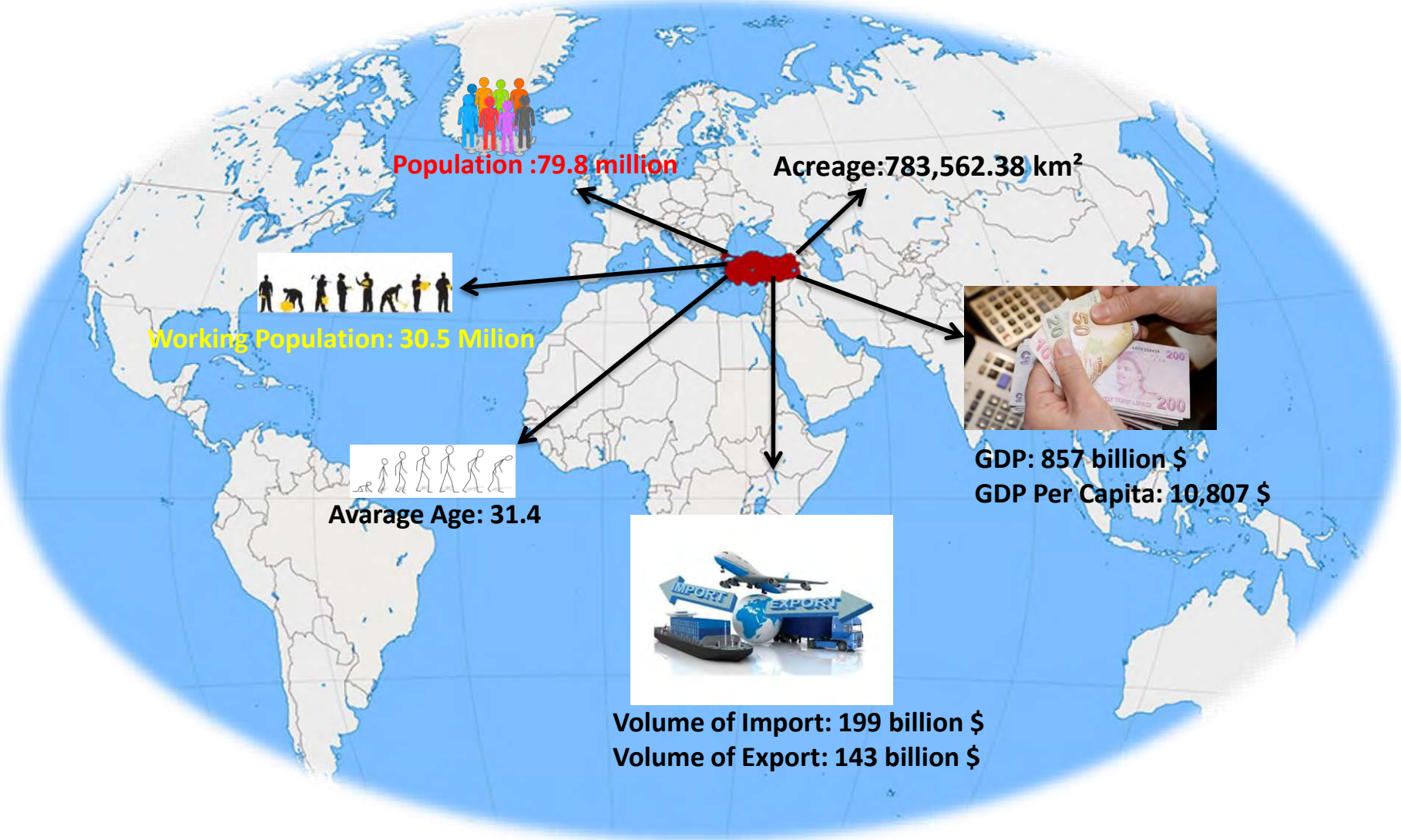


ROOFTOP SOLAR PV IN TURKEY | REGULATORY SUPPORT

Solar Knowledge Exchange 2019

Dilan Kavruk, Solar Energy Group Coordinator
Directorate General of Energy Affairs
Ministry of Energy, Turkey

OVERVIEW OF TURKEY

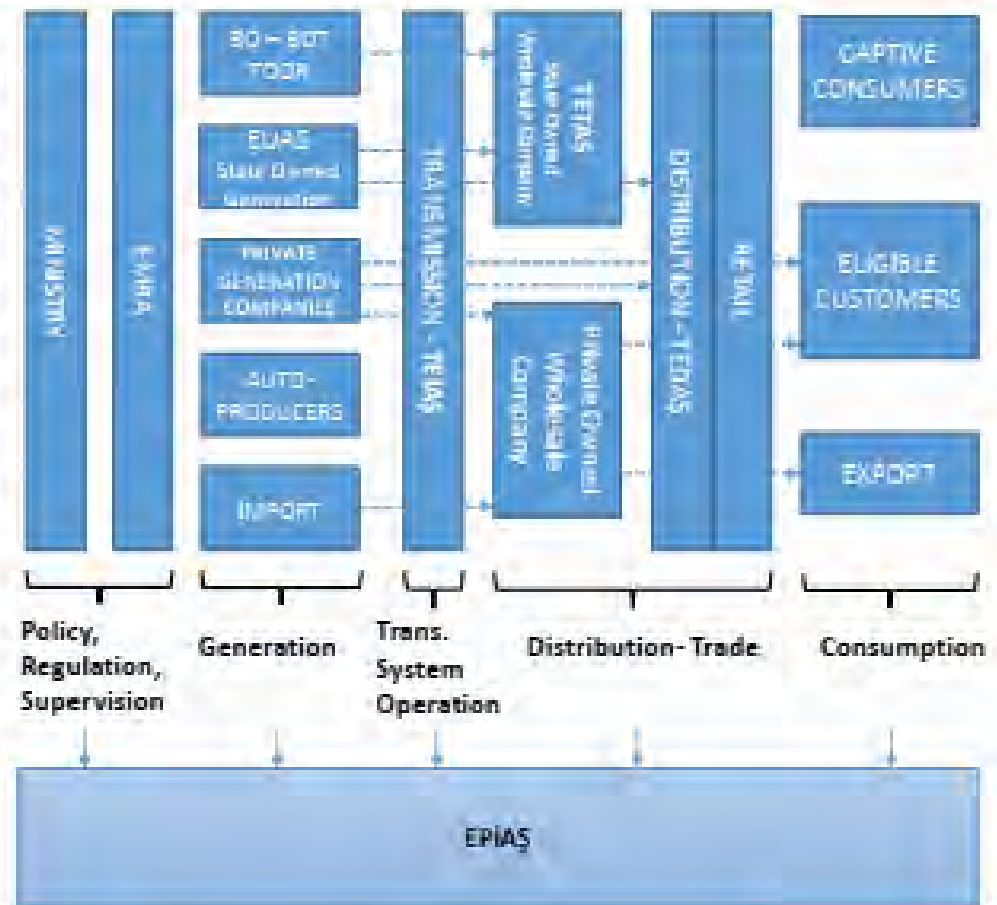


THE STRUCTURE OF ELECTRICITY SECTOR

► The 2001 EML provided the legal foundation. EMRA was established under the EML as an electricity market regulator and was soon renamed as the Energy Market Regulatory Authority as its functions were extended to cover the natural gas, liquefied petroleum gas (LPG), and petroleum markets.

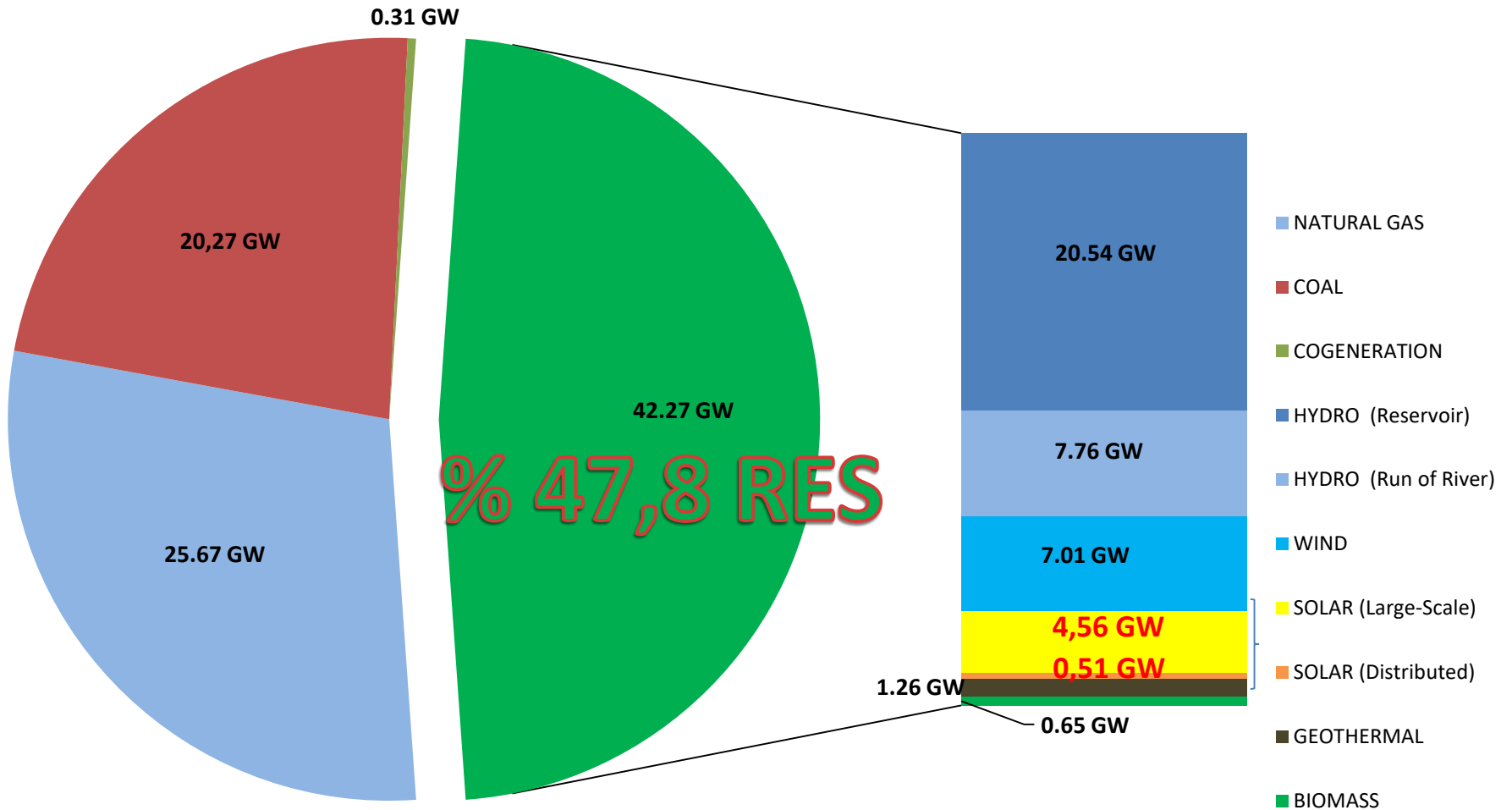
► EMRA prepared the secondary legislation necessary for

- ❖ Licensing,
- ❖ Tariffs of Regulated activities,
- ❖ Transmission and distribution grid codes,
- ❖ Market opening,
- ❖ Market rules,
- ❖ Procedures,
- ❖ Balancing and settlement.





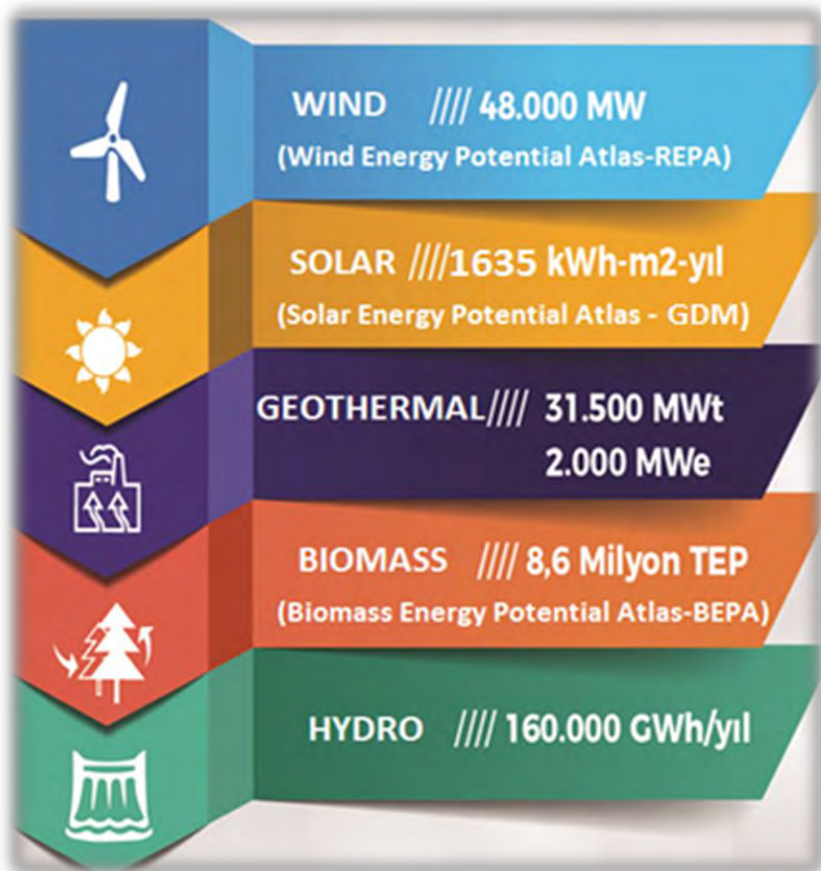
INSTALLED CAPACITY



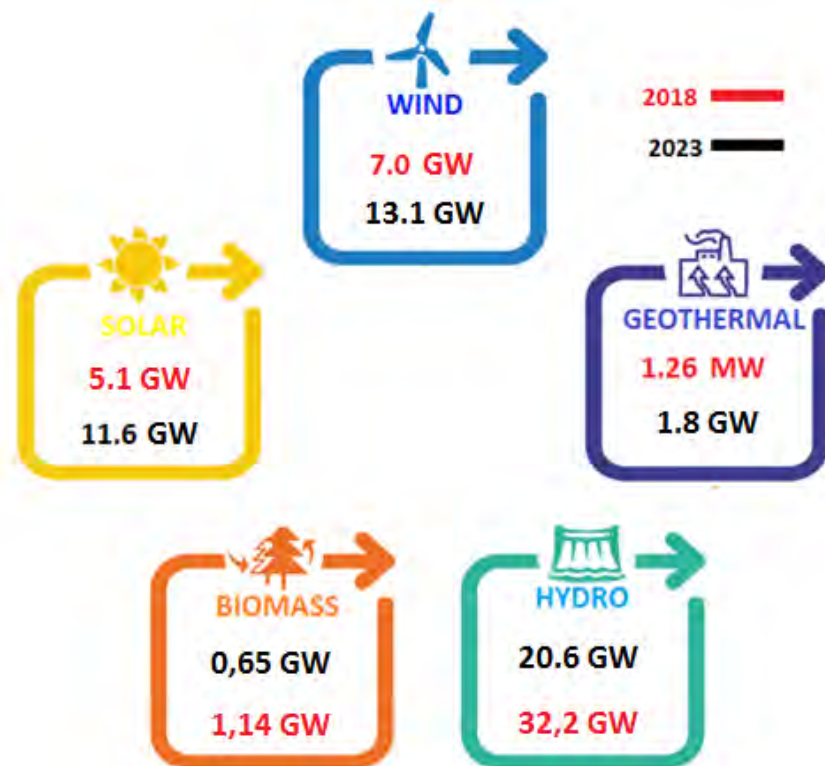
TOTAL CAPACITY: 88.5 GW (End of 2018)

RENEWABLE ENERGY in TURKEY

POTENTIAL

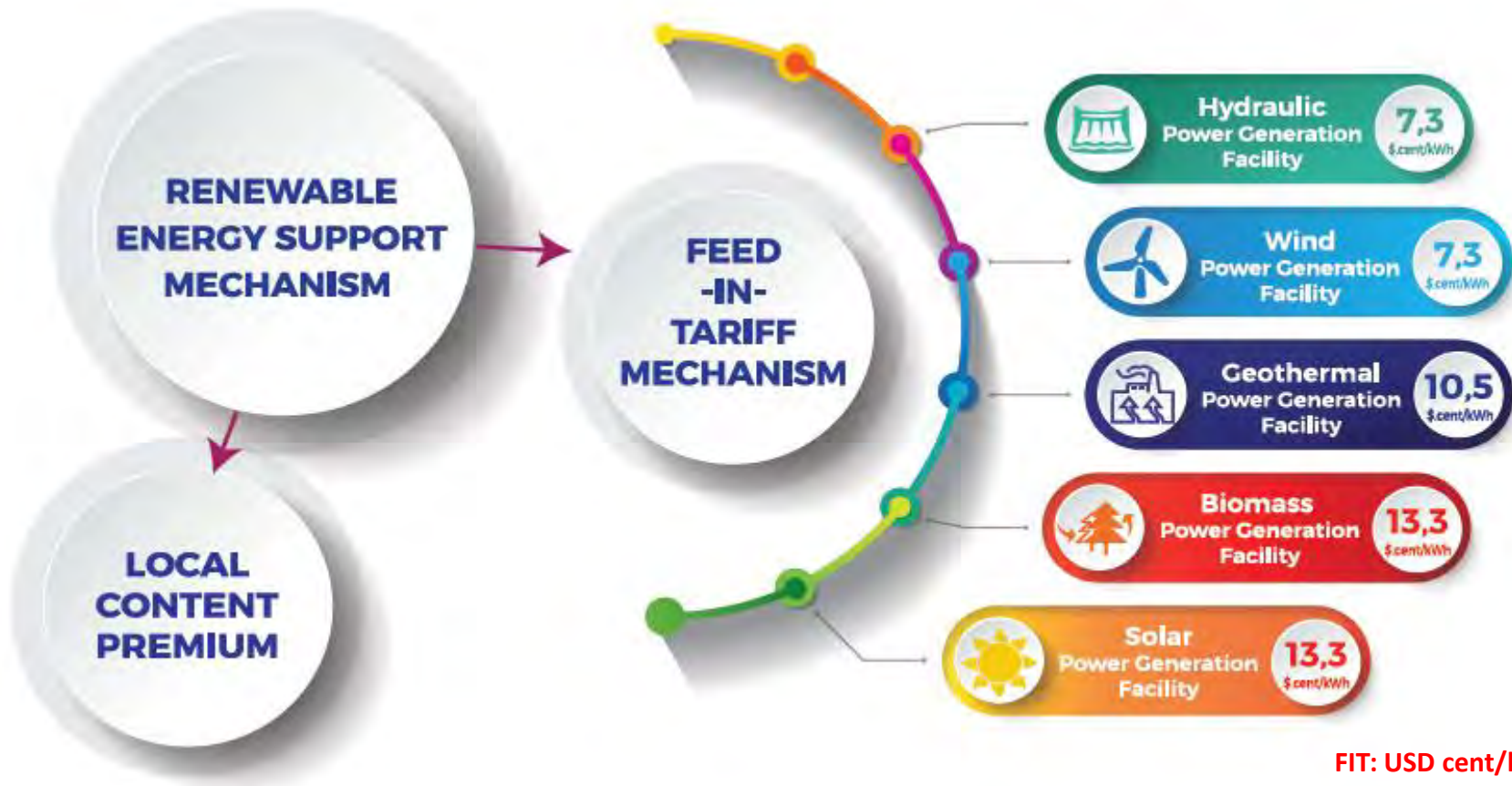


TARGET



At least 2/3 of Production of Electricity from RES in 2023

RENEWABLE ENERGY FIT SUPPORT MECHANISM

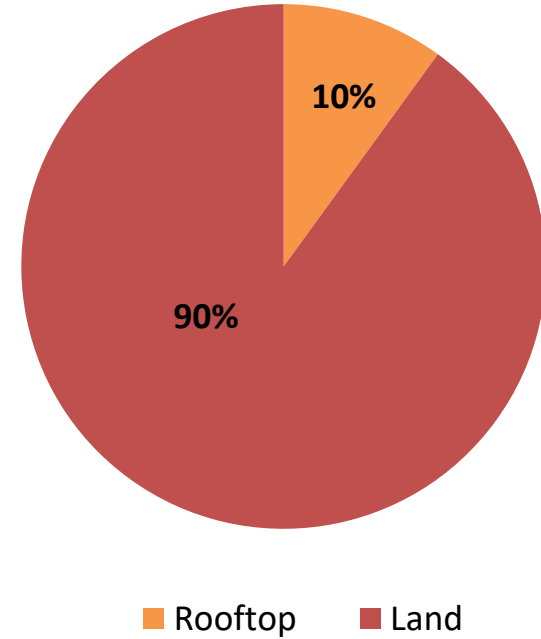
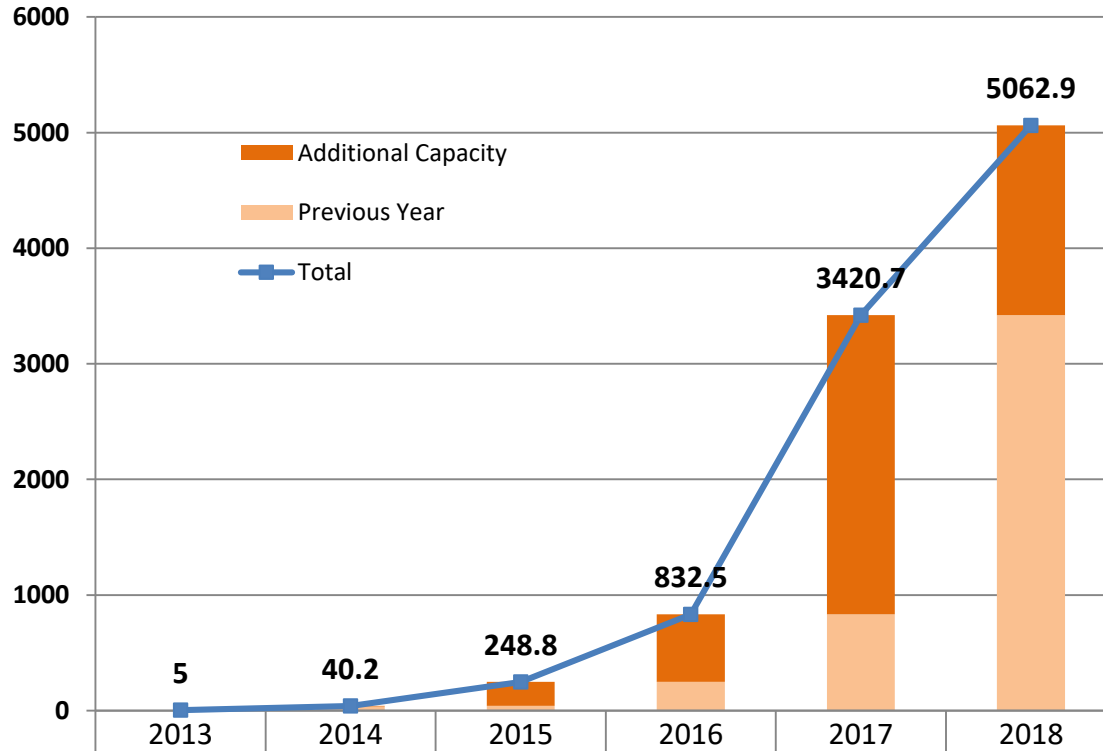


FIT: USD cent/kWh



SOLAR ENERGY PROGRESS

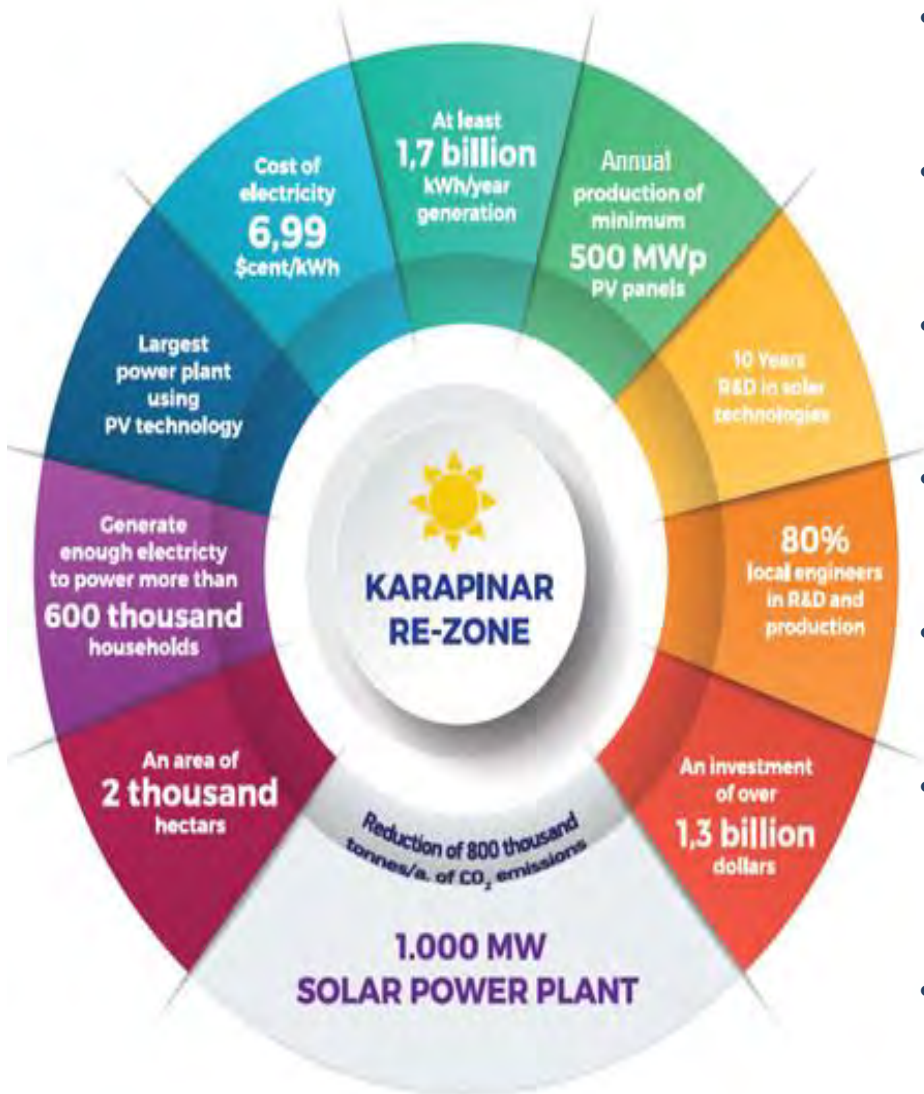
Installed Capacity (MW)



| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---------------------|------|------|-------|-------|--------|--------|
| Additional Capacity | 0 | 5 | 208.6 | 583.7 | 2588.2 | 1642.2 |
| Previous Year | 5 | 35.2 | 40.2 | 248.8 | 832.5 | 3420.7 |
| Total | 5 | 40.2 | 248.8 | 832.5 | 3420.7 | 5062.9 |



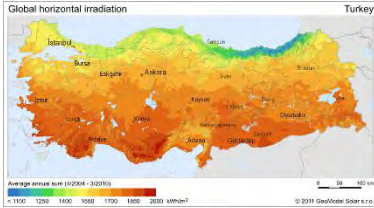
SOLAR ENERGY RE-ZONE



- Karapınar Re-Zone is a single 2000 hectar land.
- Total capacity is in the contract is **1000 MWe**
- All permissions are taken by government, ready for installation,
- 24-month pre-license and a 30-year generation license
- Electricity purchasing price is valid for 15-year period. (6,99 USD cent/kWh)
- Annual Local PV Panel production capacity is 500 MW from Ingot production
- Minimum %60 of local content for first 500 MW, %70 for second 500 MWe.
- %80 local engineer in R&D and production



SOLAR MARKET OUTLOOK



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

| | UNLICENSED MARKET | LICENSED MARKET | MEGA PROJECTS |
|---|--|--|--|
| Capacity Threshold | < 1MW, < 10 kW for rooftop | > 1MW | > 1MW |
| Location | Based on DisCo capacity | Based on TEIAS capacity | Renewable Energy Supply Zones |
| Electricity sales | Spot market at FIT via authorized supply company | Spot market at FIT | Spot market at FIT after time of agreement |
| FIT Application timeline | Apply to DisCo's with no specific timeline | Apply to YEKDEM in October | Already defined in ToR of auction |
| Auction model | No auction | Reverse auction; applications in October | Reverse auction |
| Local content | | Extra FIT | Mandatory |
| Installed capacity (as of 2018 December) | 4986 MW | 82 | - |
| Pipeline (as of 2018 December) | Nearly 1 GW | 378 MW | 1000 MW |

- 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



ROOFTOP SOLAR MARKET POTENTIAL

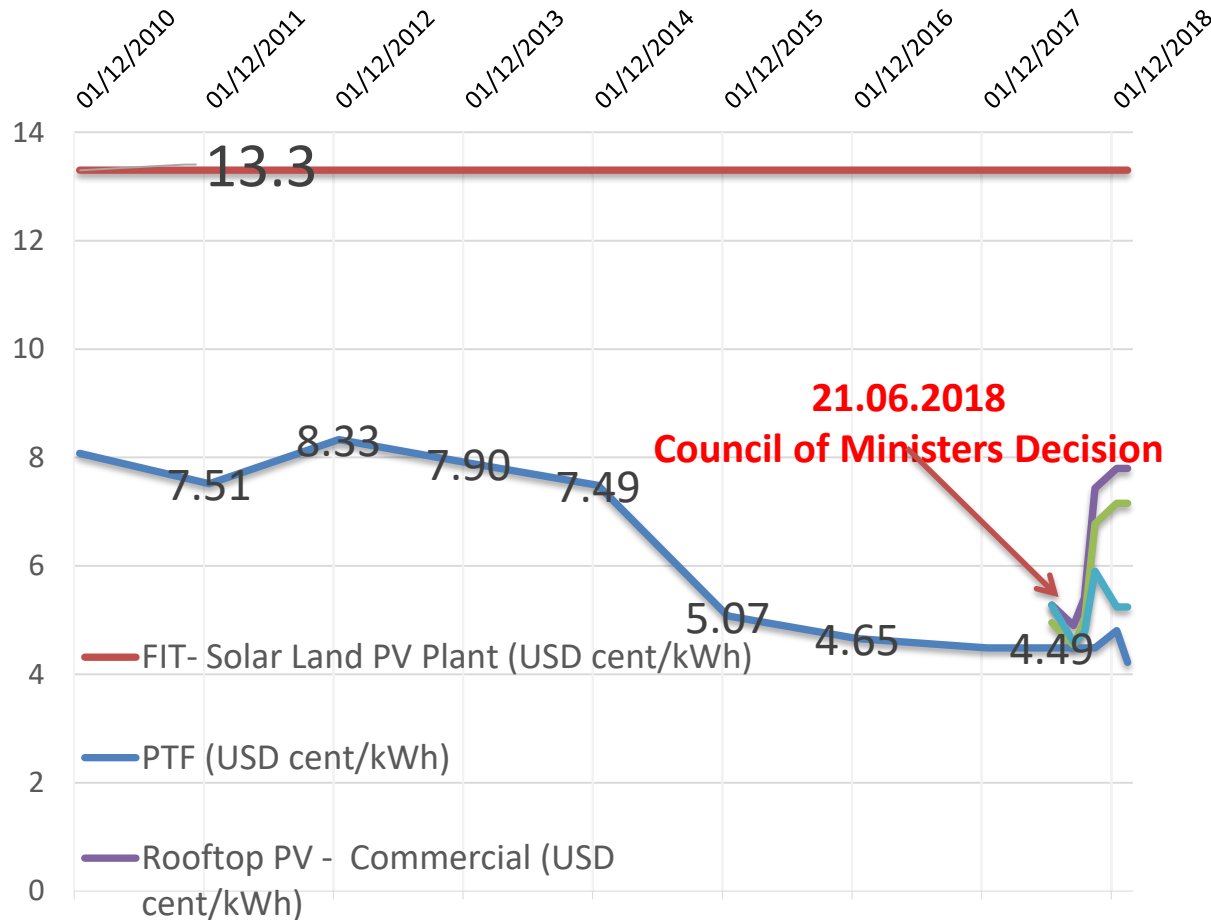


Tosçelik Steel Tubes and Pipe Factory RSPV ,
Osmaniye/TURKEY - 2017
Installed Capacity : 10 MW (1st in Europe, 5th in the world)

| RSPV Sectors | Grid Capacity for RSPV (MW) | Income Level - Impact Factor | Creditworthiness - Impact Factor | RSPV Market Potential (MW) |
|---|-----------------------------|------------------------------|----------------------------------|----------------------------|
| Residential: Single-family | 764 | 0.5 | 0.8 | 306 |
| Residential: Multi-family | 2,519 | 0.3 | 0.5 | 378 |
| <i>Residential: Total</i> | <i>3,283</i> | | | <i>683</i> |
| Commercial | 1,488 | 1 | 1 | 1,488 |
| Industrial | 1,523 | 1 | 1 | 1,523 |
| <i>Commercial & Industrial: Total</i> | <i>3,011</i> | | | <i>3,011</i> |
| Public | 291 | 0.7 | 0.8 | 163 |
| <i>Total (MW)</i> | <i>6,585</i> | | | <i>3,858</i> |

Estimated Installed Capacity for RSPV in next ten years, WB 2017

SOLAR ENERGY SUPPORT MECHANISM



Until mid 2018, FiT was 13.3 USD cent/ kWh (land-rooftop)

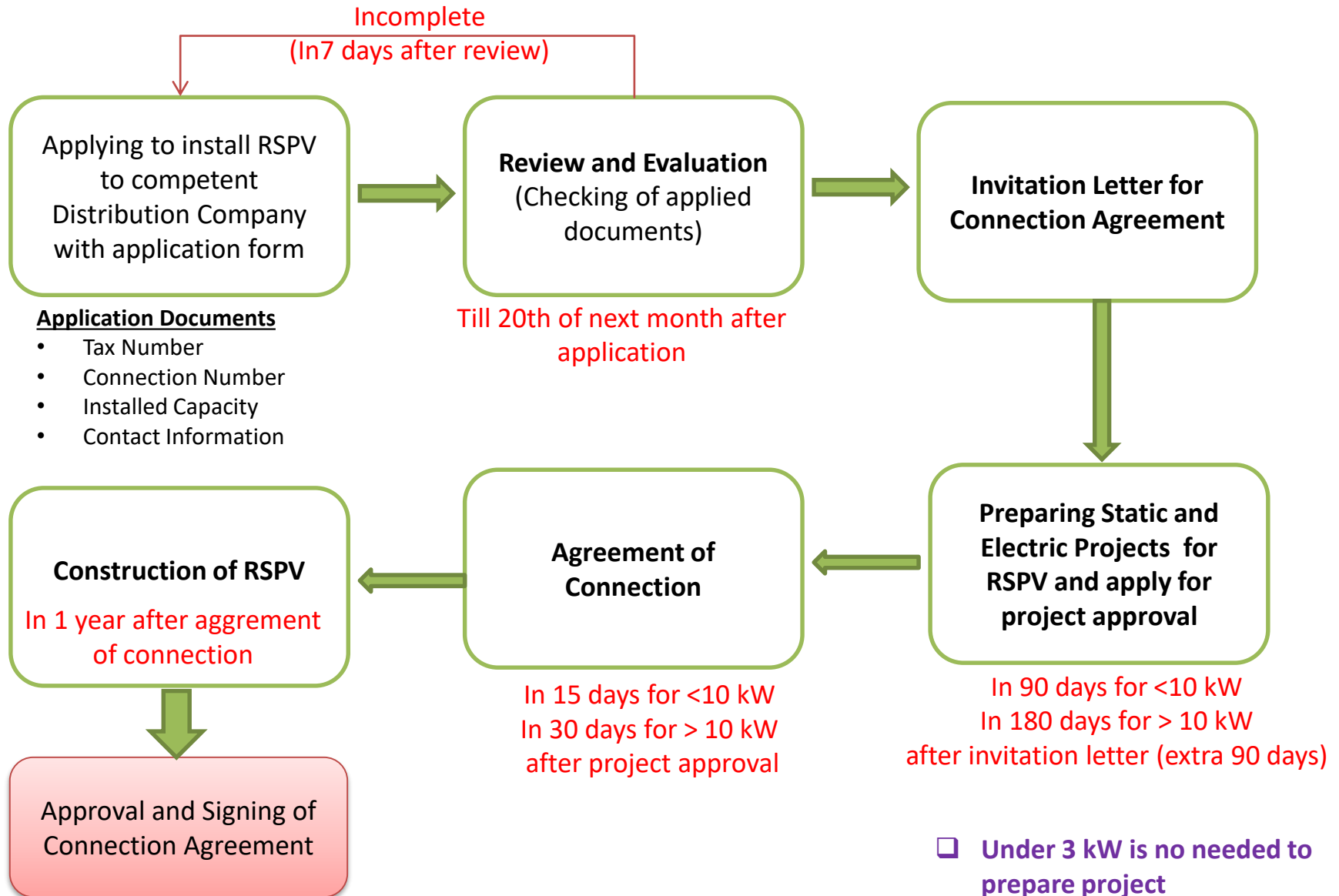
In order to incentivize self consumption;
 -In June 2018, the tariff for the rooftop productions has been equilized to the consumer tariff (exc taxes)
 -Limited to contractual installed capacity of the consumer

Consumer tariff for Distribution System excluding taxes (Turkish Liras; kr/kWh)

| | 06/2018 | 08/2018 | 09/2018 | 10/2018 | 01/2019 |
|-------------------------|---------|---------|---------|---------|---------|
| Rooftop PV - Industry | 22.98 | 26.47 | 31.60 | 39.63 | 38.09 |
| Rooftop PV - Commercial | 24.47 | 28.52 | 34.33 | 43.48 | 41.50 |
| Rooftop PV - Residence | 24.47 | 26.73 | 30.27 | 34.53 | 27.91 |



APPLICATION PROCESS FOR RSPV



THANK YOU

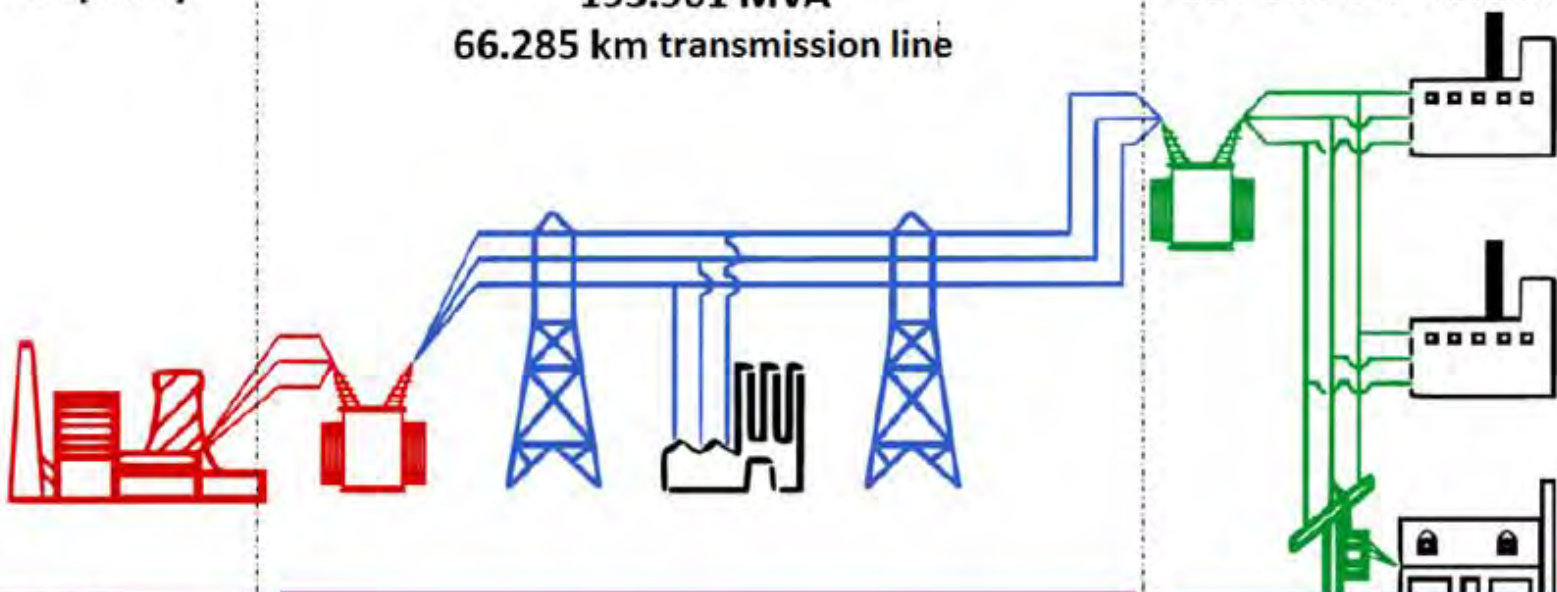
dkavruk@enerji.gov.tr

THE SIZE OF ELECTRICITY SECTOR

88.5 GW
Install Capacity

1234 substations
193.961 MVA
66.285 km transmission line

1.128.559 km line
154.319 MVA substation



60.000
employment

10.000 employment

100.000 employment

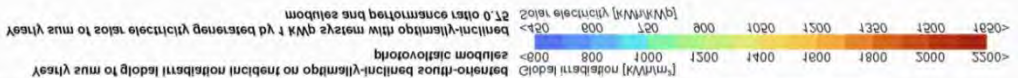
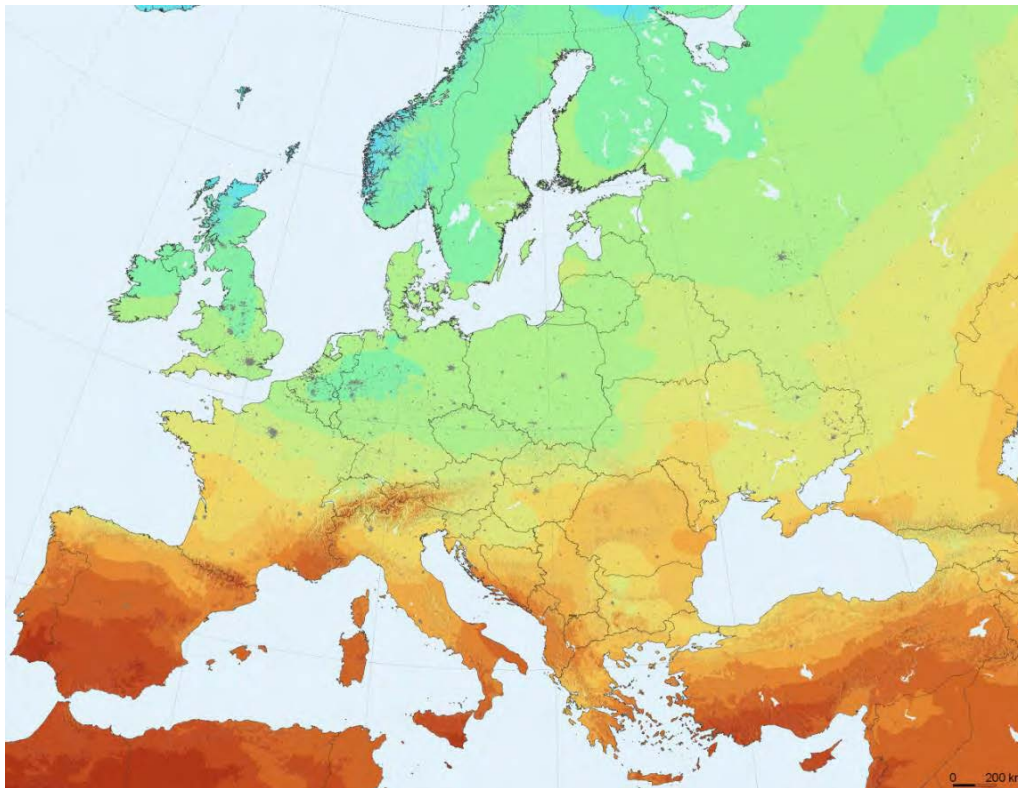
Power Generation

Transmission

Distribution

SOLAR POTENTIAL

Solar Energy Potential in Europe

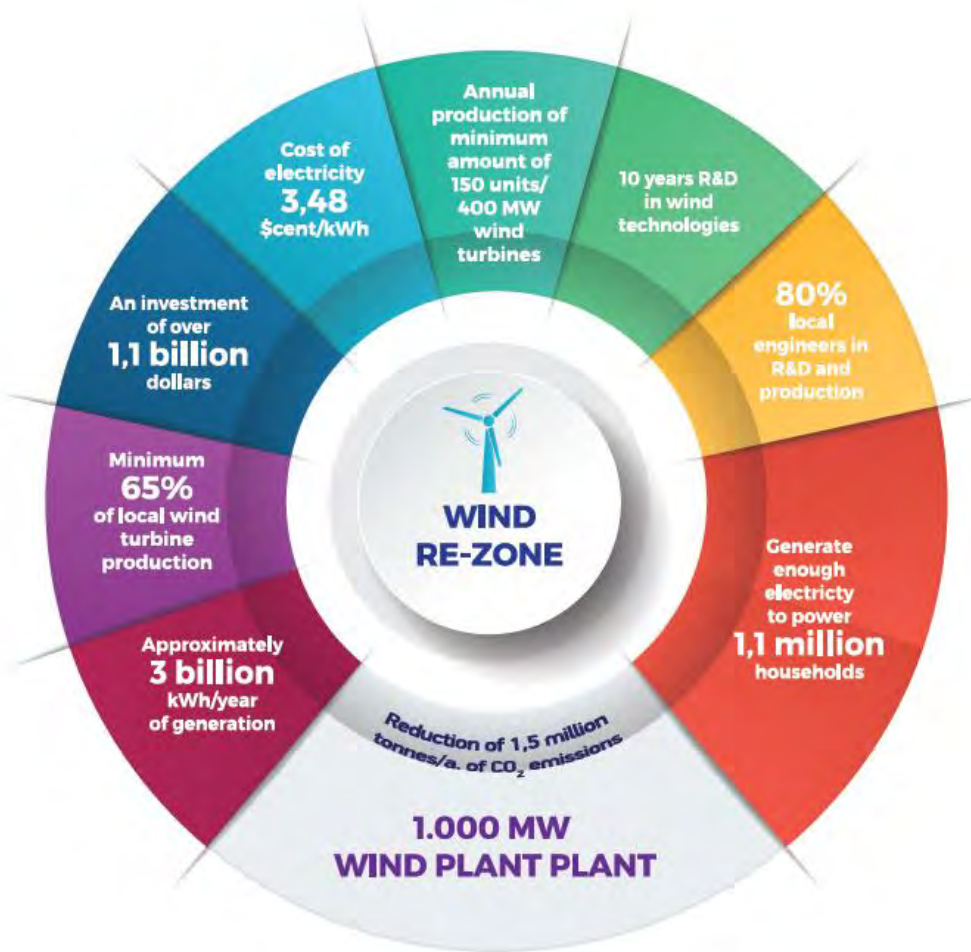


Average Annual Solar Irradiation

| # | Country | GHI (kWh/m ²) |
|---|----------|---------------------------|
| 1 | Spain | 1659 |
| 2 | Greece | 1637 |
| 3 | Turkey | 1635 |
| 4 | Portugal | 1632 |
| 5 | Italy | 1494 |

| | |
|---|----------------------|
| Annual average sunshine duration | 7.2 h/day |
| Feasible land area for PV investment | 4600 km ² |
| Total feasible PV power | 500 GWp |
| Annual PV electricity generation capacity | 700 TWh |

WIND ENERGY RE-ZONE



- 5 different region, total capacity is **1000 MWe** (permissions are taken by investor)
- 24-month pre-license and a 30-year generation license
- Electricity purchasing price is valid for 15-year period. (**3,48 USD cent/kWh**)
- Minimum %65 of local wind turbine production
- Annual Wind turbine production capacity is 150 units/400 MW
- %80 local engineer in R&D and production