 335 TWy
Uranium 13 to 20 185++ TWy
Coal 9,21 830 TWy
Potentials
Energy Consumption by 2015, Turkiye

Total Energy Supply by 2015 is 129.7 MTOE which was increased by 54% since 2005. 129.7 MTOE energy supply depends on 30.1% oil, 30.2% natural gas and 27.3% coal.
# Renewables & Turkey

A summary of potentials and projections for renewable resources in Turkey

<table>
<thead>
<tr>
<th>Renewable</th>
<th>Feasible Potential</th>
<th>2012</th>
<th>2023 Projection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydropower</td>
<td>37 GW + 5 GW small hydro</td>
<td>19 609 MW</td>
<td>All feasible potential</td>
</tr>
<tr>
<td>Wind power</td>
<td>87 GW</td>
<td>2 260 MW</td>
<td>~20GW</td>
</tr>
<tr>
<td>Geothermal</td>
<td>2 GW</td>
<td>162 MW</td>
<td>~600MW</td>
</tr>
<tr>
<td>Solar PV (1500kWh/KWp)</td>
<td>500 GW</td>
<td>~9 MW</td>
<td>7-10 GW?</td>
</tr>
<tr>
<td>Solar CSP</td>
<td>???</td>
<td>???</td>
<td>1GW?</td>
</tr>
<tr>
<td>Biomass</td>
<td>???</td>
<td>81MW</td>
<td>???</td>
</tr>
</tbody>
</table>

- Installed capacity ~ 75,1 GW (May 2016) – Private 73,4% – State 26,6%
- Generation 250.4 TWh (2014) • Consumption 255.5 TWh (2014)
- Export 2.7 TWh (2014) , • Import 7.8 TWh (2014)
- Market value ~ 37 Billion US$
Solar Energy Potential of Turkey

- Annual average solar radiation: 1527 kWh/m² per year
- Annual average total sunlight period: 2,738 hours/year (7.5 hours a day)

Using current PV technologies:

- Feasible land area for PV investment (with annual Global Solar radiation > 1650 kWh/m²):
  - ~ 4 600 km²
- Total feasible PV Power:
  - ~ 450-500 GWp
- Annual PV electricity generation capacity:
  - ~650-700 TWh


1600 km² = demand for electricity by 2050

Lake Salt – 1665 km²

39.000 GW if all lands available....
73 GW - roofs
Solar Energy Potential in Europe

<table>
<thead>
<tr>
<th>#</th>
<th>Country</th>
<th>GHI (kWh/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turkey</td>
<td>1661</td>
</tr>
<tr>
<td>2</td>
<td>Spain</td>
<td>1659</td>
</tr>
<tr>
<td>3</td>
<td>Greece</td>
<td>1637</td>
</tr>
<tr>
<td>4</td>
<td>Portugal</td>
<td>1632</td>
</tr>
<tr>
<td>5</td>
<td>Italy</td>
<td>1494</td>
</tr>
</tbody>
</table>

Average Annual Solar Irradiation

- Annual average sunshine duration: 7.2 h/day
- Feasible land area for PV investment: 4600 km²
- Total feasible PV power: 500 GWp
- Annual PV electricity generation capacity: 700 TWh

GW by 2016

- 19.3
- 5.5
Reasons to support renewables in Turkey

- **Security of supply, Use domestic sources**
- **Lower import dependency** *(less than 25% of total produced locally - 31 million TOE, 2014)*
- **Manage current account deficit** *(32.2 billion USD deficit - energy imports reached to 37.9 billion USD which is 18.3% of total imports, 2015)*
- **Meeting the target** - renewables’ share at least 30% in total electricity generation by 2023

For Turkey’s per capita household electricity consumption of 3.2 MWh, the EU average is 6.5 MWh per capita. 264 TWh consumed by 2015

**Turkish Electricity Market – Growth Potential**
The whole economically feasible hydropower potential (34 GW) of Turkey will be provided for generating electrical energy.

20,000 MW capacity of wind power plant will be in operation.

Minimum 3,000 MW of solar PV capacity will be reached.

Minimum 1,000 MWe geothermal will be implemented.

1,000 MWe installed capacity for biomass energy will be implemented.

30% electricity from renewables by 2023
Turkey Solar Market Outlook – Road to 5GW by 2023

STRONG POTENTIAL
with avg. annual irradiation of 1.7-2 MWh/m²
FIT at 13.3 cents/kWh for 10 years +
Local content FIT at 6.7 cents/kWh for 5 years

LAND CLASS IDENTIFICATION IS CRITICAL
Land should be ‘dry marginal agricultural land’
for ground-mounted installations

<table>
<thead>
<tr>
<th>UNLICENSED MARKET</th>
<th>LICENSED MARKET</th>
<th>MEGA PROJECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity Threshold</td>
<td>&lt; 1MW, &lt; 50 kW for rooftop</td>
<td>&gt; 1MW</td>
</tr>
<tr>
<td>Location</td>
<td>Based on DisCo capacity</td>
<td>Based on TEIAS capacity</td>
</tr>
<tr>
<td>Electricity sales</td>
<td>Spot market at FIT via authorized supply company</td>
<td>Spot market at FIT</td>
</tr>
<tr>
<td>FIT Application timeline</td>
<td>Apply to DisCo’s with no specific timeline</td>
<td>Apply to YEKDEM in October</td>
</tr>
<tr>
<td>Auction model</td>
<td>No auction</td>
<td>Reverse auction; applications in October</td>
</tr>
<tr>
<td>Local content</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Installed capacity (as of 2016 June)</td>
<td>562 MW</td>
<td>-</td>
</tr>
<tr>
<td>Pipeline (as of 2016 June)</td>
<td>Over 4 GW</td>
<td>600 MW</td>
</tr>
</tbody>
</table>

KONYA KARAPINAR
6,000 hectares for 4 GW
NIGDE BOR
2,500 hectares for 1.5 GW

6,99 ¢/kWh

- PV panel integration & structures: 0.8¢/kWh
- PV modules: 1.3 ¢/kWh
- PV cells: 3.5¢/kWh
- Inverter: 0.6¢/kWh
- Optical material: 0.5¢/kWh

Transfer of SPV shares is not possible until commercial operation
Regulatory Framework

MAIN LAWS FOR RENEWABLE ENERGY

• ELECTRICITY MARKET LAW (No: 6446) - 2013
  *Electricity Market Law No. 4628 (2001)*
• LAW ON UTILIZATION OF RENEWABLE ENERGY SOURCES FOR THE PURPOSE OF GENERATING ELECTRICAL ENERGY (Law No: 5346) - 2005

SECONDARY REGULATIONS FOR RENEWABLE ENERGY

• ELECTRICITY MARKET LICENSING REGULATION
• THE REGULATION FOR UNLICENSED GENERATION OF ELECTRICAL POWER IN THE ENERGY MARKET
• TECHNICAL REGULATION FOR EVALUATING LICENSE APPLICATIONS BASED ON WIND ENERGY GENERATION
• TECHNICAL REGULATION FOR EVALUATING LICENSE APPLICATIONS BASED ON SOLAR ENERGY GENERATION
• THE REGULATION ON COMPETITION FOR GRID CONNECTION RIGHTS FOR THE SOLAR AND WIND POWER GENERATION PLANTS (Tender Regulation)
• REGULATION FOR PRE-LICENSE WIND AND SOLAR MEASUREMENTS
• COMMUNIQUÉ ON MEASUREMENT STANDARDS FOR WIND AND SOLAR POWER PRE-LICENSE APPLICATIONS
Incentive for Renewables

- Feed-in-Tariffs, *(Günder’s Survey (245 participants); 76% - main leverage for PVS investments, 83% - PVS investments can not be realized without FiT)*
- Purchase guarantees,
- Connection priorities,
- Lower license fees, (Only 1% of licensing fee, Exemption to pay annual license fee for 8 years in operation)
- License exemptions for applications below 1 MW
- Various practical conveniences in project preparation and land acquisition.

Main Criteria that should be paid attention for solar project development;

- 1 MW solar plant capacity can be installed maximum in 20000 m².
- A solar power plant can not be installed on eligible agricultural lands (soil protected lands) and forestry.
100% exemption from Customs Duty and VAT

Priority Investment Incentive Scheme (Strategic Investment Incentives will apply if the investment amount is over 3 billion TL in any of the above investments)

Regional Investment Incentive Scheme (6 Regions)
# Incentives for Priority Investments

<table>
<thead>
<tr>
<th>Support</th>
<th>Regions: 1, 2, 3, 4, 5</th>
<th>Within OIZ in Region 5</th>
<th>In Region 6</th>
<th>Within OIZ in Region 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAT Exemption</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Custom Duty Exemption</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Tax Deduction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax Reduction Rate (%)</td>
<td>80</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Reduced Tax Rate (%)</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Rate of Contribution (%)</td>
<td>40</td>
<td>50</td>
<td>50</td>
<td>55</td>
</tr>
<tr>
<td><strong>Social Security Premium (SSP) Support for Employer's Share</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Support</td>
<td>7</td>
<td>10</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Cap for Support (% of Investment)</td>
<td>35</td>
<td>No limit</td>
<td>No limit</td>
<td>No limit</td>
</tr>
<tr>
<td>Land Allocation</td>
<td>✓</td>
<td>-</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td><strong>Interest Rate Support</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL Denominated Loans (points)</td>
<td>5</td>
<td>5</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>FX Loan (points)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Maximum Support (TL)</td>
<td>0-0-500K-600K-700K</td>
<td>700K</td>
<td>900K</td>
<td>900K</td>
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<tr>
<td>SSP Support for employee share (years)</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Income Tax Withholding Support (years)</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Incentive Instruments</td>
<td>Regions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAT Exemption</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customs Duty Exemption</td>
<td>II</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax Reduction</td>
<td>III</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax Reduction Rate (%)</td>
<td>IV</td>
<td></td>
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<tr>
<td>Reduced Tax Rate (%)</td>
<td>V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of Contribution to Investment (%)</td>
<td>VI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Security Premium Support (Employer’s Share)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support Period</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Limit for Support (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Allocation</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Interest Rate Support</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>TRY Denominated Loans (points)</td>
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<td></td>
</tr>
<tr>
<td>FX Loans (points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Support Amount (*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Security Premium Support (Employee’s Share)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income Tax Withholding Allowance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAT Refund</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Incentive Instruments**

- **VAT Exemption**: YES
- **Customs Duty Exemption**: YES
- **Tax Reduction**: 90%
- **Reduced Tax Rate**: 2%
- **Rate of Contribution to Investment**: 50%
- **Social Security Premium Support (Employer’s Share)**: 7 years (10 years for Region 6), 15 (No limit for Region 6)
- **Land Allocation**: YES
- **Interest Rate Support**: 5 points, 2 points
- **Maximum Support Amount**: TRY 50 million or 5% of fixed investment cost (TRY 700,000 for Priority Investments over TRY 3 billion)
- **Social Security Premium Support (Employee’s Share)**: 10 years (for investments in Region 6)
- **Income Tax Withholding Allowance**: 10 years (for investments in Region 6)
- **VAT Refund**: YES (for construction expenditures of the strategic investments over TRY 500 million)
Increased FITs included as part of 2010 law to provide more comprehensive RE support mechanism

Prior FIT levels insufficient to achieve targets

Differentiated by type

- Wind and hydro: USD Cent 7.3/kWh
- Solar and biomass: USD Cent 13.3/kWh
- Geothermal: USD Cent 10.5/kWh

Incentive tariffs apply for first ten years of commercial operation of plants commissioned by 31st December 2020

Subsequent FIT levels will be established by Cabinet of Ministers
Feed-in Tariffs

Support mechanism in the electricity market related secondary legislation:
• Payment of only 10% of the total licensing fee
• Exemption from payment of annual license fees for the first 8 years of operation
• Priority for system connection
• Exemption from being a balancing mechanism unit
• Purchasing option from the market up to 100% of the quantity inserted in the relevant license

* 10 years for plants to be commissioned until 31/12/2020
** Incentive for local content-5 years for plants to be commissioned until 31/12/2020
*** Before Law No: 6094, feed-in tariff was 5 - 5,5 €¢/kWh for all of the renewables (Law No:5346)
**** FITs are differentiated on a source basis. Additional FIT is provided for using local content.

<table>
<thead>
<tr>
<th>Power Source</th>
<th>Feed-in Tariff (US cents/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic</td>
<td>7,3</td>
</tr>
<tr>
<td>Wind</td>
<td>7,3</td>
</tr>
<tr>
<td>Geothermal</td>
<td>10,5</td>
</tr>
<tr>
<td>Biomass</td>
<td>13,3</td>
</tr>
<tr>
<td>Solar (PV)</td>
<td>13,3</td>
</tr>
<tr>
<td>Solar (CS)</td>
<td>13,3</td>
</tr>
</tbody>
</table>
In Turkey, renewable electricity production is mainly promoted through a guaranteed feed-in tariff mechanism. The Renewable Energy Support Mechanism’s feed-in tariff for renewable energy sources is between 7.3 – 13.3 $-cents/kWh for the first 10 years of operation.
## Bonus for local content

(Now 55 %, projected 100 % by 2017)

<table>
<thead>
<tr>
<th>Type</th>
<th>Feed-in Tariffs (USD Cent / kWh)</th>
<th>Production Made Domestically</th>
<th>Additional Feed-in Contribution (USD Cent / kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar (PV)</td>
<td>13,3</td>
<td>Panel structural mechanics construction</td>
<td>0,8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PV modules</td>
<td>1,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cells forming PV module</td>
<td>3,5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inverter</td>
<td>0,6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Material focusing solar irradiance onto PV module</td>
<td>0,5</td>
</tr>
<tr>
<td>Solar (CSP)</td>
<td>13,3</td>
<td>Radiation collection tube</td>
<td>2,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reflector surface plate</td>
<td>0,6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solar tracking system</td>
<td>0,6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mechanical components of the heat storage</td>
<td>1,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mechanical components steam generation</td>
<td>2,4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stirling engine</td>
<td>1,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solar panel structural mechanics</td>
<td>0,6</td>
</tr>
</tbody>
</table>
## Incentives other than feed-in tariffs for renewable energy investments

<table>
<thead>
<tr>
<th>Incentives within the Renewable Energy Law (No. 5346)</th>
<th>Assigning of land belonging to the Treasury and “land at the disposal of the state” to renewable energy projects. 85% discount in easement, usufruct, permit or lease fees for the first 10 years of operation.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Use of national parks, nature parks, natural protection areas, preservation forests, wildlife cultivation areas and special nature preservation areas with necessary permits.</td>
</tr>
<tr>
<td></td>
<td>Exemption from the compulsory 1% turnover payment for operating business on immovable assets of the Treasury.</td>
</tr>
<tr>
<td>Incentives within the Electricity Market Licensing Regulation (No. 24836)</td>
<td>99% exemption from licensing fee and annual license fees for the first 8 years of operation</td>
</tr>
<tr>
<td></td>
<td>Priority in system connection</td>
</tr>
<tr>
<td>Tax Incentives within the Cabinet Decree on State Aid Investments (No. 2009/15199)</td>
<td>VAT exemption for domestic equipment for Investment Support Certificate holders</td>
</tr>
<tr>
<td></td>
<td>VAT, Customs Tax, Resource Support Utilisation Fund payment exemptions in imports for Investment Support Certificate holders</td>
</tr>
</tbody>
</table>
Solar PV Industry in Turkey

- PV Module manufacturers 19 (over 1.500 MW production capacity yearly)
- Installers (EPC) over 100
- Installed capacity 1.014 MW (by January 2017)
- Costs around 0,8-1,0 (000) Euro/kWe (payback less than 8 years)
- Installed CSP 5 MW (solar tower with 500 heliostats)
- Parabolic collector producer (47 MW capacity yearly)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Installed</td>
<td>Number of</td>
<td>Installed</td>
</tr>
<tr>
<td></td>
<td>capacity</td>
<td>power plants</td>
<td>capacity</td>
</tr>
<tr>
<td></td>
<td>(MW)</td>
<td>(%)</td>
<td>(MW)</td>
</tr>
<tr>
<td>Fuel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil + Asfaltite + Naphta + Motorin</td>
<td>659.8</td>
<td>0.9</td>
<td>866.2</td>
</tr>
<tr>
<td>Hard coal + lignite</td>
<td>8.573.4</td>
<td>12.3</td>
<td>9.023.4</td>
</tr>
<tr>
<td>Imported coal</td>
<td>6.062.6</td>
<td>8.7</td>
<td>6.064.2</td>
</tr>
<tr>
<td>Natural gas + LNG</td>
<td>21.476.1</td>
<td>30.9</td>
<td>21.222.1</td>
</tr>
<tr>
<td>RES + waste</td>
<td>288.1</td>
<td>0.4</td>
<td>344.7</td>
</tr>
<tr>
<td>Multi fuels solid + liquid</td>
<td>667.8</td>
<td>1.0</td>
<td>653.0</td>
</tr>
<tr>
<td>Multi fuels liquid + natural gas</td>
<td>4.074.0</td>
<td>5.9</td>
<td>3.673.9</td>
</tr>
<tr>
<td>Geothermal</td>
<td>404.9</td>
<td>0.6</td>
<td>623.9</td>
</tr>
<tr>
<td>Hydraulic - reservoir</td>
<td>16.606.9</td>
<td>23.9</td>
<td>19.077.2</td>
</tr>
<tr>
<td>Hydraulic - river type</td>
<td>7.036.3</td>
<td>10.1</td>
<td>6.790.6</td>
</tr>
<tr>
<td>Wind</td>
<td>3.629.7</td>
<td>5.2</td>
<td>4.498.4</td>
</tr>
<tr>
<td>Solar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal (unlicensed)</td>
<td>56.5</td>
<td>0.1</td>
<td>82.1</td>
</tr>
<tr>
<td>Wind (unlicensed)</td>
<td>4.8</td>
<td>0.0</td>
<td>12.9</td>
</tr>
<tr>
<td>Solar (unlicensed)</td>
<td>40.2</td>
<td>0.1</td>
<td>248.8</td>
</tr>
<tr>
<td>Solar (unlicensed)</td>
<td></td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>69.519.8</td>
<td>0</td>
<td>1.126.0</td>
</tr>
</tbody>
</table>

Installed capacity - Renewables including all hydros – 42.7% by capacity 43.4% by capacity
- 71.9% by no. of plant 79.5% by no. of plant
### PV Development In Turkey - Projection

<table>
<thead>
<tr>
<th></th>
<th>Scenarios*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>2014</td>
<td>40</td>
</tr>
<tr>
<td>2015</td>
<td>400</td>
</tr>
<tr>
<td>2016</td>
<td>1000</td>
</tr>
<tr>
<td>2017</td>
<td>1900</td>
</tr>
<tr>
<td>2018</td>
<td>2800</td>
</tr>
<tr>
<td>2019</td>
<td>3800</td>
</tr>
<tr>
<td>2020</td>
<td>4800</td>
</tr>
</tbody>
</table>

* Capacities for new licensed applications and for energy specialized zones not included.
Global PV Market 2016

TOP PV MARKETS 2016

1st CHINA 34,54 GW
2nd USA 14,72 GW
3rd JAPAN 8,6 GW

75 GW Global

2016 THEORETICAL PV PRODUCTION

303 GW has been installed all over the world by the end of 2016

China is the world’s 1st PV market

24 countries had at least 1 GW of cumulative PV capacity at the end of 2016

16 countries installed at least 500MW each in 2016

SOLAR PV PER CAPITA 2016 Watt/capita

1st GERMANY 511
2nd JAPAN 336
3rd ITALY 322
Prosumers

Distributed Solar PV

Self-consumption, support to the grid, increased competition at retail level to unlock new business models, leverage of new forms of financing

One Technology

Centralized Solar PV

Grid injection, PPA, market design fit for variable generation

Prosumers

Producers

Source: SolarPower Europe
PV – New Installation by MW

Source: BSW-Solar
PV-Systems

PV-Large Scale Applications

Rooftop

Building Integrated PV

Family Houses

1-10 kWp

19%

Residential, Non Residential

10-100 kWp

15%

Industry > 100 kWp

36%

Market Share in 2015

<1%

Source: BSW
EUROPEAN SOLAR PV CUMULATIVE CAPACITY SEGMENTATION BY COUNTRY IN 2014

Source: SolarPower Europe
Global Capacity in Operation 2015

Global capacity in operation $[GW_{el}],[GW_{th}]$, and energy supplied $[TWh_{el}],[TWh_{th}]$, 2015

- Total capacity in operation $[GW_{th}],[GW_{el}]$ 2015
- Energy supplied $[TWh]$ 2015

- Solar Thermal Heat: 435
- Wind Power: 433
- Photovoltaic: 227
- Geothermal Power: 13
- Solar Thermal Power: 5
- Ocean Power: 1
- Tidal Power: 1

heat | power

Source: GUNDER

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY
• Solar Heating and Cooling Systems
• Solar Process Heat
• Thermal Energy Storage
• Solar District Heating
• Solar Architecture & Urban Planning
• Solar Renovation
• New Policy Targets in Regional Level
  – Financial Policies; New Supporting Mechanisms
  – New Laws and Regulations: Lift the current barriers, don’t create new ones!
  – Research and Technology Policies
  – Dissemination of Knowledge; Education & Training. Lessons should be learned from succesful countries (and others!)
  – Stronger Political Support
Pathway to RES Heating and Cooling

EU28 Sector’s shares on total generation (inner ring) & RES shares for each sector (outer) for 2014
From a technological point of view, by 2030 renewable heating and cooling technologies could supply over half of the heat used in Europe.

By 2050, RHC could be able to satisfy 100% of the European heating demand (biomass: 231 Mtoe, geothermal: 150 Mtoe, solar thermal: 133 Mtoe, heat pumps: 75 Mtoe).

Source: RHC Technology Platform
Trends for 2050

- Decarbonisation
- Decentralisation
- Smartness
  - Improvements in:
    - Metering
    - Function & yield control
    - Plug-and-Flow
    - Interconnectivity
- Demand reduction
- Building integration
  - Already existing for
    - New built
    - Large renovation
  - Pre-fabricated façades
- Hybrid solutions
  - Technologies
    - Ex: PVT
    - Ex: HP&ST
  - Sources
    - RES-H&C
    - RES-E
http://www.iea-pvps.org/index.php?id=4

Ongoing Tasks

**Task 1**: Strategic PV Analysis & Outreach

**Task 8**: Very large scale photovoltaic power generation systems in remote areas

**Task 9**: Deploying PV Services for regional development

**Task 12**: PV environmental health and safety

**Task 13**: Performance and Reliability of Photovoltaic Systems

**Task 14**: High Penetration of PV Systems in Electricity Grids

**Task 15**: Accelerating BIPV
http://www.iea-shc.org/tasks-current

Current Research Projects (Tasks)
The following tasks are currently being worked on by Operating Agents of the IEA Solar Heating and Cooling Programme:

Task 57 - Solar Standards and Certification
Task 56 - Building Integrated Solar Envelope Systems for HVAC and Lighting
Task 55 - Towards the Integration of Large SHC Systems into District Heating and Cooling (DHC) Network
Task 54 - Price Reduction of Solar Thermal Systems
Task 52 - Solar Energy and Energy Economics in Urban Environments
Task 51 - Solar Energy in Urban Planning
Task 46 - Solar Resource Assessment and Forecasting
Low Hanging Fruits – Energy Efficiency

..most rapid pay-back in CO2 reduction
Why is Energy Efficiency an Issue?

Energy Efficiency (EE) - Utilisation of energy in the most *cost effective* way to carry out an activity or a process whereby waste energy is minimised and overall consumption of primary energy resources reduced.

In essence, **same or more with less energy**

Drivers of Energy Efficiency:

- Rising energy prices
- Energy Security
- Climate Change
- Green Jobs

**National Energy Efficiency Action Plans**
Why is Energy Efficiency an Issue?

Efficiency gains can contribute most to emissions reductions

World energy-related CO₂ emissions abatement in the 450 Scenario relative to the New Policies Scenario

- Efficiency: 72% (2020), 44% (2035)
- Renewables: 17% (2020), 21% (2035)
- Biofuels: 2% (2020), 4% (2035)
- Nuclear: 5% (2020), 9% (2035)
- CCS: 3% (2020), 22% (2035)

Total (Gt CO₂): 2.5 (2020), 14.8 (2035)

Energy efficiency measures – driven by strong policy action across all sectors – account for 50% of the cumulative CO₂ abatement over the Outlook period
EE & RE Synergies

- Twin Pillars of Sustainable energy: the more efficiently energy services are delivered, the faster renewable energy can be deployed
- RE technologies are mostly suited for distributed purposes thereby reducing lost in transmission and transport
- Efficient Building designs that utilise passive solar heat and light reduce their energy consumption
- Savings from EE improvements can be used to finance RE sources such as PV
- The more you reduce the energy demand of an industry, the easier it is to deploy renewable energy within that industry premises
Solution

• Change the way we generate energy to sustainable forms
• Change our energy usage behavior to conserve more energy, conservation
• Reduce the need with most efficient solutions: insulation, daylighting, etc.
• Improve our technology to increase energy efficiency
• and many more…
The German «Energiewende» means fundamentally changing the power system

### Gross electricity generation 1990, 2016 and 2050

<table>
<thead>
<tr>
<th>Year</th>
<th>Total TWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>500</td>
</tr>
<tr>
<td>2015*</td>
<td>600</td>
</tr>
<tr>
<td>2050</td>
<td>700</td>
</tr>
</tbody>
</table>

- **Renewables**
- **Hard Coal**
- **Nuclear**
- **Natural Gas**
- **Lignite**
- **Others**

### Key Aspects

**Phase out of Nuclear Power**
Gradual shut down of all nuclear power plants until 2022

**Reduction of Greenhouse Gas Emissions**
Reduction targets below 1990 levels:
- 40% by 2020; - 55% by 2030; - 70% by 2040;
- 80% to - 95% by 2050

**Development of renewable energies**
Share in power consumption to increase to:
- 40 - 45% in 2025;
- 55 - 60% in 2035;
- ≥ 80% in 2050

**Increase in efficiency**
Reduction of power consumption compared to 2008 levels:
- 10% in 2020;
- 25% in 2050

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AGEB (2016), BReg (2010), EEG (2014), own calculations  * preliminary
Thank you for your attention...

Dr. Kemal Gani Bayraktar
bayraktar@izocam.com.tr / info@gunder.org.tr