

Training Workshop for the countries of Eurasia, Central Asia and the Caucasus: Deep dive into tracking NDC mitigation commitments under the Paris Agreement

Presentation: Practical cases of
projections from other countries

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Content

Example GHG emissions projections using LEAP model for Norway.

Example GHG emissions projections using GACMO model for Lao PDR.

LEAP model for Norway

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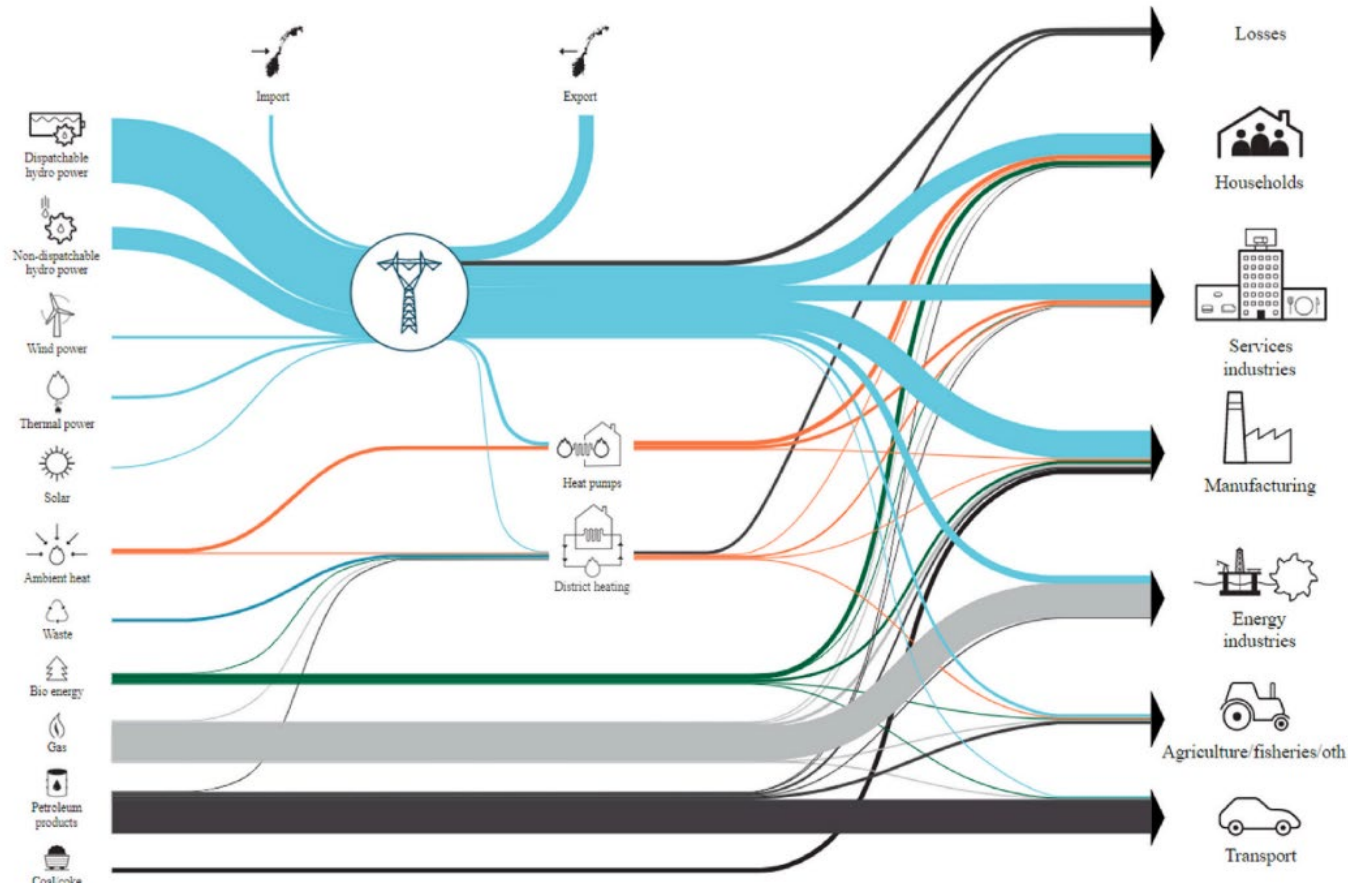
Energy system analysis with a focus on future energy demand projections:
The case of Norway

Lorenc Malka^{a,1}, Flamur Bidaj^a, Alban Kuriqi^{b,c,*}, Aldona Jaku^d, Rexhina Roçi^d,
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- LEAP model was used to conduct the analysis based on Baseline and Mitigation scenarios.
- The energy demand is estimated by sector and fuel type toward 2050
 - by considering a set of parameters and key assumptions
 - target of Norway's government in decreasing GHG emissions by 55% in 2030 and 90–95% by the year 2050 compared to 1990 levels.
- Mitigation scenario aims to diversify the overall national energy system and technological changes based on large-scale renewable energy sources (RES) integration.
- [Energy system analysis with a focus on future energy demand projections: The case of Norway - ScienceDirect](https://www.sciencedirect.com)

Norway's existing energy system overview

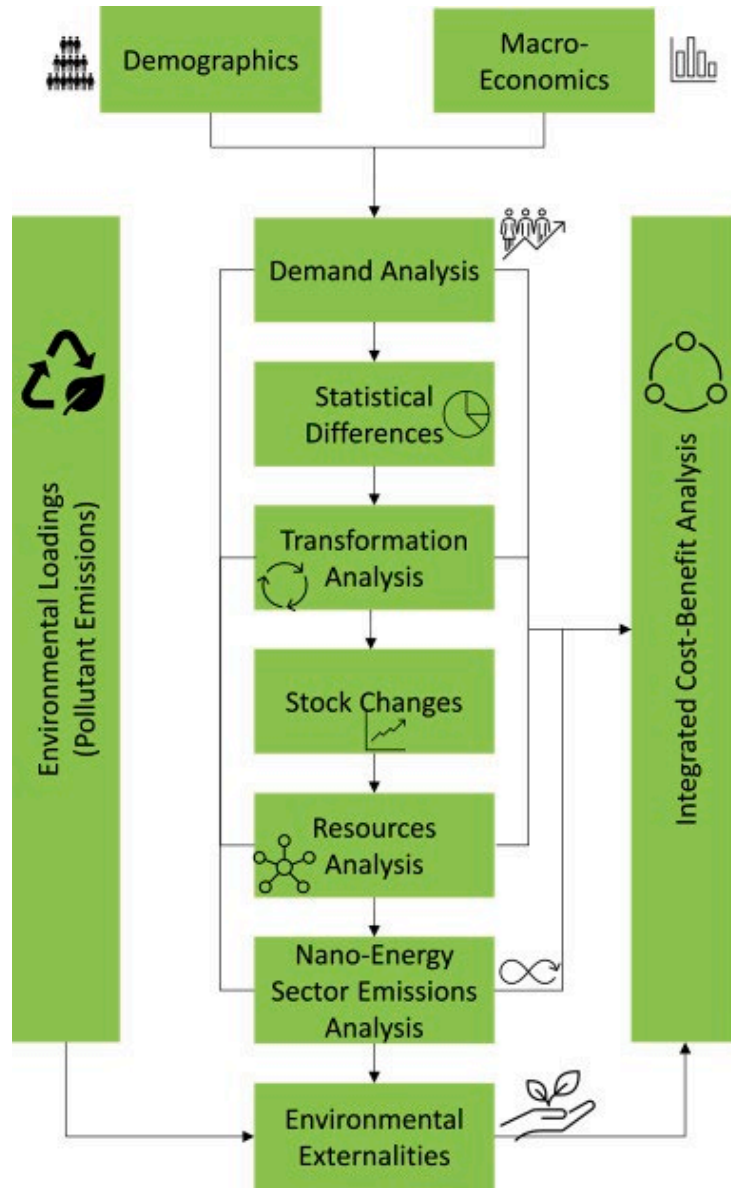


- Norwegian hydropower plants generate approximately 136.4 TWh in a normal year, accounting for 90% of Norway's total power production.
- Considerable amount of the space heating in residential sector in Norway is provided from electricity.
- There has been a push to introduce electric cars (EV's) in recent years by therefore increasing the electricity demand progressively.
- Like its significant oil exports, Norway exports electricity.

A photograph of an industrial facility, likely a refinery or chemical plant, at dusk. The scene is illuminated by warm lights from the facility, contrasting with the cool blue tones of the twilight sky. Several tall distillation columns and a complex network of pipes are visible. In the foreground, there are some green plants and a small structure with a blue roof.

Data sources and assumptions

- National energy and other energy-related data were used to model and analyze the Norwegian energy system.
- The current account scenario is **validated using 2015 energy data provided by statistics**.
- Energy demand and consumption broken down by sector (i.e., household, industry, transport sectors, and others), subsectors, and fuel types **are provided by Statistics Norway**.
- The household number, urban and rural share, passenger and freight transport data, manufacturing goods, base materials, and iron and steel data are collected from **Statistics Norway, Energy Facts, Energy Transition-2020 report, and other reliable sources**.



LEAP model structure

Scenario conceptualization

- Various factors having importance and influence on energy consumption in Norway are considered.
- Norway's population is forecast to grow from 5.4 million people; at a normal growth rate, it will be at least 6.4 up to 7.1 million in 2050
- Structural changes in industry
 - Up to 2030, continued strong growth in less energy-intensive service industries is expected

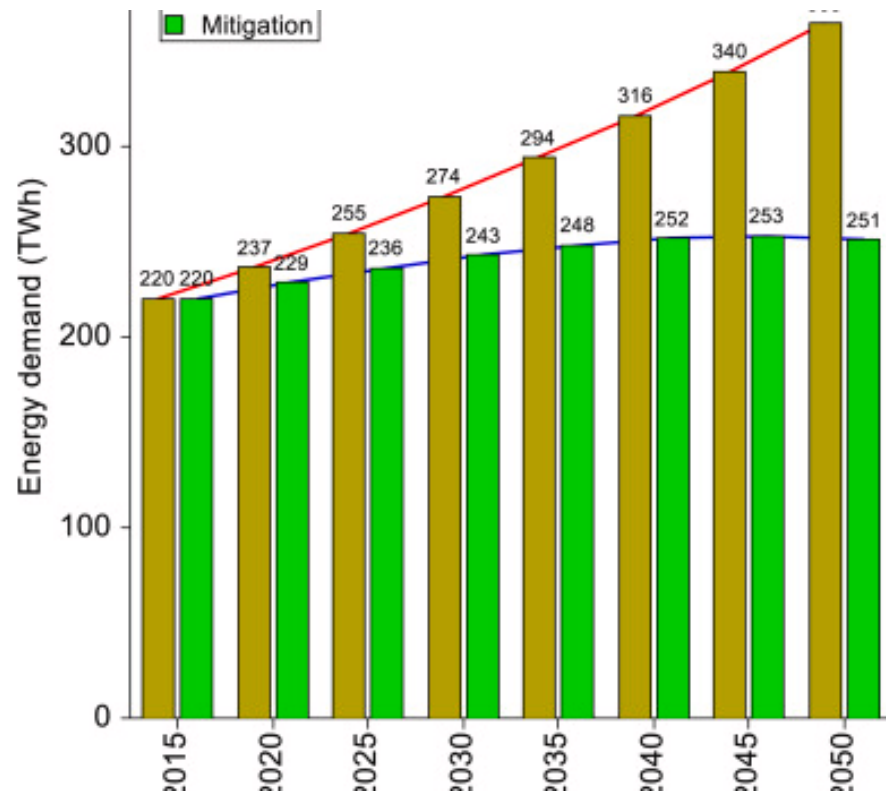
Table 1

Key assumptions, parameters, and mathematical functions considered in the study.

Key assumptions parameters	Household (ml)	Household size (Person)	Urban share (%)	Rural Share (%)	Population (ml)	Population Growth rate (%)	Income (\$)	Income growth rate (%)	GDP (\$Billion)	Household electricity consumption (kWh/Year per HSS)	Mathematical functions (–)
2015: Current account scenario	2.5	2.2	81.1	18.9	5.4	–	61,500			26,500	Simple: AL*FEI
2050: Projections and policy			71.8		6.4 7.2	0.75 up to 0.8	Growth	0.7–1.2	Growth		Interp, Growth, Step, GrowthAs

Modeling results

Total final energy demand in Norway based on baseline and mitigation scenario.

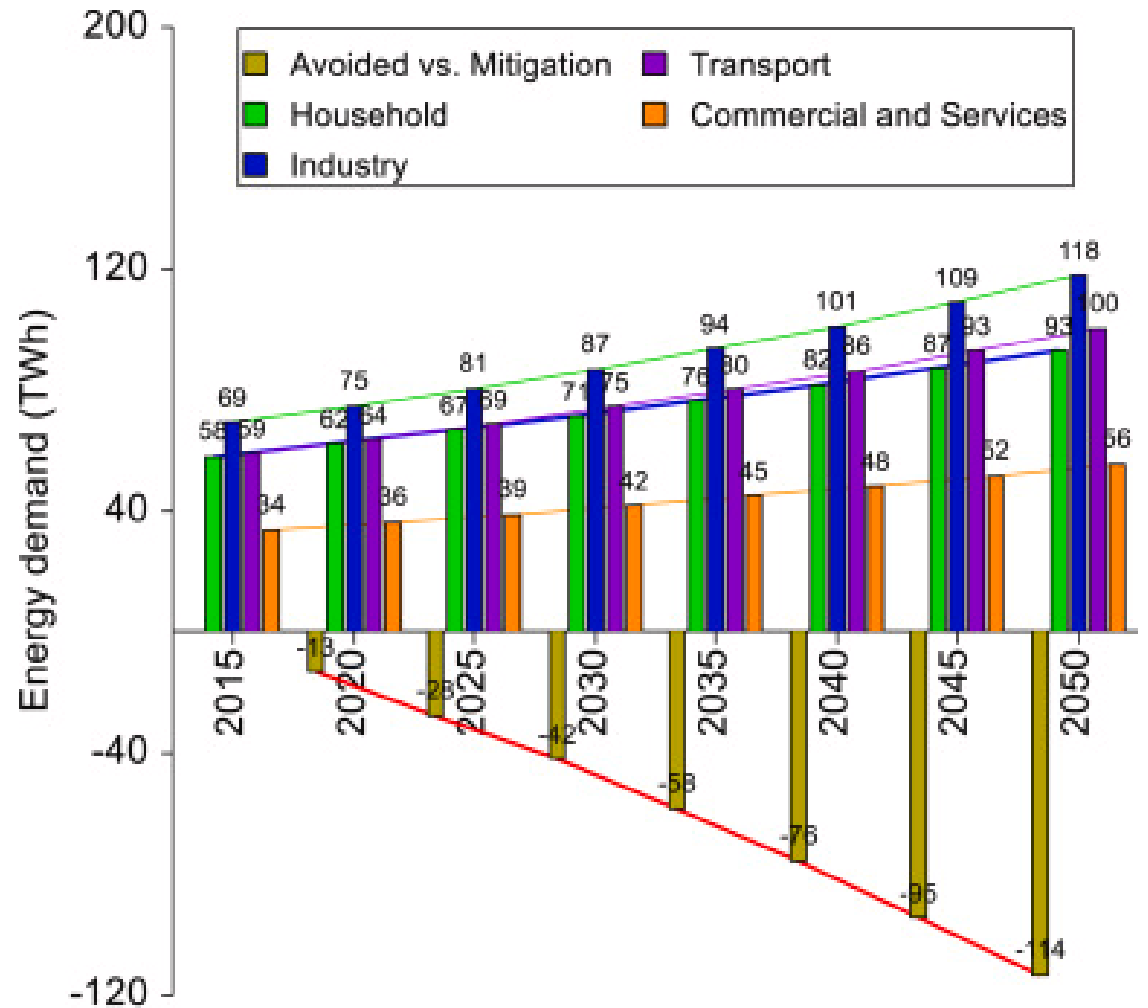


- The impact of the mitigation scenario will lead to a total demand of 251 TWh by 2050, while the baseline scenario will have a demand of 365 TWh.

Modeling results

Norway's total final energy demand by sectors

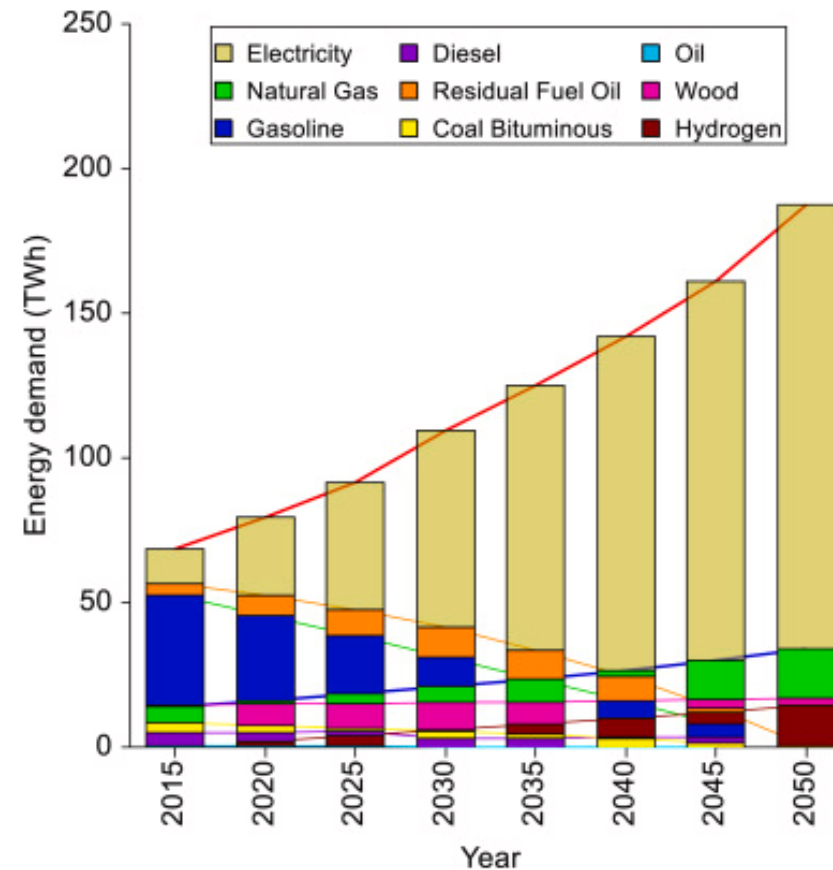
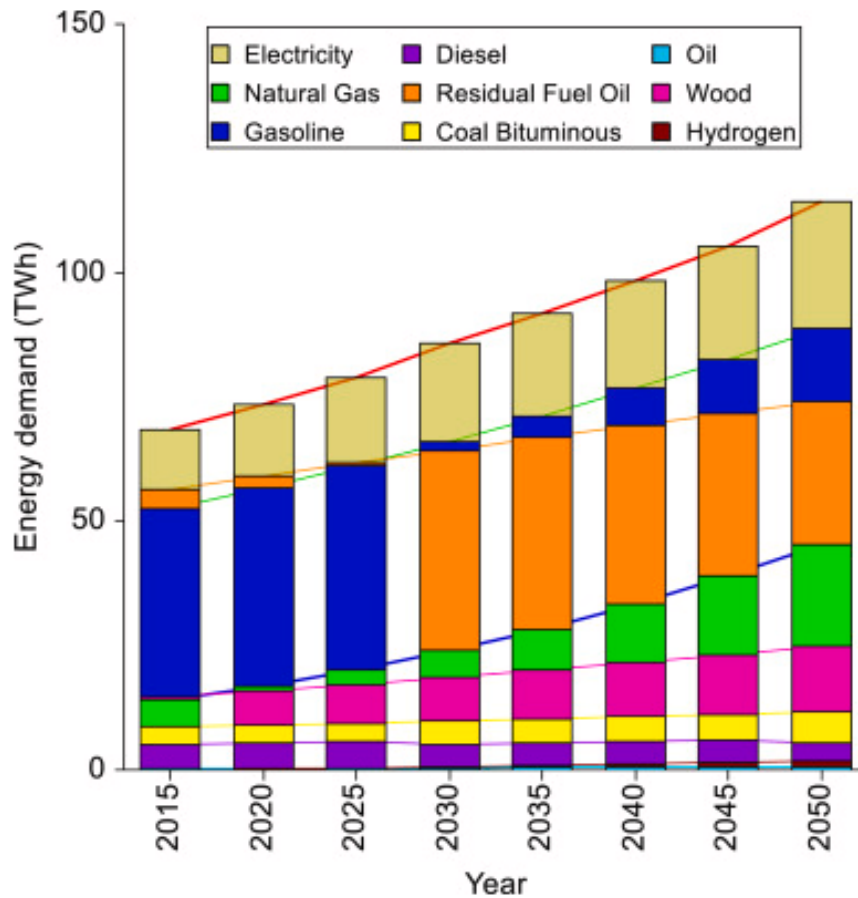
- The industry sector ranks first, having a total demand of 117.80 TWh by 2050.
- Due to the overall rising product demand driven by the GDP development of Norway, energy consumption for the manufactured goods subsector is predicted to rise by 2050.



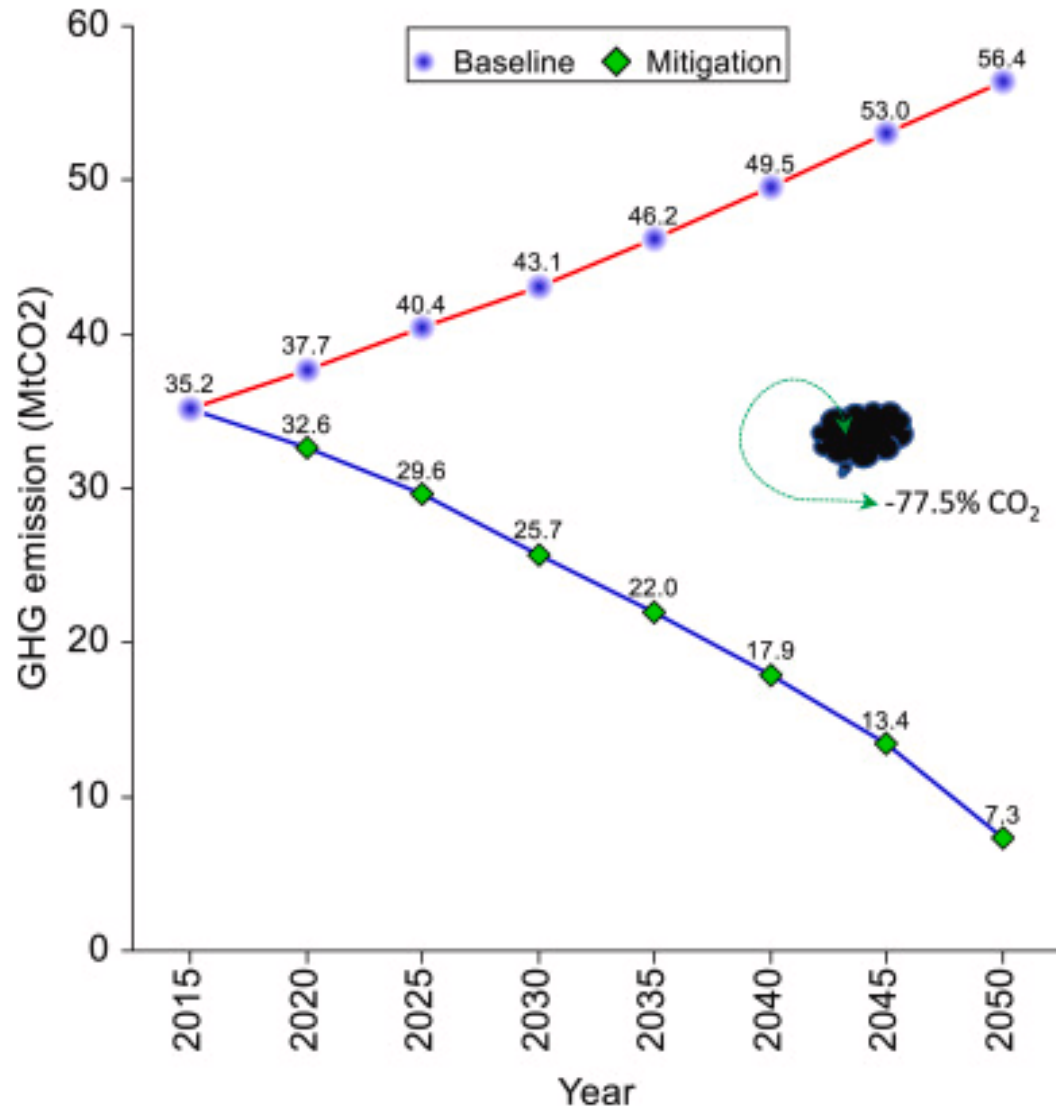
Modeling results

Total final energy demand by fuel type for baseline and mitigation scenarios

- According to these scenarios, the total final demand by the end of 2050 by fuel type will be covered mostly by electricity
- In this scenario, coal and gasoline residual fuel is replaced by electricity or natural gas.
- Natural gas will replace coal in the industry sector, while electricity and H2 will replace gasoline and oil in the transportation sector.

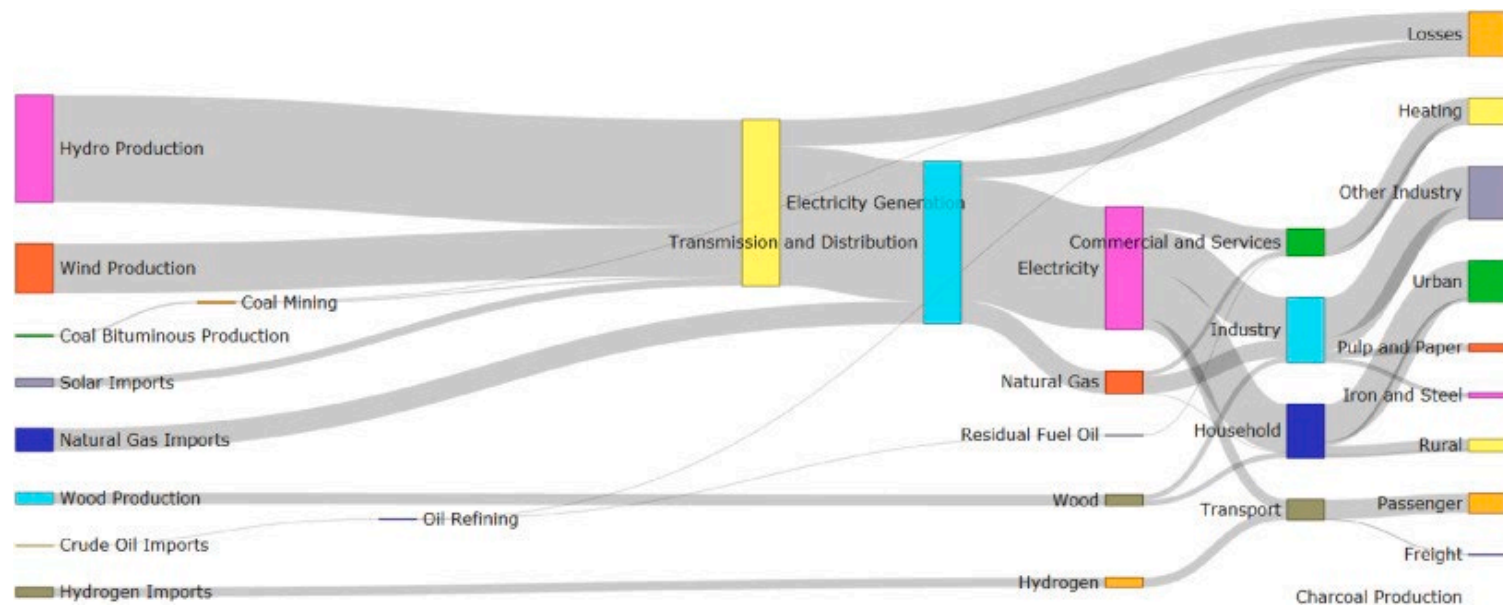


Modeling results Total GHG (MtCO₂)



- The baseline scenario will release 56.4 MtCO₂
- Mitigation scenario will have minimal impact leading to 7.3 MtCO₂ by the end of 2050.
- Government's Climate Goals is to reduce the GHG by 90–95% (1.6–3.2 MtCO₂) compared to the 1990 level (32 MtCO₂).
- The national mitigation goal is not fully completed, as more policies should be applied, especially in the oil and gas industry.

Sankey diagram of the Norwegian energy system in the mitigation scenario



- Electricity will cover more than 70% of total demand by the end of 2050.
- Increase of the appliance and industry efficiencies, insulation improvements, and introduction of EV, H2, and other renewable energy sources
- GHG emissions are expected to be reduced up to 80% concerning the 1990 emission level.



Lao People's Democratic Republic
Peace Independence Democracy Unity Prosperity

NDC of LAO PDR

Nationally Determined Contribution (NDC)

Three scenarios were considered:

- **A baseline scenario** which is a reference case that illustrates future GHG emission levels most likely to occur in the absence of GHG mitigation activities.
- **An unconditional mitigation scenario** that reflects GHG emission reductions efforts that Lao PDR can commit to, considering own resources and existing levels of support from developed country Parties.
- **A conditional mitigation scenario** that represents additional GHG emission reductions efforts that Lao PDR could achieve, contingent upon increased levels of financial support from developed country Parties
- [NDC 2020 of Lao PDR \(English\), 09 April 2021 \(1\).pdf \(unfccc.int\)](#)

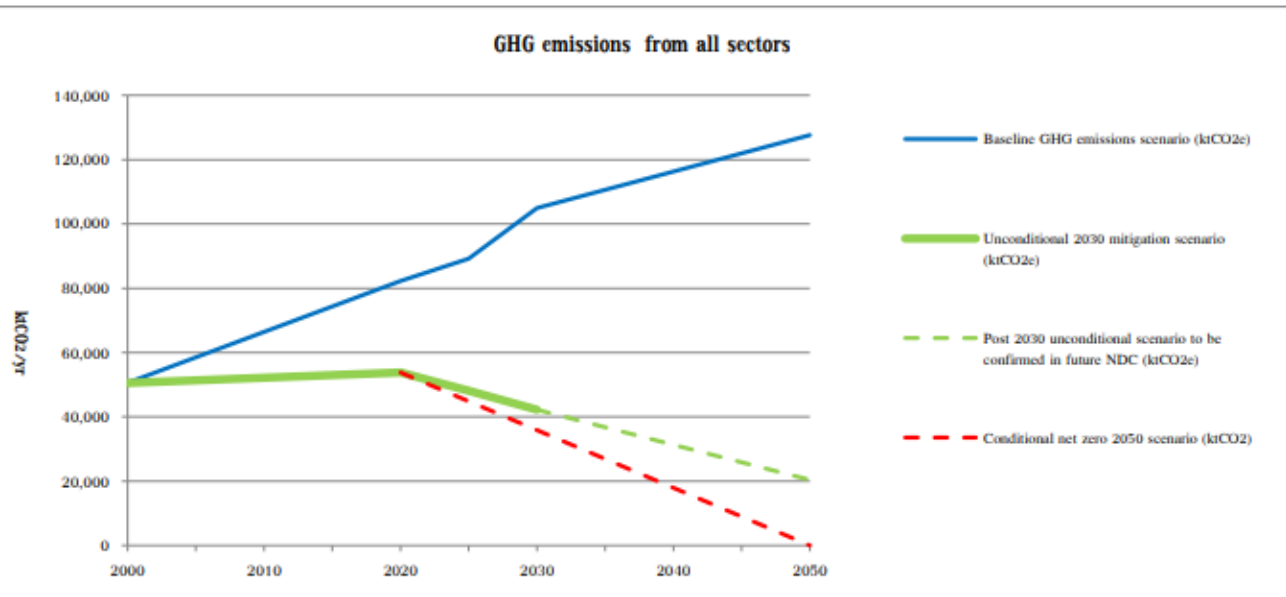
09 March 2021



Use of GACMO tool for emissions scenarios

- Baseline and mitigation scenarios have been calculated **using UNEP CCC's Greenhouse Abatement Cost Model (GACMO)**.
 - Primary data source includes Lao PDR Second National Communication to the UNFCCC, Lao PDR Technology Needs Assessments Report and other reports.
 - National electricity grid emissions factor was calculated using the UNFCCC Tool to calculate the emission factor for an electricity system.
 - GHG inventory in Lao PDR's 2nd National Communication to UNFCCC
-

GHG emissions scenarios from all sectors



- GHG emissions from all sectors from the base year 2000 according to the 3 scenarios.
- **Under the baseline scenario**, total GHG emissions levels in Lao PDR would be expected to reach around 82,000 ktCO₂e in 2020 and 104,000 ktCO₂e in 2030.
- **In the unconditional mitigation scenario**, GHG emissions could reduce to 40,000 kt CO₂e/year in 2030, and 20,000 kt CO₂e/year in 2050.
- **The conditional mitigation scenario** could further reduce GHG emissions to around 20,000 kt CO₂e/year in 2040, and to net zero in 2050.

Sectoral level 2030 unconditional mitigation targets

Sector	Mitigation target (2020-2030)	Average abatement between 2020 and 2030 (ktCO ₂ e/y)
Land Use Change and Forestry	Reduced emissions from deforestation and forest degradation, foster conservation, sustainable management of forests, buffer zones of national parks and other preserves, and enhancement of forest carbon stocks.	1,100
Energy		
Hydropower	13GW total hydropower capacity (domestic and export use) in the country	2,500
Energy Efficiency	Introduction of 50,000 energy efficient cook stoves	50
Transport	<ul style="list-style-type: none"> • New Bus Rapid Transit system in Vientiane Capital and associated Non-Motorized Transport (NMT) component • Lao-China Railway 	25 300

- In the energy sector, hydropower, energy efficiency, and transport – are the main contributors to mitigation efforts.
- The total target for installed hydropower capacity in the country by 2030 is set at 13 GW.
- The introduction of 50,000 energy-efficient cookstoves will reduce the use of biomass for combustion.

Sectoral level 2030 conditional mitigation targets

- In the LULUCF sector, Lao PDR would achieve to increase the forest cover to 70% of total land area.
- Renewable energy capacity would be increased to 1 GW solar and wind power and 300 MW biomass power capacity.

Sector	Mitigation measure (2020-2030)	Average target between 2020 and 2030 (ktCO ₂ e/y)
Land Use Change and Forestry	Increased forest cover to 70% of land area (i.e. to 16.58 million hectares) through reduced emissions from deforestation and forest degradation, foster conservation, sustainable management of forests, buffer zones of national parks and other preserves, and enhancement of forest carbon stocks.	45,000
Energy		
Other renewables	SOLAR and WIND: 1 GW total installed capacity in the country	100
	BIOMASS: 300 MW total installed capacity in the country	84
Transport	30% Electric Vehicles penetration for 2-wheelers and passengers' cars in national vehicles mix	30
	Biofuels to meet 10% of transport fuels	29
Energy efficiency	10% reduction of final energy consumption compared to business-as-usual scenario	280
Agriculture	50,000 hectares adjusted water management practices in lowland rice cultivation	128
Waste	Implementation of 500 tons/day sustainable municipal solid waste management project	40

Measure	Reduced emissions from deforestation and forest degradation, foster conservation, sustainable management of forests, buffer zones of national parks and other preserves, and enhancement of forest carbon stocks
Sector	Land Use Change and Forestry
GHG mitigation target	1,100 ktCO ₂ e/y average abatement between 2020 and 2030
Monitoring procedures	In line with monitoring plans of projects mentioned below
Comments	<ul style="list-style-type: none"> - Emissions reductions will mainly be achieved through existing mitigation projects including the Green Climate Fund's FP117: "Implementation of the Lao PDR Emission Reductions Programme through improved governance and sustainable forest landscape management", as well as the World Bank's "Lao Landscapes and Livelihoods Project (P170559)". - Mitigation target is equivalent to increasing forest stocks by about 8,300 hectares per year, based on 37.2 tC/ha average carbon stocks in plantation forest class, as per Lao PDR's Forest Reference Emission Level (UNFCCC, 2018)

LULUCF-
(Unconditional
measure)

Measure	13 GW total installed hydropower capacity (domestic and export use) in the country by 2030
Sector	Energy
GHG mitigation target	2,500 ktCO ₂ e on average per year between 2020 and 2030
Monitoring procedures	Newly added hydropower capacity will be monitored on an annual basis by the Department of Climate Change of the Ministry of Natural Resources and Environment using data from the Ministry of Energy and Mines
Comments	<ul style="list-style-type: none"> - Installed capacity as of 2018 is around 4.5 GW (EDL, 2018) - Target installed hydropower capacity by 2030 has been calculated conservatively by applying an 80% probability ratio to the 2030 anticipated installed capacity in Ministry of Energy & Mines' 2016-2030 Power Development Plan. - GHG mitigation target is estimated based on expected 8.5 GW added capacity between 2019 and 2030.

Hydro-
(Unconditional
measure)

Measure	Introduction of 50,000 energy efficient cook stoves
Sector	Energy
GHG mitigation target	50 ktCO ₂ e on average per year between 2020 and 2030
Monitoring procedures	As per World Bank's Lao PDR Clean Cook Stove Initiative

Energy efficient
cook stoves
(Unconditional
measure)

Measure	New Bus Rapid Transit system in Vientiane Capital and associated Non-Motorized Transport component
Sector	Transport
GHG mitigation target	25 ktCO ₂ e on average per year between 2020 and 2030
Monitoring procedures	Number of passengers transported in the project and total consumption of fuel/electricity in the project will be monitored on an annual basis by the Department of Climate Change of the Ministry of Natural Resources and Environment using data provided by the BRT operator.
Comments	Ex-ante estimate is based on 13km new segregated lanes, where only buses are allowed to operate

Measure	Lao-China railway
Sector	Transport
GHG mitigation target	300 ktCO ₂ e on average per year between 2020 and 2030
Monitoring procedures	Number of passengers and tons of freight transported by Lao-China railway will be monitored on an annual basis by the Department of Climate Change of the Ministry of Natural Resources and Environment using data provided by the Ministry of Public Works and Transport.
Comments	Ex-ante estimate is based on 3.4 million passenger-kilometers and 1 million ton-kilometers freight per day.

Transport
(Unconditional
measures)



CBIT-GSP
CLIMATE TRANSPARENCY



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Thank you for your attention!

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UNEP-CCC

