

**The Eighth Executive Training Programme
for Young Energy Professionals:
Visegrad+ Session
Krakow, Poland; May 2016**

Eurasian Energy Security and Governance Challenges in Light of COP21

Adonai Herrera-Martínez
Senior Manager, Energy Efficiency and Climate Change
European Bank for Reconstruction and Development (EBRD)



European Bank
for Reconstruction and Development

Greenhouse Gas Historical Emissions

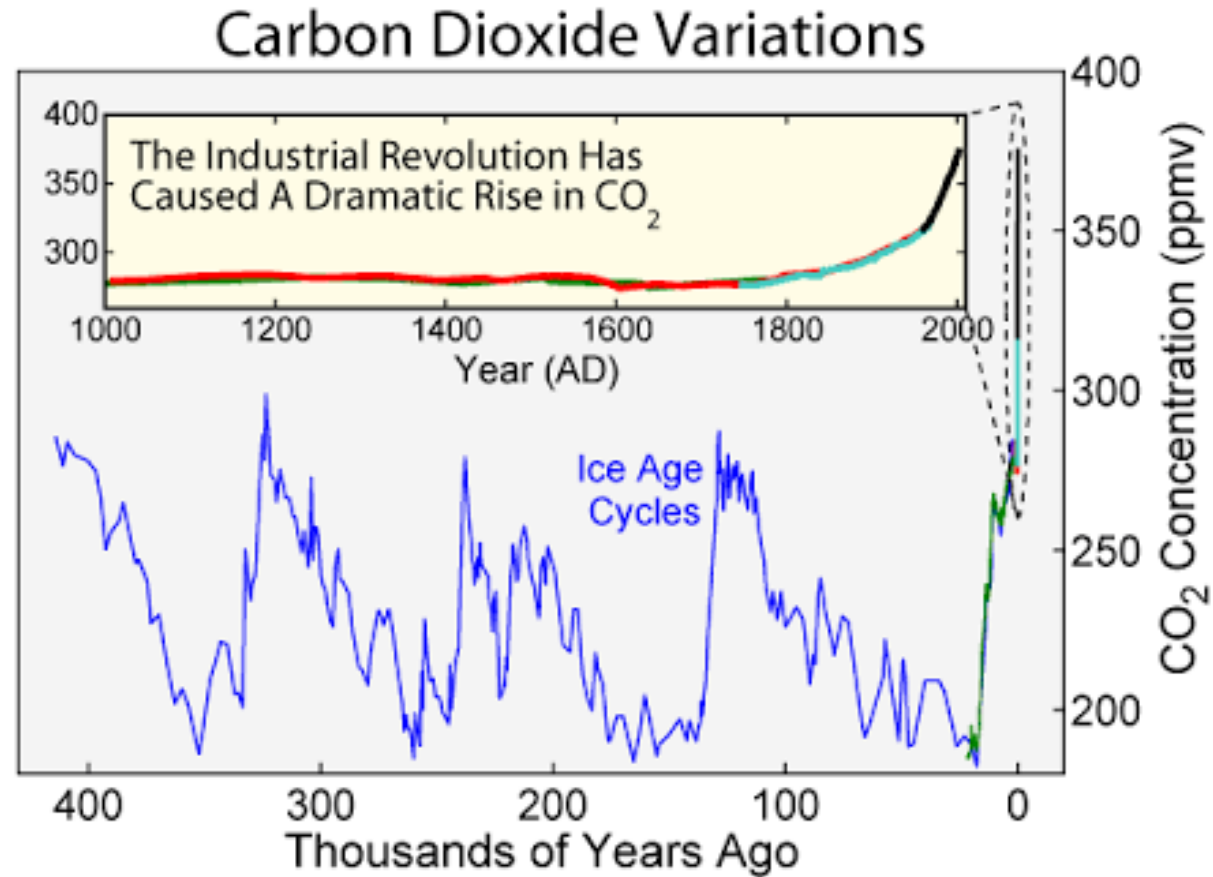
Natural vs. Anthropogenic



European Bank
for Reconstruction and Development

Current atmospheric $\text{CO}_{2\text{eq}}$ concentration amounts to **400 parts per million (ppm)** up from **350 ppm in 1990**

In 2015, over **35×10^9 tons of $\text{CO}_{2\text{eq}}$** were emitted globally, equivalent to **circa 4.4 ppm** in a single year



Global Warming Scenarios

Probabilistic Forecasts based on Historical data



European Bank
for Reconstruction and Development

'Probabilities' (in %) of exceeding a temperature increase as a function of CO₂ PPM

CO2 concentration (ppm)	2°C	3°C	4°C	5°C	6°C	7°C
450	78	18	3	1	0	0
500	96	44	11	3	1	0
550	99	69	24	7	2	1
650	100	94	58	24	9	4
750	100	99	82	47	22	9

Source: Hadley Centre; from Murphy et al. 2004
From: Stern Report

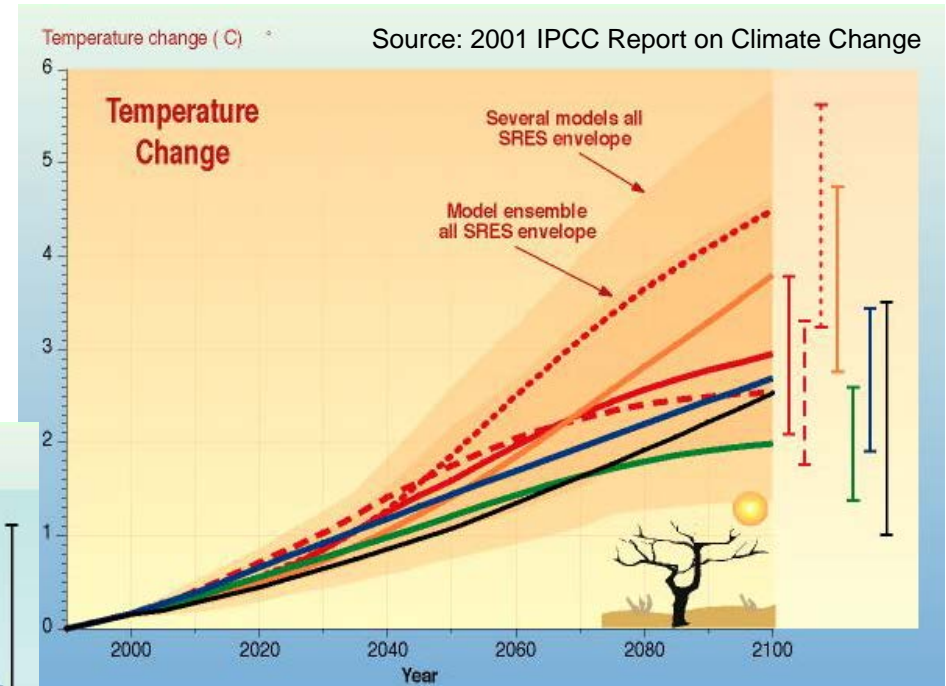
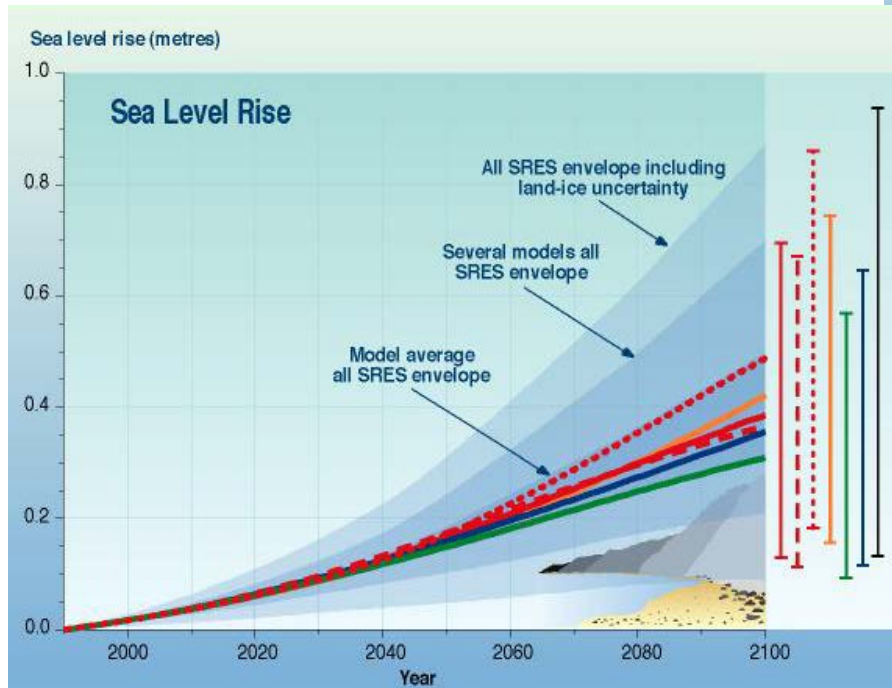
Impact of Climate Change

Implication of inaction in the foreseeable future



European Bank
for Reconstruction and Development

Different global temperature scenarios for the next century...



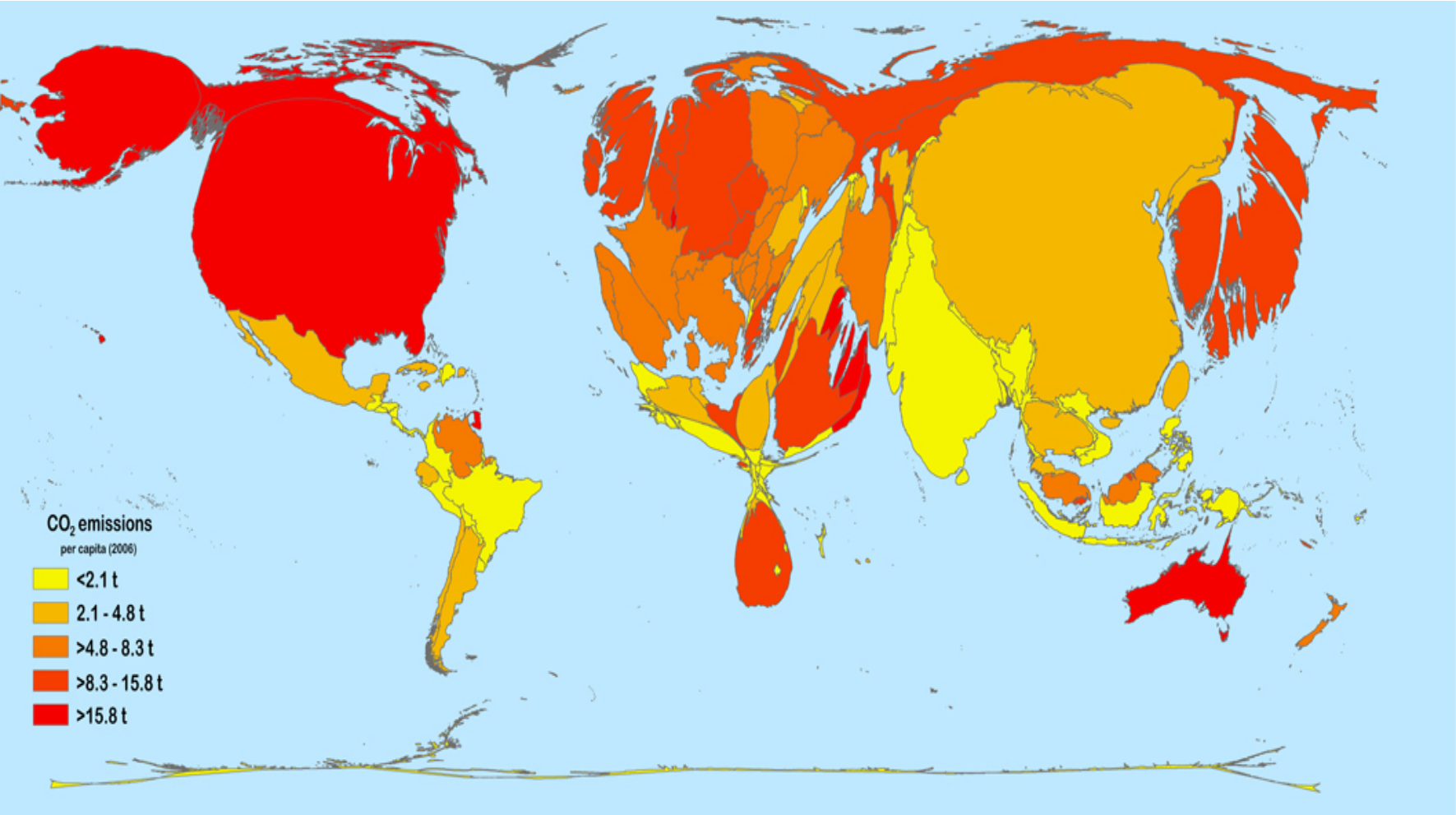
... propose disturbing outcomes for present and future generations

Global CO₂ Emissions

The Equity Issue: per capita emission and its trends



European Bank
for Reconstruction and Development



The challenge

- Sets the goal of holding the increase in global temperature to ‘well below’ 2°C, with effort towards achieving 1.5°C;
- Stresses the need to increase countries’ ability to adapt to the adverse impacts of climate change; and
- Aims to mobilize the massive flows of finance that will be needed to set the world on a pathway to low greenhouse gas (GHG) emissions and climate-resilient development.
- A long-term goal for GHG emissions which should peak ‘as soon as possible’ and reduce rapidly to net zero ‘in the second half of this century’
- A framework which includes transparent accounting and 5-yearly ‘stock-taking’ reviews of progress, to drive forward the national climate action plans which have been submitted by 187 countries, including all of the world’s major economies.

Financing

- Climate finance of at least \$100bn per annum by 2020 will flow from developed to developing countries, with a further increase to be agreed in 2025
- Co-operative approaches between countries and a new crediting mechanism are allowed for, raising the prospect of future linkages between national carbon markets to achieve GHG reductions at least cost.

The change must be focused on the Energy Sector

- Renewables will become a growing source of power, backed by quotas and targets, driven by record levels of investment, and benefitting from increased economies of scale
- Investment in smart grids and storage will ramp up in an effort to integrate fluctuating supplies of renewable power and deliver efficiencies.
- Coal power will become increasingly marginalized in the 34 OECD countries.
- Gas will become the default source of power, but with policy forcing greater controls on upstream methane leakage.
- Government funding will be needed for early carbon dioxide capture and storage (CCS) demonstrators.

Targets for 2030

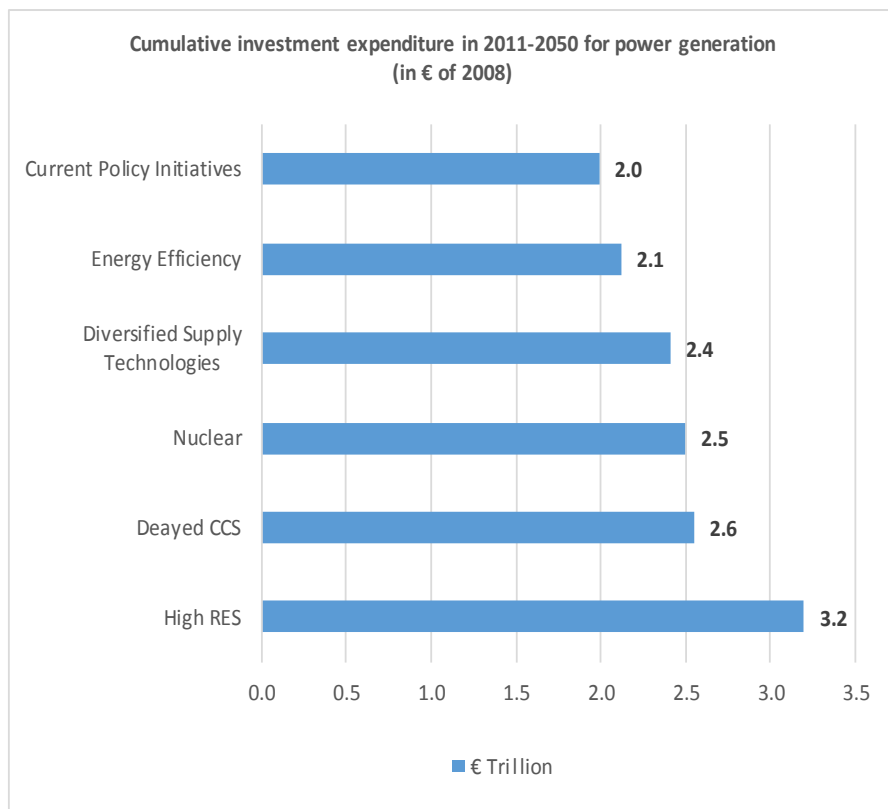
- A 40% cut in greenhouse gas emissions compared to 1990 levels
- At least a 27% share of renewable energy consumption
- At least 27% energy savings compared with the business-as-usual scenario

2050 Energy strategy

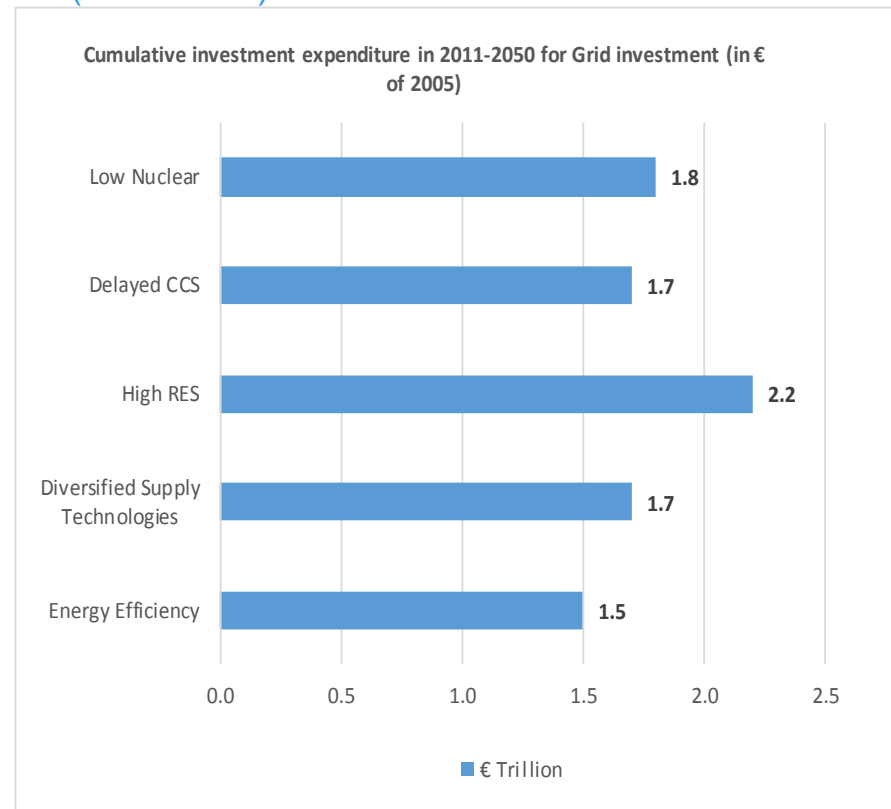
- Decarbonisation
- Higher capital expenditure and lower fuel costs
- Electricity plays an increasing role
- Electricity prices will decline since 2030
- Energy savings: key driver
- RES rises substantially
- Carbon capture and storage has to play a pivotal role
- Nuclear energy will provide a relevant contribution
- Decentralisation and centralised systems increasingly interact

Energy transition in Europe

Forecast Investment: power generation (2011-2050)



Forecast Investment: grid (2011-2050)



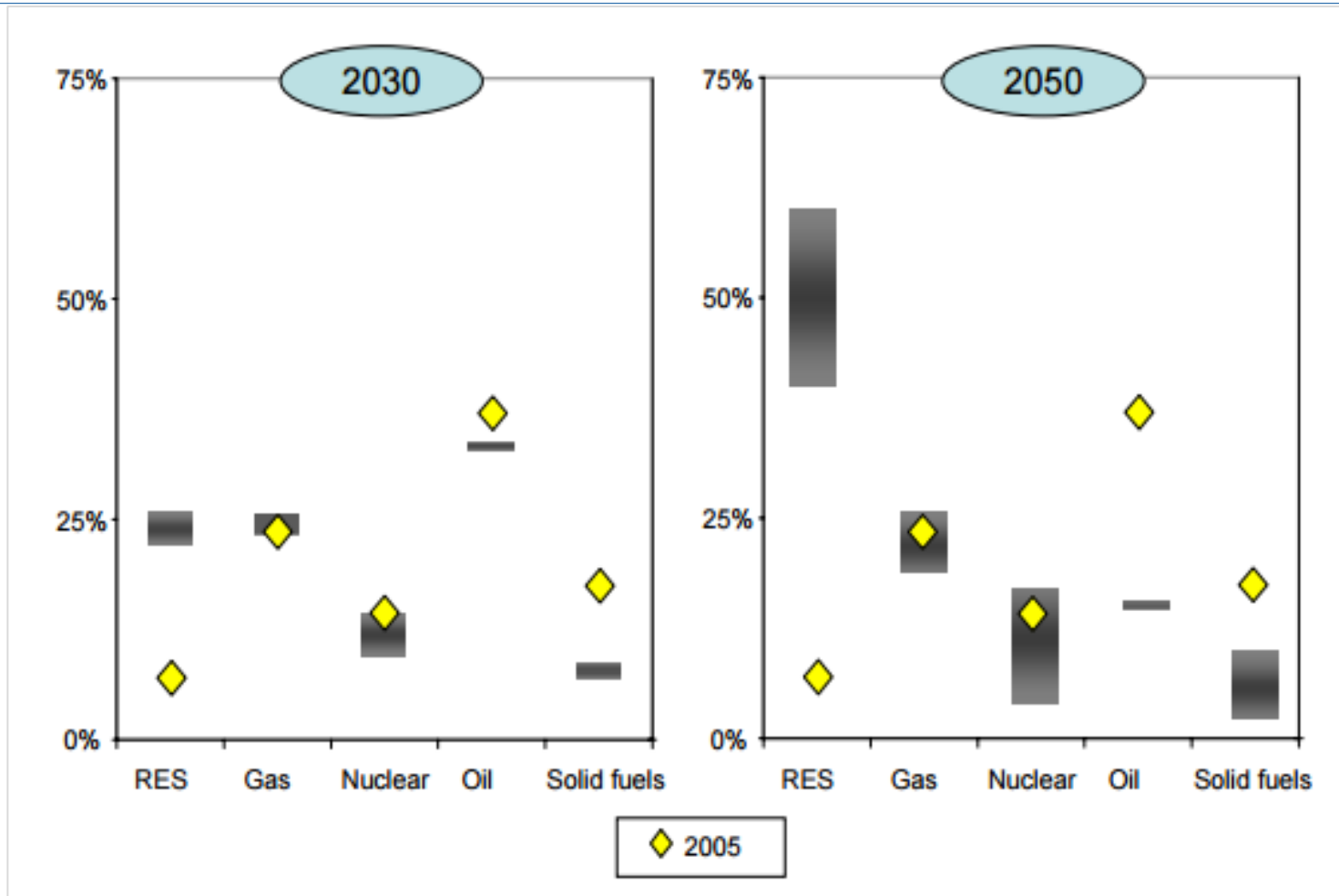
Source: Impact Assessment Accompanying the document Energy Roadmap 2050

(COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS)

Energy transition in Europe



European Bank
for Reconstruction and Development



EU Decarbonisation scenarios - 2030 and 2050 range of fuel shares in primary energy consumption compared with 2005 outcome (in %)

Energy transition in Europe

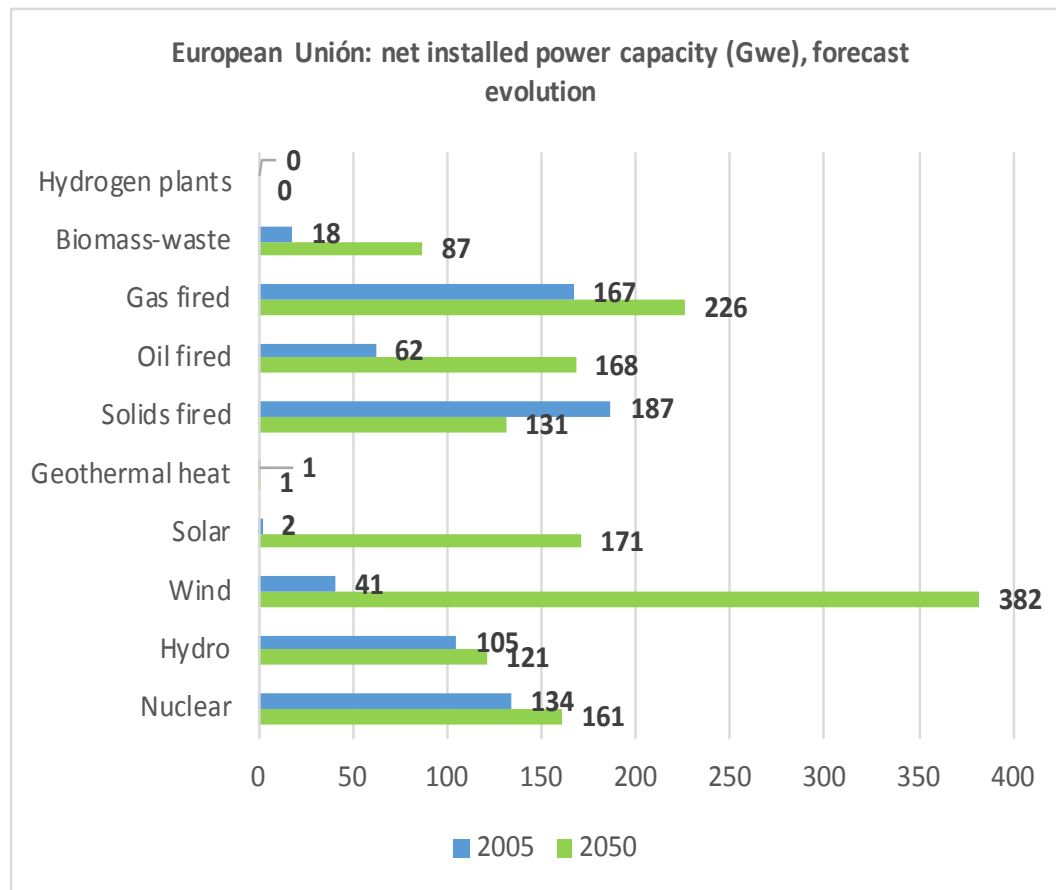
Installed power capacity: forecast evolution



European Bank
for Reconstruction and Development

European Unión: net installed power capacity (GWe), forecast evolution			
	2005	2050	Δ%
Nuclear	134	161	20%
Hydro	105	121	15%
Wind	41	382	832%
Solar	2	171	8450%
Geothermal heat	1	1	0%
Solids fired	187	131	-30%
Oil fired	62	168	171%
Gas fired	167	226	35%
Biomass-waste	18	87	383%
Hydrogen plants	0	0	0%

Source: Impact Assessment Accompanying the document Energy Roadmap 2050
(COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS)

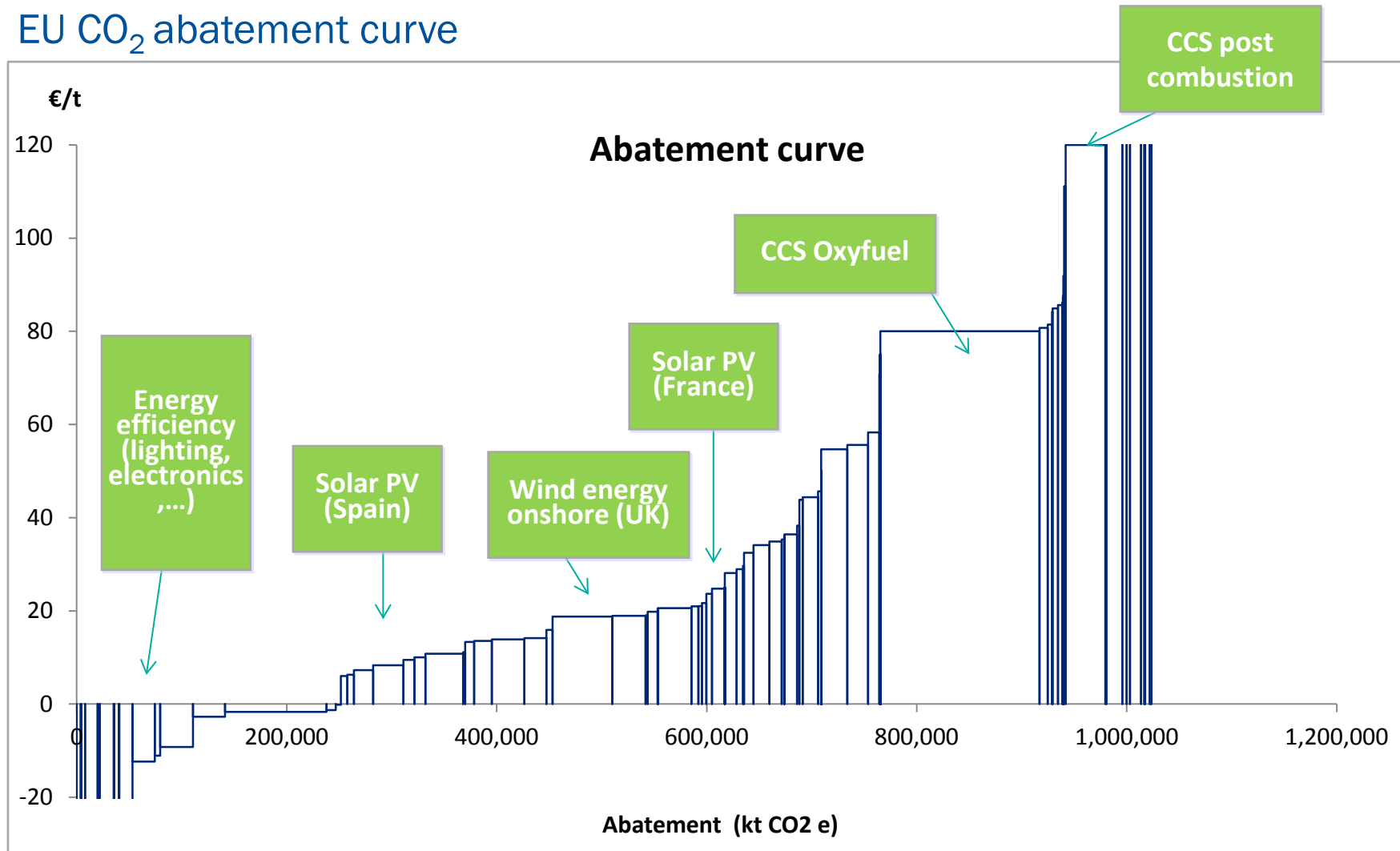


2030 carbon pricing and markets



European Bank
for Reconstruction and Development

EU CO₂ abatement curve



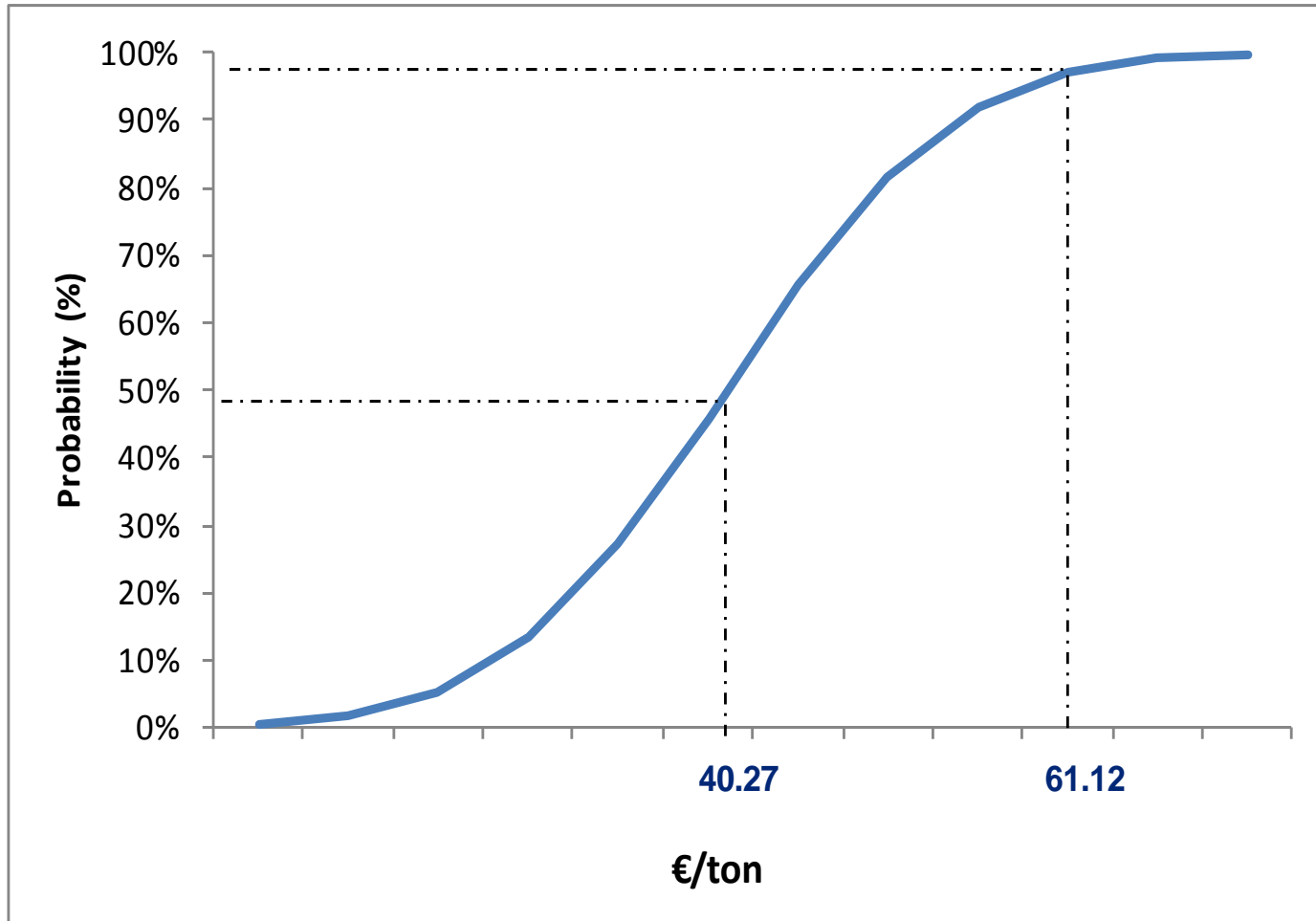
Source: Deloitte

2030 carbon pricing and markets



European Bank
for Reconstruction and Development

EU CO₂ abatement curve



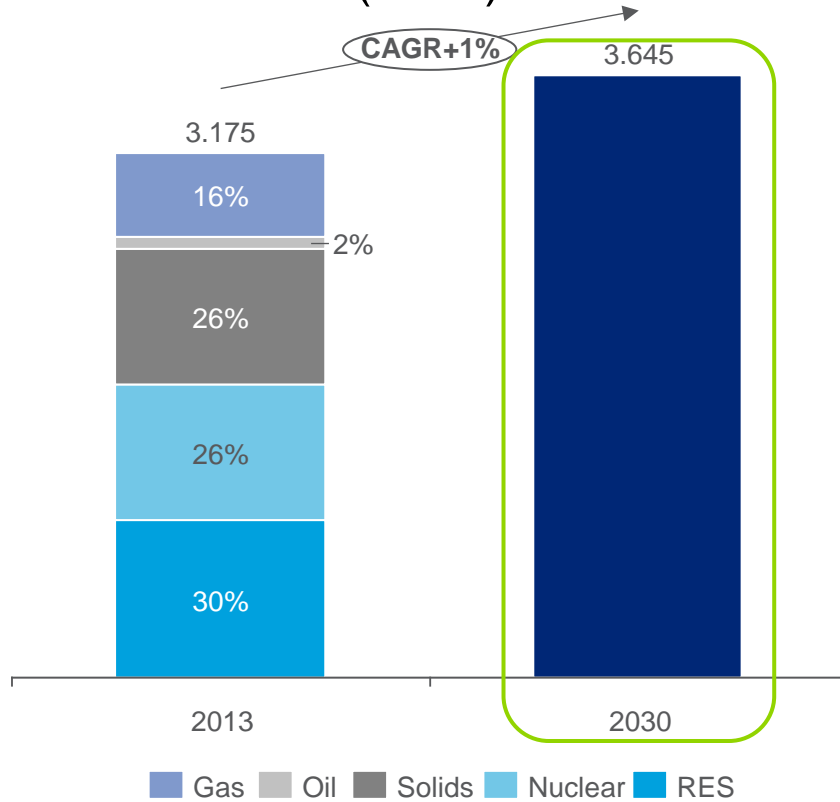
In 99% of the cases the CO₂ allowance price would be lower than €₂₀₁₃ 61/ton

Source: Deloitte

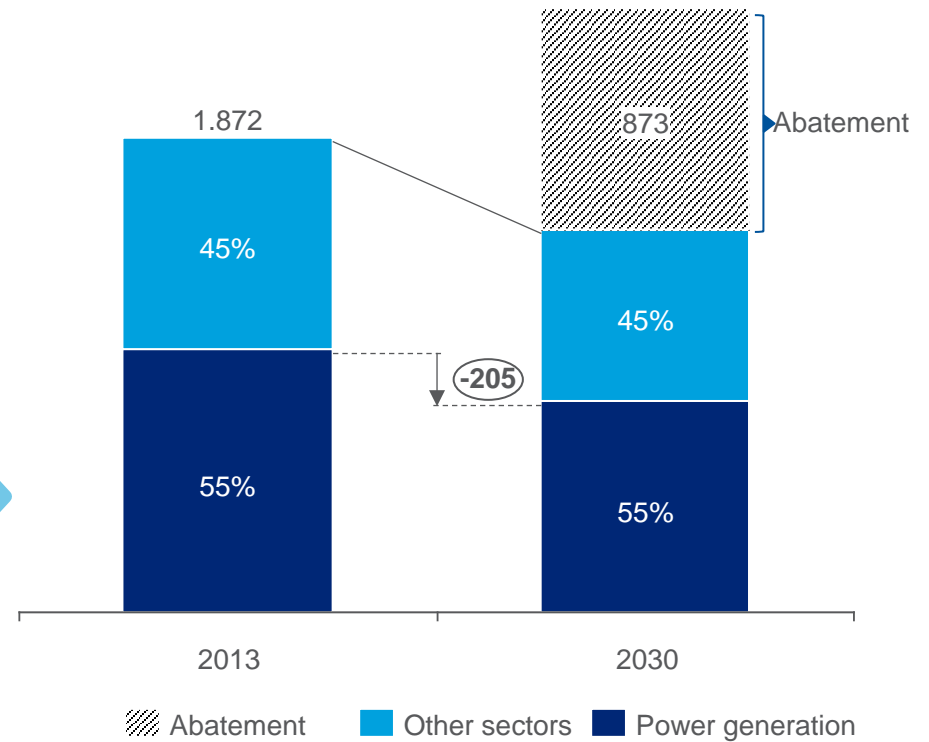
2030 carbon pricing and markets

Power and carbon market

EU forecast power demand (TWh)



CO₂ emission cap



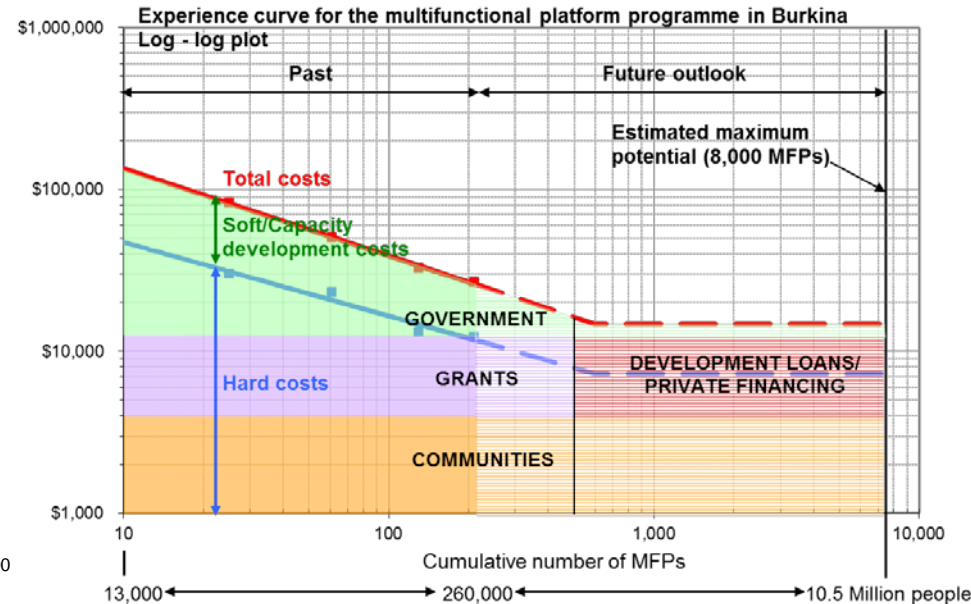
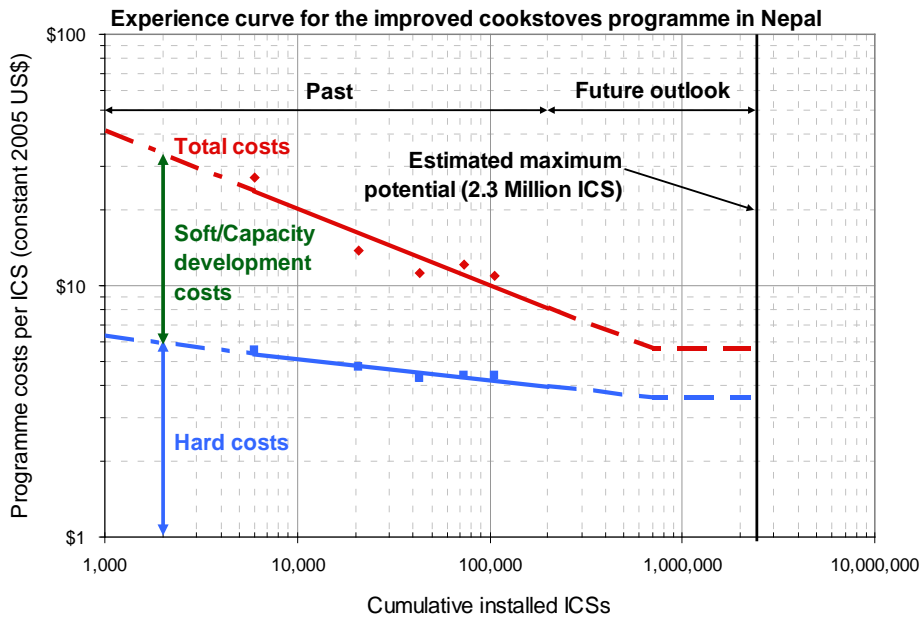
Source: Deloitte

Mainstreaming Renewables: The Experience Curve and Economies of Scale



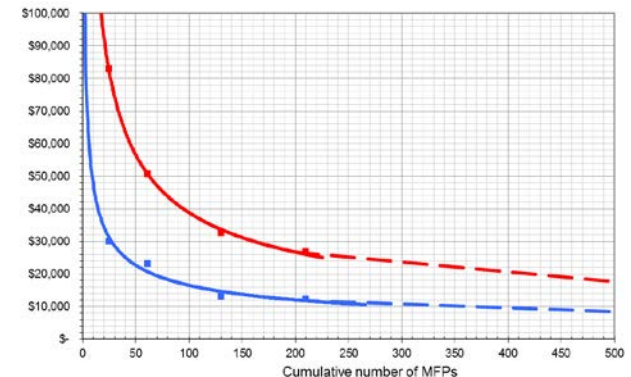
European Bank
for Reconstruction and Development

- **Experience curve** → similarly to the economies of scale, reflects the reduction in production costs as a function of the additional units produced



Generally represented by a geometric function:

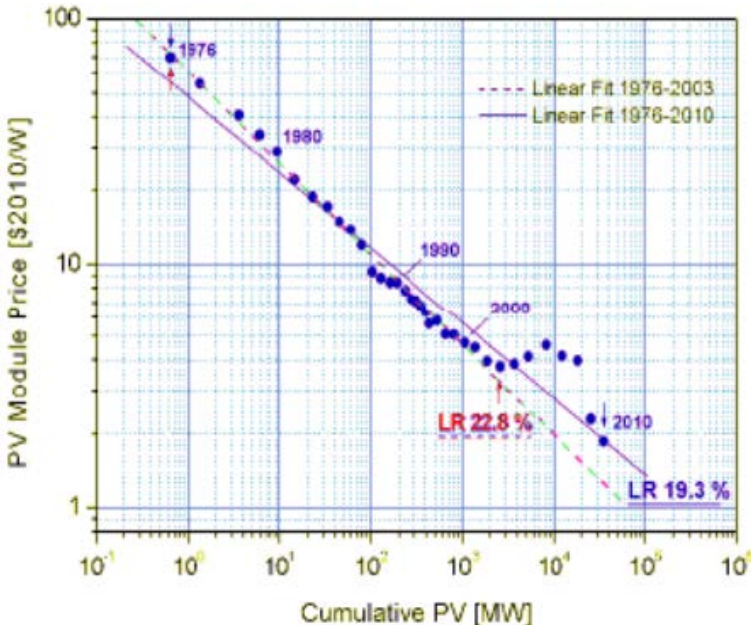
$$C_n = C_1 n^{-e}$$
 with C being costs, n being number of units produced and e being the elasticity of the curve



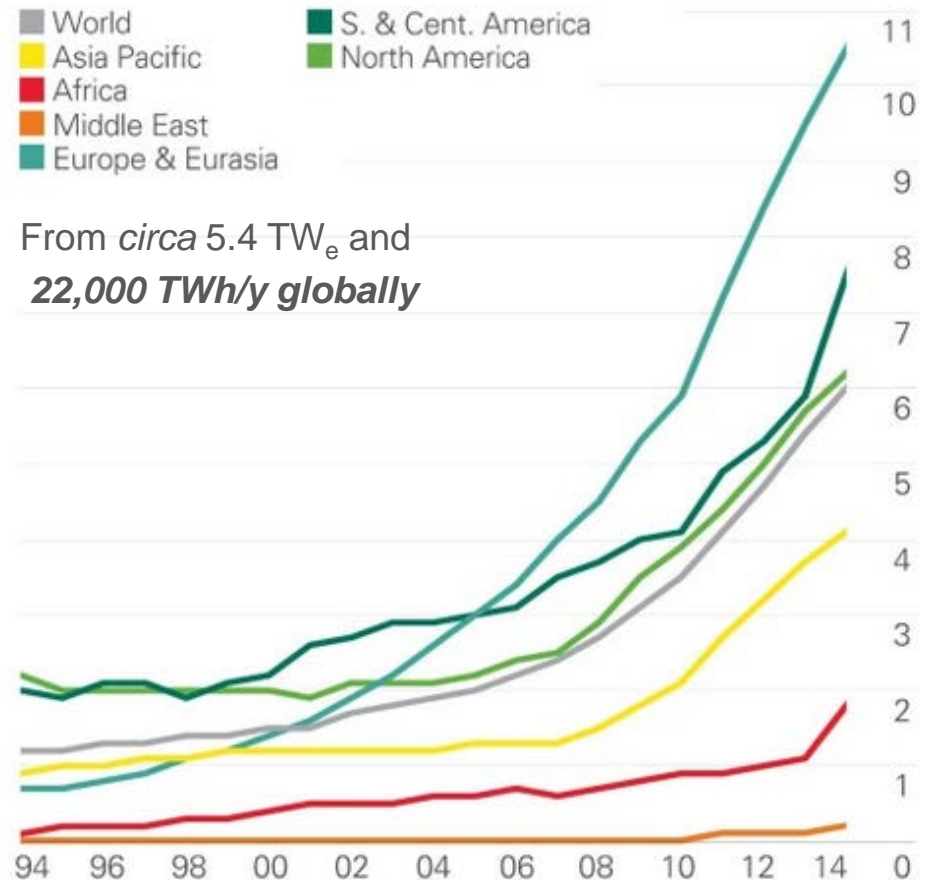
Mainstreaming Renewables: Clean Technology as a Source of Global Growth

Non-HEPP RE share of power generation (%)

Source: BP Statistical Review of World Energy 2015



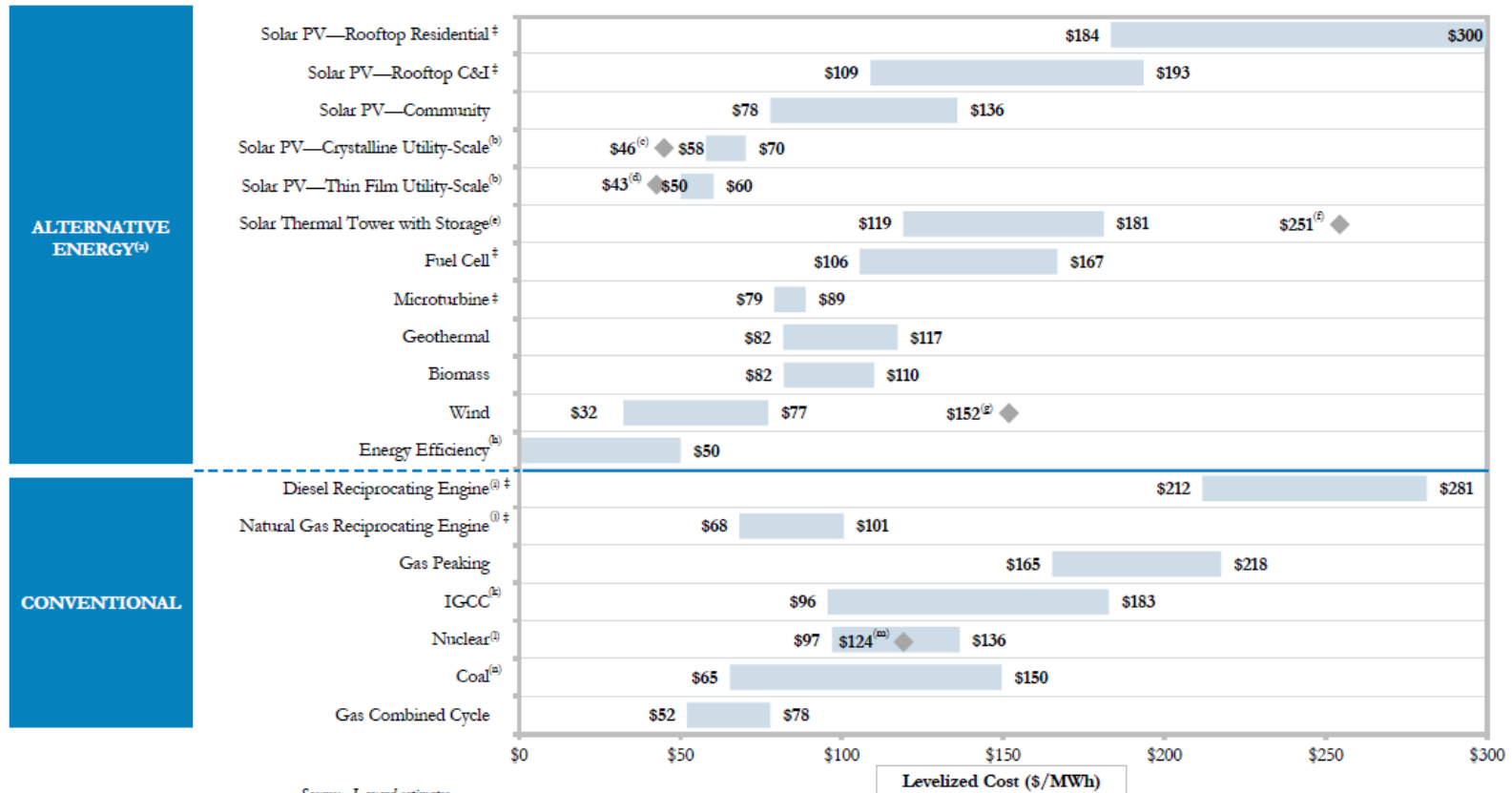
- Feed-in Tariffs
 - Concessional financing
 - Investment in R&D
 - Technology transfer
 - Elimination of subsidies to fossil fuels
- Have all contributed to advances in the learning curve and RE deployment



Mainstreaming Renewables: Upfront Risk (Overnight costs) vs. Investment Profitability (LEC)



European Bank
for Reconstruction and Development



Levelised Energy Cost for different technologies (\$/MWh)

Source: Lazard, 2015

Levelised Energy Cost (LEC) → price of electricity to break even over the project's lifetime (\$/MWh)

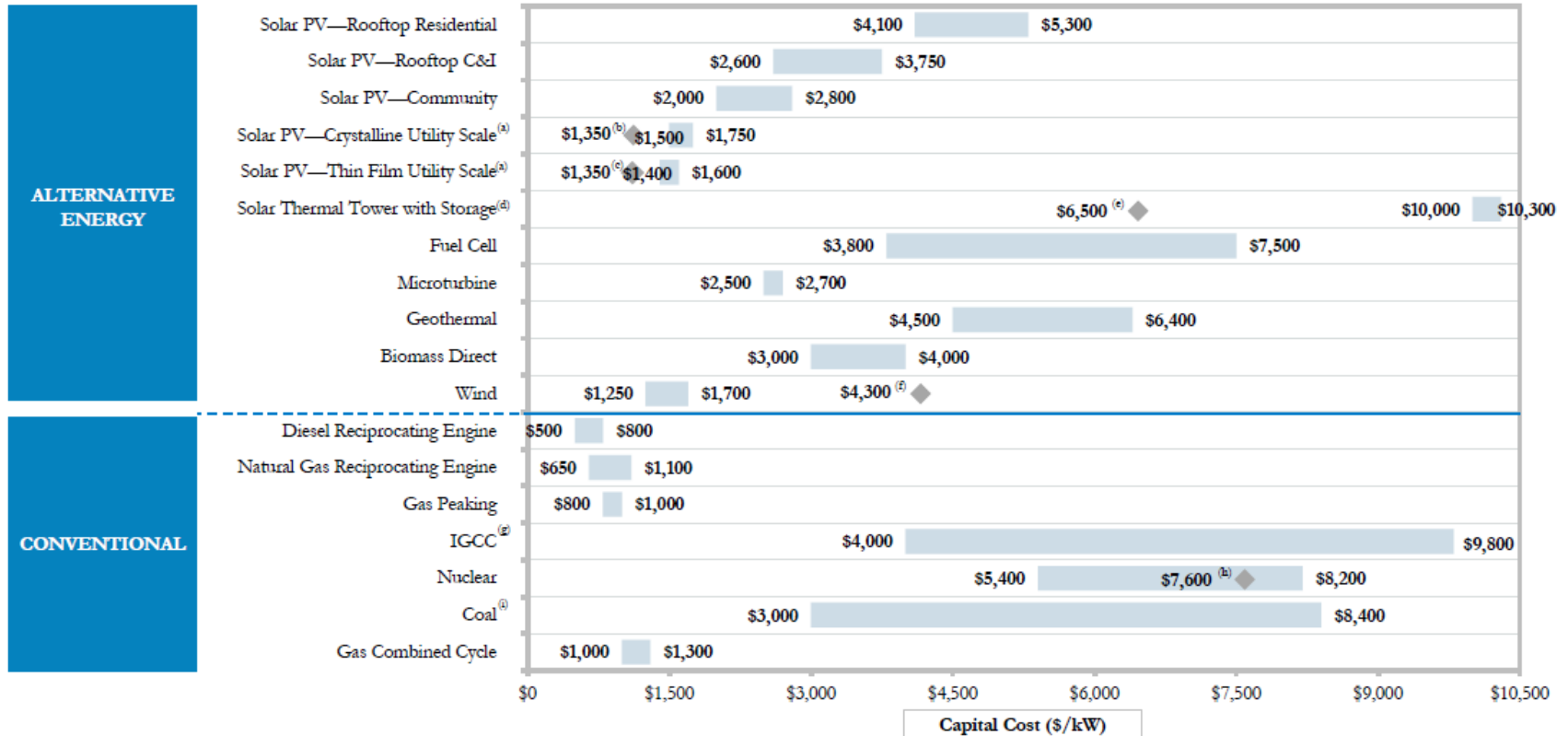
$$LEC = \frac{\sum_{t=0}^n \frac{Capex_t + Opex_t}{(1 + WACC)^t}}{\sum_{t=1}^n \frac{Electricity_t}{(1 + WACC)^t}}$$

Mainstreaming Renewables:

Upfront Risk (Overnight costs) vs. Investment Profitability (LEC)



European Bank
for Reconstruction and Development



Capital Cost Comparison of different technologies (\$/kW)

Source: Lazard, 2015

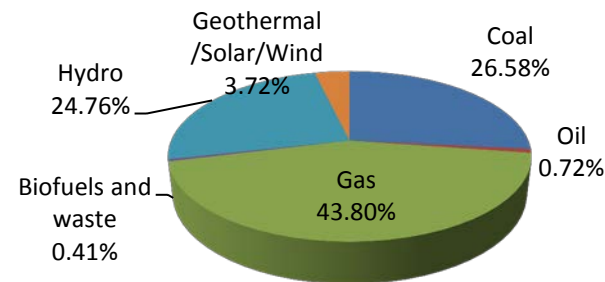
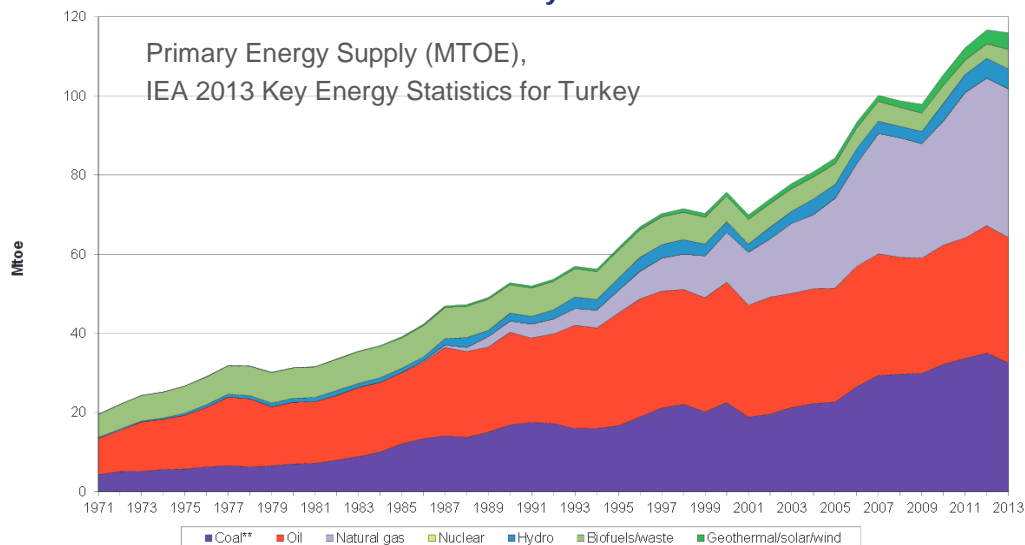
Overnight costs → cost of project construction without financing cost and as if completed “over night”

Turkish Energy Mix

The Urgency to Move Away from Fossil Fuel Imports



European Bank
for Reconstruction and Development

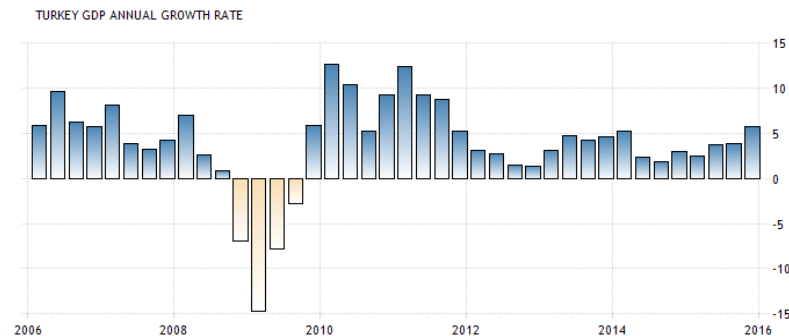
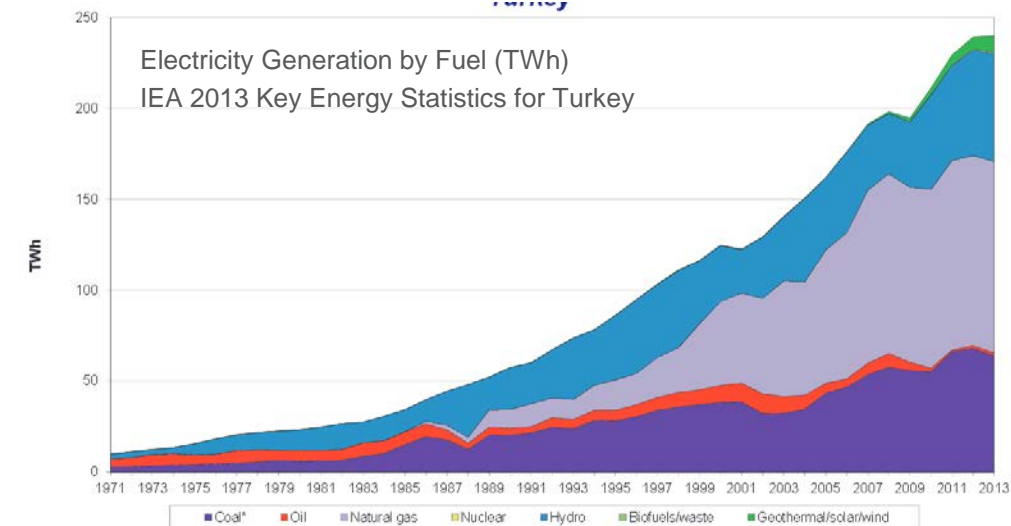


Last 20 years: 2x Primary Energy Supply and 4x Electricity Generation (7% CAGR)

Risks to security of supply due to reliance on external imports

Energy imports: Turkey imports more than 70% of its primary energy, \$46 billion in 2014

CO₂ emissions very large increase, 115% since 1990



Energy Dependence

Macro-economic implications for the current account balance

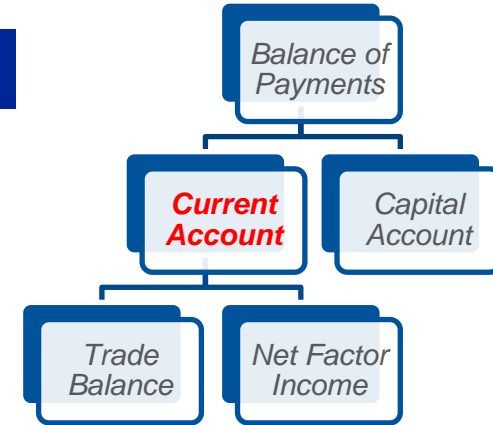
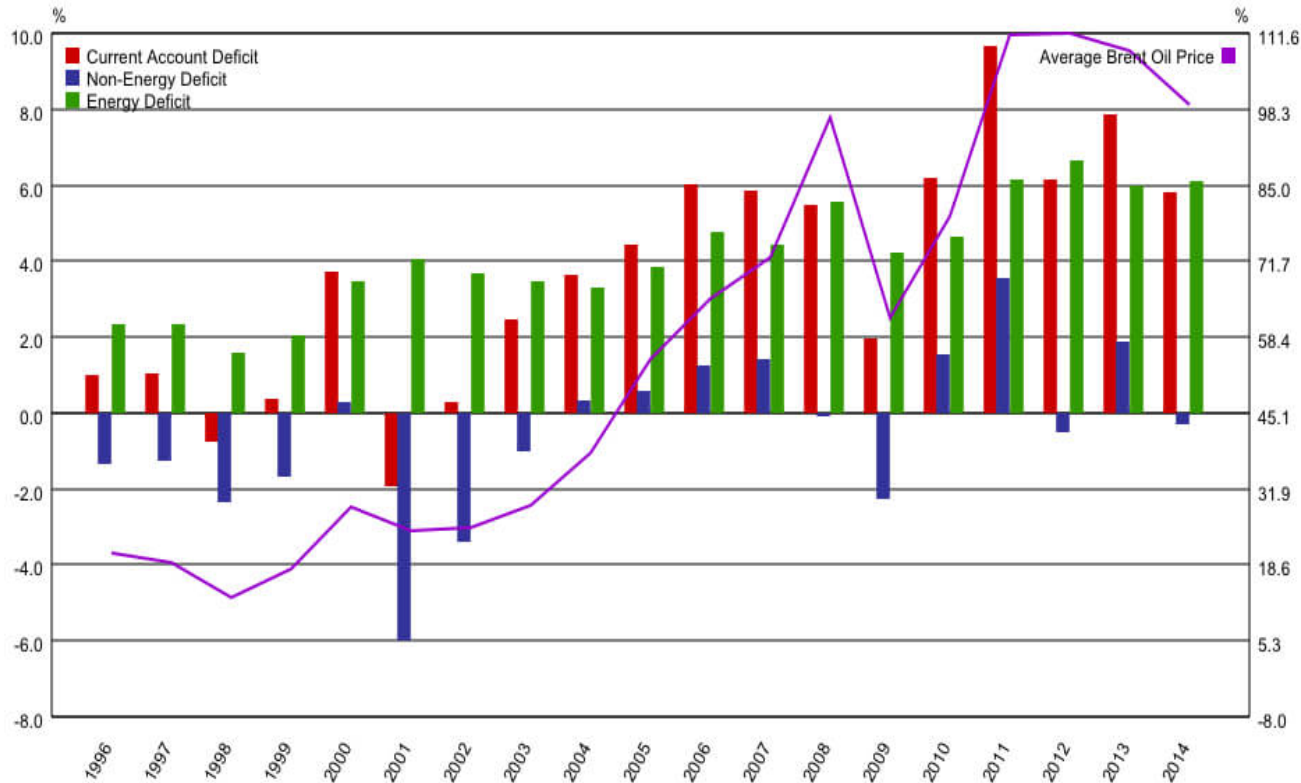


European Bank
for Reconstruction and Development

Current Account Balance

Current Account Deficit -Energy and Non-Energy- (as % of GDP) and Oil Prices

TURKEY DATA MONITOR



Very large CA deficit:
5% of the nominal GDP,
deepened by energy
imports

In Turkey, financed via
short term (i.e. volatile)
capital inflows

CBT holds record low FX
reserves, with TRY
depreciation threatening
to increase the energy
bill

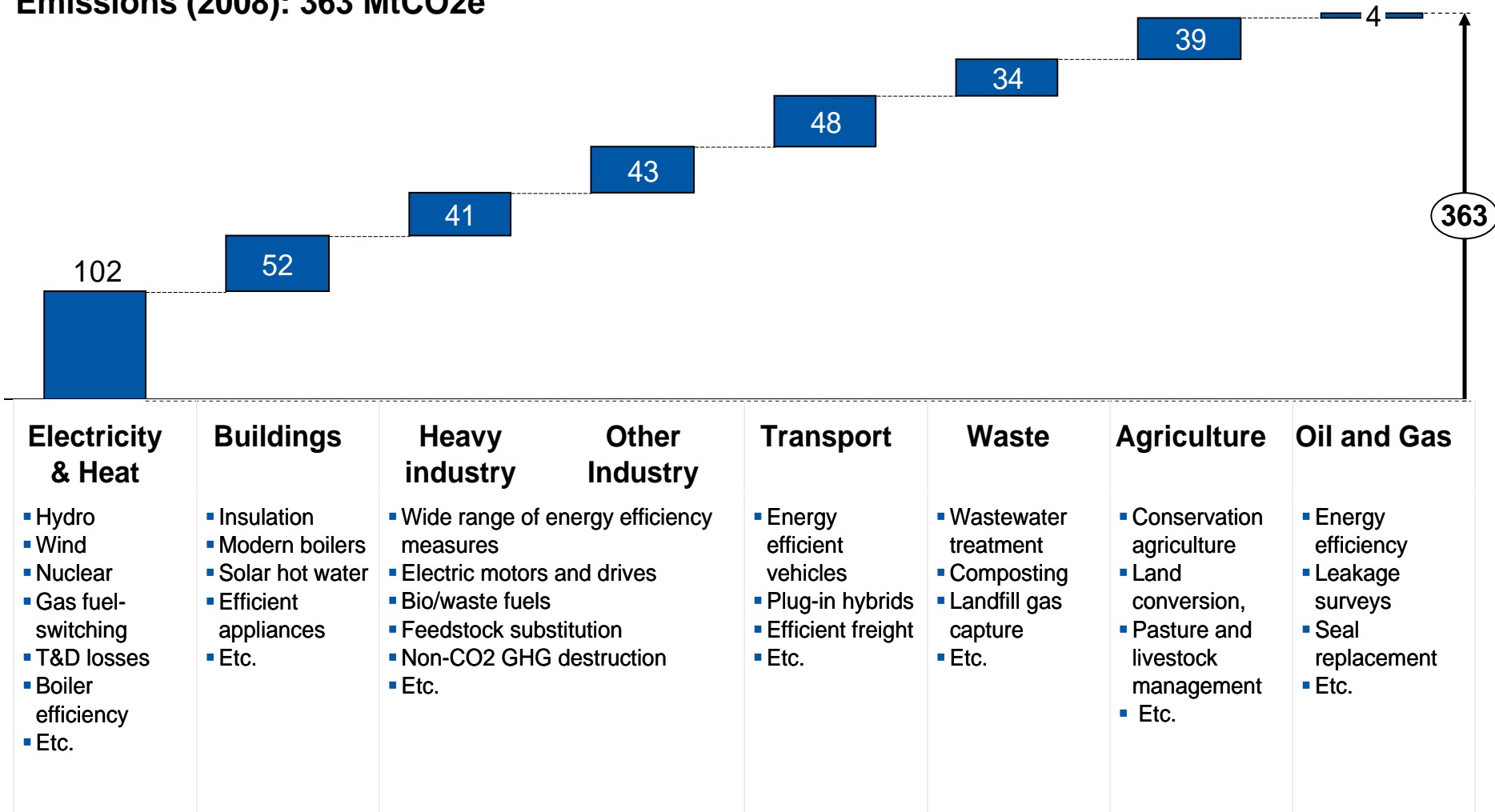
Turkish GHG by Source

Role of Different Sectors in Curving Emissions



European Bank
for Reconstruction and Development

Emissions (2008): 363 MtCO₂e

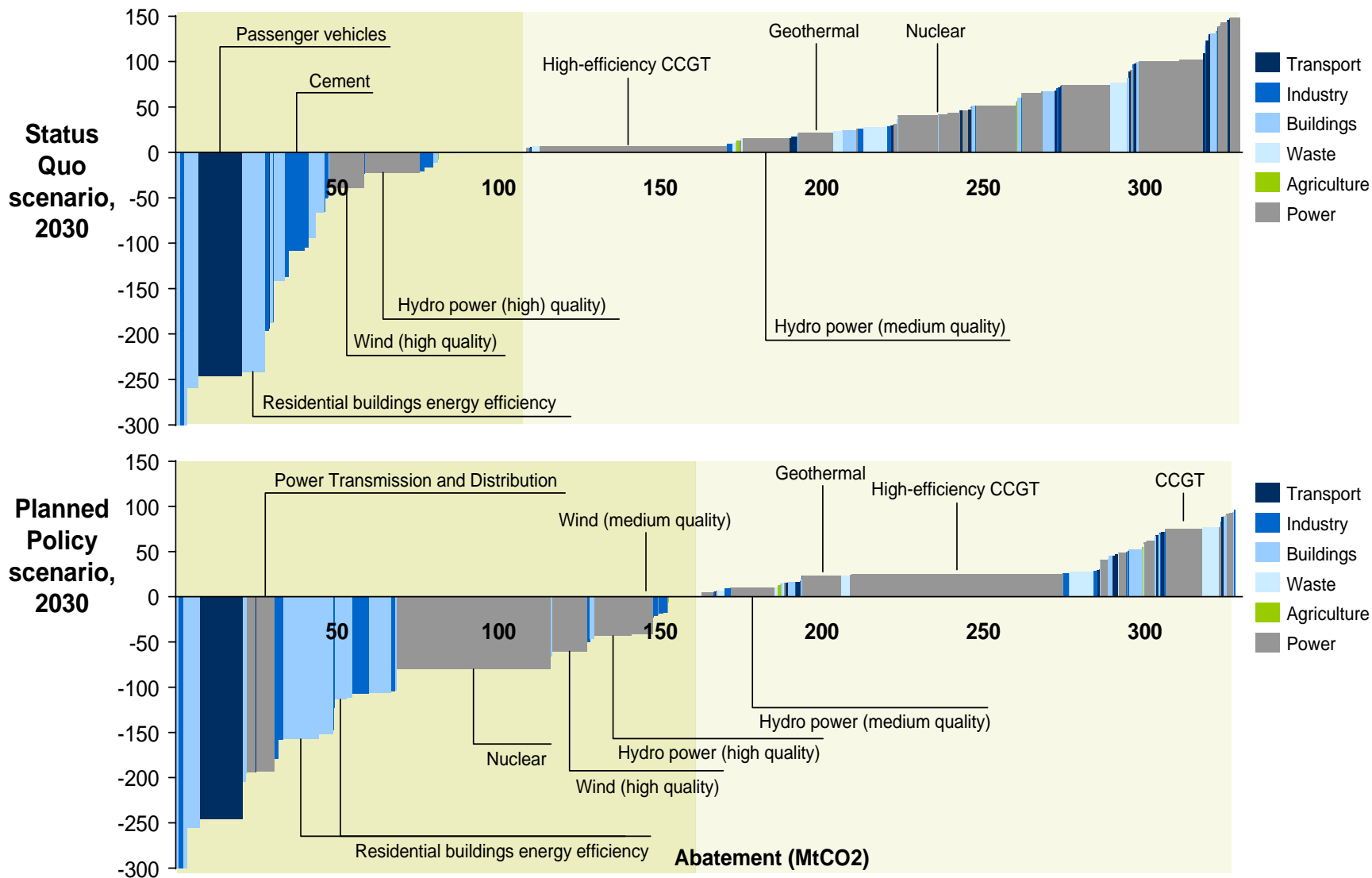


Source: UNFCCC

By 2030 Planned Policy Adds 50% Additional Commercially Viable Abatement Relative to Status Quo



European Bank
for Reconstruction and Development



Enhanced Policy Scenario Key Assumptions

Ambitious cross-cutting policy package

Sector

Key Assumptions

(relative to Planned Policy)

Cross-cutting Key Drivers

1. Carbon price of €30/tCO₂ for industry and power; €15/tCO₂ for other sectors (waste, agriculture)
2. Capital grants of 20% of incremental cost

Fuel Markets

- Full gas market liberalisation
- Phase out lignite subsidy

Power Sector

- No limitation on gas share in generation
- Ambitious FITs, up to €15/MWh higher than in PP

Buildings

- Extensive energy efficiency programme: “soft” loans, obligations on suppliers, and energy audits

Industry

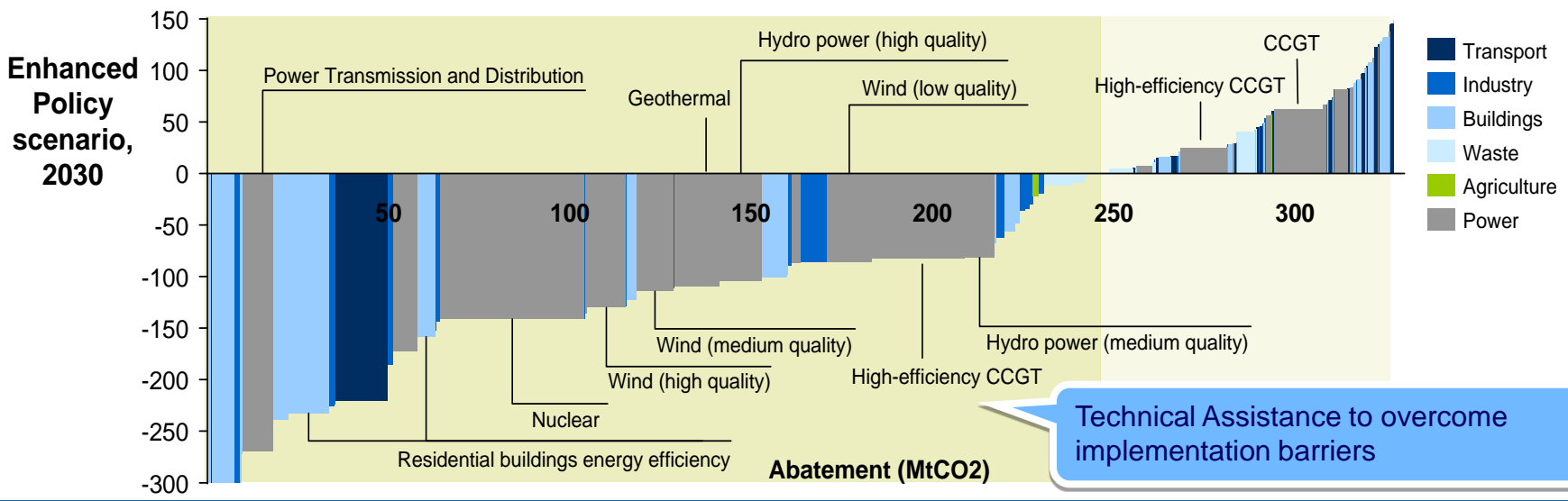
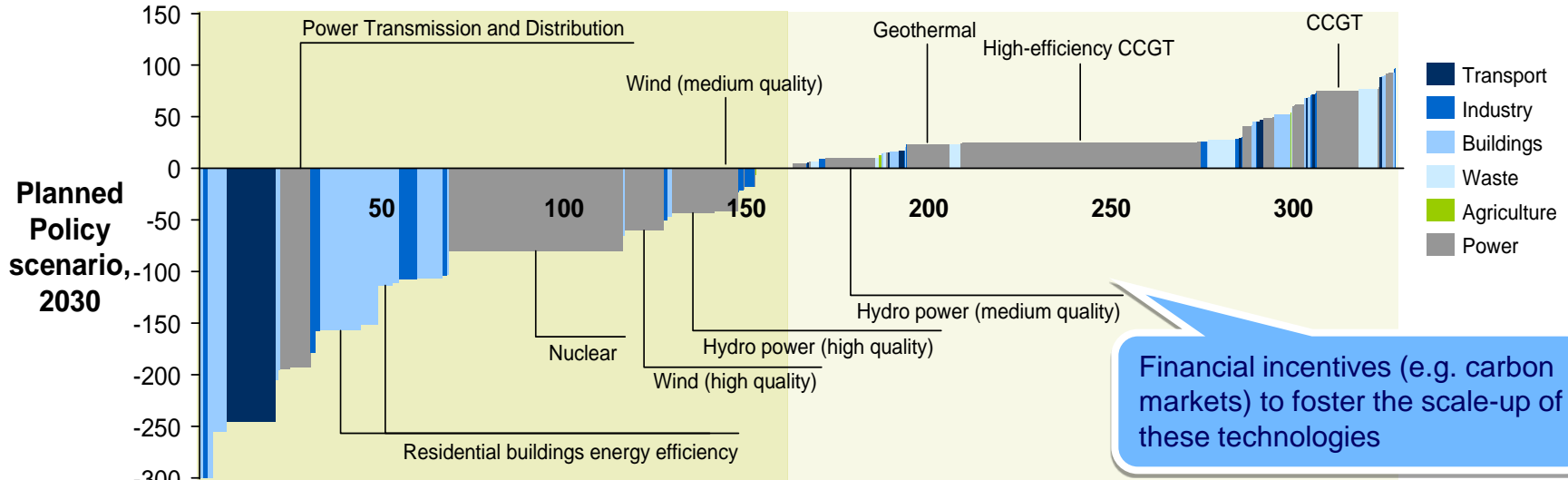
- Industry benchmark-and-target programme

Transport, Agriculture, Waste

- Carbon price (credits) is key driver
- Waste / aggregates regulation helps make emissions-reducing feedstock and fuels available to industry

Enhanced Policy Results in Another 100 MtCO₂ of Abatement, Concentrated in the Power Sector

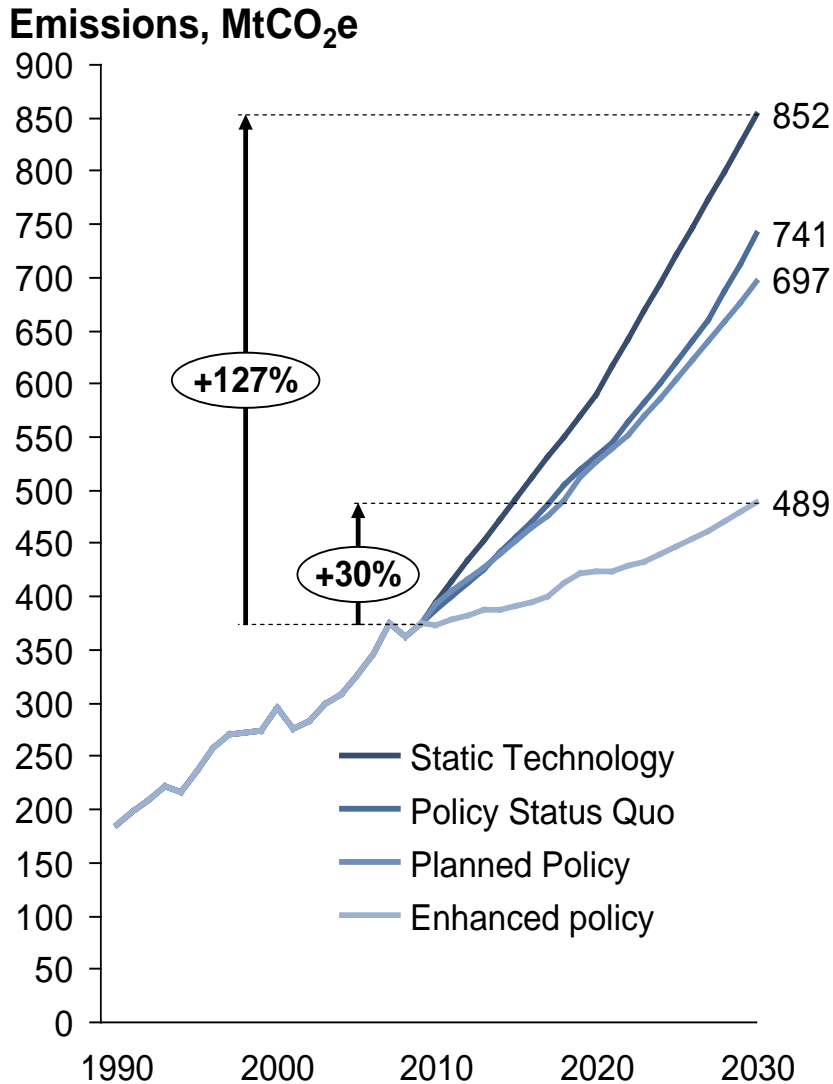
• **Economic efficiency** and capital expenditure are two major criteria for technology choice



Emissions Pathways Differ Significantly, Depending on Policies



European Bank
for Reconstruction and Development



The “static intensity” reference point sees emissions more than double by 2030

Entry of new, more efficient capacity and impact of current/planned policy can reduce 2030 emissions by 100-150 MtCO₂ relative to static case

The Enhanced Policy scenario significantly curtails emissions growth. Emissions in 2030 are 30% higher than current levels

Regulatory Framework

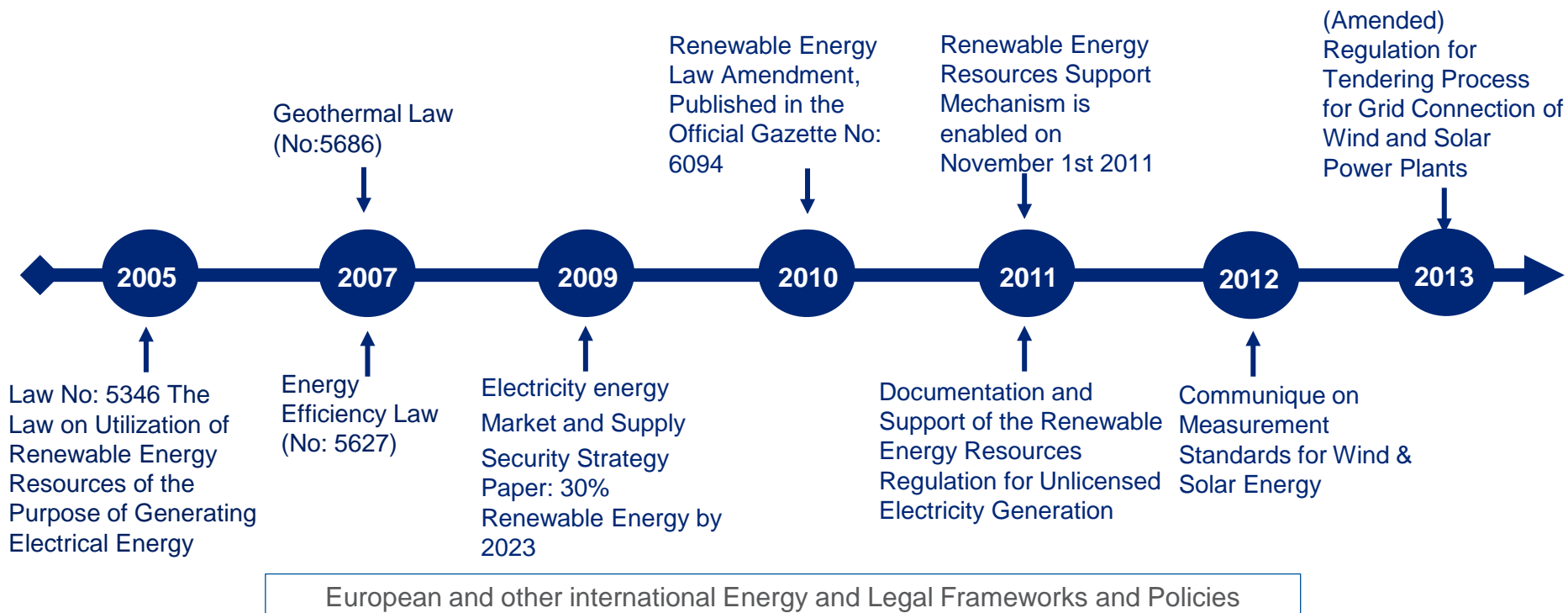
Preparing the ground for private sector investment



European Bank
for Reconstruction and Development

Turkish Renewable Energy Legal Framework Evolution

Significant progress has been made in the field of renewable energy starting from 2005 with the Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy (Renewable Energy Law). Despite the enactment of this law, investments in renewable energy technologies remained limited due to 5.5 euro cent / kWh feed-in-tariff. Practical steps toward the utilization and implementation of different renewable energy resources was introduced after the REL amendment was published in 2010. This amendment introduced higher feed-in-tariff prices compared to based on different renewable energy technologies.



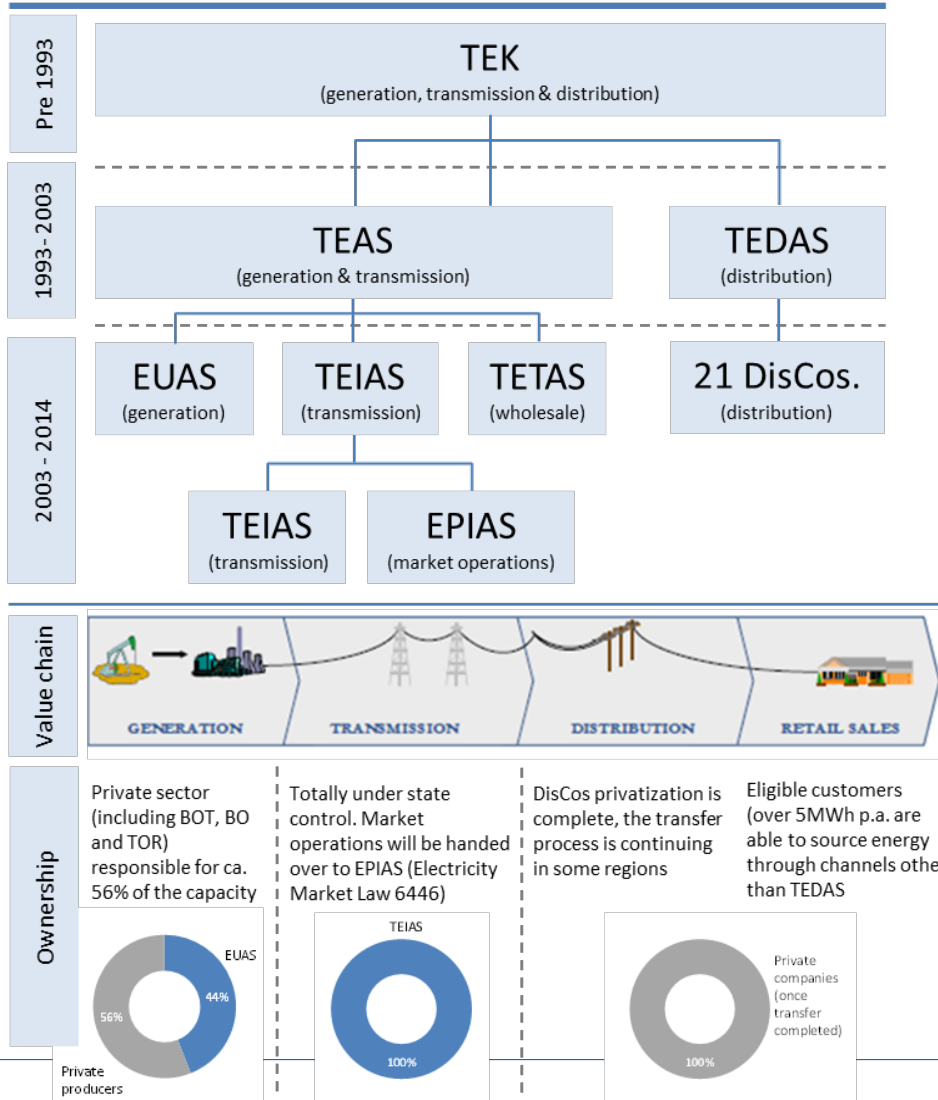
Power Sector Reform

Unbundling & privatisation to promote private sector investment

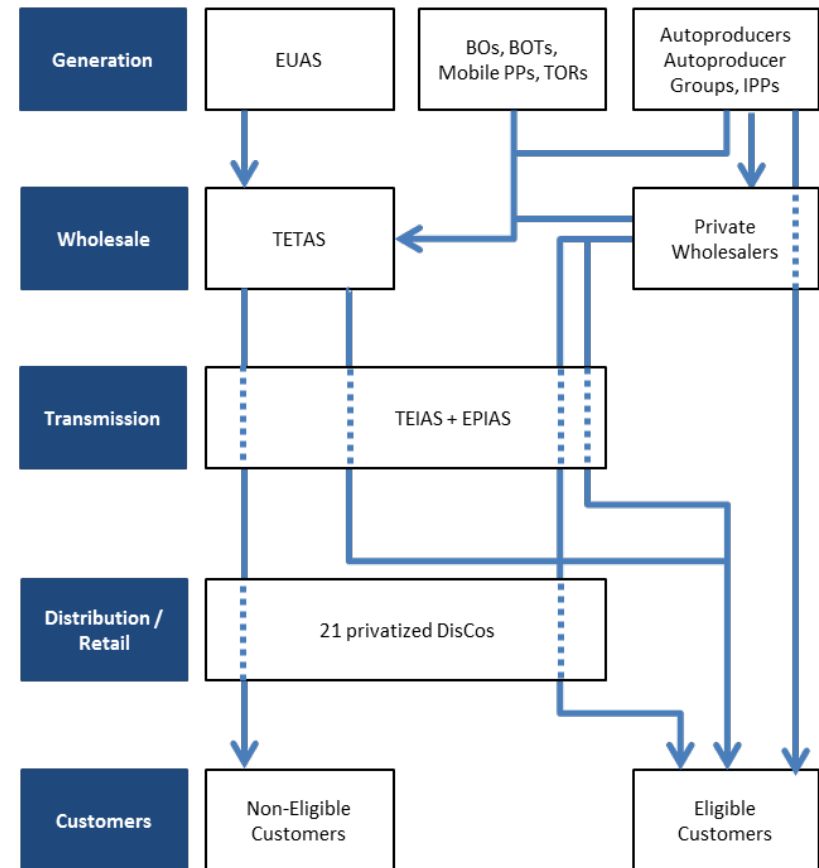


European Bank
for Reconstruction and Development

Market organizational structure



Power sector co-relations



EU Directive on Renewable Energy

Member State obligation to develop a roadmap to achieve 2020 RE targets



European Bank
for Reconstruction and Development

Directive 2009/28/EC

The Directive 2009/28/EC of The European Parliament and of The Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC:

- Set ambitious targets, EU will reach a 20% share of energy from renewable sources by 2020 and a 10% share of renewable energy specifically in the transport sector.
- Required national action plans that establish pathways for the development of renewable energy sources.

The National Renewable Energy Plan included National sectorial 2020 targets and estimated shares of energy from renewable sources in electricity, heating and cooling and transport, the estimated trajectory for renewable energy penetration from 2010-2020 and the measures to achieve these targets.

In 2010, all EU Countries elaborated according to the methodology established in the Directive 2009/28/EC their National Renewable Energy Plan.

The relevance of renewable energies for Turkey

During the next years it is forecast that Turkey will have an important economic development that will required increase the demand of energy inputs: nowadays the country has strong dependence of fossil fuel imports from third countries.

Turkey shares with the rest of the European countries the main energy policy guidelines:

- Security of supply based on reducing energy dependency.
- Mitigation of greenhouses gases emissions.
- Competitiveness according to cost-effective criteria).
- Economic and social development.
- Sustainability of the model in medium and long term.

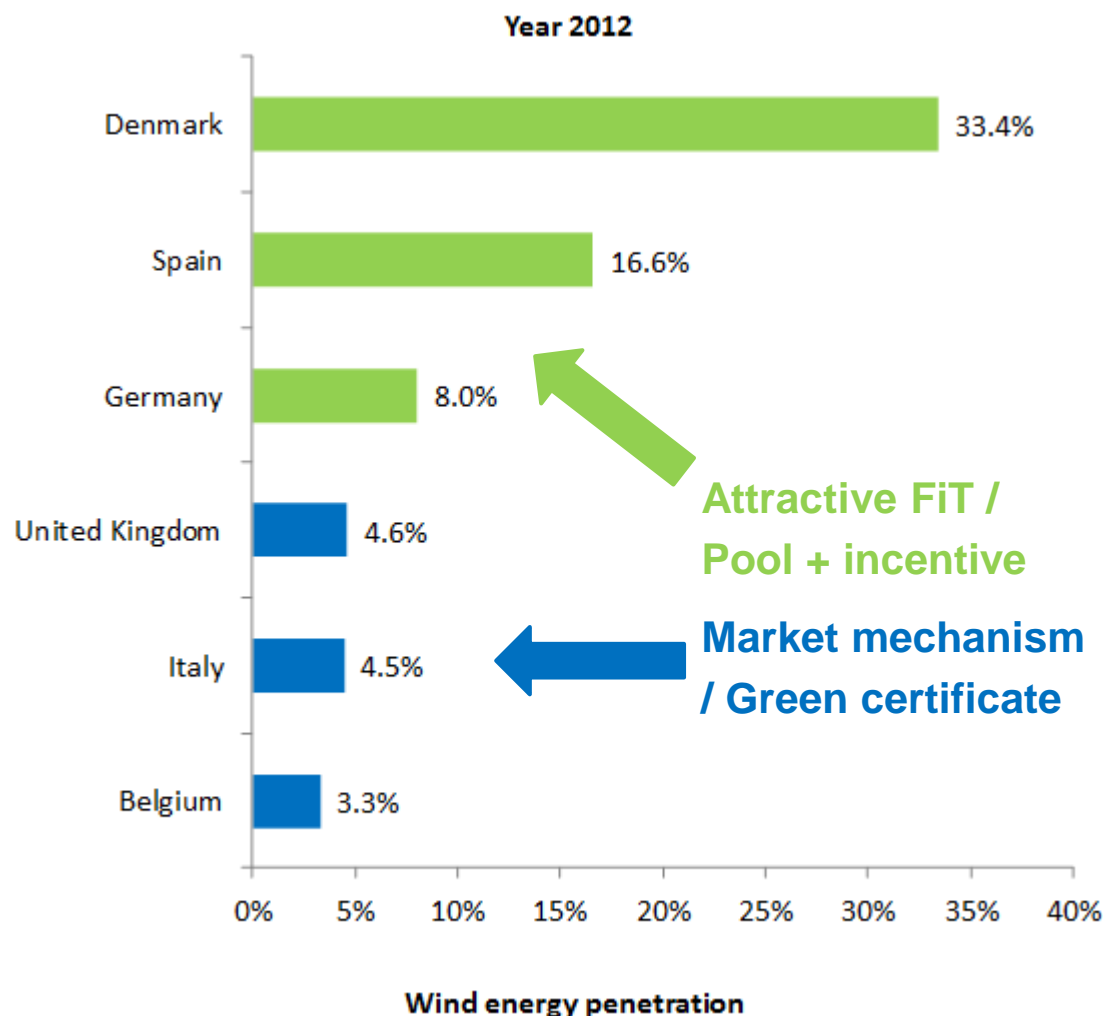
Mechanisms to Support RE

FiT vs. Market Mechanisms and differences in RE penetration



European Bank
for Reconstruction and Development

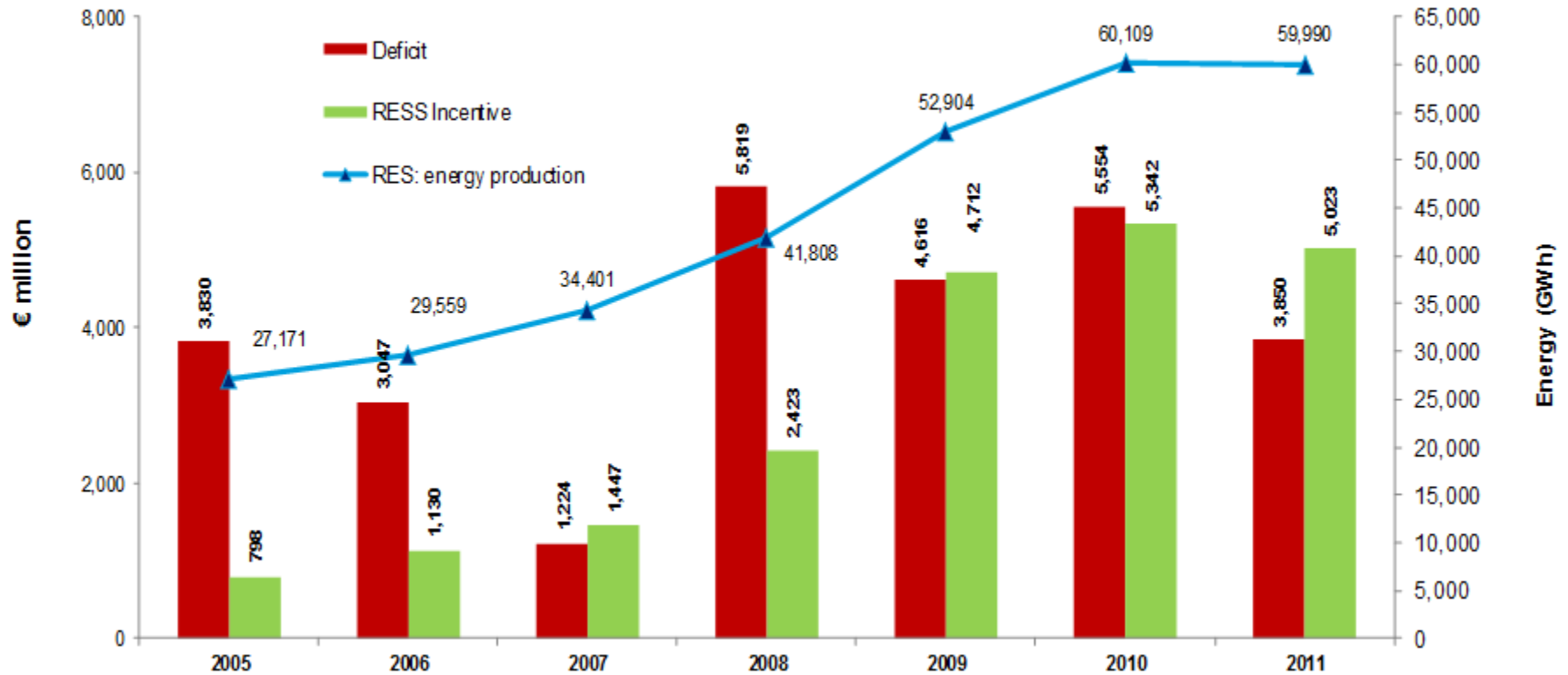
In countries where an attractive FIT or Pool+Incentive mechanism has been implemented (Denmark, Spain, Germany,...) the penetration of wind energy is higher than in countries where market mechanism or green certificates are in place (UK, Italy, Belgium,...)



Source: Eurostat and Deploying Renewables 2011: Best and Future Policy Practice (IEA, 2011a)

Impact of Feed-in Tariffs

The experience of Wind power in Spain



Data from: Comisión Nacional de Energía

Analysis: *The impact of wind power on wholesale electricity prices in Spain* (Garcia, M., Doheijo, E.; Deloitte 2013)

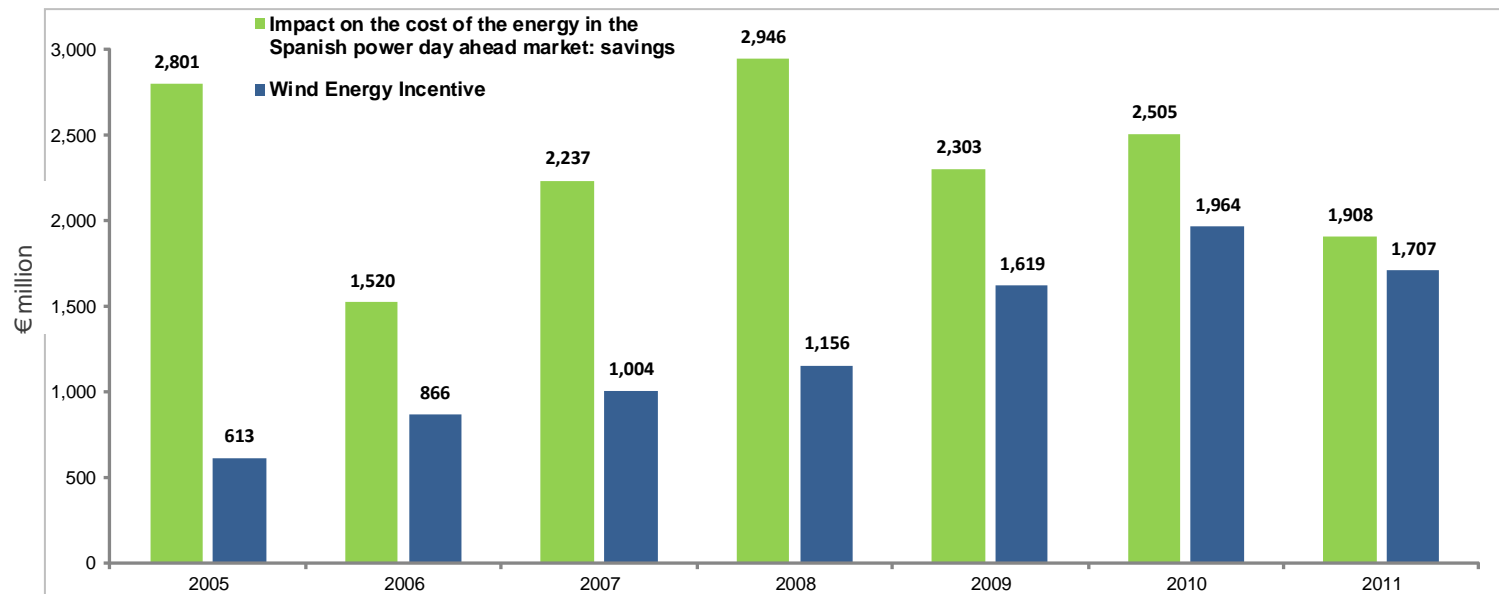
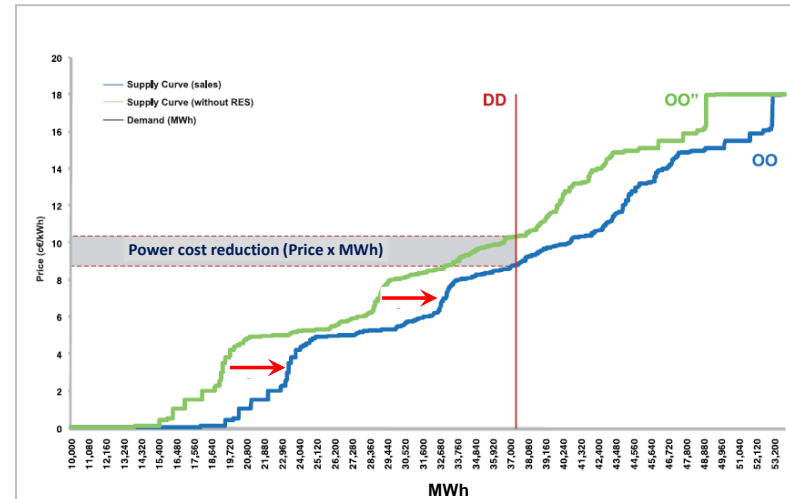
Impact of Feed-in Tariffs

Net macro-economic benefits through electricity cost savings



European Bank
for Reconstruction and Development

In Spain, RES development led to a power cost reduction and savings on the cost of the energy in the Spanish power day ahead market



The impact of wind power on wholesale electricity prices in Spain (Garcia, M., Doheijo, E.; Deloitte 2013)

Renewable Energy Feed-in Tariffs

Government guaranteed prices and priority of dispatch



European Bank
for Reconstruction and Development

Feed-in-tariff and Local Equipment Bonus for Wind Power	
Locally manufactured component	Bonus (US\$ cent/kWh)
Wind energy	7.3
Blade	0.8
Generator and power electronics	1.0
Turbine tower	0.6
All mechanical equipment in rotor and nacelle (excluding blade group, generator, and power electronics)	1.3
Total	7.3 + 3.7 = 11

Feed-in-tariff and Local Equipment Bonus Prices for Solar CSP	
Locally manufactured component	Bonus (US\$ cent/kWh)
Solar CSP	13.3
Radiation collector tube	2.4
Reflective surface	0.6
Sun tracking system	0.6
Mechanical components of heat energy storage system	1.3
Mechanical components of the steam generation system	2.4
Stirling engine	1.3
Panel integration and production of structural solar mechanics	0.6
Total	13.3 + 9.2 = 22.5

Feed-in-tariff and Local Equipment Bonus Prices for Biomass	
Locally manufactured component	Bonus (US\$ cent/kWh)
Biomass	13.3
Steam boiler with fluid bed	0.8
Liquid or gas fired steam boiler	0.4
Gasification or gas removal group	0.6
Steam or gas turbine	2
Internal combustion or stirling engine	0.9
Generator and power electronics	0.5
Cogeneration system	0.4
Total	13.3 + 5.6 = 18.9

Feed-in-tariff and Local Equipment Bonus for Solar PV	
Locally manufactured component	Bonus (US\$ cent/kWh)
Solar PV	13.3
PV panel integration and production	0.8
PV Modules	1.3
PV Module Cells	3.5
Inverter	0.6
Material which focuses radiation on PV Module	0.5
Total	13.3 + 6.7 = 20

Feed-in-tariff and Local Equipment Bonus for Hydro	
Locally manufactured component	Bonus (US\$ cent/kWh)
Hydro	7.3
Turbine	1.3
Generator and power electronics	1.0
Total	7.3 + 2.3 = 9.6

Feed-in-tariff and Local Equipment Bonus for Geothermal	
Locally manufactured component	Bonus (US\$ cent/kWh)
Geothermal	10.5
Steam or gas turbines	1.3
Generator and power electronics	0.7
Steam injector or vacuum compressor	0.7
Total	10.5 + 2.7 = 13.2

Preferential prices for electricity generated from renewable energy sources	Turkey	Czech Rep.	Germany	Italy	United Kingdom
	EUR/MWh	EUR/MWh	EUR/MWh	EUR/MWh	EUR/MWh
Hydro	54	81	40 - 130	220	230
On-shore Wind	54	108	50 - 90	300	310
PV	100	455	290 - 550	360 - 440	420
Biomass / biogas	100	77 - 103	80 - 120	200 - 300	120

Law Amending the Law on Utilization of Renewable Energy Resources in Electricity Generation (Law No: 6094): Renewable Energy Resources Support Mechanism is enabled on November 1st 2011

Impact of Feed-in Tariffs

Net macro-economic benefits through electricity cost savings



European Bank
for Reconstruction and Development

License procedure for renewable energy generation facilities

Power plants that have an installed capacity greater than 1 MW are required to obtain a generation license from Energy Market Regulatory Authority. License procedure of some of the renewables differ a bit from others: for solar and wind power plants, grid connection is the most critical step before being entitled for a license.

New Electricity Market Law regulates the tender process for the grid connection rights. Accordingly, for all solar and wind projects, that apply for the same transformer center to connect to the grid, a tender based on contribution fee payable to the Transmission System Operator for the first 3 years following commissioning is mandatory.

For small hydro, water usage right is granted by General Directorate of State Hydraulic Works (DSI), which follow a similar procedure: water usage fee is payable to DSI, where it can organize a tender for the water usage rights.

For biomass power plants, a tender is applicable for those companies who want to build a power plant that uses landfill as a fuel. In that case, usage rights of the city landfill is granted through a tender by the municipality.

Legal Framework

Energy Efficiency Law



European Bank
for Reconstruction and Development

Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC

This Directive establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union's 2020 20% headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date.

The National Authorities has to establish a target and elaborate a plan to achieve it.

Energy Efficiency Law (Law No: 5627)

The purpose of this Law is to increase efficiency in using energy sources and energy in order to use energy effectively, avoid waste, ease the burden of energy costs on the economy and protect environment.

This law covers principles and procedures applicable to increasing and promoting energy efficiency in energy generation, transmission, distribution and consumption phases at industrial establishments, buildings, power generation plants, transmission and distribution networks and transport, raising energy awareness in the general public, and utilizing renewable energy sources.

Energy Efficiency Strategy Paper 2012- 2023

This paper documents the strategies and actions for building, transport and industry sectors.

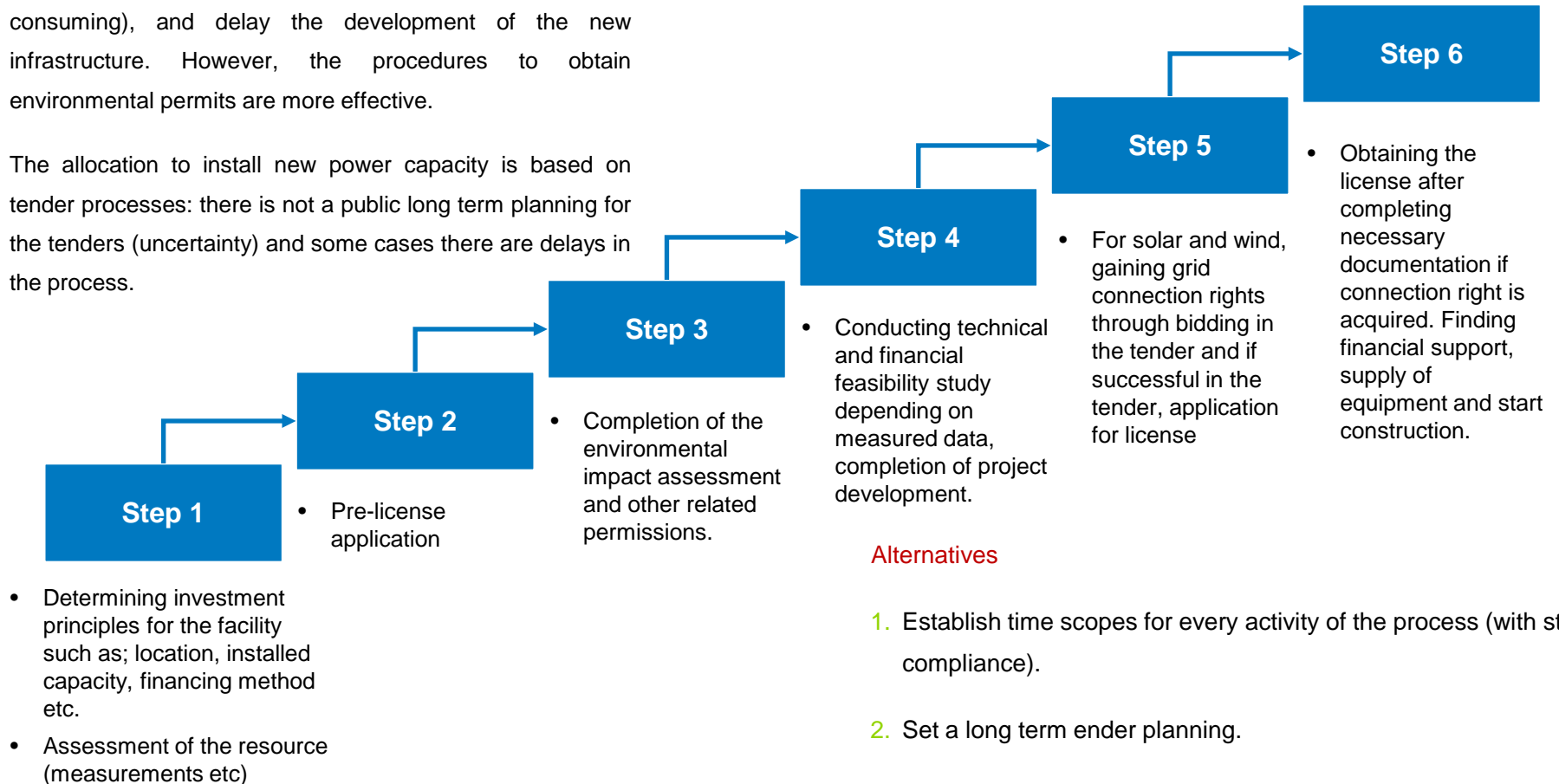
Measures for Achieving Targets

Administrative procedures and technical issues

License procedure for renewable energy generation facilities

Risks

1. Licensing procedures are complex and long (and time consuming), and delay the development of the new infrastructure. However, the procedures to obtain environmental permits are more effective.
2. The allocation to install new power capacity is based on tender processes: there is not a public long term planning for the tenders (uncertainty) and some cases there are delays in the process.



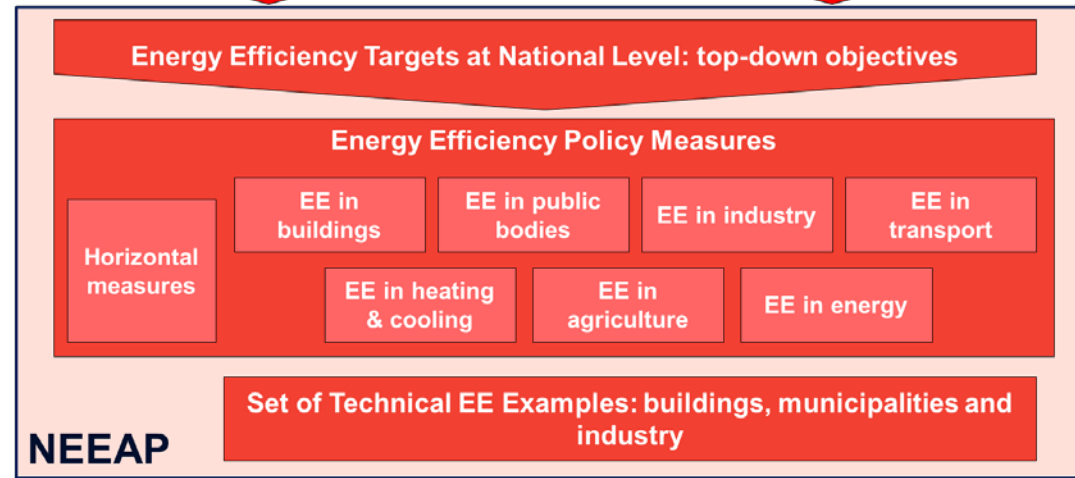
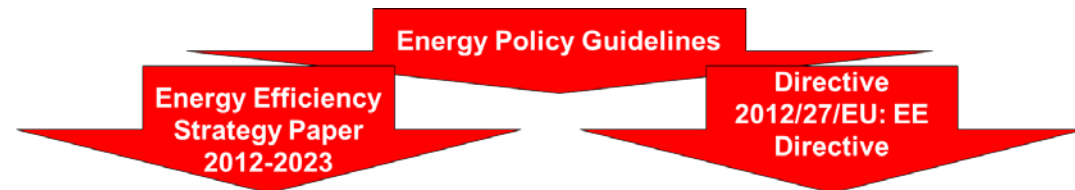
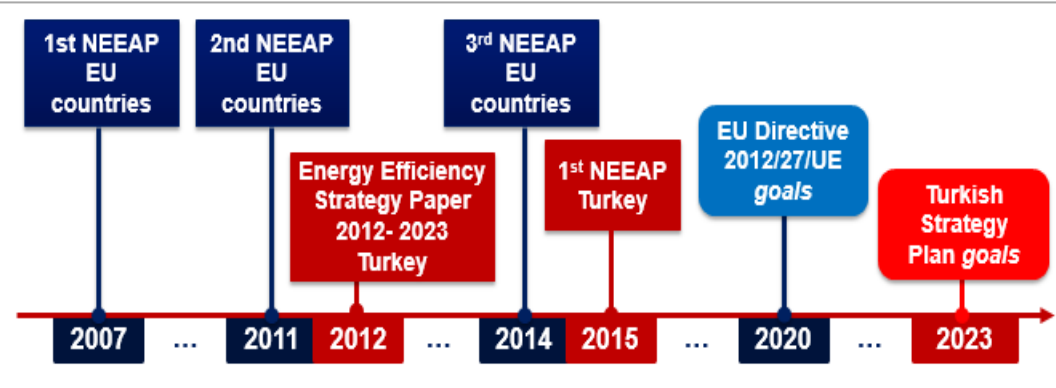
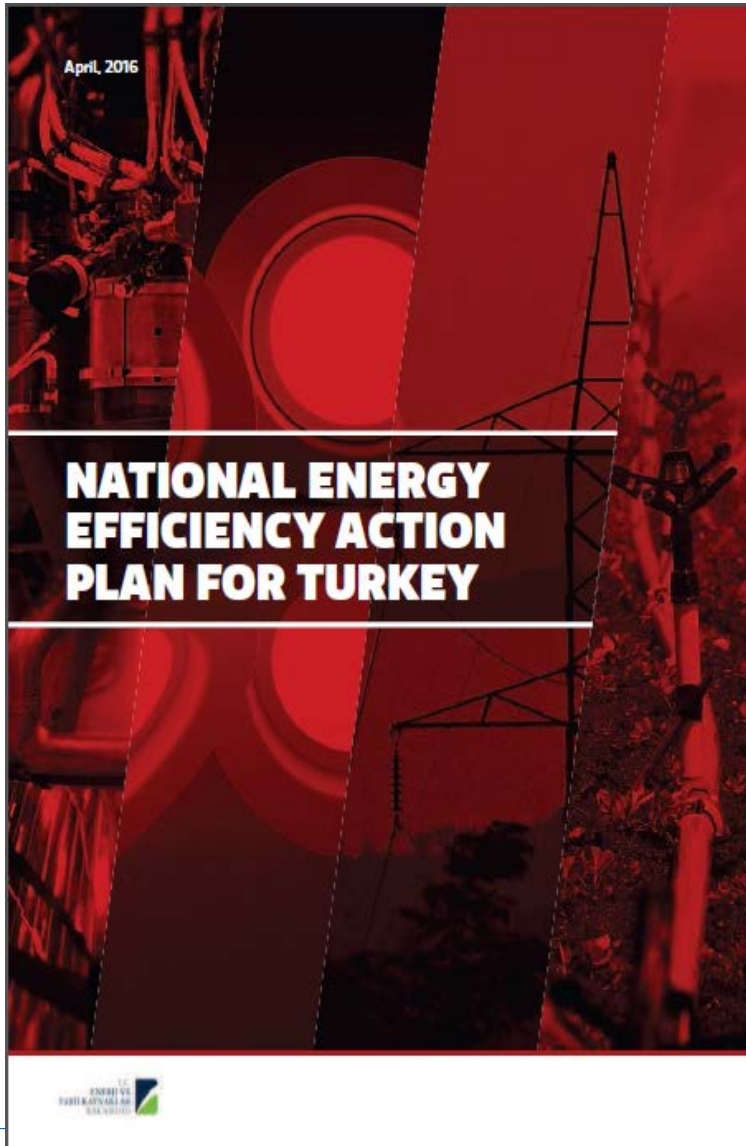
Alternatives

1. Establish time scopes for every activity of the process (with strict compliance).
2. Set a long term ender planning.

NEEAP Framework



European Bank
for Reconstruction and Development

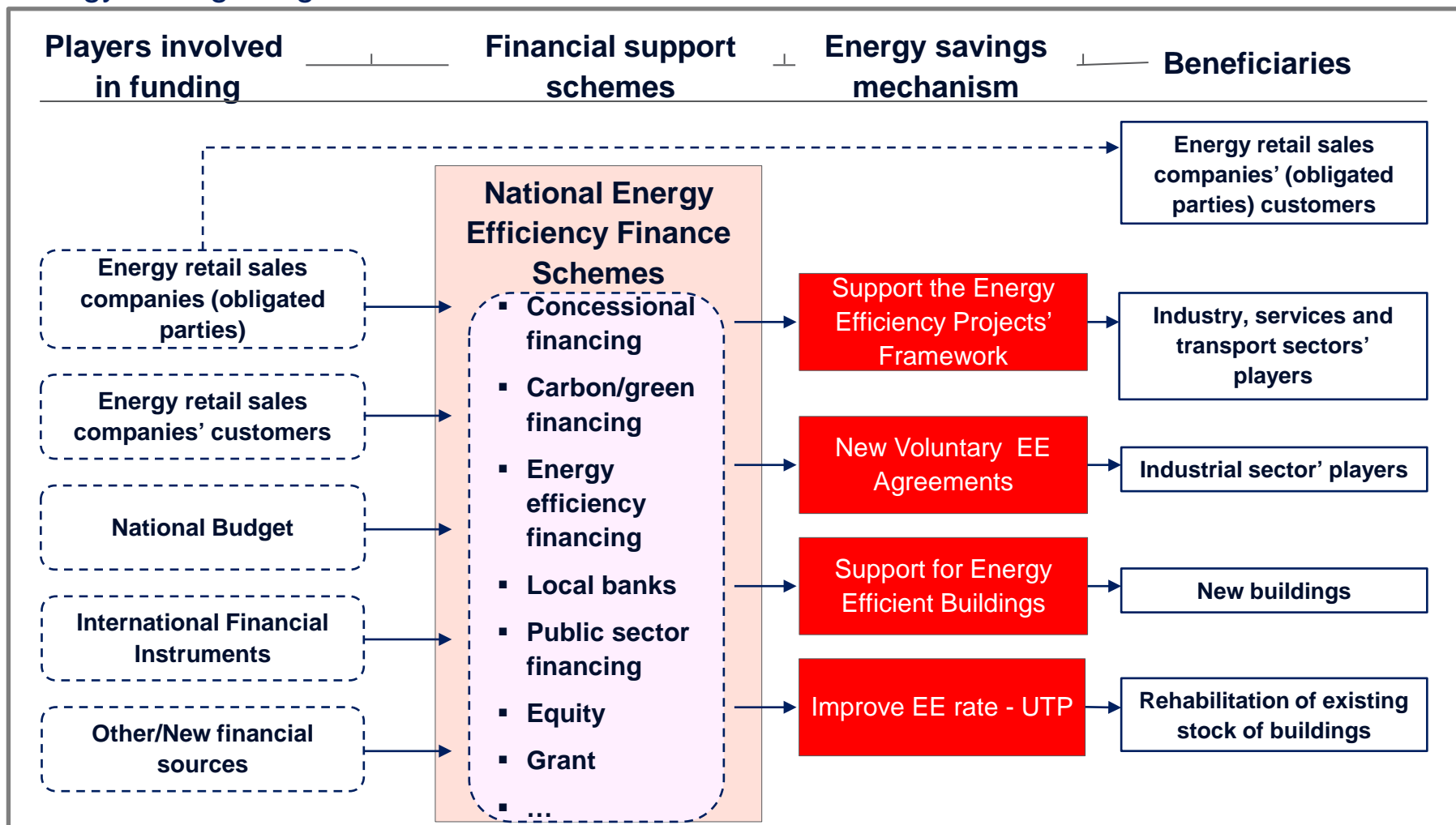


NEEAP Framework



European Bank
for Reconstruction and Development

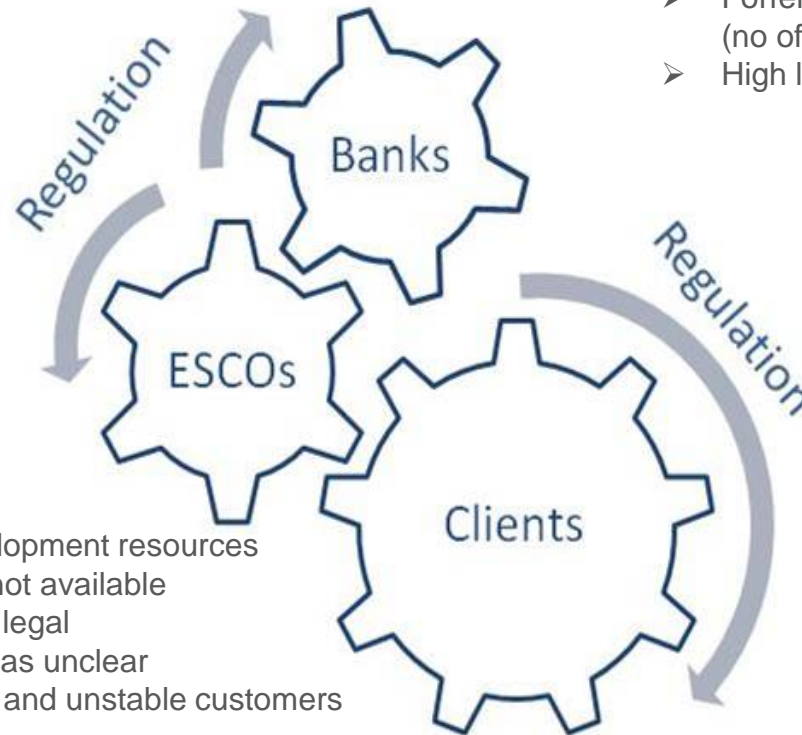
Operative scheme proposed for the National Energy Efficiency Finance Schemes focused on energy savings targets



Barriers to overcome in Turkey



European Bank
for Reconstruction and Development



Banks perspective

- ESCO projects considered as small and risky, therefore:
 - Forfeiting/factoring currently not offered in Turkey (no off balance sheet financing)
 - High level of collateral required

ESCO perspective

- Client lack project development resources
- Long term financing is not available
- Tender procedures and legal framework are perceived as unclear
- Lack of M&V protocols, and unstable customers

Public client perspective

- Lack of awareness and information
- Lack of expertise for developing ESCO projects
- Lack of budget funds
- A perceived lack of instructions for ESCO project implementation (procurement, budget code, Third Party Financing)

EBRD can support through (1) **policy dialogue** to improve the legal framework for enabling ESCO market development; (2) developing a **dedicated financing mechanism** that can be replicated by commercial banks; (3) Support public building owners through **project development**.

Carbon Markets

How big would Turkey be compared to rest of Europe?



European Bank
for Reconstruction and Development

Annual EU Member State CO₂ yearly allowances for Phase II (in million tonnes)

Selection of EU Member States and Turkey	2005 verified emissions	2008-2012 Cap allowed
Germany	474	453
Turkey*		Estimated 250
United Kingdom	242	246
Poland	203	209
Italy	223	196
Spain	183	152
France	131	133
Czech Republic	83	87
Netherlands	80	86
Other EU Members	501	519
Total		2080

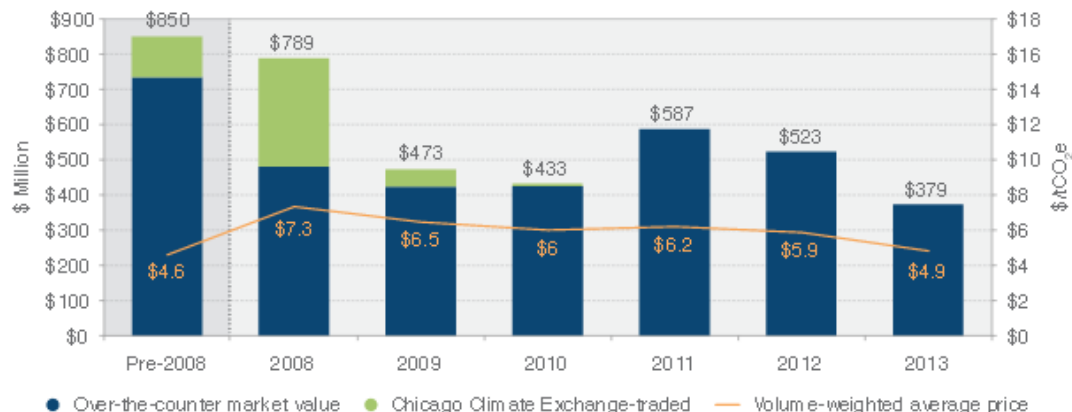
* Own estimation based on calculations

Voluntary Carbon Markets

Size and main players

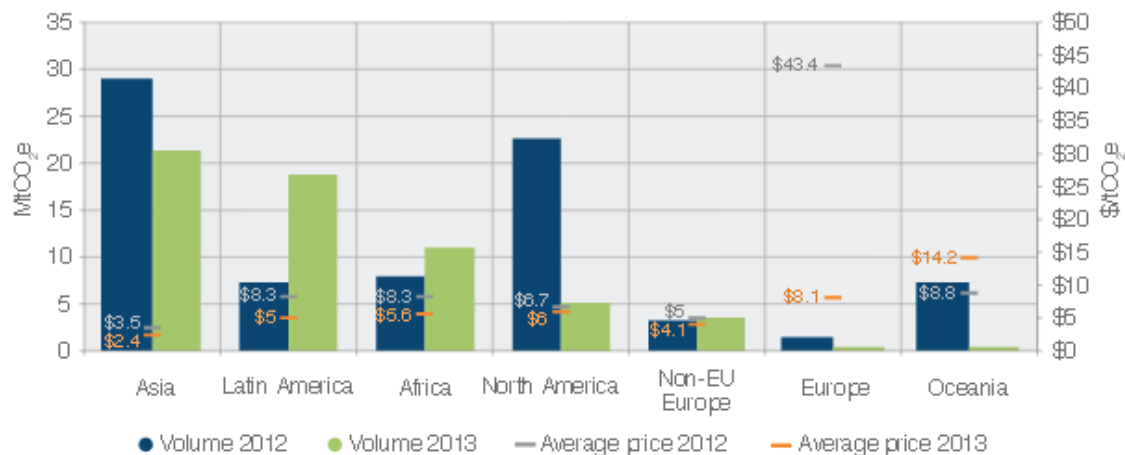


European Bank
for Reconstruction and Development



Notes: Based on responses representing 76 MtCO₂e in transacted offset volume.

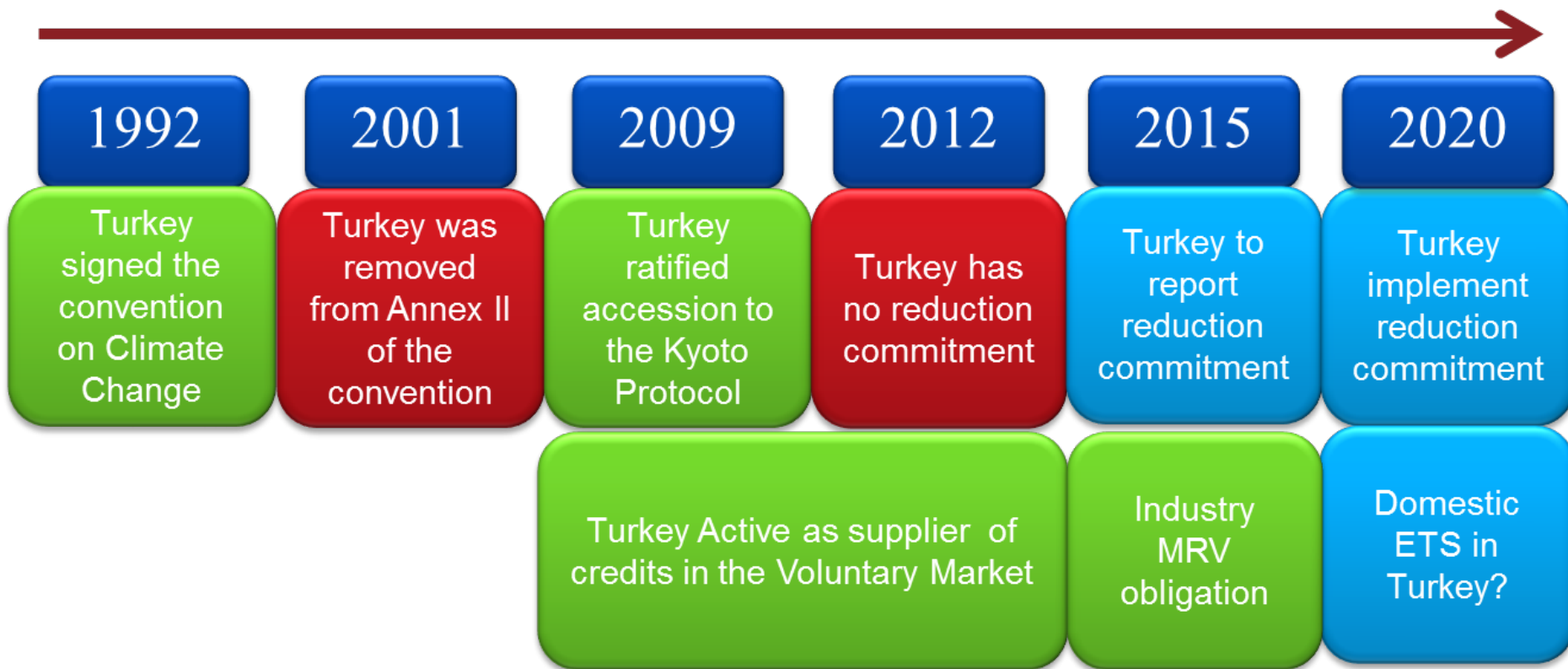
Source: Forest Trends' Ecosystem Marketplace. *Sharing the Stage: State of the Voluntary Carbon Markets 2014*.



Notes: Based on survey responses representing 62 MtCO₂e (2013) and 79 MtCO₂e (2012).

Source: Forest Trends' Ecosystem Marketplace. *Sharing the Stage: State of the Voluntary Carbon Markets 2014*.

Turkey in the Climate Change Negotiations



Turkish Climate Certificate

Government of Turkey

Private Sector

Company



Identify
Carbon Footprint

Commit
Formulate Reduction Target

Reduce
Opportunities within
boundary

Offset
Opportunities outside
boundary

Sets
norms

Accredits
verification
bodies

Issues
certificate

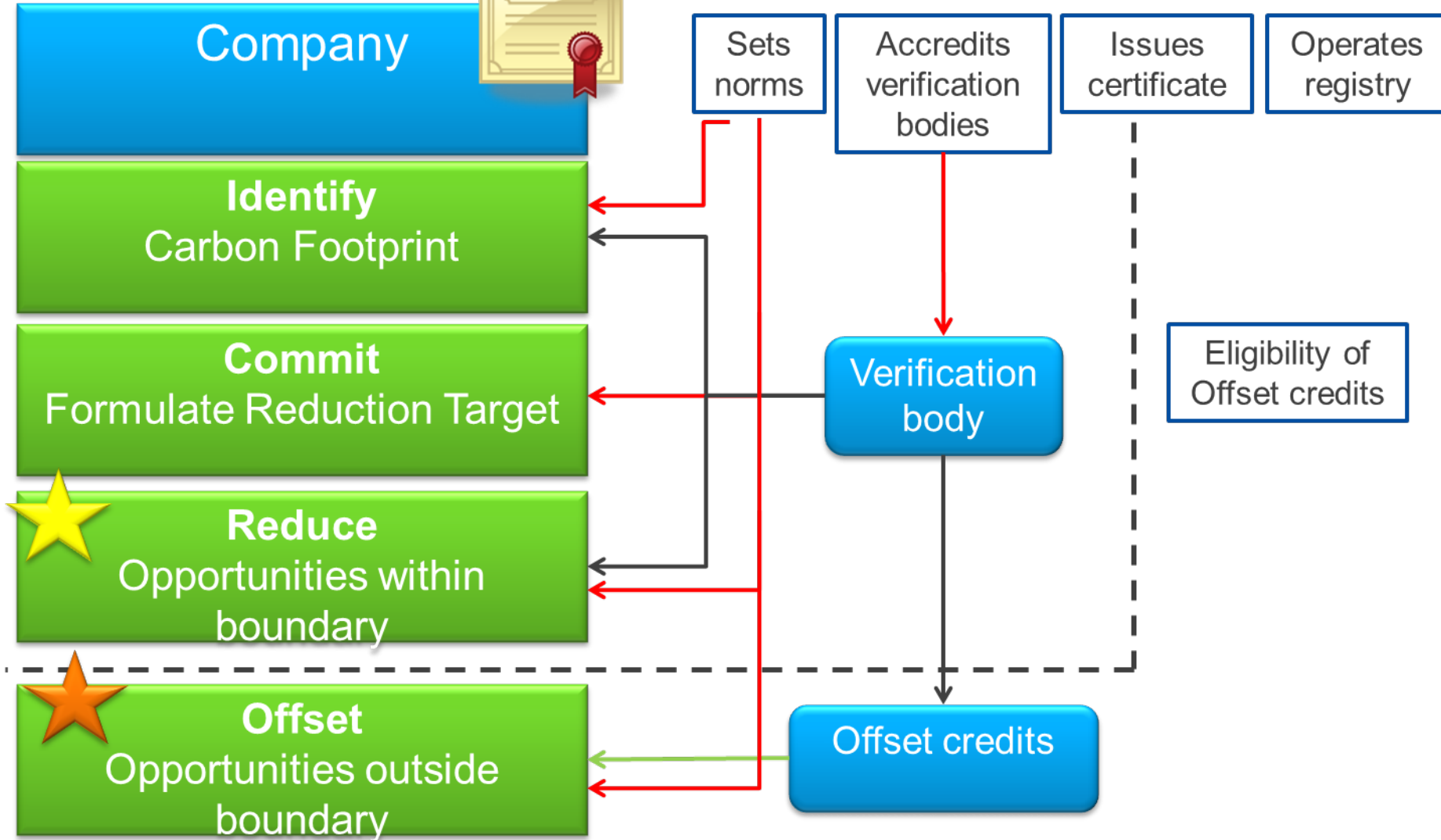
Operates
registry

Verification
body

Eligibility of
Offset credits

Offset credits

Optional



TCC Possible Coverage



European Bank
for Reconstruction and Development

Participants	Justification	Description
Tourism	Certificate can enhance attractiveness of Turkish holiday destinations to consumers	Hotel can position itself as climate friendly compared to other hotels for (foreign) tourist
Companies listed/to be listed at LSE or other exchange	Allows for attracting financing (requirement or tool to enhance)	Analysts at trading houses often use carbon efficiency to correlate overall efficiency of the company when they analyse attractiveness of listed company
General industries – avoid overlap with possible ETS system garments to export to EU need to	Certificate can cater to consumers with a preference for green products	Garments company can sell produce to foreign markets where carbon footprinting is required



For more information

Contact

Adonai Herrera-Martínez

Senior Manager

Energy Efficiency and Climate Change

EBRD, Kanyon Ofis, Istanbul, Turkey

MartineA@ebrd.com