An Assessment Of Romanian National Determined Contribution (NDC) to Climate Change Mitigation

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Outlines

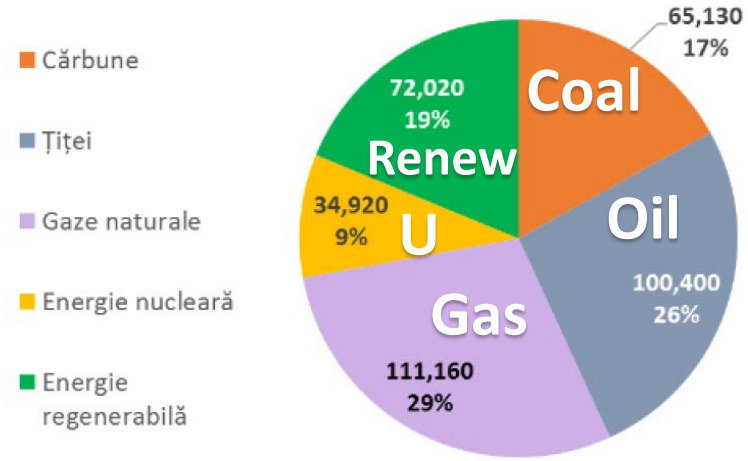
- Romania general overview, energy situation and role of nuclear energy sector
- Possible **N**ational **D**etermined **C**ontributions (**NDC**s) and those considered in analysis
- Scenarios Description (Basic, NDC50, NDC70 and NDC90)
- MESSSAGE Model (Demand, Load regions, Tech. Chain)
- **Results**: Electricity, Heat & Oil Production, Shadow Price of Electricity, National NDC (ktons of CO_2 emission avoiding);
- Conclusions and Recommendations.

Romania Overview

- Romania is an East European Country
- 20 millions people,
- 238, 391 sq. km, temperate-continental climate, 4 seasons

Romanian Primary Energy Share (2015)

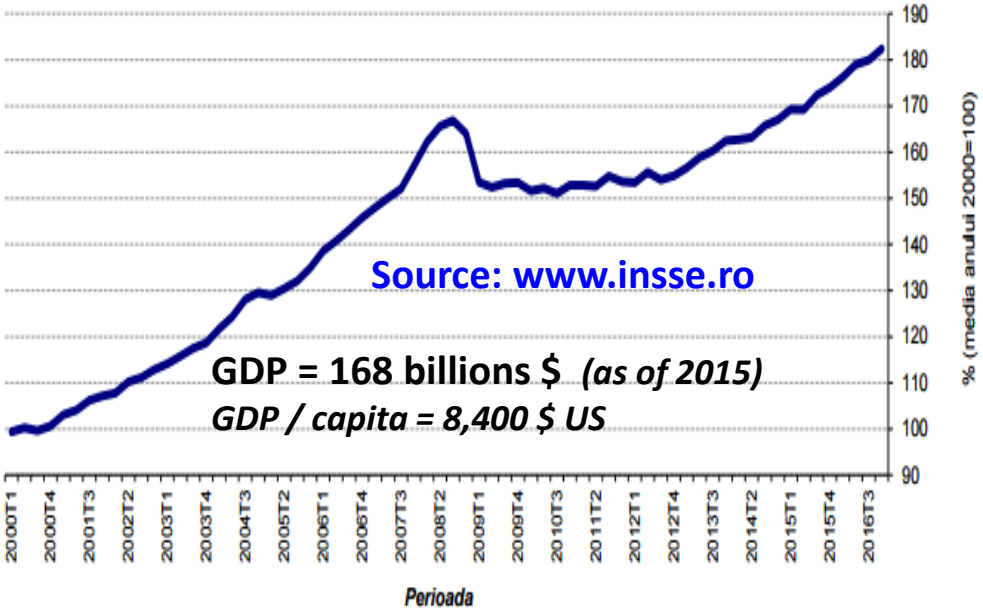
2015 - 377 TWh



Gas ~29%
Oil ~26%
Renew ~19%
Coal ~17%
Uranium ~ 9%

TOTAL ~377 TWh

Source: www.energie.gov.ro

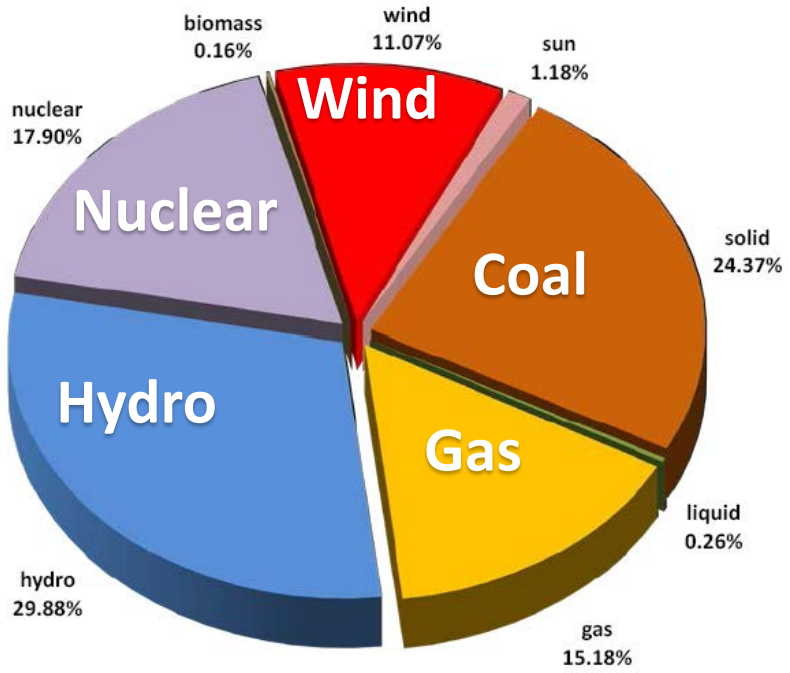


Source: www.insse.ro

GDP = 168 billions $ ***(as of 2015)***

GDP / capita = 8,400 $ US

Romanian Electricity Generation (2016)



Hydro ~30%
Coal ~25%
Nuclear ~18%
Gas ~15%
Wind ~11%
Solar ~1.2%

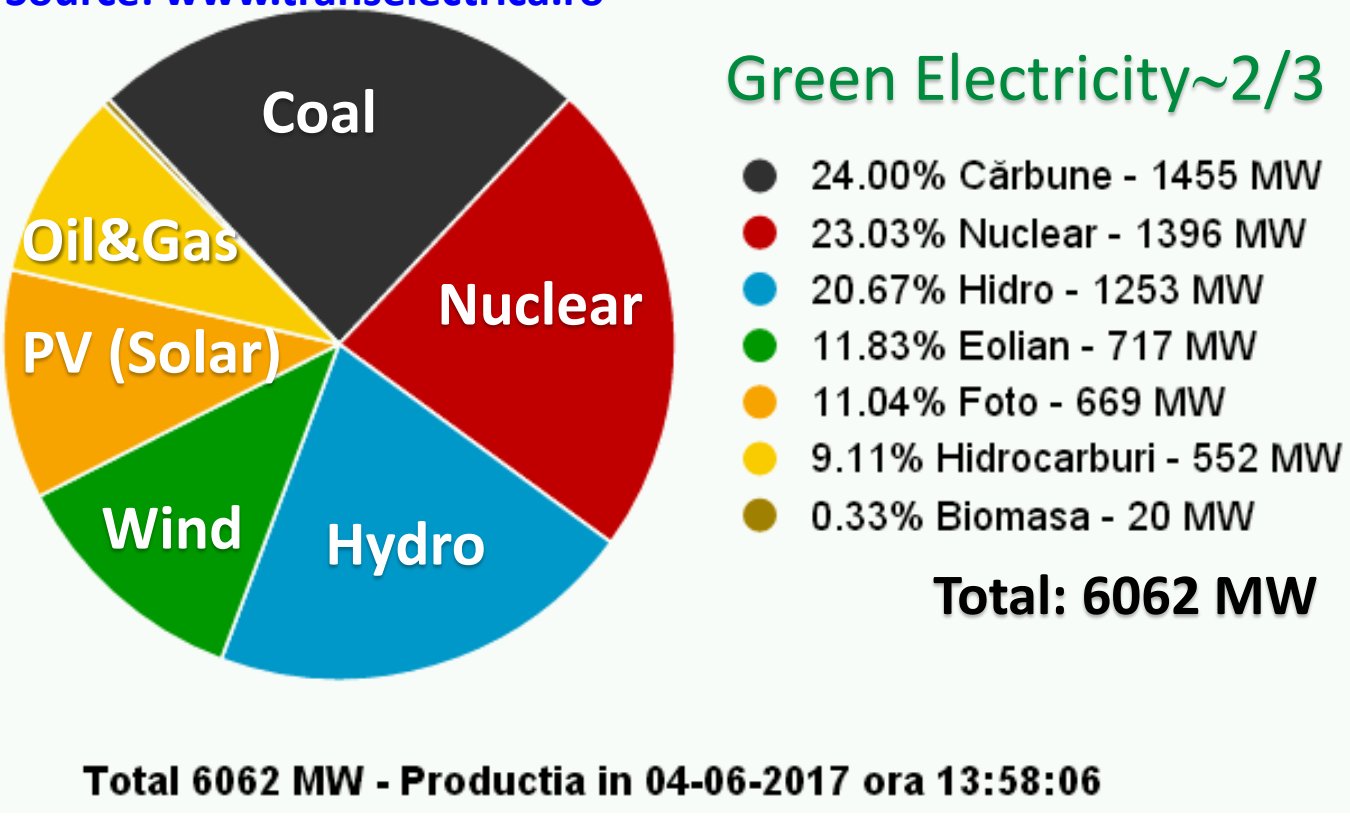
Green Electricity~60%

Source: www.insse.ro

Instantaneous Electricity Production

as by 2017, June, 4

Source: www.transelectrica.ro



- Nuclear energy plays an important role in Romania
- Romanian Gov. Commitment to accomplish U3,4 in Cernavoda NPP & supporting ALFRED building in Romania

Possible NDCs and those considered in Analysis

- Following the European Union's energy policies (20/20/20 by 2020), Romania has introduced renewable energy support mechanisms to stimulate the development of renewable energy (hydro, wind and solar);

NDC considered in Analysis:

- introducing adv. Coal PP with low emissions

  (**0.4** ktonsCO2/Mwyr, 8 times less than an old one, **3.2** ktons/MWyr);
- **1,400** MW in Nuclear Power (other 2 CANDU Units in Cernavoda NPP by 2025);
- up to **1,000** MW new Hydro PP by 2020;
- Increasing share of renewables (wind, solar, hydro) ;
- decommissioning up to **3,000** MW in old coal PP by 2025.

Basic Scenario Assumptions

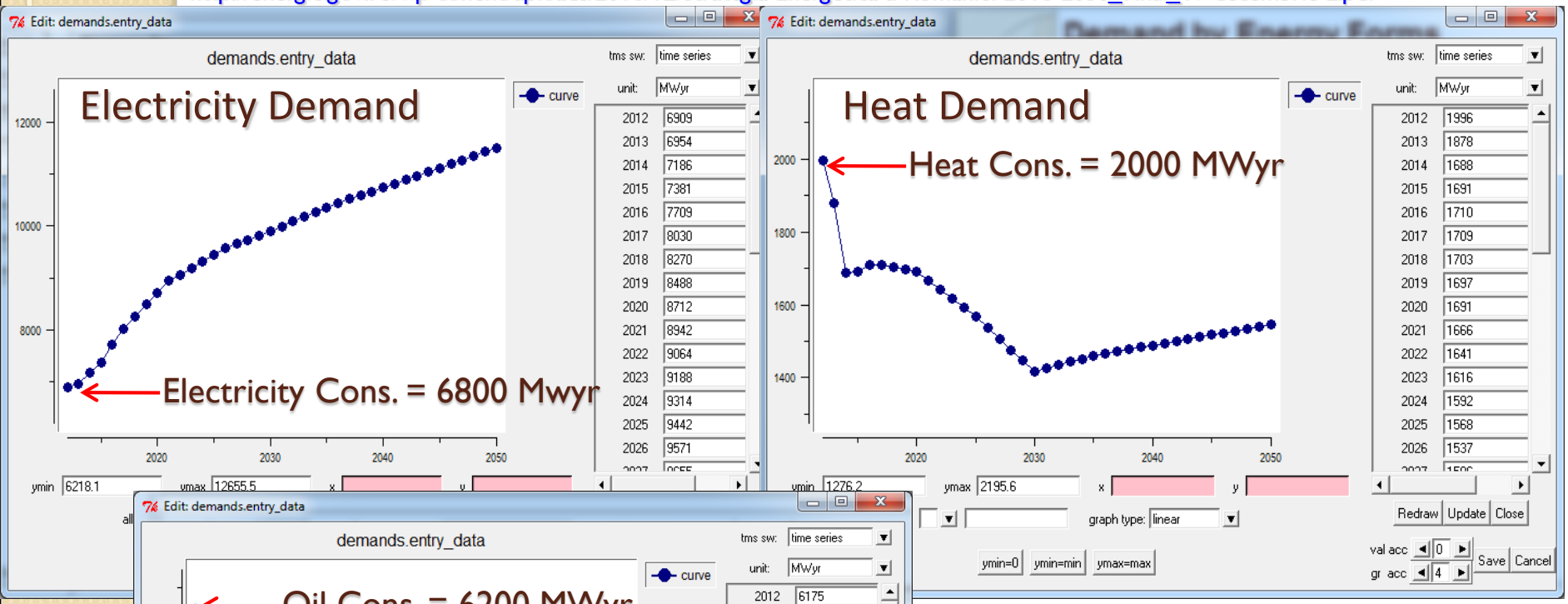
- Modeling Period: **2012** (ref.), 2013-2050 year by year
- Oil Import Price = **100** $/KWyr, cg 1.05%/yr
- No Uranium import;
- No CO2 emission Taxes;
- No Carbon **C**apture & **S**torage **T**echnologies (**CCS**);
- Simply model of Heat, produced only by 2 tech. (Oil & Gas) in generic Power Plant (no biomass burning by individuals considered),

NDC50, NDC70 and NDC90 Scenarios

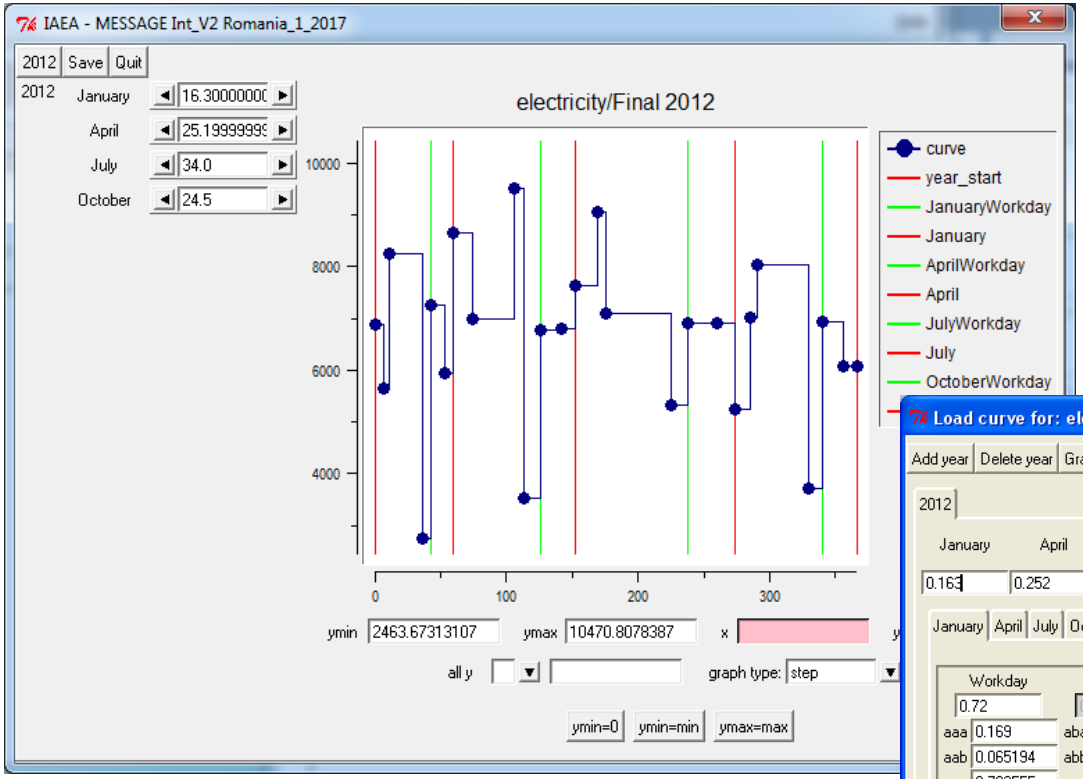
- **50%, 70%, 90%** CO2 emission reducing till 2050, respectively (RO1NDC50, RO1NDC70, RO1NDC90) from **2012** levels
- 2012 CO2 emissions: **15,000** ktons

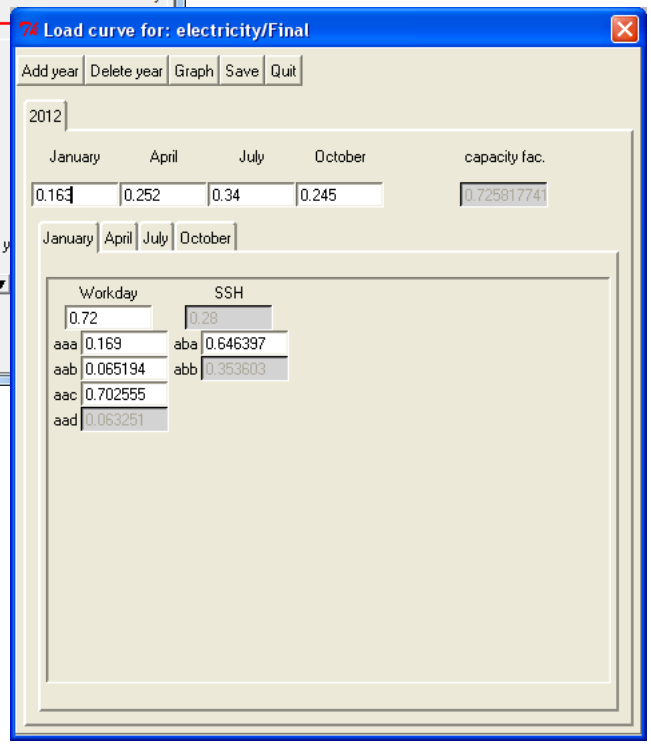
Demand by Energy Forms (in Mwyr)

Romanian Ministry of Energy, "Romanian Energy Strategy for 2016-2030, with perspectives for 2050", (in Romanian)
http://energie.gov.ro/wp-conent/uploads/2016/12/Strategia-Energetica-a-Romaniei-2016-2030_Final_19-decembrie-2.pdf



MESSAGE Model: Load Regions for Electricity





4 seasons, 2 type of days, 4 parts of a day

Energy Flow Chain in Romania MESSAGE Model

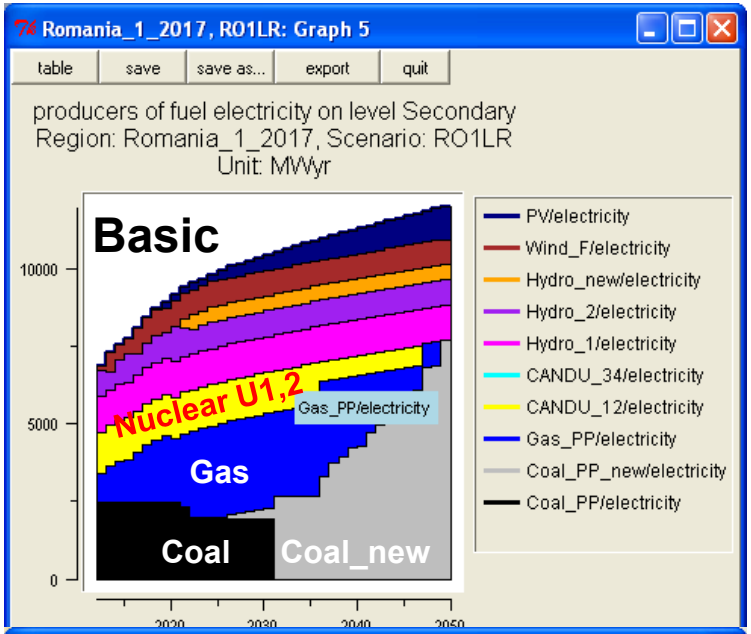
Level	Energyform	Producers	Consumers
Resources	Coal		Coal_Extr
	Gas		Gas_extr
	Oil		Oil_Extr
	Uranium		U_conv
Primary	Coal	Coal_Extr	Coal_PP Coal_PP_new
	Gas	Gas_extr	Gas_PP Gas_Heat
	Oil	Oil_Extr Oil_imp	Oil_Heat Oil_TD
Front-end	U_conv	U_conv	U_fuel
	U_fuel	U_fuel	CANDU_12 CANDU_34
Back-end	fromCore		Fr_core12 Fr_core34
	dummy	Fr_core12 Fr_core34	
Secondary	electricity	Coal_PP Coal_PP_new Gas_PP CANDU_12 CANDU_34 Hydro_1 Hydro_2 Hydro_new Wind_F PV	Ele_TD
	heat	Oil_Heat Gas_Heat	Heat_TD
Final	electricity	Ele_TD ADD_Ele	
	heat	Heat_TD ADD_Heat	
	oil	Oil_TD	

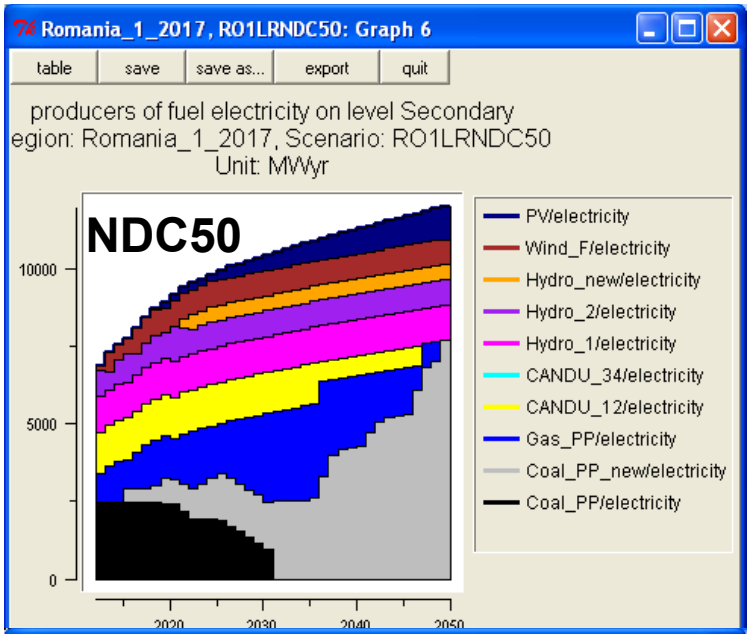
IAEA RTC on Evaluation of Cost-Effective Energy Technologies, including Nuclear Power, as Nationally Determined Contributions to Climate Change Mitigation

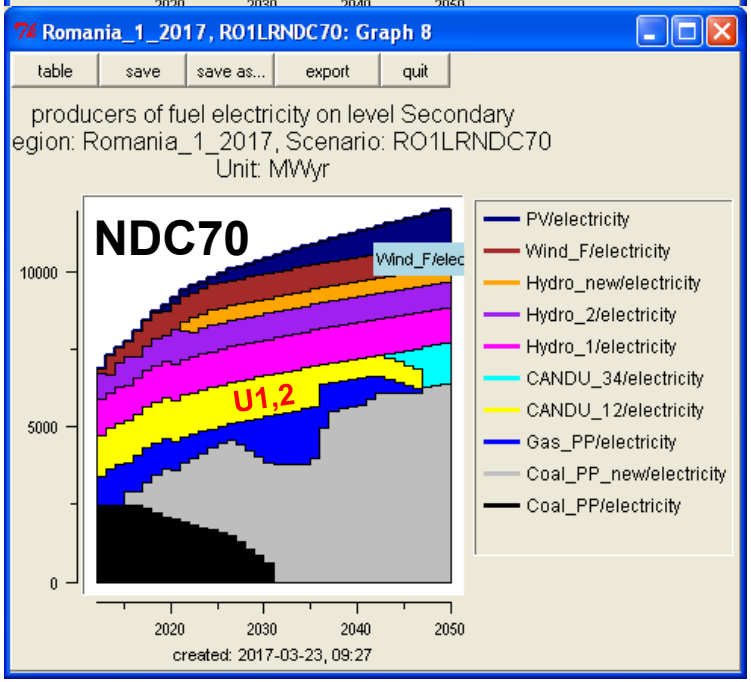
Pitesti,Romania,
13-24 March 2017

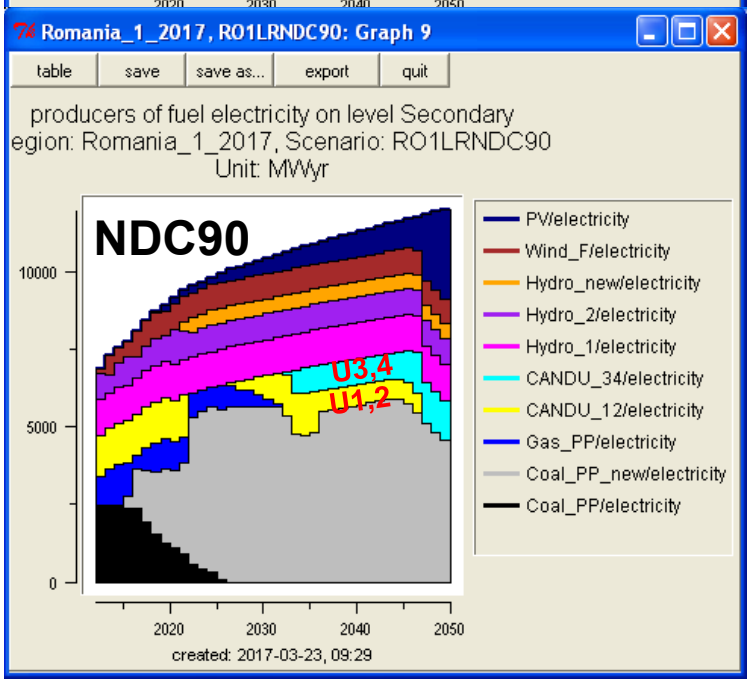
CO2 constraint in group 1 applied for all fossil fuel based tech.

Electricity Production

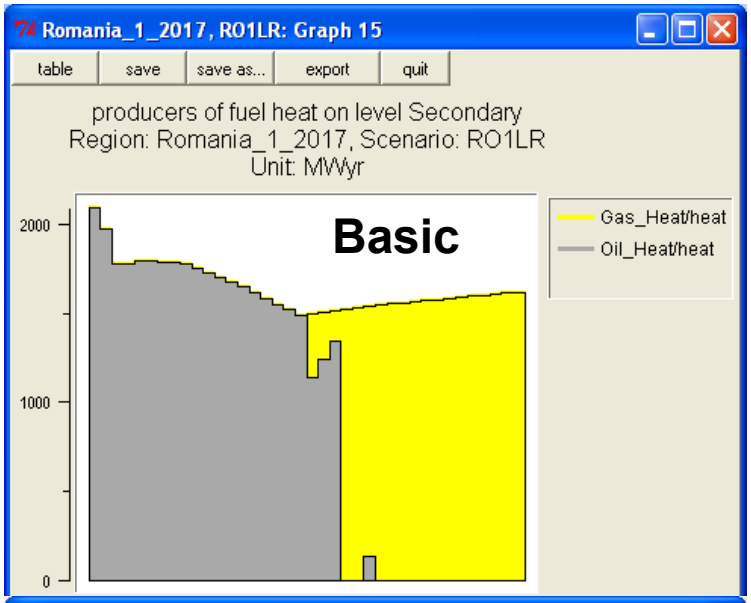


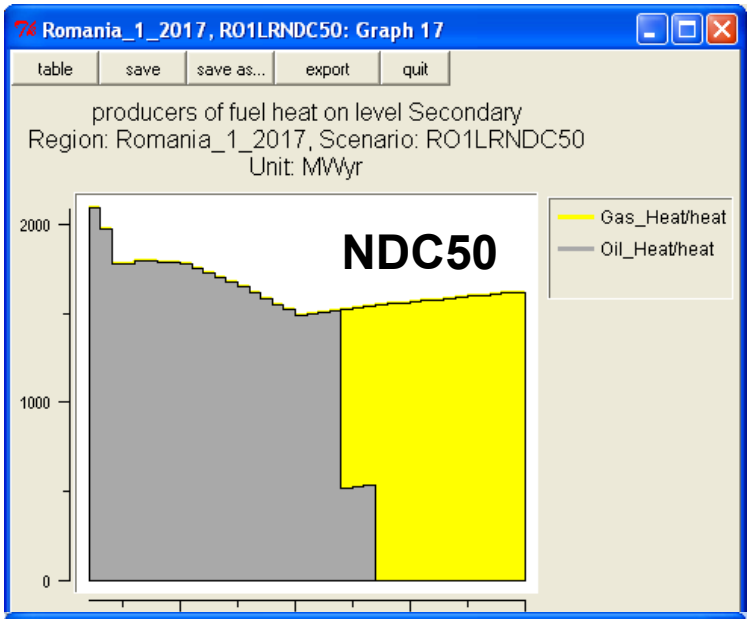


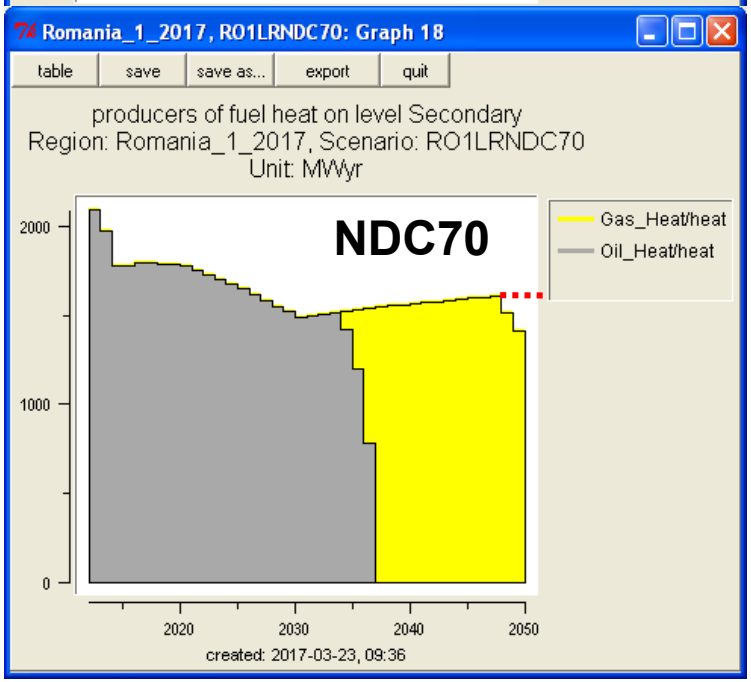


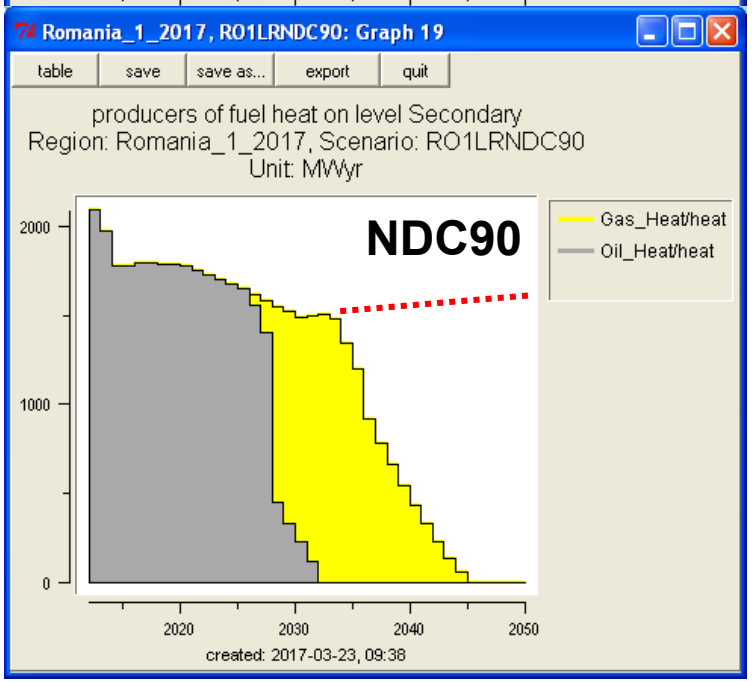


Heat Production / Secondary

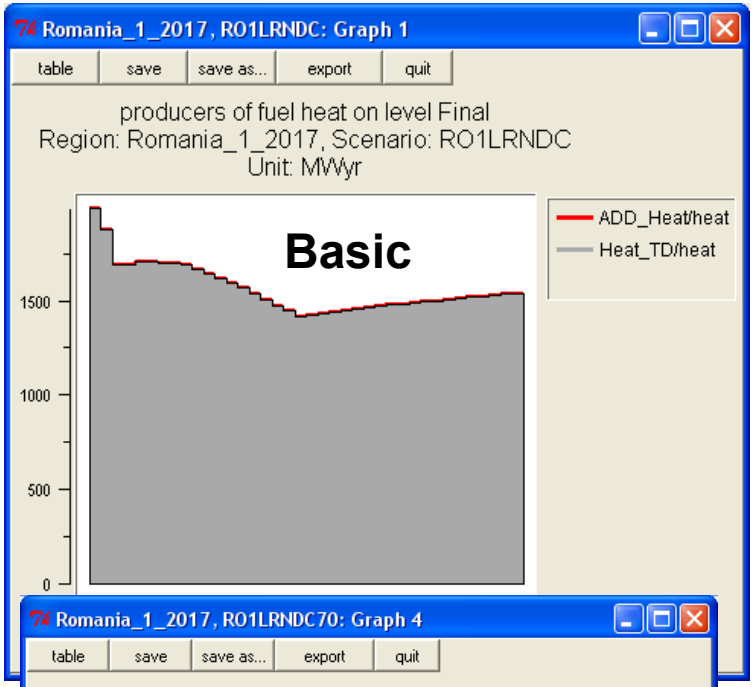


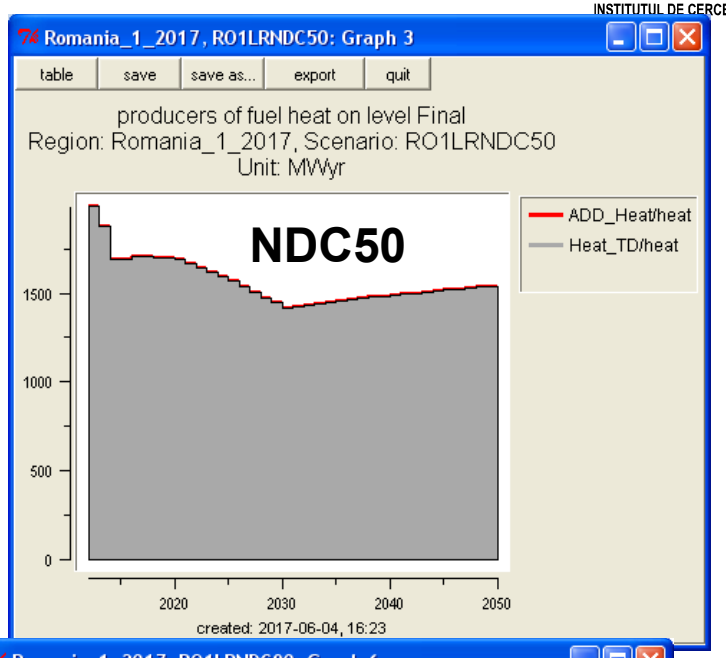


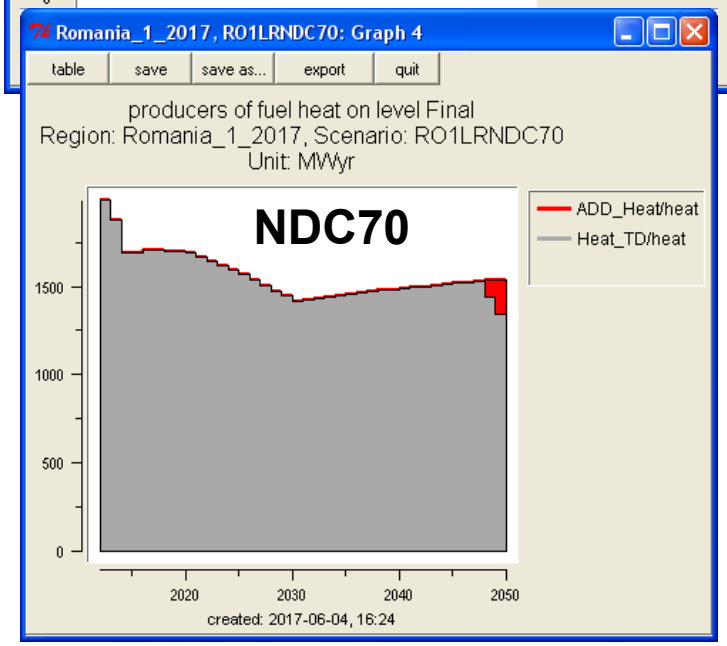


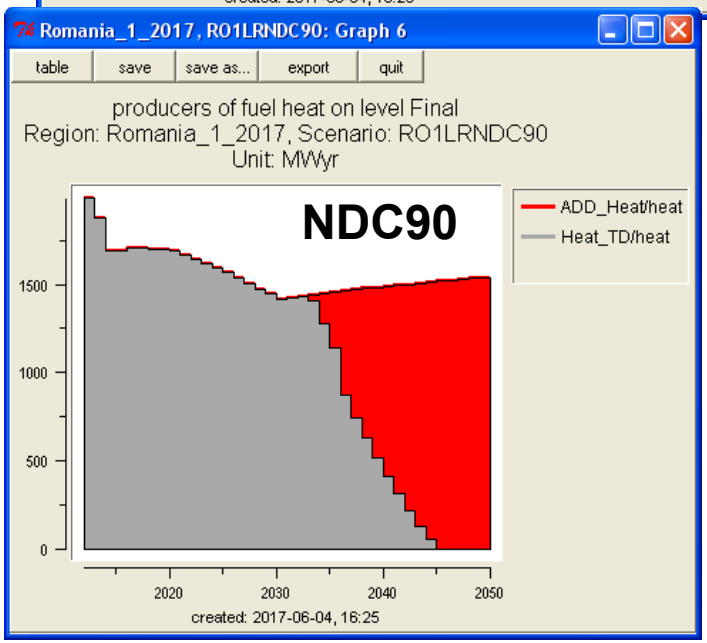


Heat Production

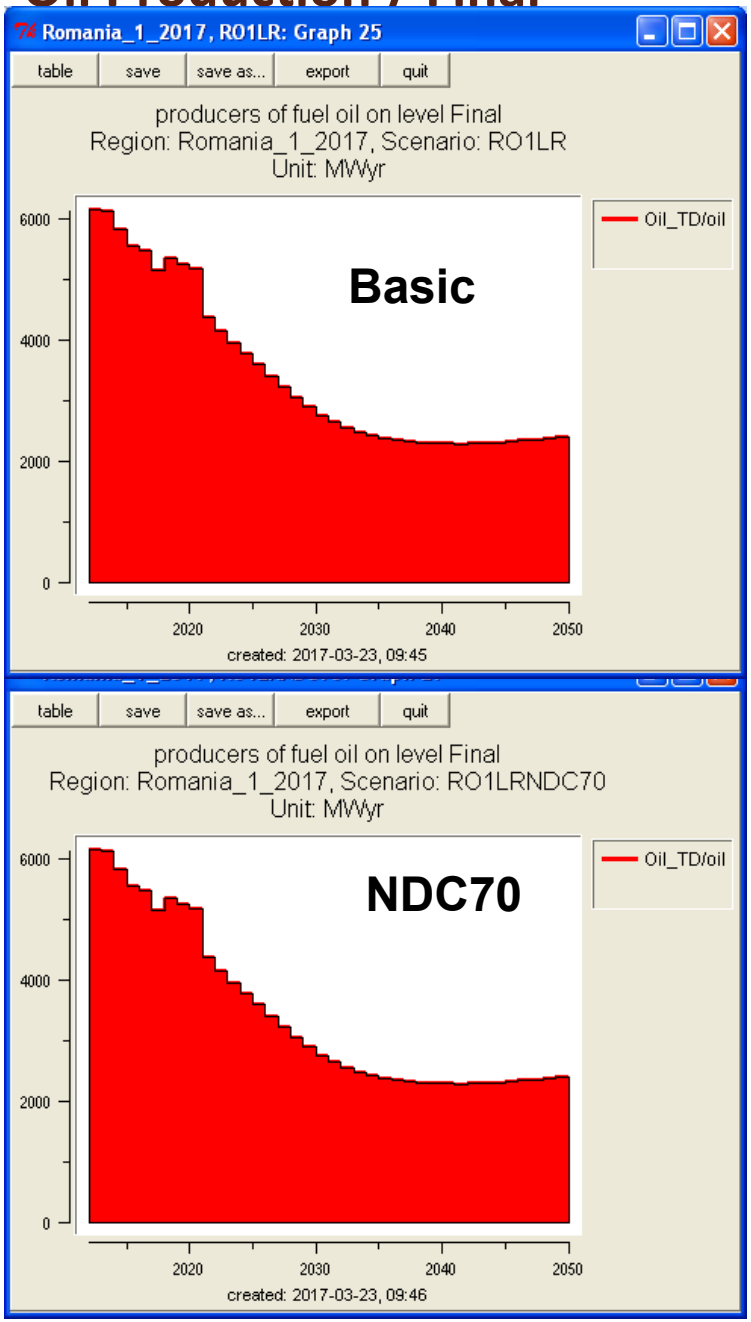


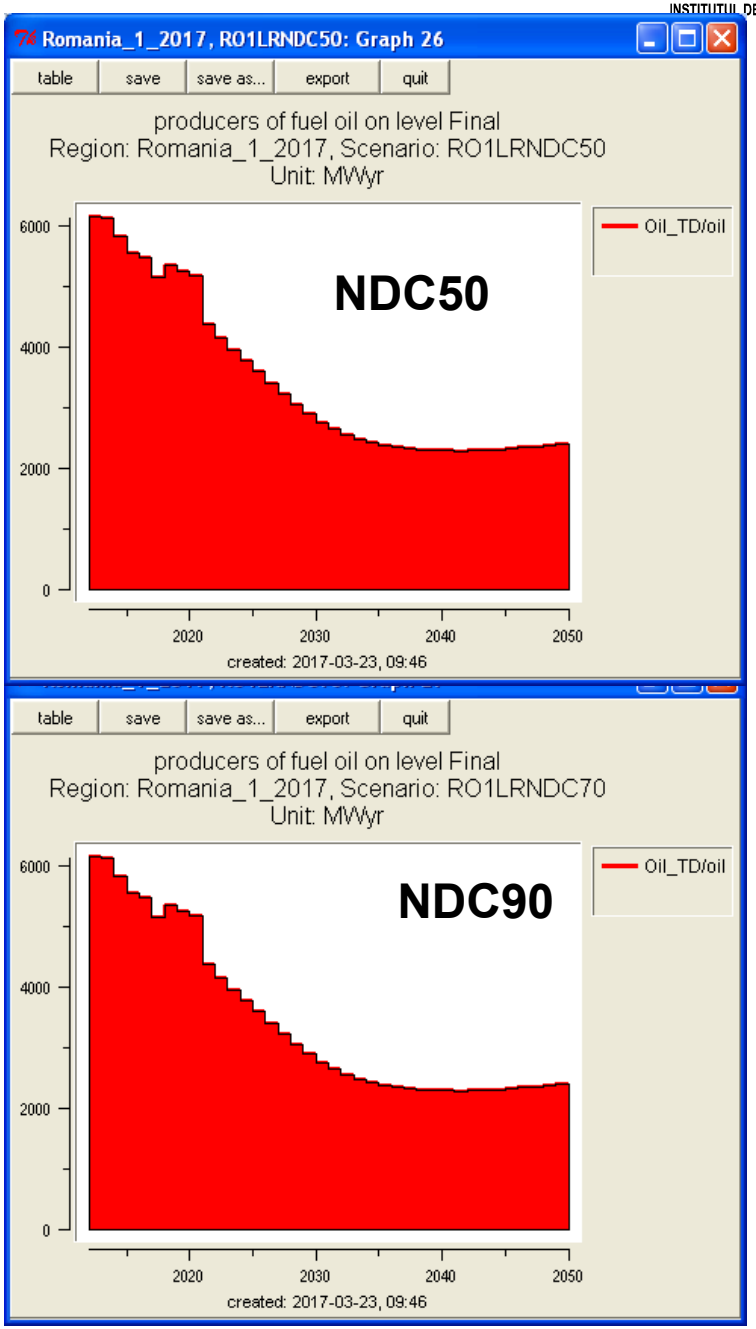




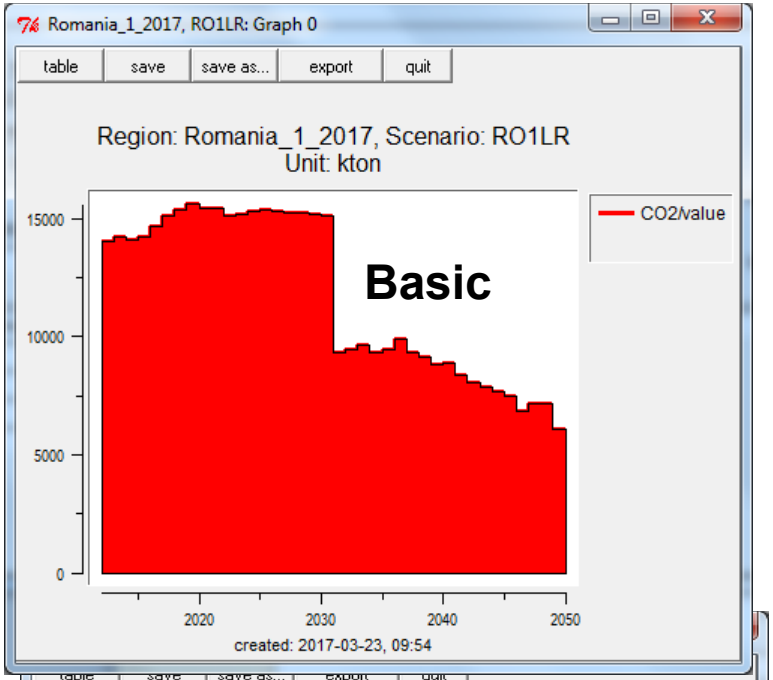


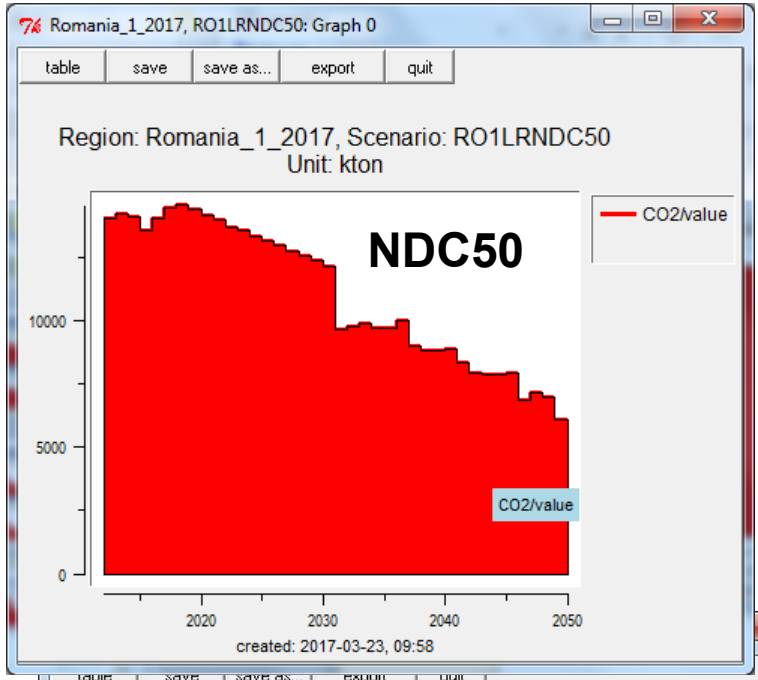
Oil Production / Final

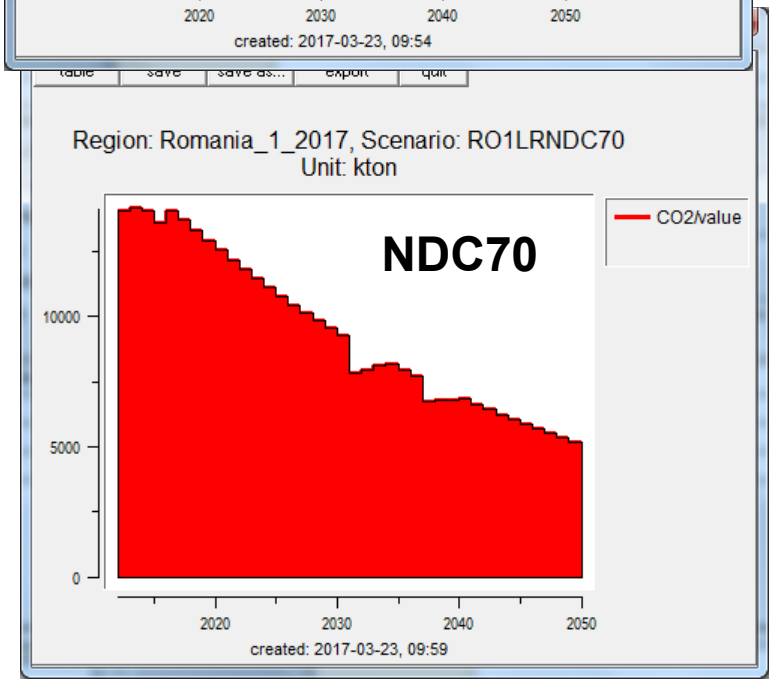


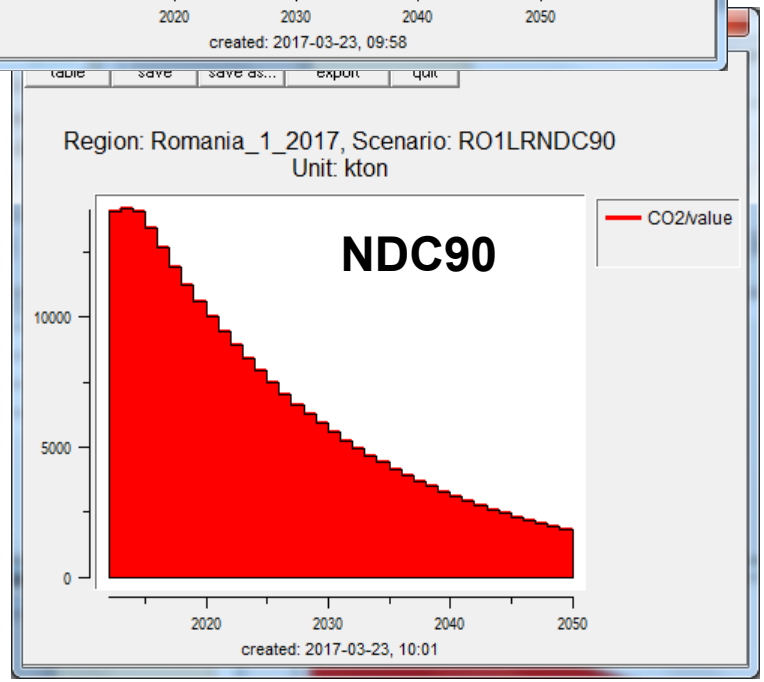


CO2 Emissions (ktons)









CO2 Emissions (ktons)

Scenario	Basic	NDC50	NDC70	NDC90
Cumulative CO2 emissions (ktons)	459,312	437,578	362,033	248,181
CO2 emission avoiding relative to the Basic Scenario (ktons)	0	21,733	**97,278**	211,131

Maximum sustainable Romanian NDC < 100,000 ktons CO2

Conclusions and Policy Recommendations

The present MESSAGE model for Romanian energy system fulfils the energy demand in the **Basic**, **NDC50** scenarios and almost in **NDC70**, this meaning that a **60-70**% reduction in CO2 emissions can be easily achieved in a sustainable manner.

Is not possible that Romania to achieve important NDCs to GHG mitigation without building new nuclear capacities as reliable electricity sources and replacing the old coal-fired technology by the latest hi-tech low emission solutions.

A sustainable Romanian NDC to CO2 emission avoiding can be up to **100,000 ktons**, this corresponding to a **70%** gradually reduction of CO2 emissions from 2012 levels, till 2050.

Focusing on the investment projects that ensure a "green" energy production, including the nuclear one and to raise awareness on how carbon capture & storage technologies can be used for climate change mitigation.

Thank you for your attention!