pathways to
deep decarbonization
in Italy

Analysing Deep Decarbonization with technological and economic models

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Overview

- Description of DDPP (Deep Decarbonization Pathways Project)
- Italy Country Report
- Methodological approach and scenario definition
- Results from TIMES-Italy model
- Results from macroeconomic models
- Conclusions

Organization of DDPP

- Reaching the 2°C objective requires **profound transformations** in national energy systems and economies
- The project is a joint initiative Sustainable Development Solutions Network (SDSN-UN)/Institute for Sustainable Development and International Relations (IDDRI)
- It covers 16 countries (70% of global GHG emissions)
  - 16 country teams, independent of their governments
    - Expert judgment
    - National models
    - Policy relevance
- It adopts a transparent, iterative, collaborative, and not prescriptive approach

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Deep decarbonization at country level

Figure 3. (L) Average energy intensity of GDP for DDPP countries as a whole, 2010 and 2050. (R) Changes in energy intensity, 2010 to 2050, for individual DDPP countries.

Figure 4. (L) Average carbon intensity of electricity for DDPP countries as a whole, 2010 and 2050. (R) Carbon intensity of electricity in 2050, for individual DDPP countries.

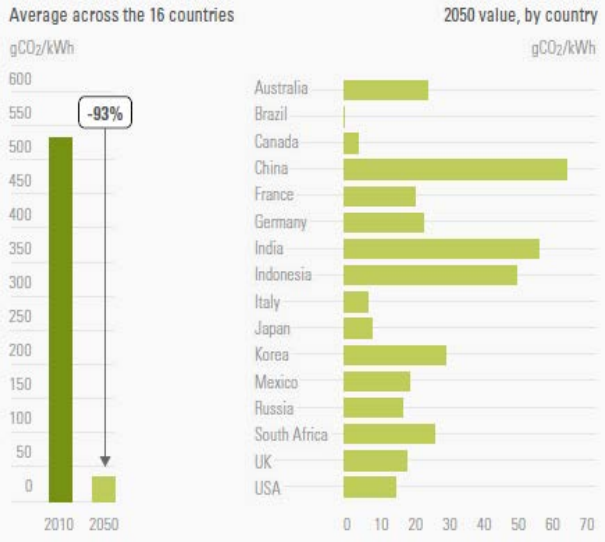
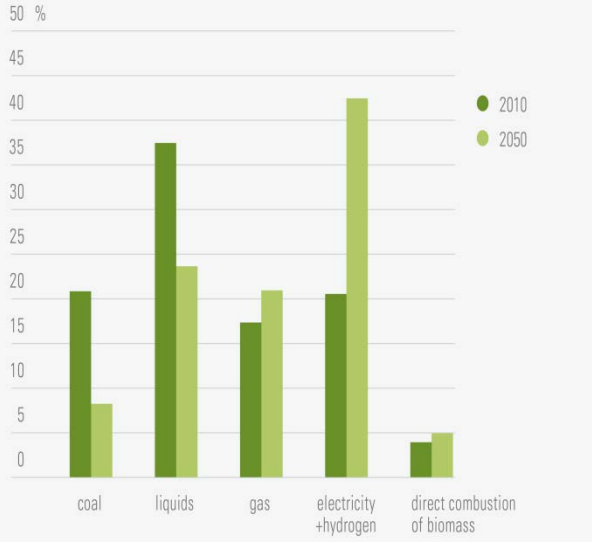


Figure 5. Share of different fuel types in final energy consumption.



Deep decarbonization is country specific in strategies, technologies, and sequences, but all countries need each of the three pillars:

Energy Efficiency,

Decarbonization of electricity

Strong electrification of final energy use.

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Italy Country Report

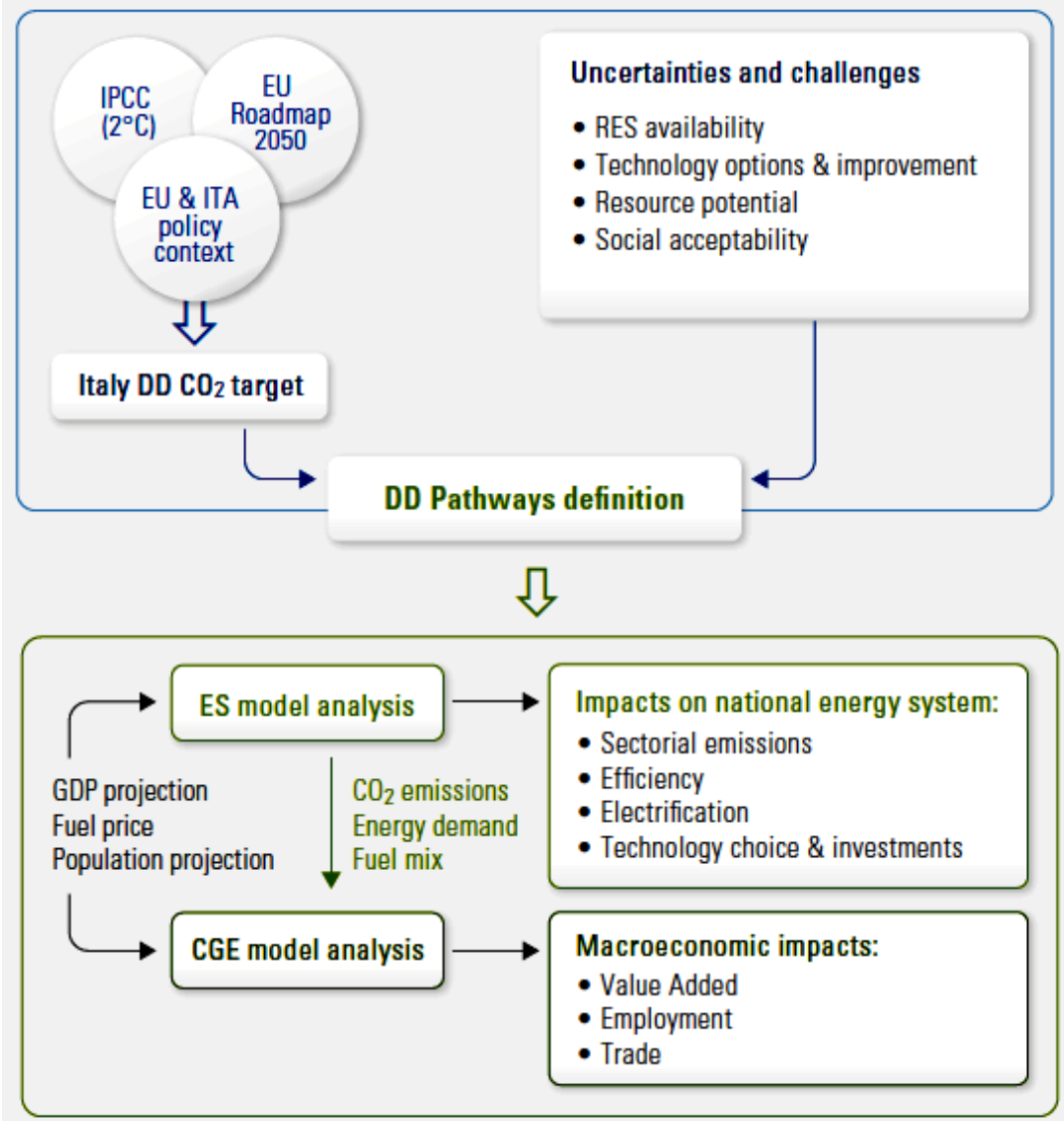
- Decarbonization objective: 80% reduction in 2050 CO_2 emissions relative to 1990.
- Aim of this study: providing useful insights to define a strategy to reach this objective.
- Three policy scenarios including different hypotheses for the penetration of key technologies, namely Energy Efficiency, Renewables and CCS.
- Energy system behaviour is analyzed by the linear optimization model **TIMES-Italy.**
- Macroeconomic impacts (GDP, Value Added, Employment and Trade Balance) evaluated using two Computable General Equilibrium models, **GDyn-E** (ENEA) e **ICES** (FEEM).

Key aspects – Italy peculiarities

Several peculiarities characterize the Italian energy system

1. Limited availability of fossil fuel resources and resulting high dependency on energy imports.
2. Italian energy mix has a higher share of gas and oil products, and a lower share of coal, compared to average EU levels.
3. Existing technological barriers in terms of competitiveness and high investment cost.
4. Potential problems in social acceptance of some technological options, in the case of energy efficiency due to the perceived risk of decrease in comfort.

Methodological Approach



Stage 1: Analysis of Italian energy system and its main challenges

Stage 2: Definition of main drivers of baseline and policy scenarios in the models used

Stage 3: Quantification of main energy trends in TIMES-Italy

Stage 4: Harmonization of drivers defined in Stage 2 with the TIMES-Italy in Stage 3 and macroeconomic evaluation with GDyn-E and ICES

Scenario Definition

❖ **Scenario RES + CCS (CCS)**
- High availability of RES and CCS
- High electrification in sectoral final energy use
- Energy efficiency

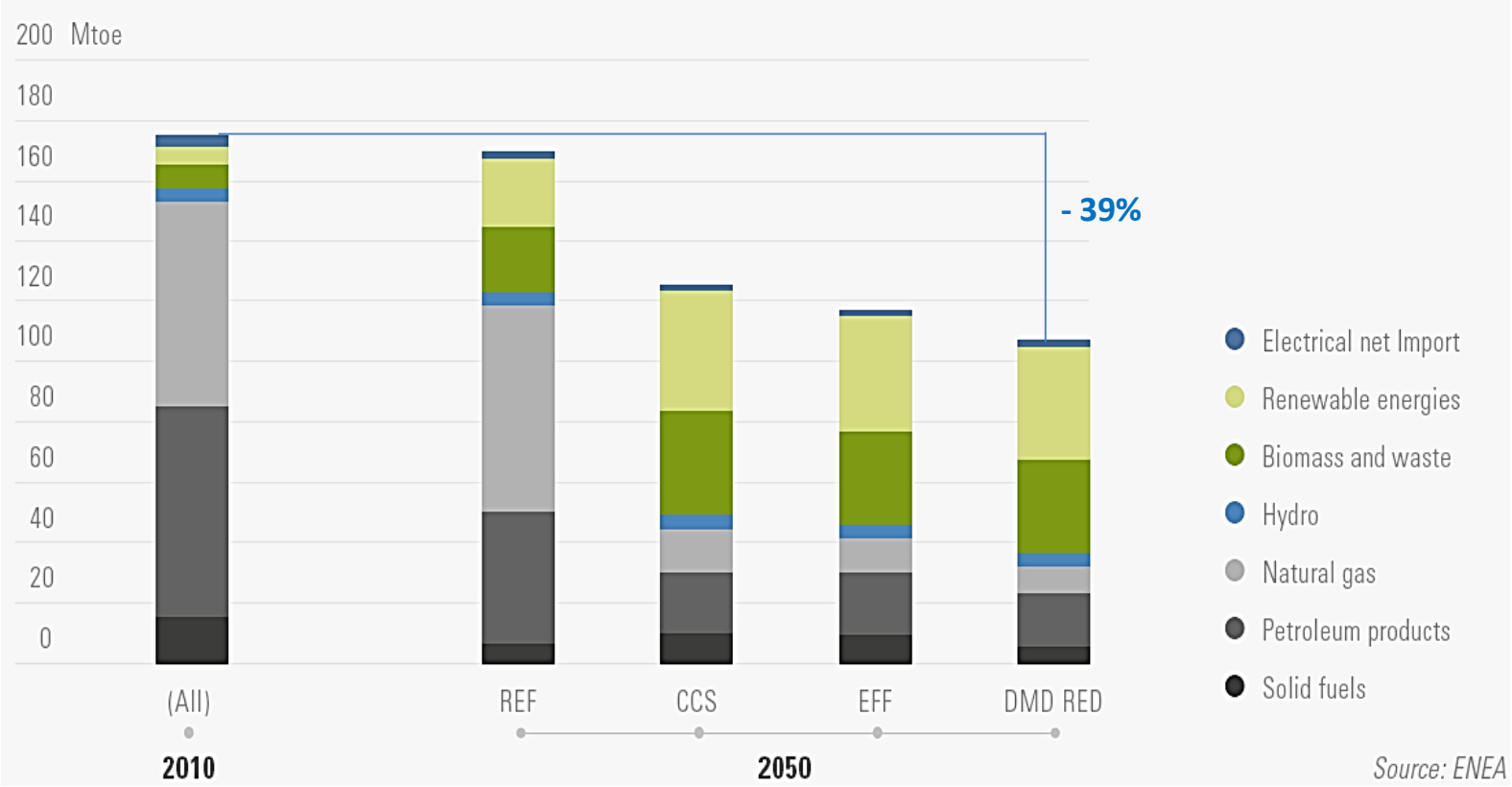
❖ **Scenario Energy Efficiency (EFF)**
- High availability of advanced energy efficiency technological options
- Relatively lower availability of RES for electricity generation

❖ **Scenario Demand Reduction (DMD_RED)**
- Limited technological availability, in particular of RES and CCS in industrial sectors
- Energy efficiency

		CCS	EFF	DMD_RED
Generation				
	Nuclear	-	-	-
	RES	+++	++	++
	CCS	+++	++	+
Electrification				
	Heat pumps, EV and PHEV	+++	++	++
	Fuel switch to electricity	+++	+	+
End-use sectors				
	Building retrofit	++	+++	+++
	Advanced eff. technologies	++	+++	+++
	RES for heat and transportation	+++	+++	++
	Fuel switch in final sectors	++	+++	+++
	CCS in Industrial sector	+++	++	+
Service demand in final sectors				
	Transport modal shift	+	+	++
	Reduction in Industry output	-	-	++

TIMES-ITALY - Energy dependency

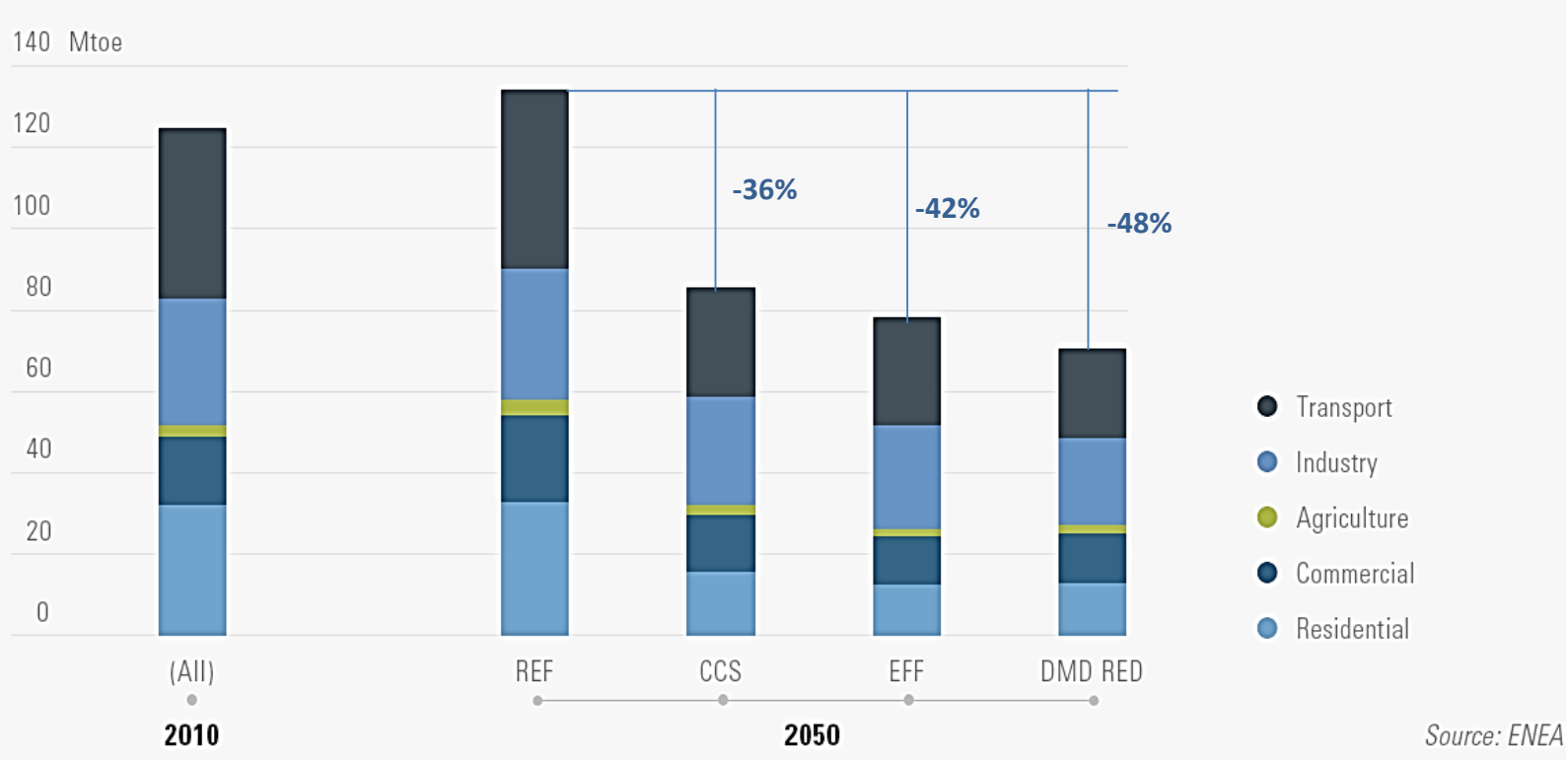
Primary energy by source – Mtoe



Energy dependency is significantly reduced from current 77% up to 30-35% in 2050 (70% in baseline scenario)

TIMES ITALY – Energy efficiency

Final energy use by sector - Mtoe



Civil sector: -(45-55%) vs REF

Industrial sector: -(20-34%) vs REF

Transport sector: - (38-49%) vs REF

Key aspects – policy scenarios

- Each of examied scenarios imply
  - an increase in Efficiency of Energy System
  - a Decarbonization of Power Generation
  - a strong Electrification of Final Energy Use
- **A deep decarbonization of Italian energy system can be achieved**

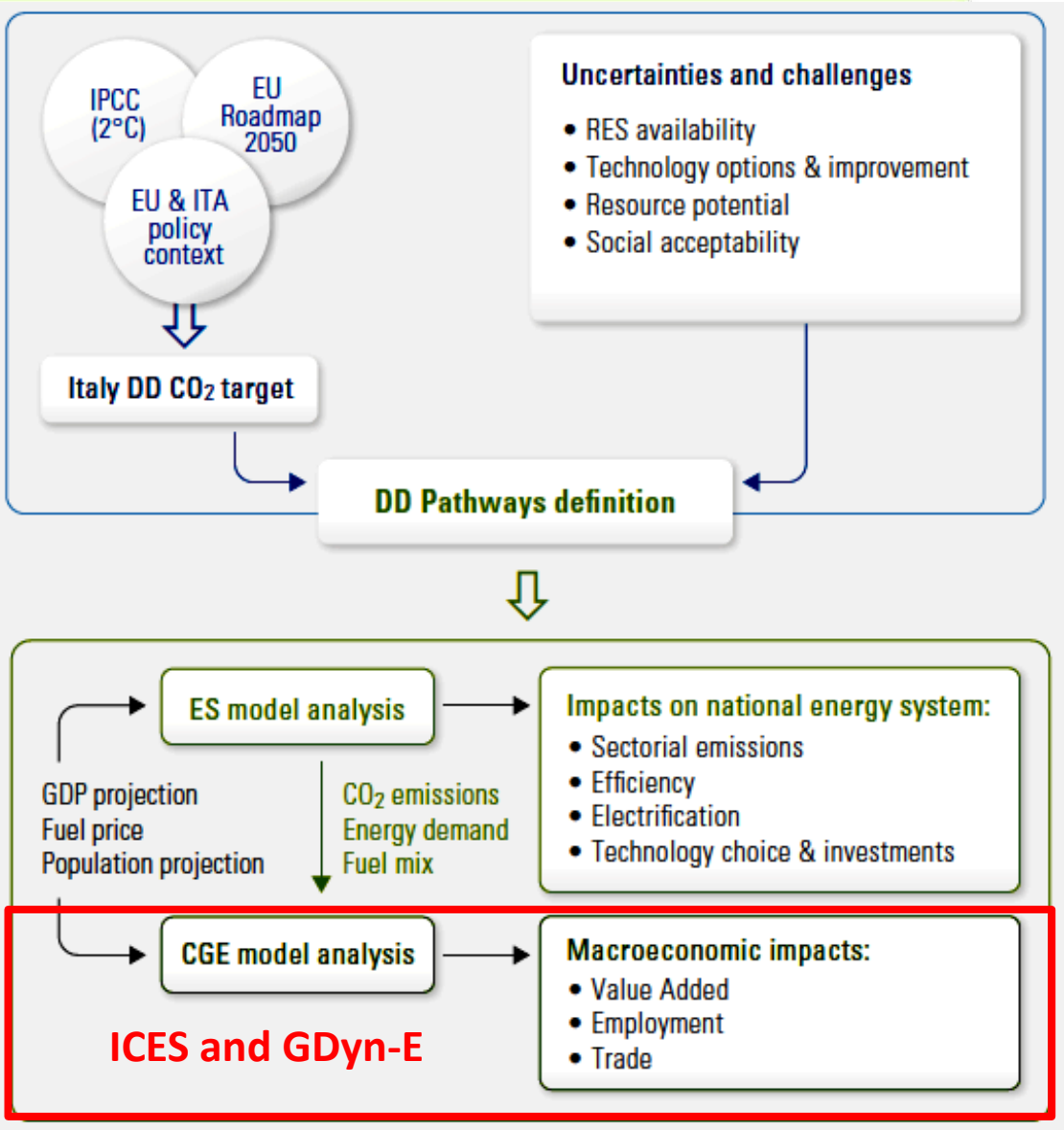
Key aspects – recommendations

- The availability of technologies able to produce less CO_2 emissions but also able to use less energy to provide the same energy service is a key factor
- R&D investments are required to enhance technology commercialization and adoption at sectoral level, together with appropriate public incentives to influence their costs
- Transition policies could be required to adapt to the reduced role of fossil energy sources, due to increasing energy efficiency and penetration of reneweables
- Different impacts would arise according to the economic sector, and could be addressed by specific policies

Macroeconomic analysis

Which are the possible implications for Italian economy?

Imports, employment, GDP



Models for macroeconomic analysis

ICES (FEEM) e GDyn-E (ENEA)

- Long-term (2050) models of all economic sectors
- Production and consumption processes
- International trade flows
- Emission flows from production and consumption of fossil fuels
- Energy efficiency in industrial and residential sectors
- Renewable technologies and CCS

Macroeconomic and energy hypotheses

GDP	Europe and Italy: European Commission Rest of the world: Energy Technology Perspectives (IEA)
Population	World Bank
Labour force	International Labor Organization
Primary energy mix	Italy: TIMES-Italy Europe and rest of the world: Energy Technology Perspectives (IEA)

Climate policy hypotheses

Baseline scenario

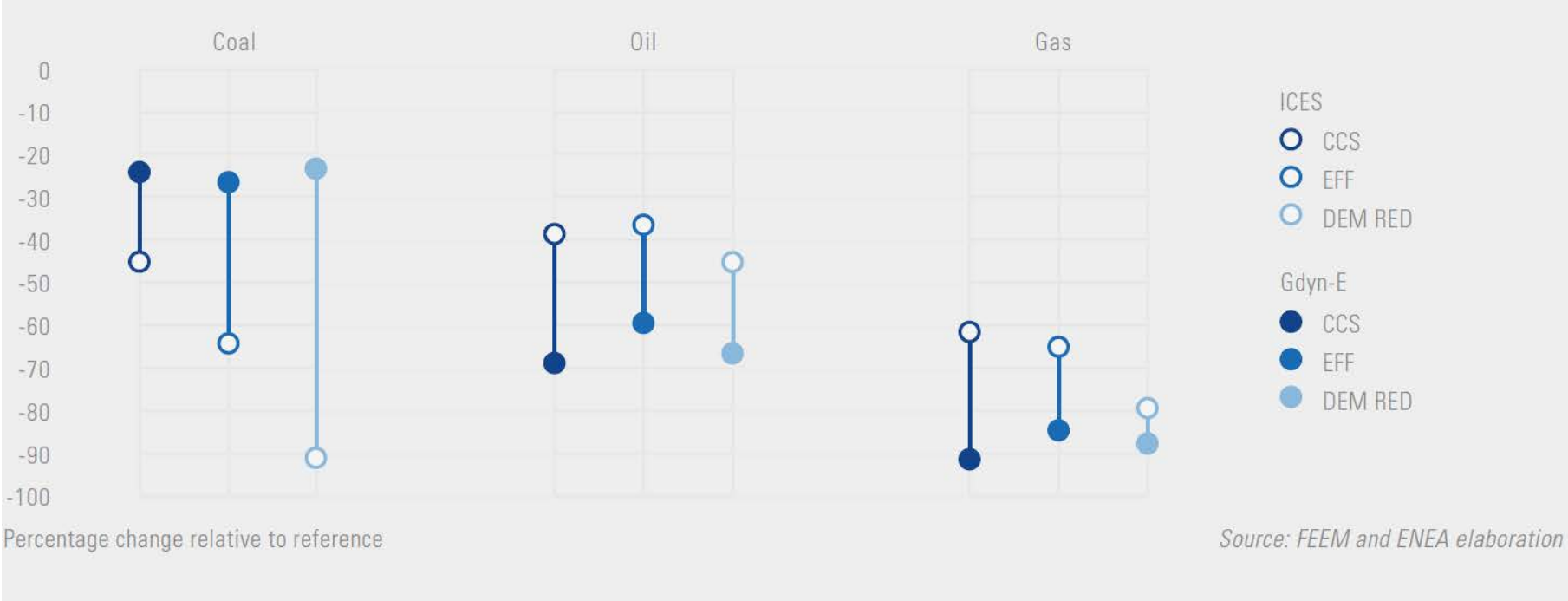
CO_2 emission reduction	Current and announced policies (4DS ETP IEA)

Decarbonization scenarios

CO_2 emission reduction (2050 vs 1990)	Italy: -80% (EU) Europa: -72% (EU) Mondo: -31% (IEA)
Technologies	Energy efficiency in final energy use, Renewables, CCS
Cooperation	No international or regional coordination

Results: energy imports

Imports change in 2050 (%)



A higher energy efficiency and fossil fuels substitution with renewables reduce import dependency

Results: employment

Employment change in 2050 (%)

The adoption of energy efficiency and renewable thecnologies increases employment in energy intensive sectors, connected to specific goods fundamental for these technologies

Results: growth

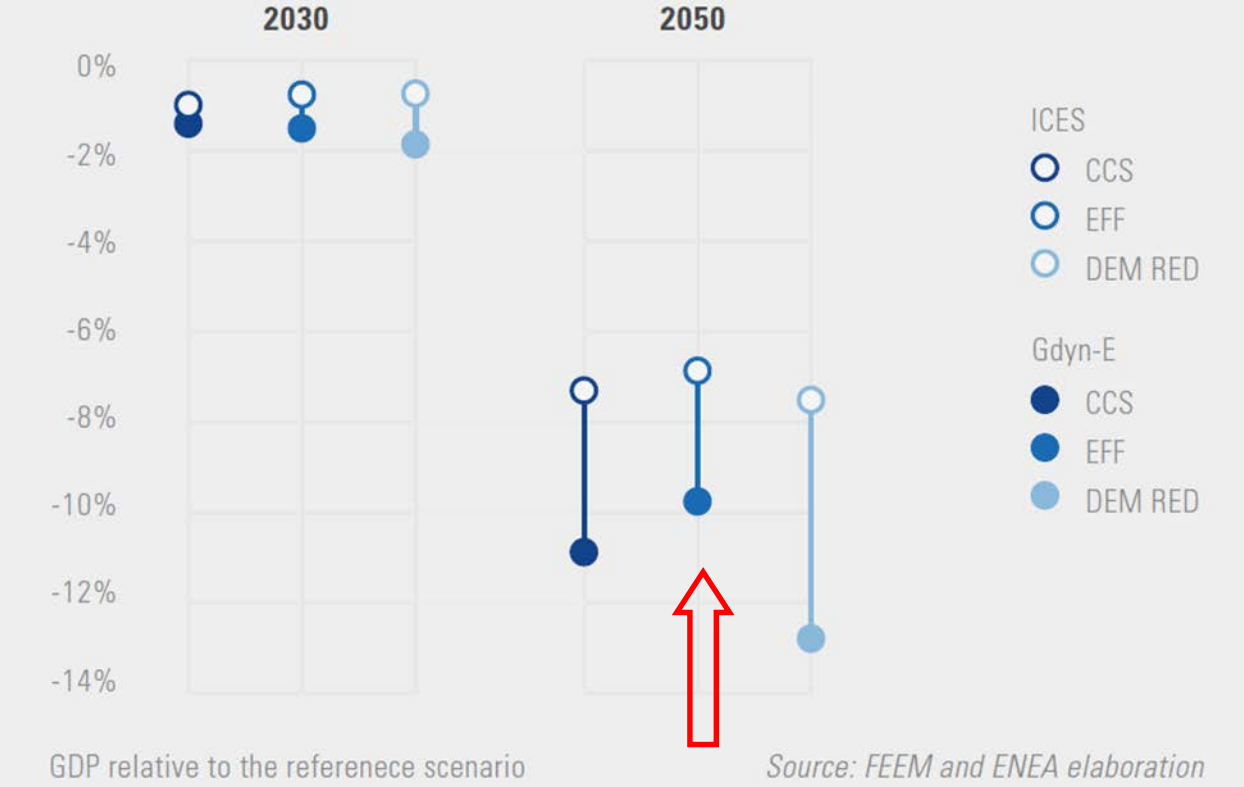
Real GDP average growth rate
2010-2050 (%)

	ICES	GDyn-E
Baseline scenario	**1.2**	**1.2**
Decarbonization scenarios		
CCS	**1.1**	**0.9**
EFF	**1.1**	**0.9**
DEM_RED	**1.0**	**0.8**

Economy will continue to grow, but at a slower rate

Risultati: PIL

GDP change in 2050 (%)



Without international cooperation and ambitious investments in technologies and infrastructures, reducing emissions by 80% would imply a GDP decrease

Conclusions

Radically rethinking how energy is consumed and produced

Investments are needed relative to

- **R&D, both in public and private sector**
- **Technology and infrastructures**
- **Education and sensibilization**
- **International cooperation**

What would be needed

- Concentrating policy interventions on more promising technologies
- Investing to improve the efficiency of power grid, with the ultimate goal of developing smart grids
- Ensuring a clear and stable regulatory framework
- Providing stimulus for public-private partnerships
- Strenghtening an industrial development strategy
- Implementing a education and awareness raising project on decarbonization issues
- Intensifing international technology and climate cooperation
- Fostering a framework for citizen participation to the deep decarbonization process

Thank you for you attention

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Pathways to Deep Decarbonization in Italy

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http://deepdecarbonization.org/