PATH2LC

LEARNING MUNICIPALITY NETWORKS

D4.4 Working paper on the comparison of targets defined in local action plans, national and EU 2050 targets

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CONSORTIUM PARTNERS

LOGO	PARTICIPANT	COUNTRY	TYPE
IREES research for future.	Institute for Resource Efficiency and Energy Strategies (IREES)	Germany	Scientific
Fraunhofer ISI	Fraunhofer Institute for Systems and Innovation Research ISI (Fraunhofer)	Germany	Scientific
TU WIEN TECHNISCHE UNIVERSITÄT WIEN Vienna|Austria	Technische Universität Wien (TU Wien)	Austria	Scientific
e think ENERGY RESEARCH	Zentrum für Energiewirtschaft und Umwelt (e-think)	Austria	Scientific
ENERGYCITIES	Energy Cities (ENC)	France	Scientific
HESPUL	Hespul (HESP)	France	Communication
ucsa Ufficio Comune per la Sostenibilità Ambientale	Ufficio Comune per la Sostenibilità Ambientale (UCSA)	Italy	Local network
SUSTAINABLE CITY CITY NETWORK	Sustainable City Network (SCN)	Greece	Local network
OESTE SUSTENTÁVEL AGÊNCIA REGIONAL DE ENERGIA E AMBIENTE DO OESTE	Agência Regional de Energia e Ambiente do Oeste – OesteSustentavel (Oeste)	Portugal	Local network
CITIES NORTHERN NETHERLANDS	City Northern Netherlands represented by City of Leeuwarden (CNNL)	Netherlands	Local network
ALTE69	Agence Locale de la Transition Énergétique du Rhône (ALTE69)	France	Local network

THE PATH2LC PROJECT

In the PATH2LC project, public authorities are working together within the framework of a holistic network approach (so-called learning municipality networks) with the aim to achieve low-carbon municipalities.

The core of the project activities is the SE(C)APs (Sustainable Energy (and Climate) Action Plans) or similar climate protection plans developed by the municipalities. The PATH2LC project will foster an exchange of existing knowledge and experiences among municipalities, enhance coordination among different administrative bodies within the municipalities, improve cooperation with local stakeholders and civil society and will equip stakeholders in public authorities with required planning and monitoring tools to develop and implement transition roadmaps for achieving the targets set in the SE(C)APs.

The holistic network approach intends to link stakeholders in public authorities among municipalities enabling peer-to-peer learning and increasing the engagement for the energy and climate transition. Policymakers and public authorities at the local level are supported with scientific analysis and expertise in order to understand and implement their SE(C)AP measures. Five existing networks of municipalities in Italy, Greece, Portugal, the Netherlands and France are participating in the project.

A special interest of the project is to invite other municipalities to replicate the learning municipality network approach and take advantage of the knowledge base collected in the project.

Further information on www.path2lc.eu

Project information

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

CM	Calculation Module
CoM	Covenant of Mayors for Climate and Energy - Europe
EU	European Union
GFA	Gross Floor Area
GHG	Greenhouse Gas(es)
HD	Heat Demand
H2020	Horizon 2020, the EU funding programme for research and innovation from 2014 to 2020.
IPCC	International Panel on Climate Change, the intergovernmental body of the United Nations mandated to publish every 7 years the Assessment Report on human-induced climate change.
JRC	Joint Research Centre, a European Commission's science, and knowledge service which carries out research to provide independent scientific advice and support to EU policy.
LMN	Learning Municipal Networks
NECP	National Energy and Climate Plans
NEEAP	National Energy Efficiency Action Plans
NREAP	National Renewable Energy Action Plans (NREAPs)
PV	Photovoltaics
RES	Renewable Energy Source(s)
SEAP	Sustainable Energy Action Plan
SECAP	Sustainable Energy and Climate Action Plan
ST	Solar Thermal
UNEP	United Nations Environment Program
WRI	World Resource Institute

Units of measure

mtCOeq/ktCOeq	Metric tons/Kilotons of carbon dioxide equivalent, a measure of different GHG gases, based upon their global warming potential
MWh/GWh	Megawatt hour/Gigawatt hour, a measure of energy
MWp	Megawatt peak, a measure of nominal installed capacity output at rated laboratory conditions (typically used for PVs)
MWth	Megawatt thermal, a measure of installed capacity output of thermal plants (typically used for ST)
TJ/PJ	Tera Joule/Peta Joule, a measure of energy

Local Administrations

ALTE69 — Agence Locale de la Transition Énergétique du Rhône, coordinating the French network “Rhône Network”, which comprises:

CCMDL	Communauté de Communes (CdC) des Monts du Lyonnais (32 municipalities)
CCSB	CdC Saône-Beaujolais (42 municipalities)
COR	Communauté d'agglomération de l'Ouest Rhodanien (31 municipalities)
SOL	Syndicat de l’Ouest Lyonnais (41 municipalities)

CNNL	City Northern Netherlands, coordinating the Dutch Network, which comprises: Groningen, Assen, Emmen, and Leeuwarden.
Oeste	Agência Regional de Energia e Ambiente do Oeste – OesteSustentavel, coordinating the Portuguese Network, which comprises: Alcobaça, Alenquer, Arruda dos Vinhos, Bombarral, Caldas da Rainhas, Nazaré, Óbidos, Peniche, and Torres Vedras.
SCN	Sustainable City Network, coordinating the Greek network, which comprises: Oichalia, Ierapetra, Korinthos, Vari-Voula-Vouliagmeni, and Messinis.
UCSA	Ufficio Comune per la Sostenibilità Ambientale, coordinating the Italian network which comprises: Palma Campania, San Giuseppe Vesuviano, and Striano.

1. INTRODUCTION

Local climate action is marshalled by municipalities' voluntary commitment to advance their energy transition. The Covenant of Mayors for Climate and Energy, Europe (CoM) introduced in 2008 the Sustainable Energy Action Plan (SEAP) updated then in 2015 with the Sustainable Energy and Climate Action Plan (SECAP): instruments to support this multi-level governance approach to the energy transition, by structuring and driving local climate action. Administrations who sign the pact of the CoM agree to submit within two years an action plan. Municipalities describe in these documents their current energy landscape, their GHG emissions profile, their strategy, and the targets they publicly commit to. The CoM provides a template for compiling the plan sections, including the energy balance and the emission inventory, and requires their signatories to pledge publicly to an emission reduction target in line with the EU policy: -20% by 2020 for a SEAPs, and -40% by 2030 for SECAPs (soon to be raised to -55% net by 2030). Renewable energy and energy efficiency targets are recommended but not compulsory.

EU and national targets are set in a few different formats, (World Resource Institute (WRI) and Greenhouse Gas Protocol, 2015). Local targets are defined with similar formats but use very diverse reference base and target years, parameters, units of measure, as well as absolute or relative values. National and EU targets are mostly directly comparable or can be compared using official historical data (World Resource Institute (WRI), 2015), while local climate targets are not directly comparable to EU/national targets, therefore it is not clear whether they are aligned to EU and national policies and to what extent (Boswell et al., 2010; Salvia et al., 2021). As the Commission already noted, in this phase of the transition, "*energy efficiency is one of the key pillars for meeting our climate objectives […] however, this is often underestimated in existing planning*" (EU Commission, 2021). Therefore, it would be interesting investigating a set of local action plans regarding their targets alignment and the application of the Energy Efficiency First (EE1st) principle (EU Commission, 2015): considering first the potential for energy efficiency in any energy-related decision and prioritizing energy efficiency investments, especially in buildings.

Some literature acknowledges heterogeneity of local climate targets and the several limits to their direct comparability (Australian Government Climate Change Authority, 2015; Bansard et al., 2017; Hoff and Strobel, 2013; Houbart, 2015; Pablo-Romero et al., 2015; UNEP, 2018, 2015). However, remarkably scarce literature can be found on attempts of normalization of misaligned climate pledges (Rowan, 2019; Senbel et al., 2013; Stevens and Senbel, 2020). The present work aims at investigating this seemingly uncovered research area by answering the question: "Are local climate and energy targets aligned to national and European targets?". To do that, the targets stated in a selection of 25 SEAPs and SECAPs SECAPs are collected and harmonized to national and EU targets. The selection of municipalities is provided by the 5 Learning Municipal Networks (LMN) in 5 European countries participating in the Horizon2020 project "Public Authorities together with a holistic network approach on the way to low-carbon municipalities" (PATH2LC). The harmonization process is done creating a country index for emissions and energy consumption, based on historical data and EU reference scenarios, estimating local past GHG emission values, and making local targets comparable by expressing them in a common base year. Finally, four scenarios of heat demand in buildings are calculated for 2050 with the Invert/Opt model (Hummel and al., 2021), showing the major role of energy efficiency in the low-carbon transition.

2. METHODOLOGY AND INPUT DATA

The study proceeds in subsequent steps: first climate and energy targets for GHG emissions, renewable energy and energy efficiency are collected at local, national and EU levels, for the years 2020, 2030 and 2050. Secondly, target heterogeneity is identified and recorded: any targets differences preventing a direct comparison, to be considered in the subsequent harmonization. Third, local targets are harmonized to common national/EU base years and national targets are expressed in local base years, to offer an indication where local targets were not set or not aligned. Fourth, harmonized local targets are assessed against national and EU targets. Finally, Enefirst scenarios are calculated with the Invert/Opt model (Hummel and al., 2021), evolution of the Invert/EE-Lab model, offering a focus on how energy demand and efficiency in buildings should evolve to achieve carbon neutrality by 2050. Projections include population, gross floor area, total heat demand, specific heat demand, and renovation rates.

2.1. Structure of the Analysis

2.1.1. Methods for targets collection

First, local climate targets are collected from the 25 selected municipalities' action plans, examining every SEAP, SECAPs and associated documents, with regards to the three key areas: emission reductions, renewable energy, and energy efficiency. The same is done for the respective national targets, collected from the National Energy and Climate Plans (NECPs), according to EU effort sharing mechanism, sometimes completed by previous commitments reported in the National Energy Efficiency Action Plans (NEEAPs) and the National Renewable Energy Action Plans (NREAPs). European targets are collected from the Commission website. For each target, the following information is gathered: target value and parameter, unit of measure, target year, reference year and reference scenario where relevant according to the type of target. A full overview of the targets collected is available in Annex 5.

2.1.2. Data and Targets Heterogeneity

A high degree of heterogeneity can be observed in the collected energy and climate targets, namely regarding the type of targets, target years, reference years, units of measure, and parameters.

Type of targets – These can be base year goals (a percentage of a past year value, mostly 1990 and 2005), target year goals (a percentage of the target year value), baseline scenario goals (a percentage of the projected future value, according to a reference scenario), and fixed-level goals (absolute values of the target year). Emission targets are mainly set as base year goals, or as the corresponding fixed level goal. Renewable energy targets are set mainly as fixed level goals by target year, either as renewable energy sources (RES) share of the energy consumption (sometimes defined as gross and/or final energy consumption) by target year, as total energy production from RES as an absolute value by target year, or as total or additional installed capacity. Efficiency targets at the EU level are indicated as trend scenario goals: reduction in primary and/or final energy consumption compared to the projected future consumption according to a reference trend scenario by the target year. At the national level, they are percentage reduction targets either compared to the same trend scenario or to a base year, but at the local level, they are expressed as absolute or percentage reduction of total or sector-specific final energy consumption compared to a base year.

Target years – The EU and national targets are set for 2020, 2030 and 2050. The great majority of municipalities (19 out of 25) set targets for 2020, many for 2030 (9), few for 2050 (5), but sometimes no targets are set for any of these years, but for years such as 2021, 2024, 2025, 2026, 2035, and 2040.

Reference years – Since the first Intergovernmental Panel on Climate Change (IPCC) Assessment Report was published, 1990 has been taken as the reference year for most emission targets. At the EU and national level, official GHG inventories and energy balances are recorded and published yearly since 1990. EU and national targets are expressed as base years goals compared to 1990 or target year goals (2030 targets also compared to 2005). However, at the local level, the first complete energy balance and emission inventory are very often compiled when the first SEAP/SECAP is written, and usually, there are no other historical data before that. Each administration sets its emission targets with a different base year, the one taken in the action plan, and with different target years. This causes that in a country on a decreasing emission trend, a local target with the same relative value (e.g. 20%) but a later reference year (e.g. 2015), corresponds to a smaller emission reduction (e.g. 18% compared to 1990) than the national target (e.g. 20% compared to 1990), because it refers to a smaller base (local emissions in 2015 were less than in 1990 if we assume them to have followed the national trend). However, because we assume such a trend at the local level, also some progress occurred between 1990 and the year when the target was set (e.g. 10% compared to 1990). Thus, a harmonized local target together with the previous progress could even sum up to an emission reduction (e.g. 10%+18%=28%) higher than national policies (e.g. 20%).

Units of measure and parameters – Emission targets are defined as percentage reduction either of GHG emissions or of CO_2 emissions, but both are measured in CO_2 equivalent tonnes, not leading to any substantial difference. A minority of municipalities express emission targets as an absolute value, for which the equivalent percentage was calculated in this study, but many indicate them both in percentage and absolute value. Some municipalities do not commit to a target but present a projection, expected if the action plan is fully implemented, or an overall regional target. Some municipalities expressly indicate their final target, but provide no figure for intermediate targets, which must be deduced from charts and figures. The term carbon neutrality is also used with various definitions: from "-80%", "-80% or more", "-80% or -90%" to "-95%" emission reduction compared to the base year. The units of measures for renewable energy targets include GWh/MWh, PJ/TJ, MWp and MWth. Efficiency targets are defined either as a reduction of energy consumption or as an increase of energy efficiency, which is also a reduction of energy consumption, indicated with the opposite sign. The EU target mentions a reduction of "final and/or primary energy consumption". National targets mostly mention reductions of both primary and final energy consumption. However, local targets refer only to final energy consumption or simply to "energy consumption".

2.2. Harmonization process

2.2.1. Emission Targets

In this study, a national GHG emissions index is calculated and used as a proxy to backcast local GHG emissions. This methodology assumes that local GHG emissions might have followed a pattern similar to their countries' GHG emissions, being strongly connected to their national economy, however, this is an approximation. Through estimated local GHG emissions, local targets are harmonized and expressed in the common base year 1990. The variation that occurred until local targets were set is also estimated. Previous progress together with harmonized targets is then assessed to determine whether they are in line with national and EU goals or not. Finally, with a similar but opposite process, national targets are expressed in the local base year, to indicate the minimum value for local targets to be in line with national targets.

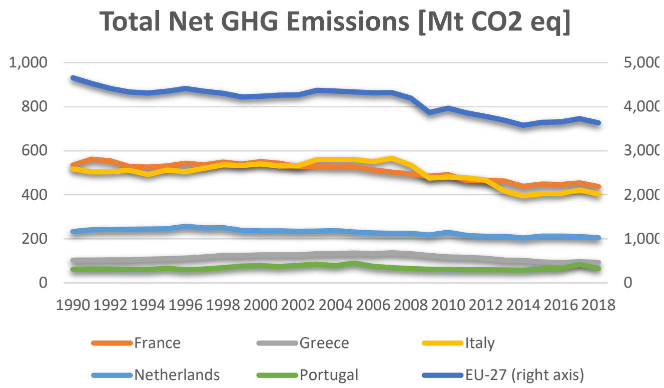

Figure 1: Country Total Net GHG emissions (Mt CO_2 eq).

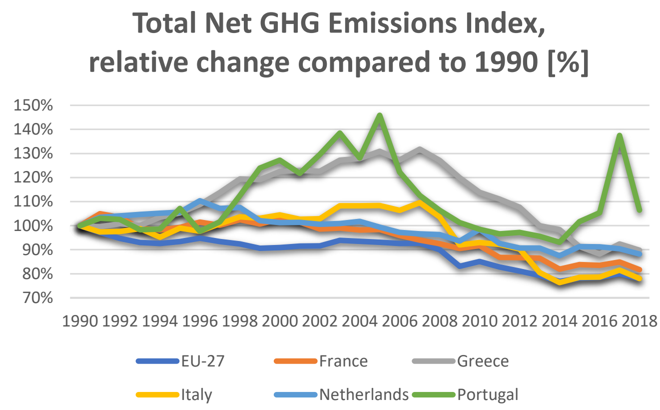

Figure 2: Total Net Emission Index per country (relative change compared to 1990).

First, official yearly values of Total Net GHG emissions from 1990 to 2018, measured in [Mt CO_2 eq], are collected for EU 27 and the 5 countries of the selected municipalities: France, Greece, Italy, Netherland, and Portugal. See Figure 1 for a graphical representation of the emission historical data. Then, the percentage change from 1990 is calculated per year and country, as shown in equation (1), and an index is created with the base year in 1990 (1990 = 100%), as shown in equation (2). All terms used in the following equations are defined in Table 1. Figure 2 shows a graphical representation of the yearly change in Total Net GHG emissions compared to 1990, expressed in percentage. Emissions do not only depend on efficiency, but mostly on GDP: looking at the trend in Portugal, two peaks can be seen, in 2005, corresponding to the demand-led boom after the introduction of the EURO, and in 20018, aligned with the recovery after the long recession sparkled by the global crises and the European sovereign debt crisis. Similarly, the sustained economic growth in Greece and subsequent crisis are reflected in its total net emissions.

$$Emissions\ Delta\ {}^{n}_{1990} = Emissions\ _{n} \div Emissions\ _{1990} - 1\ [\%] \tag{1}$$

$$Emissions\ Index\ {}^{n}_{1990} = Emissions\ _{n} \div Emissions\ _{1990}\ [\%] \tag{2}$$

Table 1: Overview and Definition of Equations Terms.

Equation Term	Definition	Example	Unit of Measure
$\boldsymbol{Emissions}_{\ year}$	Historical data of Total Net National GHG emissions	$Emissions_{\ 1990}, Emissions_{\ 1991}, \dots Emissions_{\ n}$	[kt CO_2 eq]
$\boldsymbol{Emissions\ Delta}_{\ base\ year}^{\ given\ year}$	Percentage deviation (positive or negative) in historical GHG emissions in the given year compared to the base year	$Emissions\ Delta_{\ 1990}^{\ 1991}, Emissions\ Delta_{\ 1990}^{\ 1992}, \dots$ $Emissions\ Delta_{\ 1990}^{\ available}, \dots Emissions\ Delta_{\ 1990}^{\ n}$	[%]
$\boldsymbol{Emissions\ Index}_{\ base\ year}^{\ given\ year}$	Index of national GHG emissions for every given year with base 1990 (1990=1)	$Emissions\ Index_{\ 1990}^{\ 1991}, Emissions\ Index_{\ 1990}^{\ 1992}, \dots$ $Emissions\ Index_{\ 1990}^{\ available}, \dots Emissions\ Index_{\ 1990}^{\ n}$	[%]
$\boldsymbol{Local\ Emissions}_{\ year}$	Total Net GHG emissions at the local level, the available year is the only historical data, all others are estimations.	$Local\ Emissions_{\ 1990}, Local\ Emissions_{\ 1991}, \dots$ $Local\ Emissions_{\ available}, \dots Local\ Emissions_{\ n}$	[kt CO_2 eq]
$\boldsymbol{Local\ Emissions\ Reduction}_{\ base\ year}^{\ target\ year}$	Local estimated GHG emission reduction in absolute value at the target year.	$Local\ Emissions\ Reduction_{\ local\ base\ year}^{\ 2020}, Local\ Emissions\ Reduction_{\ n}^{\ n}, \dots$	[kt CO_2 eq]
$\boldsymbol{Local\ Target\ (Emissions)}_{\ base\ year}^{\ target\ year}$	Local target expressed as % difference (reduction) compared to the local reference year.	$Local\ Target\ (Emissions)_{\ local\ base\ year}^{2020}, Local\ Target\ (Emissions)_{\ 2008}^{2020}, \dots$	[%]
$\boldsymbol{Local\ Target\ H\ (Emissions)}_{\ base\ year}^{\ target\ year}$	Harmonized local target expressed as % deviation compared to the National/EU reference year (1990).	$Local\ Target\ H\ (Emissions)_{\ EU\ base\ year}^{2020}, Local\ Target\ H\ (Emissions)_{\ 1990}^{2020}, \dots$	[%]
$\boldsymbol{National\ Target\ (Emissions)}_{\ base\ year}^{\ target\ year}$	Harmonized national target expressed as % difference (reduction) compared to the local reference year (1990).	$National\ Target\ (Emissions)_{\ local\ base\ year}^{\ 2020}, \dots$	[%]
$\boldsymbol{Target\ Year}_{reference}$	The target year by when a target is planned to be achieved	$Target\ Year_1, Target\ Year_2, Target\ Year_{local}, \dots$	-
$\boldsymbol{Local\ Change\ (Emissions)}_{\ 1990}^{given\ year}$	Local estimated GHG emission reduction in percentage at the local reference year.	$Local\ Change\ (Emissions)_{\ given\ year}^{1990}, Local\ Change\ (Emissions)_{\ 2010}^{1990}, \dots$	[%]
$\boldsymbol{Total\ Local\ (Emissions)}_{1990}^{\ target\ year}$	Sum of harmonized evolution from 1990 to the available year and harmonized local target.	$Total\ Local\ (Emissions)_{1990}^{\ target\ year}, Total\ Local\ (Emissions)_{1990}^{\ 2020}, \dots$	[%]
$\boldsymbol{National\ Target\ (Emissions)}_{\ local\ base\ year}^{\ 2020}$	National target expressed in the local reference year.	$National\ Target\ (Emissions)_{\ local\ base\ year}^{\ 2020}, Nat.Target\ (Emissions)_{\ 2009}^{\ 2020}, \dots$	[%]

Next, missing historical data of local GHG emissions are estimated for the common base year 1990, and for the other relevant base year, 2005. As shown in equation (3), the available local emission value ($Local\ Emissions_{\ available}$), whose year is usually the base year of local targets, is divided by the national GHG emissions index base 1990 of the same year ($Emissions\ Index_{\ 1990}^{\ available}$). Then, as shown in equation (4), the local GHG emission value estimated for 1990 is multiplied by the $Emissions\ Index_{\ 1990}^{\ 2005}$ for the given year (2005), to estimate the local GHG emission value for 2005.

$$Local\ Emissions_{\ 1990} = \ Local\ Emissions_{\ available} \ \div \ Emissions\ Index_{\ 1990}^{\ available}\ [kt\ CO2\ eq] \qquad (3)$$

$$Local\ Emissions_{\ n} = \ Local\ Emissions_{\ 1990} \ \times \ Emissions\ Index_{\ 1990}^{\ n}\ [kt\ CO2\ eq] \qquad (4)$$

With the estimate of the local GHG emissions in 1990, local targets can be harmonized and expressed in the 1990 base.

First, as shown in equation (5), the absolute value of the expected local GHG emissions reduction at the target year is calculated, then, as shown in equation (6), this value is divided by the estimated local GHG emissions of 1990 and thus expressed as a percentage of 1990 value. Local targets expressed in the 1990 and 2005 base years are used to assess if local policies and targets are aligned to national policies and targets, as explained in paragraph 2.3.

$$\underset{Reduction}{Local\ Emissions}\ {}^{target\ year}_{base\ year} = \underset{(Emissions)}{Local\ Target}\ {}^{target\ Year}_{base\ year} \times Local\ Emissions_{\ base\ year}\ [kt\ CO2\ eq] \tag{5}$$

$$\underset{(Emissions)}{Local\ Target}\ {}^{target\ year}_{base\ year} = Local\ Emissions\ Reduction_{target\ year} \div Local\ Emissions_{\ 1990}\ [\%] \tag{6}$$

EU and national targets consider the whole evolution between 1990 and the target year, while local targets only account for the progress starting from the local reference year, thus, to see if local targets are high enough to meet national and EU targets, also the previous progress must be considered. The emissions change occurred before local targets were set, between the common base year (1990) and the local reference years, is calculated as shown in equation (7).

$$\underset{(Emissions)}{Local\ Change}\ {}^{given\ year}_{1990} = \frac{Local\ Emissions_{\ given\ year} - Local\ Emissions_{\ 1990}}{Local\ Emissions_{\ 1990}}\ [\%] \tag{7}$$

Then previous change and harmonized targets are summed up as shown in equation (8), and this value is assessed against the national and EU targets.

$$\underset{(Emissions)}{Total\ Local}\ {}^{target\ year}_{1990} = \underset{(Emissions)}{Local\ Change}\ {}^{given\ year}_{1990} + \underset{(Emissions)}{Local\ Target}\ {}^{target\ year}_{base\ year}\ [\%] \tag{8}$$

Finally, the national target for the target year is expressed in the local baseline, with a similar, but inverse transformation, as shown in equation (8). This value serves as an indication of the minimum level to reach at the local level, to be in line with national policies, where no local target was set.

$$\underset{(Emissions)}{National\ Target}\ {}^{2020}_{local\ base\ year} = \frac{Local\ Emissions_{\ 1990} \times \underset{(Emissions)}{National\ Target}\ {}^{2020}_{1990}}{Local\ Emissions_{\ local\ base\ year}}\ [\%] \tag{9}$$

With the local targets in target years different than the national/EU targets (2020, 2030, 2050), for simplicity a linear progression has been used to estimate national targets on any other date (2021, 2024, 2025, etc.). The delta between the previous and the following national target is divided by the number of years between the two national targets and multiplied by the years between the previous national target year and the local target year, as shown in equation (9).

$$\underset{(Emissions)}{National\ Target}\ {}^{t\ year}_{b\ year} = \frac{\left(\underset{(Emissions)}{National\ Target}\ {}^{target\ year\ 2}_{1990} - \underset{(Emissions)}{National\ Target}\ {}^{target\ year\ 1}_{1990}\right)}{(Target\ Year_2 - Target\ year_1)} \times (Target\ Year_{local} - Target\ Year_1) \tag{10}$$

The following box illustrates the above-explained process applied to a practical example: the Communauté de Communes (CdC) des Monts du Lyonnais CCMDL, one of the 25 local administrations assessed.

Example of the harmonization process for the local administration CCMDL forGHG emissions targets.

1. Calculations used to back cast the emission value of missing years (1990, 2005, and 2007):

$$Local\ Emissions_{\ 1990} = Local\ Emissions_{\ available} \div Emissions\ Index\ {}^{available}_{1990}\ [kt\ CO2\ eq] \tag{3}$$

$$Local\ Emissions_{\ 1990} = 277 \div 83\% = 331\ [kt\ CO2\ eq]$$

$$Local\ Emissions_{\ n} = Local\ Emissions_{\ 1990} \times Emissions\ Index_{\ 1990}^{\ n}\ [kt\ CO2\ eq] \qquad (4)$$

$$Local\ Emissions_{\ 2007} = 331 \times 94\% = 310\ [kt\ CO2\ eq]$$

$$Local\ Emissions_{\ 2005} = 331 \times 98\% = 325\ [kt\ CO2\ eq]$$

2. Calculations used to forecast the absolute values of emission reductions at target years:

$$\begin{matrix} Local\ Emissions \\ Reduction \end{matrix}\ {}^{target\ year}_{base\ year} = \begin{matrix} Local\ Target \\ (Emissions) \end{matrix}\ {}^{target\ Year}_{base\ year} \times Local\ Emissions_{\ base\ year}\ [kt\ CO2\ eq] \qquad (5)$$

$$\begin{matrix} Local\ Emissions \\ Reduction \end{matrix}\ {}^{2020}_{2007} = -28\% \times 310 = -87\ [kt\ CO2\ eq]$$

$$\begin{matrix} Local\ Emissions \\ Reduction \end{matrix}\ {}^{2025}_{2015} = -11.2\% \times 277 = -30.99\ [kt\ CO2\ eq]$$

$$\begin{matrix} Local\ Emissions \\ Reduction \end{matrix}\ {}^{2030}_{2015} = -18\% \times 277 = -50\ [kt\ CO2\ eq]$$

$$\begin{matrix} Local\ Emissions \\ Reduction \end{matrix}\ {}^{2050}_{1990} = -80\% \times 277 = -264\ [kt\ CO2\ eq]$$

3. Calculations used to express local targets in common base years 1990 and 2005:

$$\begin{matrix} Local\ Target \\ (Emissions) \end{matrix}\ {}^{target\ year}_{base\ year} = Local\ Emissions\ Reduction_{target\ year} \div Local\ Emissions_{\ 1990}\ [\%] \qquad (6)$$

$$\begin{matrix} Local\ Target \\ (Emissions) \end{matrix}\ {}^{2020}_{1990} = -86.93 \div 330.53 = -26.30\%$$

$$\begin{matrix} Local\ Target \\ (Emissions) \end{matrix}\ {}^{2025}_{1990} = -30.99 \div 330.53 = -9.38\%$$

$$\begin{matrix} Local\ Target \\ (Emissions) \end{matrix}\ {}^{2030}_{1990} = -49.86 \div 330.53 = -15.08\%$$

$$\begin{matrix} Local\ Target \\ (Emissions) \end{matrix}\ {}^{2020}_{2005} = -87 \div 325 = -27\%$$

$$\begin{matrix} Local\ Target \\ (Emissions) \end{matrix}\ {}^{2025}_{2005} = -31 \div 325 = -10\%$$

$$\begin{matrix} Local\ Target \\ (Emissions) \end{matrix}\ {}^{2030}_{2005} = -50 \div 325 = -15\%$$

4. Calculations used to esmitate previous progress at local level until local reference year:

$$\begin{matrix} Local\ Change \\ (Emissions) \end{matrix}\ {}^{1990}_{given\ year} = \frac{Local\ Emissions_{\ given\ year} - Local\ Emissions_{\ 1990}}{Local\ Emissions_{\ 1990}}\ [\%] \qquad (7)$$

$$\begin{matrix} Local\ Change \\ (Emissions) \end{matrix}\ {}^{2007}_{1990} = \frac{Local\ Emissions_{\ 2007} - Local\ Emissions_{\ 1990}}{Local\ Emissions_{\ 1990}}\ [\%]$$

$$\begin{matrix} Local\ Change \\ (Emissions) \end{matrix}\ {}^{2007}_{1990} = \frac{310 - 331}{331} = -6\%$$

$$\begin{matrix} Local\ Change \\ (Emissions) \end{matrix}\ {}^{2007}_{1990} = \frac{277 - 331}{331} = -16\%$$

5. Calculations used to estimate total progress at local level:

$$\begin{matrix} Total\ Local \\ (Emissions) \end{matrix}\ {}^{target\ year}_{1990} = \begin{matrix} Local\ Change \\ (Emissions) \end{matrix}\ {}^{given\ year}_{1990} + \begin{matrix} Local\ Target \\ (Emissions) \end{matrix}\ {}^{target\ year}_{base\ year}\ [\%] \qquad (8)$$

$$\begin{matrix} Total\ Local \\ (Emissions) \end{matrix}\ {}^{2007}_{1990} = -6\% + -26\% = -32\%$$

$$\begin{matrix} Total\ Local \\ (Emissions) \end{matrix}\ {}^{2020}_{1990} = -16\% + -9\% = -26\%$$

6. Calculations used to define minimum targets in local baseline, in line with national targets:

$$\begin{pmatrix}National\ Target\\(Emissions)\end{pmatrix}^{2020}_{local\ base\ year} = \frac{Local\ Emissions_{1990} \times \begin{pmatrix}National\ Target\\(Emissions)\end{pmatrix}^{2020}_{1990}}{Local\ Emissions_{local\ base\ year}} \quad (9)$$

$$\begin{pmatrix}National\ Target\\(Emissions)\end{pmatrix}^{2020}_{2007} = \frac{331 \times -20\%}{310} = -21\%$$

$$\begin{pmatrix}National\ Target\\(Emissions)\end{pmatrix}^{2020}_{2015} = \frac{331 \times -20\%}{277} = -24\%$$

$$\begin{pmatrix}National\ Target\\(Emissions)\end{pmatrix}^{2025}_{2007} = \frac{331 \times -30\%}{277} = -36\%$$

$$\begin{pmatrix}National\ Target\\(Emissions)\end{pmatrix}^{2030}_{2007} = \frac{331 \times -40\%}{277} = -48\%$$

$$\begin{pmatrix}National\ Target\\(Emissions)\end{pmatrix}^{2050}_{2007} = \frac{331 \times -80\%}{277} = -95\%$$

7. Calculations used to define the national targets for a non- common year, 2025:

$$\begin{pmatrix}National\ Target\\(Emissions)\end{pmatrix}^{n}_{1990} = \frac{\left(\begin{pmatrix}National\ Target\\(Emissions)\end{pmatrix}^{target\ year\ 2}_{1990} - \begin{pmatrix}National\ Target\\(Emissions)\end{pmatrix}^{target\ year\ 1}_{1990}\right)}{(Target\ Year_2 - Target\ year_1)} \times (Local\ Target\ Year - Target\ Year_1) \quad (10)$$

$$\begin{pmatrix}National\ Target\\(Emissions)\end{pmatrix}^{2025}_{1990} = \frac{-(40\%-20\%)}{(2030-2020)} \times (2025-2020) = \text{-30\%}$$

2.2.2. Renewable Energy Targets

To compare local targets to national and EU targets, a much simpler harmonization process is needed. Where local renewables targets are defined as a percentage of final consumption by a given target year, these are directly comparable to national and EU targets, as they also are expressed in these same terms.

Conversely, where local targets are defined as production from renewable energy sources (RES absolute value) by a given target year, this value is divided by the projected total final energy consumption forecasted for that target year and expressed as a percentage, as shown in equation (9). Where the expected total final energy consumption by target year is not provided, the efficiency target is used for estimating the total final energy consumption by the target year.

$$\begin{pmatrix}Local\ Target\\(Renewables)\end{pmatrix}^{target\ year}_{base\ year} = Local\ RES\ Production_{target\ year} \div Local\ Energy\ Consumption_{target\ year}\ [\%] \quad (9)$$

Where local renewable energy targets are defined as total or additional installed capacity, without a projection of the expected production, this study considers them not comparable to national and EU targets.

2.2.3. Energy Efficiency Targets

This study assumes final energy consumption as the relevant parameter for local efficiency targets, also comparing them to national and EU targets, as no data on primary energy consumption is typically available at the local level. At the EU and national levels, efficiency targets are indicated as trend scenario goals, with reference to the Primes Reference Scenarios: REF2007 for 2020 targets and REF2016 for 2030 targets (EU Commission, 2019; EU Commission and DG Energy and Transport, 2016, 2007). Whether local efficiency targets are indicated as trend scenario goals, or as base year goals, in either case, to avoid depending on scenarios that are not used at the local level, national targets are expressed as percentage change compared to 1990, then a process similar to the one shown for emission targets is followed, using historical national final energy consumption for the index. Figure 3 and Figure 4 show the final energy consumption values and index. Figure 5 and Figure 6, show the Primes Reference Scenarios 2007, 2016 and their indexes.

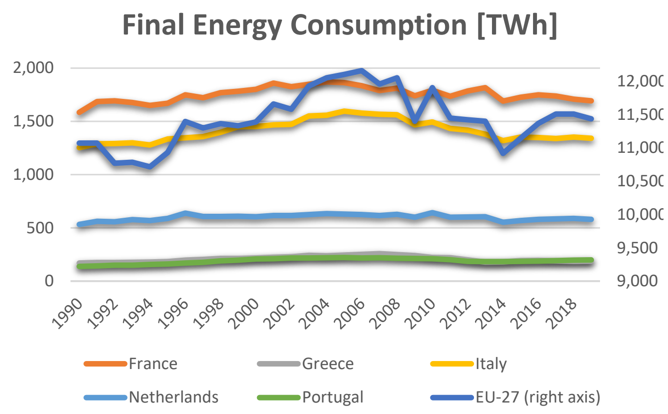

Figure 3: Final Energy Consumption per country (GWh). (Note that Greece and Portugal overlap)

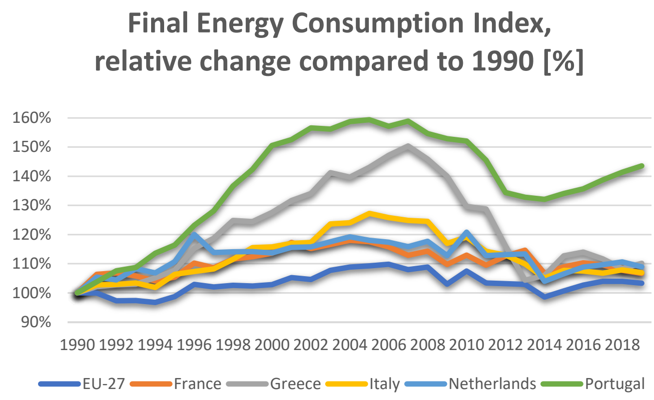

Figure 4: Final Energy Consumption Index per country (relative change compared to 1990).

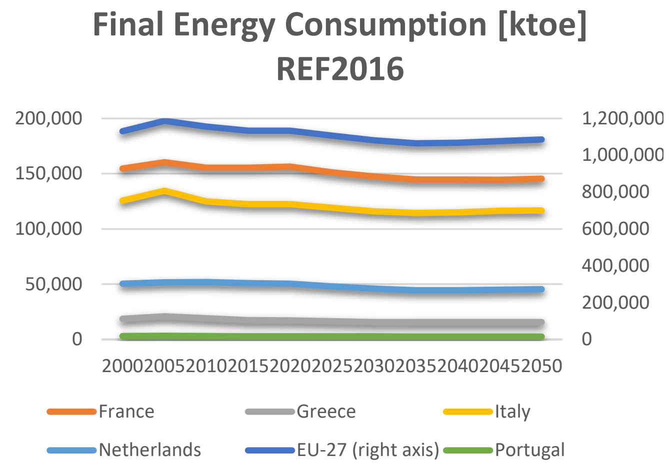

Figure 5: Final Energy consumption per country, Primes Scenarios v4 2016, used for 2030 EU efficiency targets.

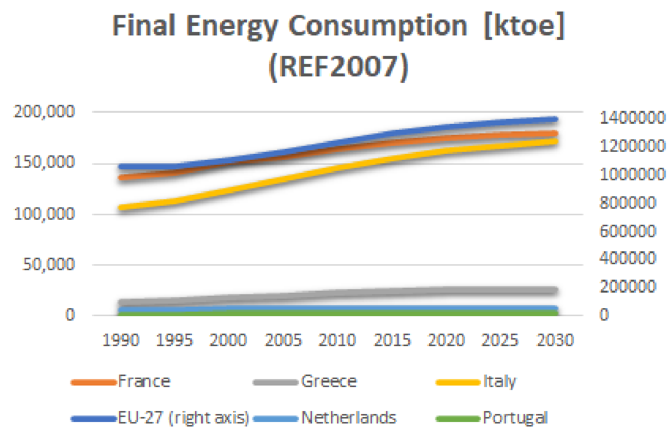

Figure 6: Final Energy consumption per country, Primes Scenarios v1 2007, used for 2020 EU efficiency targets.

2.3. Assessment process

Parameters (Emissions, Renewables, Efficiency) – The first level of assessment regards whether municipalities set in their SEAPs/SECAPs any targets for the three key areas: GHG emissions reduction, renewables and energy efficiency.

Time Horizon – The second level of assessment regards whether municipalities set in their SEAPs/SECAPs any targets for 2020, 2030 and 2050, or which other time horizon they adopted.

Target Ambition – The third level of assessment regards whether harmonized local target values are at least as high as national targets. The complete assessment is available in Annex 5. Figure 8 and Figure 9 show an example of the assessment carried out for the local administration of CCMDL. Regarding GHG emissions, no 2020 target is set, the SECAP mentions a regional target, that the municipality has not committed to, which is higher than national and EU targets. Emission targets for 2025 and 2030 fall short compared to national targets, no target was set for 2050. Regarding renewables, no target was set for 2020, the 2025 target (15,3%) scores below national and EU targets, but targets for 2030 (42%) and 2050 (97%) are higher than the national 2030 target (32%), no 2050 renewable energy targets are set at EU and national levels.

LEGEND
EU reference data
Verified national/local data
Estimated local emissions (backcasting)
Values in TWh, despite the column indicates GWh

Estimated prgress between 1990 and local ref. year
Harmonized national targets
Esimated missing local targets
Harmonized local targets in line or above national target
Harmonized local targets below national target

Figure 7: Legend and colour coding used in Figures 12 and 13. Targets in line with national goals are highlighted in intense green, targets not in line in red, and national reference targets in yellow. Grey cells are indicated in TWh, instead of GWh

Network	Region	GHG Emissions														
		Target Year	Target Value	Parameter	Ref. Year	Ref. Year Absolute Value [ktCOeq]	1990 Absolute Value [ktCOeq]	2005 Absolute Value [ktCOeq]	Target (Local Refrence Year) [%]	Target Reduction Absolute value [ktCOeq]	Target Total Final Emissions [ktCOeq]	Change from 1990 to Local Ref Year	Target (Ref. 1990) [%]	Target (Ref. 2005) [%]	National Target (Local Ref.) [%]	Total Reduction from 1990 [%]
EU-27		2020	-20% (21% ETS + 10% non ETS)	GHG emissions	1990	4,656,859	4,656,859	4,334,527	-20%	-931,372	3,725,487		-20%	-21.5%		
		2030	-55% at least -> -43% ETS + -30% non ETS	GHG emissions	1990				-55%	-2,561,272	2,095,587		-55%	-59.1%		
		2050	carbon neutral	GHG emissions (net-zero)					-80% or more	-3,725,487	931,372		-80% or more	-85.9%		
France		2020	-20%	GHG emissions	1990	535,026	535,026	526,037		-107,005	428,021		**-20%**	**-14%**		
		2030	-40%	GHG emissions	1990					-214,010	321,016		**-40%**	**-37%**		
		2050	carbon neutral	without the use of carbon offsetting						-428,021	107,005		**carbon neutral (-80%?)**			
ALTE69 - France	CCMDL	2020	NOT SET (-28% objectif SRCAE)	GHG emissions	2007	310			NOT SET (-28% SRCAE)	-87	224	-6%	-26%	-27%	-24%	-32%
		2025	-11.19% (to 246 ktCO2eq)	GHG emissions	**2015**	**277**	331	325	-11.2%	-31	246	-16%	-9%	-10%	-36%	-26%
		2030	-18%* (seems from the chart, no figures)	GHG emissions (somethig like 226 ktCO2eq from the chart p.152 SECAP)					-18%	-50	227		-15%	-15%	-48%	-31%
		2050							NOT SET	-264	66		-80%	N.A.	-95%	-80%

Figure 8: Example of the assessment carried out for the local administration CCMDL, after harmonization, for the emission targets.

Network	Region	Renewable Energy				Energy Efficiency												
		Target year	Target Value	Parameter	Absolute value [GWh]	Target year	Target Value	Parameter	Reference Year	Ref. Year Absolute Value [GWh, TWh in grey]	1990 Absolute Value [GWh, TWh in grey]	Target (Local Refrence Year) [%]	Target Reduction Absolute value [GWh]	Target Total Final Consumption [GWh]	Change from 1990 to Local Ref Year	Target (Ref. 1990) [%]	National Target (Local Ref.) [%]	Total Reduction from 1990 [%]
EU-27		2020	20%	RES in final energy consumption		2020	+20%	EE (reduction in primary and final energy consumption compared to trend scenario)	2007 PRIMES projection for 2020	849		20%	-			20.00%		
		2030	32%	RES in final energy consumption (14% in transport and 1,3% in H&C)		2030	+32,5%	EE (reduction in primary and final energy consumption compared to trend scenario)	2016 PRIMES projection for 2030	846		32.5%	-			32.50%		
		2050	80%	electricity from RES														
France		2020	23%	RES in gross final energy consumption		2020	131.4 Mtoe (1,528 TWh)	Final energy consumption	2012	1,786	1,585		- 57	1,528		**-4%**		
		2030	33%	RES in final energy consumption (14% RES in transport, +1%/year in DHC up to 60% and +1,3% in H&C)		2030	120.9 Mtoe (1,406 TWh) = -20% vs 2012	Final energy consumption	2012			-20%	- 179	1,406		**-11%**		
		2050	more than >80%	of electricity from RES		2050	-50% vs 2012	Final energy consumption	2012			-50%	- 692	893		**-44%**		
ALTE69 - France	CCMDL	2025	15%	RES in final energy consumption	114	2025	-12% vs 2015 (746GWh)	Final energy consumption	2015	849	779	-12%	- 102	746	9%	-13.07%	-4%	-4%
		2030	40%	RES in final energy consumption	248	2030	-27% vs 2015 (620GWh)	Final energy consumption	2015			-27%	- 229	620		-29.41%	-10%	-20%
		2050	97%	RES in final energy consumption	419	2050	-49% vs 2015 (433GWh) and Energy Positive	Final energy consumption	2015			-49%	- 416	433		-53.37%	-40%	-44%

Figure 9: Example of the assessment carried out for the local administration CCMDL, after harmonization, RES and efficiency targets.

2.4. Heat demand in buildings: 2050 projections with Invert/Opt model and Enerfirst scenarios

A more in-depth analysis is carried out with regards to the heat demand in buildings using the Enerfirst scenarios which were developed in the framework of the Horizon 2020 project "Making Energy Efficiency First principle operational". These scenarios are aimed at identifying which set of interventions is more cost-efficient to achieve carbon neutrality by 2050. The analysis in this study is done using the Invert/Opt model (Hummel and al., 2021) which is an evolution of the Invert-EE Lab model, built to optimize several variables with a given number of constraints. Four scenarios are used, all respecting the constraint of achieving carbon neutrality by 2050 (-95% GHG emissions compared to 1990): a scenario with high use of renewable energy, one with a high level of building renovation, one with a low level of building renovation, and one with low restrictions, as detailed in Table 2. The main differences are set in the indication of how many refurbishment actions should be of maintenance, with the remaining ones being of thermal renovation. The increased renovation scenario also has a shorter refurbishment life cycle time The low restriction one is particularly aimed at choosing freely how to achieve carbon neutrality with the most cost-effective combination of thermal renovation and energy resources.

A projection to 2050 with 2017 data is calculated applying four Enerfirst scenarios to the Invert/Opt model for each of the 25 municipalities and the 5 networks of municipalities, providing an estimation of the local population, Gross Floor Area (GFA, declined as total, residential, and non-residential), Heat Demand (HD, intended as total energy demand for space heating and hot water, declined as well as total, residential, and non-residential) for each Enerfirst scenario used. The projection also estimates the share of the building stock that shall undergo thermal renovation per year per country. Starting from each national building stock, the model calculates the share of buildings to be demolished by 2050, using a demolition function with a Weibull probability distribution based on the buildings age distribution. Based on this, the model also estimates the share of new constructions needed. These two values, the share of demolished buildings and new constructions, vary by country but are constant across all scenarios in the same country. A chart obtained from this model shows the estimated projection of different interventions on the building stock (no intervention, maintenance, thermal renovation, and new constructions) by 2050. Although these results are calculated at the national, and not at the local level, they still provide an important indication for each considered network and their respective municipalities.

Table 2: Description of the Enerfirst scenarios used with the Invert/Opt model.

Scenario	Description	Share of maintenance actions	Life Cycle Refurbishment Length
Dir_resh_95	Default scenario (applying the EU renewable energy directive): high level of RES (heat pumps, photovoltaic, solar thermal, biomass), minor role of DHC, some hydrogen, high electrification.	20%-50%	1
Increased renovation	Scenario with an increased level of renovation of the building stock, imposed by a forced higher level of building retrofitting, therefore higher efficiency.	10%-90%	0.7
Low efficiency	Scenario with a low level of building renovation compared to the baseline.	65%-90%	1
Low restrictions	Scenario with as little restriction as possible, where the model identifies the highest cost-efficient equilibrium.	10%-90%	1

3. RESULTS AND FINDINGS

Parameters (Emissions, Renewables, Efficiency) – Not all municipalities have set targets for all the three key areas. Emission reduction is the area where at least a target was set in most cases (24 municipalities out of 25), followed by energy efficiency (9 out of 25) and renewables (7 out of 25).

Time Horizon – Not all municipalities set targets for all the three main target years. Most municipalities set only a target for 2020, a few also a target for 2030, almost none for 2050, and some adopted other timelines (2021, 2024, 2025, 2026, 2035, 2040…). On average, for the three main target years, over the three key areas, only 25% of considered municipalities have set at least one target.

Target Ambition – After the harmonization, very few targets result aligned to EU and national policies. The highest number of local targets set and aligned can be seen for GHG emissions reduction by 2020 (36%) and intermediate years between 2021 and 2029 (16%), 2030 (12%) and 2050 (12%), as well as for renewables by 2050 (12%). All other parameters and time horizons scored even lower, with the lowest results for energy efficiency targets (average 5.6%). A condition set by the CoM to accept and publish a SEAP/SECAP, is that it includes an emission target at least of the same value as the EU/national targets. This might explain why many municipalities do not set targets for renewables and efficiency, unless they are forced to, as in the French case. Also, the old SEAP template did not require setting any target beyond 2020, similarly to SECAP beyond 2030, therefore municipalities are not pushed to set long-term targets, and having assessed action plans that date a few years may also explain why 2030 and 2050 targets are more neglected than 2020 targets.

Figure 11 and Figure 10 show a summary of the target assessment results just described. The complete assessment can be seen in Annex 5 and here. As previously mentioned, where no target is set at the local level, this study has provided each municipality with an indication of the climate and energy targets in line with national goals.

		Emission Reduction Targets					Renewable Energy Targets					Energy Efficiency Targets				
		2020	2021-2029	2030	2021-2049	2050	2020	2021-2029	2030	2021-2049	2050	2020	2021-2029	2030	2021-2049	2050
ALTE69 - France	CCMDL	- (A)	✖ (2025)	✖	-	-	-	✖ (2025)	✓	-	✓	-	✓ (2025)	✓	-	✓
	CCSB	-	✓ (2021, 2026)	✓	-	✓	-	✖, ✓ (2021, 2026)	✓	-	✓	-	✖,✓ (2021, 2026)	✓	-	✓
	COR	-	✖ (2024)	✖	-	✖	-	✖ (2024)	✖	-	✓	-	✖ (2024)	✓	-	✓
	SOL	-	✖ (2021, 2026)	✖	-	✖	-	✖ (2021, 2026)	✖	-	✖	-	✖ (2021, 2026)	✖	-	✖
SCN - Greece	Oichalia	✓	-	- (A)	-	-	- (A)	-	-	-	-	- (A)	-	-	-	-
	Ierapetra	✓	-	-	-	-	- (N)	-	-	-	-	- (N)	-	-	-	-
	Korinthos	✓	-	-	-	-	- (N)	-	-	-	-	- (N)	-	-	-	-
	Vari-Voula-Vouliagmeni	✓	-	-	-	-	- (N)	-	-	-	-	- (A)	-	-	-	-
	Messinis	✓	-	-	-	-	- (N)	-	-	-	-	- (A)	-	-	-	-
UCSA - Italy	Palma Campania	✓	-	✓	-	-	- (N)	-	- (A)	-	-	- (A)	-	- (A)	-	-
	San Giuseppe Vesuviano	✓	-	✓	-	-	- (N)	-	- (A)	-	-	- (A)	-	- (A)	-	-
	Striano	✓	-	✓	-	-	- (N)	-	- (A)	-	-	- (A)	-	- (A)	-	-
CNNL - The Netherlands	Groningen	-	-	-	✓ (2035)	✓	-	-	-	- (2035, NQ)	-	-	-	-	✓ (2035)	-
	Assen	-	-	- (NQ)	- (2040, NQ)	✓	- (A)	- (2023, N)	-	-	-	- (A)	- (2023, A)	-	-	-
	Emmen	✖	-	-	✖ (2035)	✓	✖	-	-	-	-	-	-	-	-	-
	Leeuwarden	-	-	-	-	-	✓	-	-	-	-	✓	-	-	-	-
Oeste Sustentável - Portugal	Alcobaça	✖	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Alenquer	✖	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Arruda dos Vinhos	✖	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Bombarral	✖	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Caldas da Rainhas	✖	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Nazaré	✖	-	-	-	-	-	-	-	-	-	✖	-	-	-	-
	Óbidos	✓	-	-	-	-	-	-	-	-	-	✖	-	-	-	-
	Peniche	✖	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Torres Vedras	✖	-	-	-	-	✖	-	-	-	-	✖	-	-	-	-

EU/National Target years: 2020, 2030, 2050	
✓	in line with National (EU) targets
✖	not in line with National (EU) targets
-	not set

Other target years (per linear interpolation)	
✓	in line with National (EU) targets
✖	not in line with national (EU) targets
-	not set

Projections, no target set	
(NQ)	not quantifiable
(A)	projection aligned
(N)	projection not aligned

Figure 10: Harmonized Target Assessment Overview

Invert/Opt model and Enerfirst scenarios – Different municipalities show different results, but some common trends can be seen across all 5 networks. To achieve carbon neutrality by 2050, a significant decrease in total heat demand is projected, as shown in Table 3. The default scenario forecasts total heat demand to be almost halved basically in all municipalities and networks, with the smallest reduction in the French network and the biggest in the Greek one.

What is most interesting, is that the low restriction scenario suggests a substantial use of efficiency and renovation, somewhere between the default and the increased renovation scenario. All scenarios for all networks (except the low-efficiency one) forecast the specific energy demand to decrease by at least 40%, with peaks of at least 50% in the Dutch network and at least 60% in the Greek network. The national yearly share of the building stock projected to undergo thermal renovation is reported in

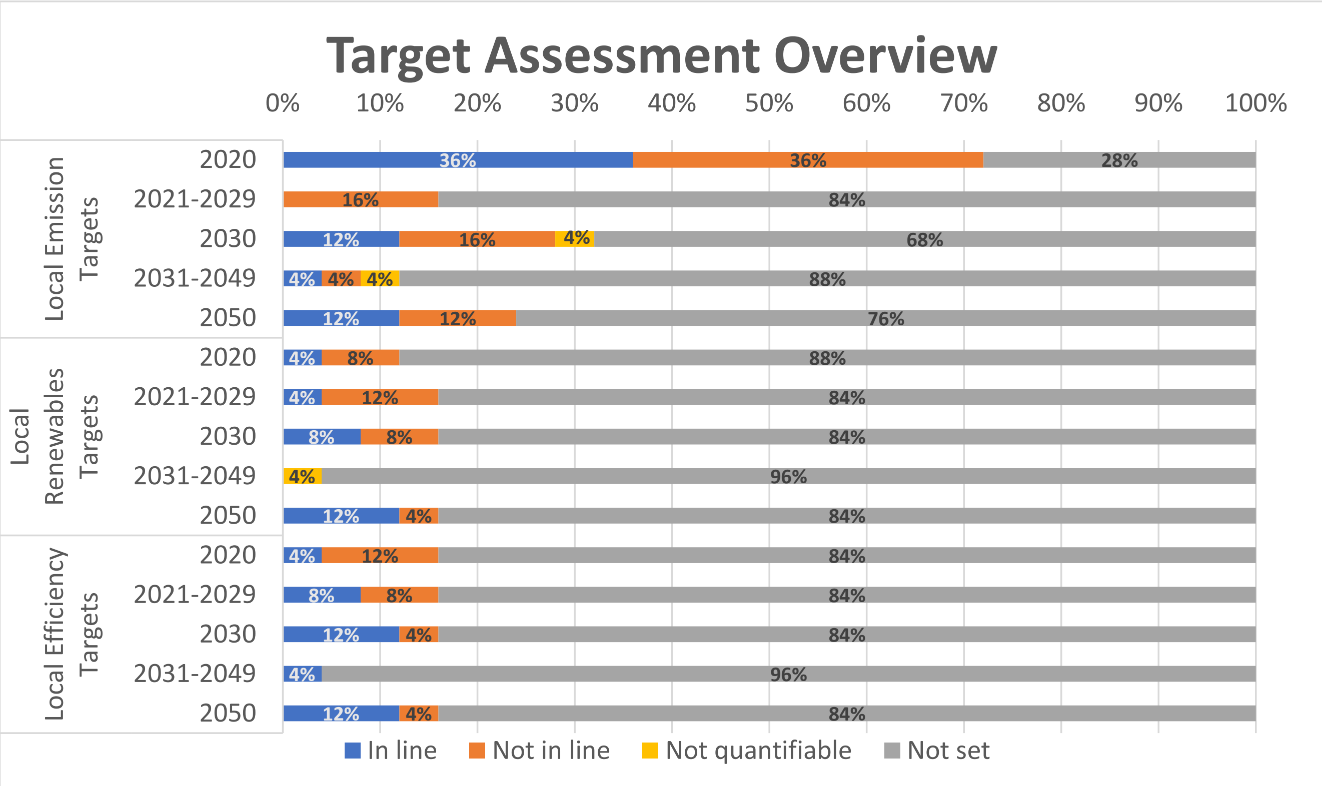

Figure 11: Targets Assessment Overview regarding alignment with national/EU targets.

Table 4 Consistently with the previous results, the model with a low-restrictions scenario estimates a significant level of renovation, about halfway between the default scenario and the increased renovation scenario. Although these values are not calculated at the local level, they are still a relevant indication for each network considered.

Table 3: Results of the projection per each country.

Network	Gross Floor Area (GFA)			GFA per capita	Population	Heat Demand			
	Total	Residential	Non-Residential			Default	Inc. Renov.	Low efficiency	Low restrictions
France – Alte69	+18%	+22%	-3%	-3%	+22%	-34%	-40%	-16%	-37%
Greece – SNC	-15%	-16%	-7%	-7%	-9%	-67%	-70%	-60%	-69%
Italy - UCSA	-8%	+17%	+2%	+2%	-10%	-45%	-51%	-34%	-49%
CNNL – Netherlands	+9%	+43%	+11%	+11%	-2%	-46%	-55%	-27%	-50%
Oeste - Portugal	-5%	-2%	+2%	+2%	-7%	-43%	-47%	-31%	-45%

Table 4: Share of building stock per year, per country projected to be renovated, according to construction period and scenario adopted, to achieve carbon neutrality by 2050.

Network	Construction period before 1975				Construction period between 1976 and 1990				Construction period between 1991 and 2014			
	Default	Inc. Renov.	Low efficiency	Low restrictions	Default	Inc. Renov.	Low efficiency	Low restrictions	Default	Inc. Renov.	Low efficiency	Low restrictions
France	1.5%	2.3%	0.8%	1.7%	1.9%	2.5%	0.4%	2.3%	1.1%	1.5%	0.1%	1.3%
Greece	1.2%	2%	0.6%	1.5%	1.8%	2.4%	0.7%	2.2%	1.5%	2%	0.3%	1.7%
Italy	1.3%	1.9%	0.6%	1.5%	1.8%	2.4%	0.5%	2.2%	1.4%	1.7%	0.2%	1.7%
Netherlands	1.5%	2.3%	0.4%	1.8%	1.7%	2.4%	0.5%	2.2%	1.2%	1.6%	0.6%	1.4%
Portugal	1.2%	2.1%	0.6%	1.4%	1.6%	2.1%	0.5%	1.8%	1.3%	2.0%	0.3%	1.7%

4. DISCUSSION

Local GHG emissions might not have followed a pattern similar to the national trend, so a level of error must be accounted for when considering the backcasting estimation of local GHG emissions in 1990 and 2005.

Emissions reduction has proved to follow a linear progression hardly ever. Its curve is affected by several factors including progressively decreasing prices of renewable and efficient technologies, incremental learning curve, incremental available funds (EU/national), incremental socio-political pressure urging for climate action, but also the widespread trend of aiming at the low hanging fruits in early stages, with possible step-like acceleration and deceleration phases. Nonetheless, a linear progression was adopted to interpolate the emission reduction targets at the national and local levels where targets have different target years. A level of error must be accounted for this approximation; however, this paper aims at raising awareness on the fact that local climate targets often seem to be deceivingly aligned to national and EU targets, but a simple harmonization process can remove this gap. IT would be desirable that local administrations and municipalities are aware of such issues and run a harmonization process when setting their climate targets in future.

Some local targets remain not comparable, simply because the same data are not available at the local and national levels. For example, energy efficiency at the EU and national level is indicated as reduction of primary and final energy consumption, but the primary energy consumption is not available at the local level, thus this target cannot be found in local policies. Others are not comparable because they are not expressed with the same parameters. For example, renewable energy targets at the national level are indicated as a percentage of final energy consumption or national energy production as opposed to targets at the local level indicated as installed capacity, without providing a projection of expected production that could help to estimate the expected generated energy.

Even some national targets show a degree of variability despite using the same wording, as the concept of carbon neutrality has multiple definitions: -80%, -80% or more, -80%/-90%, -95%.

5. CONCLUSIONS

This analysis shows that the great majority of local climate and energy targets in the municipalities assessed, are either not set or not aligned to national and EU policies. Even when targets in local baseline seem aligned to national and EU goals, once harmonized they prove to be not. Given these results, local climate action seems to be less ambitious than national and EU commitments, nonetheless, this is still a great achievement. The fact that so many municipalities committed voluntarily to some climate and energy targets show a broad, genuine, strong desire to advance local climate action in Europe. The CoM alone counts to date 10,711 signatories and 6,833 published action plans, without including all municipalities who adopted an action plan out of national requirements, without joining the CoM, as the majority of French local administrations, for instance. At the same time, while any step forward on the road to climate change mitigation is a precious effort, this assessment reveals a limit of local climate action, where better coordination and clearer guidance could be attained. This study has not investigated whether such target misalignment was known by the local administrations, or they were unaware of the harmonization bias.

National/EU targets expressed in the local baseline for each key area (emissions, renewable and efficiency) by 2020, 2030, and 2050 could guide future policy developments, especially until a roadmap for implementation or the action plan is updated.

The scenarios calculated with the Invert/Opt model with current price information proved to consider building renovation a cost-effective option to achieve carbon neutrality. This confirms how energy efficiency plays a pivotal role in climate action and how building renovation is both a necessary and a cost-effective solution to achieve the EU 2050 net carbon zero target. Considering that many SEAPs and SECAPs do not set efficiency targets, nor a building stock renovation plan, it seems essential to identify what barriers prevent an adequate local climate action with regards to heating and cooling and building efficiency, and support municipalities in overcoming such barriers to start tackling these core sectors. This is where the PATH2LC project steps in.

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REFERENCES

Australian Government Climate Change Authority, 2015. Comparing Countries' Emissions Targets - A Practical Guide.

Bansard, J.S., Pattberg, P.H., Widerberg, O., 2017. Cities to the rescue? Assessing the performance of transnational municipal networks in global climate governance. Int. Environ. Agreem. Polit. Law Econ. 17, 229–246. https://doi.org/10.1007/s10784-016-9318-9

Boswell, M.R., Greve, A.I., Seale, T.L., 2010. An Assessment of the Link Between Greenhouse Gas Emissions Inventories and Climate Action Plans. J. Am. Plann. Assoc. 76, 451–462. https://doi.org/10.1080/01944363.2010.503313

EU Commission, 2021. Energy efficiency first [WWW Document]. Energy - Eur. Comm. URL https://ec.europa.eu/energy/topics/energy-efficiency/targets-directive-and-rules/energy-efficiency-first_en (accessed 9.20.21).

EU Commission, 2019. EU Reference Scenario 2020 [WWW Document]. Energy - Eur. Comm. URL https://ec.europa.eu/energy/data-analysis/energy-modelling/eu-reference-scenario-2020_en (accessed 8.23.21).

EU Commission, 2015. Energy Union Package. COM(2015) 80 final "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy."

EU Commission, DG Energy and Transport, 2016. EU Reference Scenario 2016 - Energy, transport and GHG emissions Trends to 2050.

EU Commission, DG Energy and Transport, 2007. European energy and transport: trends to 2030. Office for Official

Publications of the European Communities, Luxembourg.

Hoff, J., Strobel, B.W., 2013. A Municipal 'Climate Revolution'? The Shaping of Municipal Climate Change Policies.

Houbart, C., 2015. Greenhouse Gas Emission Reduction Targets among Member Cities.

Hummel, M., al., 2021. How cost-efficient is energy efficiency in buildings? A comparison of building shell efficiency and heating system change in the European Building stock.

Pablo-Romero, M. del P., Pozo-Barajas, R., Sánchez-Braza, A., 2015. Understanding local CO2 emissions reduction targets. Renew. Sustain. Energy Rev. 48, 347–355. https://doi.org/10.1016/j.rser.2015.04.014

Rowan, S.S., 2019. Pitfalls in comparing Paris pledges. Clim. Change 155, 455–467. https://doi.org/10.1007/s10584-019-02494-7

Salvia, M., Reckien, D., Pietrapertosa, F., Eckersley, P., Spyridaki, N.-A., Krook-Riekkola, A., Olazabal, M., De Gregorio Hurtado, S., Simoes, S.G., Geneletti, D., Viguié, V., Fokaides, P.A., Ioannou, B.I., Flamos, A., Csete, M.S., Buzasi, A., Orru, H., de Boer, C., Foley, A., Rižnar, K., Matosović, M., Balzan, M.V., Smigaj, M., Baštáková, V., Streberova, E., Šel, N.B., Coste, L., Tardieu, L., Altenburg, C., Lorencová, E.K., Orru, K., Wejs, A., Feliu, E., Church, J.M., Grafakos, S., Vasilie, S., Paspaldzhiev, I., Heidrich, O., 2021. Will climate mitigation ambitions lead to carbon neutrality? An analysis of the local-level plans of 327 cities in the EU. Renew. Sustain. Energy Rev. 135, 110253. https://doi.org/10.1016/j.rser.2020.110253

Senbel, M., Fergusson, D., Stevens, M., 2013. Local responses to regional mandates: assessing municipal greenhouse gas emissions reduction targets in British Columbia. Sustain. Sci. Pract. Policy 9, 28–41. https://doi.org/10.1080/15487733.2013.11908105

Stevens, M., Senbel, M., 2020. What Happens When Municipalities Set Targets to Reduce Their Greenhouse Gas Emissions? J. Plan. Educ. Res. 40, 44–55. https://doi.org/10.1177/0739456X17741716

UNEP, 2018. Bridging the emissions gap - The role of non-state and subnational actors (Pre-release version of a chapter of the forthcoming UN Environment Emissions Gap Report 2018).

UNEP, 2015. Climate Commitments of Subnational Actors and Business.

World Resource Institute (WRI), 2015. Canada, EU, Japan and US Post-2020 GHG Emissions Targets: Estimated Emissions Reductions Relative to Different Base Years [WWW Document]. World Resour. Inst. URL https://www.wri.org/data/canada-eu-japan-and-us-post-2020-ghg-emissions-targets-estimated-emissions-reductions-relative (accessed 8.18.21).

World Resource Institute (WRI), Greenhouse Gas Protocol, 2015. GHG Protocol Mitigation Goal Standard, Overview Presentation [WWW Document]. URL https://ghgprotocol.org/sites/default/files/standards_supporting/Overview_Presentation_Mitigation_Goal_Standard_1.pdf

ANNEX 1: COMPLETE ASSESSMENT: CALCULATIONS OVERVIEW

GHG Emissions

Network	Region	Target Year	Target Value	Parameter	Ref. Year	Ref. Year Absolute Value [ktCOeq]	1990 Absolute Value [ktCOeq]	2005 Absolute Value [ktCOeq]	Target (Local Refrence Year) [%]	Target Reduction Absolute value [ktCOeq]	Target Total Final Emissions [ktCOeq]	Change from 1990 to Local Ref Year	Target (Ref. 1990) [%]	Target (Ref. 2005) [%]	National Target (Local Ref.) [%]	Total Reduction from 1990 [%]
	EU-27	2020	-20% (21% ETS + 10% non ETS)	GHG emissions	1990	4,656,859	4,656,859	4,334,527	-20%	-931,372	3,725,487		-20%	-21.5%		
	EU-27	2030	-55% at least -> -43% ETS + -30% non ETS	GHG emissions	1990				-55%	-2,561,272	2,095,587		-55%	-59.1%		
	EU-27	2050	carbon neutral	GHG emissions (net-zero)					-80% or more	-3,725,487	931,372		-80% or more	-85.9%		
	France	2020	-20%	GHG emissions	1990	535,026	535,026	526,037		-107,005	428,021		**-20%**	**-14%**		
	France	2030	-40%	GHG emissions	1990					-214,010	321,016		**-40%**	**-37%**		
	France	2050	carbon neutral	without the use of carbon offsetting						-428,021	107,005		**carbon neutral (-80%?)**			
ALTE69 - France	CCMDL	2020	NOT SET (-28% objectif SRCAE)	GHG emissions	2007	310			NOT SET (-28% SRCAE)	-87	224	-6%	-26%	-27%	-24%	-32%
ALTE69 - France	CCMDL	2025	-11.19% (to 246 ktCO2eq)	GHG emissions	**2015**	**277**	331	325	-11.2%	-31	246	-16%	-9%	-10%	-36%	-26%
ALTE69 - France	CCMDL	2030	-18%* (seems from the chart, no figures)	GHG emissions (somethig like 226 ktCO2eq from the chart p.152 SECAP)					-18%	-50	227		-15%	-15%	-48%	-31%
ALTE69 - France	CCMDL	2050							NOT SET	-264	13		-80%	N.A.	-95%	-96%
ALTE69 - France	CCSB	2021	-15.17% (285ktCO2eq/an)	GHG emissions	**2013**	**336**	389	382	-15.2%	-51	285	-14%	-13%	-13%	-25%	-27%
ALTE69 - France	CCSB	2026	-28% (241ktCO2eq/an)						-28%	-94	242		-24%	-25%	-37%	-38%
ALTE69 - France	CCSB	2030	-41% (198 ktCO2eq/an)	GHG emissions					-41%	-138	198		-35%	-36%	-46%	-49%
ALTE69 - France	CCSB	2050	-83% (50? ktCO2eq/an) not written, from charts	GHG emissions					-83%	-279	57		-72%	-73%	-93%	-85%
ALTE69 - France	COR	2020	NOT SET						NOT SET	-71	283		-20%	N.A.	-24%	-20%
ALTE69 - France	COR	2024	-9%	GHG emissions	**2015**	**296**	354	348	-9%	-27	270	-16%	-8%	-8%	-33%	-24%
ALTE69 - France	COR	2030	-22%	GHG emissions					-22%	-65	231		-18%	-19%	-48%	-35%
ALTE69 - France	COR	2050	-50%	GHG emissions					-50%	-148	148		-42%	-43%	-95%	-58%
ALTE69 - France	SOL	2021	- 1% (560.33)	GHG emissions	**2015**	**566**	675	664	-1%	-6	560	-16%	-1%	-1%	-26%	-17%
ALTE69 - France	SOL	2026	-14% (487.90)	GHG emissions					-14%	-79	487		-12%	-12%	-38%	-28%
ALTE69 - France	SOL	2030	-19% (458.74)	GHG emissions					-19%	-108	458		-16%	-16%	-48%	-32%
ALTE69 - France	SOL	2050	-54% (258.68)	GHG emissions					-54%	-306	260		-45%	-46%	-95%	-61%
	Greece	2020	-20% (4%)	CO2 emissions	1990 (2005)		103,697	135,786	**-20%**	-20,739	82,958		**-20%**	**-4%**		
	Greece	2030	-42% / -56% GHG emissions	(+ phase out lignite by 2028)	1990 / 2005				**-42%**	-43,553	-43,553		**-42%**	**-56%**		
	Greece	2050	climate neutral	CO2e emissions (-56%)	1990 (2005)				**carbon neutral (-80%?)**	-82,958	-82,958		**carbon neutral (-80%?)**			
SCN - Greece	Oichalia	2020	-32,40%	CO2e emissions	**2011**	**58**	52	68	-32.40%	-19	39	11%	-36%	-27%	-18%	-25%
SCN - Greece	Oichalia	2030	NOT SET Ready for 40% emission reduction target, no commitment	CO2 emissions					NOT SET (-40%)	-23	35		-44%	-34%	-38%	-33%
SCN - Greece	Oichalia	2050	NOT SET						NOT SET	-41	16		-80%	N.A.	-72%	-69%
SCN - Greece	Ierapetra	2020	-22,4% (40670 teCO2)	CO2e emissions	**2010**	**182**	159	209	-22.40%	-41	141	14%	-26%	-19%	-18%	-12%
SCN - Greece	Ierapetra	2030	NOT SET						NOT SET	-67	92		-42%	N.A.	-37%	-42%
SCN - Greece	Ierapetra	2050	NOT SET						NOT SET	-128	54		-80%	N.A.	-70%	-66%
SCN - Greece	Korinthos	2020	-20% (77,769 tonnes of CO 2 per year)	CO2e emissions	**2011**	**389**	350	458	-20%	-78	311	11%	-22%	-17%	-18%	-11%
SCN - Greece	Korinthos	2030	NOT SET						NOT SET	-147	203		-42%	N.A.	-38%	-42%
SCN - Greece	Korinthos	2050	NOT SET						NOT SET	-280	109		-80%	N.A.	-72%	-69%
SCN - Greece	Vari-Voula-Vouliagmeni	2020	-23,81% (118,091 t CO2)	CO2e emissions	**2010**	**499**	438	574	-23.81%	-119	380	14%	-27%	-21%	-18%	-13%
SCN - Greece	Vari-Voula-Vouliagmeni	2030	NOT SET						NOT SET	-184	315		-42%	N.A.	-37%	-28%
SCN - Greece	Vari-Voula-Vouliagmeni	2050	NOT SET						NOT SET	-351	148		-80%	N.A.	-70%	-66%
SCN - Greece	Messinis	2020	-20% (24,536 ton of CO2)	CO2e emissions	**2012**	**123**	114	149	-20%	-25	98	8%	-22%	-16%	-19%	-14%
SCN - Greece	Messinis	2030	NOT SET						NOT SET	-48	66		-42%	N.A.	-39%	-42%
SCN - Greece	Messinis	2050	NOT SET						NOT SET	-91	32		-80%	N.A.	-74%	-72%
	Italy	2020	-13% (-21% ETS)	GHG emission non-ETS	2005		516,817	559,987		-72,798	444,019		**-14%**	**-13%**		
	Italy	2030	-33% (-43% ETS)	GHG emission non-ETS	2005					-184,796	-184,796		**-36%**	**-33%**		
	Italy	2050	carbon neutral							-413,454	-413,454		**-80% or more**			
UCSA - Italy	Palma Campania	2020	-20% (9068 tCO2e)	CO2 emissions	**2008**	**45**	44	47	-20%	-9	36	4%	-21%	-19%	-14%	-17%
UCSA - Italy	Palma Campania	2030	-60.3% (27.284 tCO2e)	CO2 emissions	2008	45	44	47	-60.30%	-27	18		-62%	-58%	-35%	-59%
UCSA - Italy	Palma Campania	2050	NOT SET						NOT SET	-35	10		-80%	N.A.	-77%	-76%
UCSA - Italy	San Giuseppe Vesuviano	2020	-26% (34283 tCO2e)	CO2 emissions	**2008**	**132**	127	138	-26%	-34	97	4%	-27%	-25%	-14%	-23%
UCSA - Italy	San Giuseppe Vesuviano	2030	-61.77% (81330 tCO2e)	CO2 emissions	2008	132	127	138	-61.70%	-81	50		-64%	-59%	-31%	-60%
UCSA - Italy	San Giuseppe Vesuviano	2050	NOT SET						NOT SET	-102	30		-80%	N.A.	-77%	-76%
UCSA - Italy	Striano	2020	-41.9% (19275 tCO2e)	CO2 emissions	**2008**	**46**	44	48	-41.90%	-19	27	4%	-43%	-40%	-14%	-40%
UCSA - Italy	Striano	2030	-61.08% (28130 tCO2e)	CO2 emissions	2008	46	44	48	-61.08%	-28	18		-63%	-58%	-31%	-60%
UCSA - Italy	Striano	2050	NOT SET						NOT SET	-36	10		-80%	N.A.	-77%	-76%

Renewable Energy

Network	Region	Target year	Target Value	Parameter	Absolute value [GWh]
	EU-27	2020	20%	RES in final energy consumption	
	EU-27	2030	32%	RES in final energy consumption (14% in transport and 1,3% in H&C)	
	EU-27	2050	80%	electricity from RES	
	France	2020	23%	RES in gross final energy consumption	
	France	2030	33%	RES in final energy consumption	
	France	2050	more than >80%	of electricity from RES	
ALTE69 - France	CCMDL	2020	NOT SET		
ALTE69 - France	CCMDL	2025	15%	RES in final energy consumption	114
ALTE69 - France	CCMDL	2030	40%	RES in final energy consumption	248
ALTE69 - France	CCMDL	2050	97%	RES in final energy consumption	419
ALTE69 - France	CCSB	2021	22%	RES production	261
ALTE69 - France	CCSB	2026	33%	RES production	361
ALTE69 - France	CCSB	2030	45%	RES production	441
ALTE69 - France	CCSB	2050	127%	RES (energy positive)	805
ALTE69 - France	COR	2020	NOT SET		
ALTE69 - France	COR	2024	17%	RES	190
ALTE69 - France	COR	2030	28%	RES	285
ALTE69 - France	COR	2050	101%	RES (energy positive)	610
ALTE69 - France	SOL	2021	9%	RES	241.69
ALTE69 - France	SOL	2026	13%	RES	345.26
ALTE69 - France	SOL	2030	15%	RES	381.56
ALTE69 - France	SOL	2050	46%	RES	740.65
	Greece	2020	18%	RES	
	Greece	2030	35% (60% in gross electricity consumption, 43% in H&C, 19% in transport)	RES share in gross final energy consumption	
	Greece	2040	41% (72% in gross electricity consumption, 43% in H&C, 41% in transport)	RES share in gross final energy consumption	
SCN - Greece	Oichalia	2020	37%	Estimated RES in final consumption, no target	49.251
SCN - Greece	Oichalia	2030	NOT SET		
SCN - Greece	Oichalia	2050	NOT SET		
SCN - Greece	Ierapetra	2020	7%	Estimated RES in final consumption, no target	20.584
SCN - Greece	Ierapetra	2030	NOT SET		
SCN - Greece	Ierapetra	2050	NOT SET		
SCN - Greece	Korinthos	2020	9%	Estimated RES in final consumption, no target	77
SCN - Greece	Korinthos	2030	NOT SET		
SCN - Greece	Korinthos	2050	NOT SET		
SCN - Greece	Vari-Voula-Vouliagmeni	2020	9%	Estimated RES in final consumption, no target	81.88
SCN - Greece	Vari-Voula-Vouliagmeni	2030	NOT SET		
SCN - Greece	Vari-Voula-Vouliagmeni	2050	NOT SET		
SCN - Greece	Messinis	2020	9%	Estimated RES in final consumption, no target	20.38
SCN - Greece	Messinis	2030	NOT SET		
SCN - Greece	Messinis	2050	NOT SET		
	Italy	2020	17%	RES in gross final consumption	
	Italy	2030	30%	RES in gross final consumption	
UCSA - Italy	Palma Campania	2020	2%	Estimated RES in final consumption, no target	1.646
UCSA - Italy	Palma Campania	2030	55%	Estimated RES in final consumption, no target	32.743
UCSA - Italy	Palma Campania	2050	NOT SET		
UCSA - Italy	San Giuseppe Vesuviano	2020	8%	Estimated RES in final consumption, no target	23.509
UCSA - Italy	San Giuseppe Vesuviano	2030	36%	Estimated RES in final consumption, no target	69.848
UCSA - Italy	San Giuseppe Vesuviano	2050	NOT SET		
UCSA - Italy	Striano	2020	16%	Estimated RES in final consumption, no target	17.49
UCSA - Italy	Striano	2030	27%	Estimated RES in final consumption, no target	21.55
UCSA - Italy	Striano	2050	NOT SET		

Energy Efficiency

Network	Region	Target year	Target Value	Parameter	Reference Year	Ref. Year Absolute Value [GWh, TWh in grey]	1990 Absolute Value [GWh, TWh in grey]	Target (Local Refrence Year) [%]	Target Reduction Absolute value [GWh]	Target Total Final Consumption [GWh]	Change from 1990 to Local Ref Year	Target (Ref. 1990) [%]	National Target (Local Ref.) [%]	Total Reduction from 1990 [%]
	EU-27	2020	+20%	EE (reduction in primary and final energy consumption compared to trend scenario)	2007 PRIMES projection for 2020	849		20%	-			20.00%		
	EU-27	2030	+32,5%	EE (reduction in primary and final energy consumption compared to trend scenario)	2016 PRIMES projection for 2030	846		32.5%	-			32.50%		
	France	2020	131.4 Mtoe (1,528 TWh)	Final energy consumption	2012	1,786	1,585		-257	1,528	-57	**-3.57%**		
	France	2030	120.9 Mtoe (1,406 TWh) = -20% vs 2012	Final energy consumption	2012			-20%	-380	1,406	-179	**-11.28%**		
	France	2050	-50% vs 2012	Final energy consumption	2012			-50%	-893	893	-692	**-43.66%**		
ALTE69 - France	CCMDL	2020	NOT SET						-28	821	8.92%	-3.57%	-3.28%	5.35%
ALTE69 - France	CCMDL	2025	-12% vs 2015 (747GWh)	Final energy consumption	2015	849	779	-12%	-102	747		-13.07%	-6.82%	-4.15%
ALTE69 - France	CCMDL	2030	-27% vs 2015 (620GWh)	Final energy consumption	2015			-27%	-229	620		-29.41%	-10.35%	-20.49%
ALTE69 - France	CCMDL	2050	-49% vs 2015 (433GWh) and Energy Positive	Final energy consumption	2015			-49%	-416	433		-53.37%	-40.09%	-44.45%
ALTE69 - France	CCSB	2021	-14.6% vs 2013 (1213 GWh)	Final energy consumption	2013	1,421	1,239	-15%	-208	1,213	14.65%	-16.76%	-3.79%	-2.11%
ALTE69 - France	CCSB	2026	-23.7% vs 2013 (1084 GWh)	Final energy consumption				-24%	-337	1,084		-27.17%	-7.15%	-12.52%
ALTE69 - France	CCSB	2030	-31% vs 2013 (981 GWh)	Final energy consumption				-31%	-440	981		-35.52%	-9.83%	-20.87%
ALTE69 - France	CCSB	2050	635 GWh final energy consumption -55%	Final energy consumption				-55%	-786	635		-63.40%	-38.08%	-48.75%
ALTE69 - France	COR	2020	NOT SET						-41	1,217	8.92%	-3.57%	-3.28%	5.35%
ALTE69 - France	COR	2024	1134GWh (-9.9%)	Energy consumption	2015	1,258	1,155	-10%	-124	1,134		-10.74%	-2.83%	-1.82%
ALTE69 - France	COR	2030	1010GWh (-19.7%)	Energy consumption				-20%	-248	1,010		-21.47%	-10.35%	-12.55%
ALTE69 - France	COR	2050	605GWh (-51.9%)	Energy consumption				-51.9%	-653	605		-56.54%	-40.09%	-47.62%
ALTE69 - France	SOL	2021	2764.71 GWh (-0.3%)	Energy consumption	2015	2,773	2,546	-0.32%	-9	2,764	8.92%	-0.35%	-3.79%	8.56%
ALTE69 - France	SOL	2026	2561.53 GWh (-7.6%)	Energy consumption				-7.65%	-212	2,561		-8.33%	-7.15%	0.59%
ALTE69 - France	SOL	2030	2496.50 GWh (-10%)	Energy consumption				-9.99%	-277	2,496		-10.88%	-9.83%	-1.96%
ALTE69 - France	SOL	2050	1604,51 GWh (-42.1%)	Energy consumption				-42.16%	-1,169	1,604		-45.92%	-38.08%	-37.00%
	Greece	2020	18.4 Mtoe (213,992GWh)	Final energy consumption	-28% vs 2007 PRIMES projection for 2020		171	-28%		214	43	**25.18%**		
	Greece	2030	16.5 Mtoe (191,895GWh)	Final energy consumption	-38% vs 2007 PRIMES projection for 2030			-38%		192	21	**12.26%**		
SCN - Greece	Oichalia	2020	Expected -6836MWh =-4.86%	Final energy consumption	2011	141	109	-4.86%	-7	134	28.75%	-6.26%	19.56%	22.49%
SCN - Greece	Oichalia	2030	NOT SET					NOT SET	13	123		12.26%	9.52%	12.26%
SCN - Greece	Ierapetra	2020	Expected -34829MWh = -11%	Final energy consumption	2010	316	243	-2.17%	-7	309	29.65%	-2.81%	19.43%	26.84%
SCN - Greece	Ierapetra	2030	NOT SET					NOT SET	30	273		12.26%	9.45%	12.26%
SCN - Greece	Korinthos	2020	Estimated -89158MWh =-11%	Final energy consumption	2011	825	641	-1%	-7	818	28.75%	-1.07%	19.56%	27.69%
SCN - Greece	Korinthos	2030	NOT SET					NOT SET	79	719		12.26%	9.52%	12.26%
SCN - Greece	Vari-Voula-Vouliagmeni	2020	Estimated -185,101MWh = -17,21%	Final energy consumption	2010	1,075	829	-17.21%	-185	890	29.65%	-22.32%	19.43%	7.33%
SCN - Greece	Vari-Voula-Vouliagmeni	2030	NOT SET					NOT SET	102	931		12.26%	9.45%	12.26%
SCN - Greece	Messinis	2020	Estimated -24,219MWh = -10%	Final energy consumption	2012	244	210	-10%	-24	220	16.08%	-11.51%	21.70%	4.57%
SCN - Greece	Messinis	2030	NOT SET					NOT SET	26	236		12.26%	10.56%	12.26%
	Italy	2020	-24% vs PRIMES scenarios (primary energy consumption 158.0Mtoe, final energy consumption 124.0Mtoe)	Energy consumption	2007 PRIMES projection for 2020	1,566	1,254	-24%	-124	1,442	188	**14.99%**		
	Italy	2030	-39.7% vs PRIMES scenarios (primary energy consumption 125.1Mtoe, final energy consumption 103.8Mtoe)	Energy consumption	2016 PRIMES projection for 2030			-40%	-358	1,207	-47	**-3.74%**		
UCSA - Italy	Palma Campania	2020	Estimated -16.937GWh = -16%	Estimated final energy consumption, no target	105834MWh in 2008,	106	85	-16%	-17	89	24.53%	-19.92%	12.04%	4.60%
UCSA - Italy	Palma Campania	2030	Estimated -46.278GWh= -43.7%	Estimated final energy consumption, no target				-43.70%	-46	60		-54.42%	-3.00%	-29.89%
UCSA - Italy	San Giuseppe Vesuviano	2020	Estimated -52.264MWh = -14.9%	Estimated final energy consumption, no target	350392 MWh in 2008	350	281	-15%	-52	298	24.53%	-18.55%	12.04%	5.97%
UCSA - Italy	San Giuseppe Vesuviano	2030	Estimated -156.688GWh = -44.7%	Estimated final energy consumption, no target				-44.70%	-157	194		-55.66%	-3.00%	-31.14%
UCSA - Italy	Striano	2020	Estimated -17.432GWh = -13.8%	Estimated final energy consumption, no target	125801 MWh in 2008	126	101	-13.80%	-17	108	24.53%	-17.18%	12.04%	7.34%
UCSA - Italy	Striano	2030	Estimated -46.051GWh = -36.6%	Estimated final energy consumption, no target				-36.60%	-46	80		-45.58%	-3.00%	-21.05%

GHG Emissions

Network	Region	Target Year	Target Value	Parameter	Ref. Year	Ref. Year Absolute Value [ktCOeq]	1990 Absolute Value [ktCOeq]	2005 Absolute Value [ktCOeq]	Target (Local Refrence Year) [%]	Target Reduction Absolute value [ktCOeq]	Target Total Final Emissions [ktCOeq]	Change from 1990 to Local Ref Year	Target (Ref. 1990) [%]	Target (Ref. 2005) [%]	National Target (Local Ref.) [%]	Total Reduction from 1990 [%]
The Netherlands		2020	-25% (previously -16% compared to 2005)	GHG emission (non-ETS)	1990		232,793	231,292		-58,198	174,595		**-25%**	**-25%**		
		2030	-49% (Max 15.3MtonCo2e)	GHG emission	1990					-114,069	-114,069		**-49%**	**-49%**		
		2050	-95%/climate neutral, water resilient and fully circular economy (Max 1.5 MtonCo2e)	GHG emission	1990					-186,234	-186,234		**-95%**	**-96%**		
CNNL - The Netherlands	Groningen	2020	NOT SET						NOT SET	-369	1,108	-9%	-25%	N.A.	-27%	-25%
		2030								-724	753		-49%	N.A.	**-54%**	-49%
		2035	almost 0 MtCO2 carbon neutral (already set in 2011)		**2015**	**1,348**	1,477	1,467	carbon neutral by 2035	-1,403	74		-95%	N.A.	**-61%**	-95%
		2050	NOT SET						NOT SET	-1,403	74		-95%	N.A.	**-61%**	-95%
	Assen	2020	NOT SET						NOT SET	-98	295	-9%	-25%	N.A.	**-27%**	-25%
		2030	municipal organization carbon neutral		**2015**	**359**	394	391	N.A.	-211	182		-49%	N.A.	**-54%**	-54%
		2040	all buildings carbon neutral						N.A.	-284	110		-72%	N.A.	**-79%**	-72%
		2050	carbon neutral						carbon neutral	-374	20		-95%	N.A.	**-104%**	-95%
	Emmen	2020	-23%	emissions	**1990 (data: 2014)**	**933**	1,023	1,016	-23%	-235	787	-9%	-23%	-23%	-27%	-23%
		2030	NOT SET						NOT SET	-501	522		-49%	N.A.	-54%	-49%
		2035	-30%	emissions	1990				-30%	-307	716		-30%	N.A.	**-61%**	-30%
		2050	carbon neutral						carbon neutral	-971	51		-95%	N.A.	**-95%**	-95%
	Leeuwarden	2020	NOT SET		**2015**	**742**	813	808	NOT SET	-185	556	-9%	-25%	-23%	-22%	-32%
		2030	NOT SET						NOT SET	-398	415		-49%	N.A.	-54%	-49%
		2050	NOT SET						NOT SET	-772	41		-95%	N.A.	-104%	-95%
Portugal		2020	-18% ~ -23%, +1% non-ETS	GHG emissions	2005	89,502	61,344	89,502		-16,110 / -20,585	73,391 / 68,916	20% / 12%	**-26.26% / -33.56%**	**-18%/-23%**		
		2030	-45% ~ -55% (previously -30%/-40%), -17% non-ETS	GHG emissions	2005					-40,276 / -49,226	49,226 / 40,276	-20% / -34%	**-65.66% / -80.25%**	**-45% / -55%**		
		2050	carbon neutral (-80~90%)	GHG emissions	2005					-71,601 / -80,552	17,900 / 8,950	-71% / -85%	**-116.72% / -131.31%**	**-80% / -90%**		
Oeste Sustentável - Portugal	Alcobaça	2020	-10% (-39.896 ton CO2)	CO2 emissions	**2009**	**399**	394	575	-10%	-40	359	1%	-10%	-7%	-25.9% / -33.2%	-9%
		2030	NOT SET						NOT SET	-259 / -316	135 / 78		-65.66% / -80.25%	N.A.	-64.9% / -79.3%	-65% / -80%
		2050	NOT SET						NOT SET	-460 / -518	-72 / -130		-116.72% / -131.31%	N.A.	-115.3% / -129.7%	-117% / -132%
	Alenquer	2020	-20% (-57 632tCO2)	CO2 emissions	**2009**	**288**	285	415	-20%	-58	231	1%	-20%	-14%	-25.9% / -33.2%	-19%
		2030	NOT SET						NOT SET	-187 / -228	98 / 56		-65.66% / -80.25%	N.A.	-64.9% / -79.3%	-65% / -80%
		2050	NOT SET						NOT SET	-332 / -374	-52 / -94		-116.72% / -131.31%	N.A.	-115.3% / -129.7%	-117% / -132%
	Arruda dos Vinhos	2020	-20% (-9 167tCO2)	CO2 emissions	**2009**	**46**	45	66	-20%	-9	37	1%	-20%	-14%	-25.9% / -33.2%	-19%
		2030	NOT SET						NOT SET	-30 / -36	16 / 9		-65.66% / -80.25%	N.A.	-64.9% / -79.3%	-65% / -80%
		2050	NOT SET						NOT SET	-53 / -59	-8 / -15		-116.72% / -131.31%	N.A.	-115.3% / -129.7%	-117% / -132%
	Bombarral	2020	-10% (-4527 ton CO2)	CO2 emissions	**2009**	**45**	45	65	-10%	-5	41	1%	-10%	-7%	-25.9% / -33.2%	-9%
		2030	NOT SET						NOT SET	-29 / -36	15 / 9		-65.66% / -80.25%	N.A.	-64.9% / -79.3%	-65% / -80%
		2050	NOT SET						NOT SET	-52 / -59	-8 / -15		-116.72% / -131.31%	N.A.	-115.3% / -129.7%	-117% / -132%
	Caldas da Rainhas	2020	-20% (-51951tCO2)	CO2 emissions	**2009**	**260**	257	374	-20%	-52	208	1%	-20%	-14%	-25.9% / -33.2%	-19%
		2030	NOT SET						NOT SET	-169 / -206	88 / 51		-65.66% / -80.25%	N.A.	-64.9% / -79.3%	-65% / -80%
		2050	NOT SET						NOT SET	-300 / -337	-47 / -84		-116.72% / -131.31%	N.A.	-115.3% / -129.7%	-117% / -132%
	Nazaré	2020	-20% (-10198 tCO2)	CO2 emissions	**2009**	**51**	50	74	-20%	-10	41	1%	-20%	-14%	-25.9% / -33.2%	-19%
		2030	NOT SET						NOT SET	-33 / -40	17 / 10		-65.66% / -80.25%	N.A.	-64.9% / -79.3%	-65% / -80%
		2050	NOT SET						NOT SET	-59 / -66	-9 / -17		-116.72% / -131.31%	N.A.	-115.3% / -129.7%	-117% / -132%
	Óbidos	2020	-34% (-14.167,54 tCO2)	CO2 emissions	**2009**	**33**	33	48	-34%	-11	22	1%	-34%	-24%	-25.9% / -33.2%	-33%
		2030	NOT SET						NOT SET	-21 / -26	11 / 6		-65.66% / -80.25%	N.A.	-64.9% / -79.3%	-65% / -80%
		2050	NOT SET						NOT SET	-38 / -43	-6 / -11		-116.72% / -131.31%	N.A.	-115.3% / -129.7%	-117% / -132%
	Peniche	2020	-10% (25976 tonCO2)	CO2 emissions	**2009**	**98**	97	142	-10%	-10	89	1%	-10%	-7%	-25.9% / -33.2%	-9%
		2030	NOT SET						NOT SET	-64 / -78	33 / 19		-65.66% / -80.25%	N.A.	-64.9% / -79.3%	-65% / -80%
		2050	NOT SET						NOT SET	-113 / -128	-18 / -32		-116.72% / -131.31%	N.A.	-115.3% / -129.7%	-117% / -132%
	Torres Vedras	2020	-20% (at least)	CO2 emissions	**2009**	**118**	116	170	-20%	-24	94	1%	-20%	-14%	-25.9% / -33.2%	-19%
		2030	NOT SET						NOT SET	-76 / -93	40 / 23		-65.66% / -80.25%	N.A.	-64.9% / -79.3%	-65% / -80%
		2050	NOT SET						NOT SET	-136 / -153	-21 / -38		-116.72% / -131.31%	N.A.	-115.3% / -129.7%	-117% / -132%

Renewable Energy

Network	Region	Target year	Target Value	Parameter	Absolute value [GWh]
The Netherlands		2020	14%	RES	
		2030	27%	RES in gross final consumption	
		2050	100%	renewable heat and CO2 neutral electricity generation	
CNNL - The Netherlands	Groningen	2020	NOT SET		
		2030	NOT SET		
		2035	Target not quantifiable		500MWp PV, 166MWth ST, 36MWp winf, 100% biofuels
		2050	NOT SET		
	Assen	2020	14% (+4 ~ -3%)	RES in gross final consumption	3 scenarios: 421TJ = 11.11%; 530TJ = 14% ; 685TJ = 18.1%
		2023	16% (+4 ~ -3%)	RES in gross final consumption	3 scenarios: 486TJ=13,27% / 595TJ=16,24% / 751TJ=20,49%
		2040	NOT SET		
		2050	NOT SET		
	Emmen	2020	13%	RES in gross final consumption	1400TJ
		2030	NOT SET		
		2035	NOT SET		
		2050	NOT SET		
	Leeuwarden	2020	16%	from sustainable energy 2013 energy consumption	1.41PJ
		2030	NOT SET		
		2050	NOT SET		
Portugal		2020 (22, 25, 27)	31% (34%, 38%, 41%)	RES in final consumption (19.5% in 2005, 30.6% in 2017)	
		2030	47% (20% in transport)	RES in final consumption	
Oeste Sustentável - Portugal	Alcobaça	2020	NOT SET	RES in final consumption	31%
		2030	NOT SET	RES in final consumption	47%
		2050	NOT SET	-	-
	Alenquer	2020	NOT SET	RES in final consumption	31%
		2030	NOT SET	RES in final consumption	47%
		2050	NOT SET	-	-
	Arruda dos Vinhos	2020	NOT SET	RES in final consumption	31%
		2030	NOT SET	RES in final consumption	47%
		2050	NOT SET	-	-
	Bombarral	2020	NOT SET	RES in final consumption	31%
		2030	NOT SET	RES in final consumption	47%
		2050	NOT SET	-	-
	Caldas da Rainhas	2020	NOT SET	RES in final consumption	31%
		2030	NOT SET	RES in final consumption	47%
		2050	NOT SET	-	-
	Nazaré	2020	NOT SET	RES in final consumption	31%
		2030	NOT SET	RES in final consumption	47%
		2050	NOT SET	-	-
	Óbidos	2020	NOT SET	RES in final consumption	31%
		2030	NOT SET	RES in final consumption	47%
		2050	NOT SET	-	-
	Peniche	2020	NOT SET	RES in final consumption	31%
		2030	NOT SET	RES in final consumption	47%
		2050	NOT SET	-	-
	Torres Vedras	2020	20%	RES in final consumption	
		2030	NOT SET	RES in final consumption	47%
		2050	NOT SET		-

Energy Efficiency

Network	Region	Target year	Target Value	Parameter	Reference Year	Ref. Year Absolute Value [GWh, TWh in grey]	1990 Absolute Value [GWh, TWh in grey]	Target (Local Refrence Year) [%]	Target Reduction Absolute value [GWh]	Target Total Final Consumption [GWh]	Change from 1990 to Local Ref Year	Target (Ref. 1990) [%]	National Target (Local Ref.) [%]	Total Reduction from 1990 [%]
The Netherlands		2020	1,5%/ energy savings per year to 482PJ (60.7 Mtoe) -100 petajoules in 2020 compared to 2012 (2080PJ) -4.6%	Energy consumption	2012 (final energy consumption 2180PJ)	606	533	-4.6%	- 28	578	45	**8.46%**		
		2030	-32.5% of energy consumption, -0.8%/y 925PJ (Primary Energy Consumption 1950PJ and final energy consumption 1837)	Energy Consumption	Total Primary Energy Consumption in 2000 was2830PJ, 2702PJ in 2017, Final was 2181 in 2000 and 2108 in 2017			-32.50%	- 95	510	- 22	**-4.21%**		
CNNL - The Netherlands	Groningen	2020	NOT SET					NOT SET	387	5,442	10.60%	8.46%	7.65%	19.05%
		2030	NOT SET					NOT SET	- 193	4,862		-4.21%	-3.81%	6.38%
		2035	-34%	Energy consumption	compard to 2018 (from 18.2PJ to 11.2PJ)	5,055	4,571	-34%	- 1,719	3,336		-37.60%	-3.81%	-27.01%
	Assen	2020	-10% (expectd total consumption 3787 TJ = -9.9%)	Energy consumption	not explicit, SECAP takes 2014 baseline 4202TJ	1,285	1,236	-10%	- 129	1,157	3.94%	-10.39%	8.14%	-6.45%
		2023	expected -12.8% (3665TJ)					-12.80%	- 164	1,121		-13.30%	4.48%	-9.36%
		2030	NOT SET					NOT SET	- 52	1,233		-4.21%	-4.05%	-0.27%
	Emmen	2020	NO SET	71% of energy consumption is due to the industry and horticolture	2014 16084TJ	4,468	4,298	NOT SET	364	4,831	3.94%	8.46%	8.14%	12.40%
		2030	NOT SET					NOT SET	- 181	4,287		-4.21%	-4.05%	-0.27%
	Leeuwarden	2020	-20% consumption in buildings (total saving in 10 years of 608GJ)	built environment was 49% of energy consumption in 2018 50% of emissions	2010	2,765	2,289	-20%	- 553	2,212	20.81%	-24.16%	7.00%	-3.35%
		2030	NOT SET					NOT SET	- 96	2,669		-4.21%	-3.49%	16.59%
Portugal		2020	-25% primary energy consumption compared to projections		compared to baseline projections (final energy consumption 15.4-15.6Mtoe)	221	139	**-25%**	- 41	180	41	**-29.43%**		
		2030	-35% primary energy consumption	Energy consumption	compared to baseline projections (final energy consumption 14.4-14.8Mtoe)			**-35%**	- 51	170	31	**-36.97%**		
								NOT SET						
Oeste Sustentável - Portugal	Alcobaça	2020	NOT SET			1,380	903	NOT SET	- 266	1,114	52.85%	-29.43%	-19.25%	23.42%
		2030	NOT SET						- 334	1,046		-36.97%	-24.19%	15.88%
		2050												
	Alenquer	2020	NOT SET			1,078	706	NOT SET	- 208	871	52.85%	-29.43%	-19.25%	23.42%
		2030	NOT SET						- 261	818		-36.97%	-24.19%	15.88%
		2050												
	Arruda dos Vinhos	2020	NOT SET			176	115	NOT SET	- 34	142	52.85%	-29.43%	-19.25%	23.42%
		2030	NOT SET						- 43	134		-36.97%	-24.19%	15.88%
		2050												
	Bombarral	2020	NOT SET			169	110	NOT SET	- 32	136	52.85%	-29.43%	-19.25%	23.42%
		2030	NOT SET						- 41	128		-36.97%	-24.19%	15.88%
		2050												
	Caldas da Rainhas	2020	NOT SET			999	653	NOT SET	- 192	806	52.85%	-29.43%	-19.25%	23.42%
		2030	NOT SET						- 242	757		-36.97%	-24.19%	15.88%
		2050												
	Nazaré	2020	-20%	Energy consumption	2009 (16103 tep)	187	123	-20%	- 37	150	52.85%	-30.57%	-20.00%	22.28%
		2030	NOT SET						- 45	142		-36.97%	-24.19%	15.88%
		2050												
	Óbidos	2020	-23%	Energy consumption+AE59	2009 (123357,93 MWh, 13022tep)	123	81	-23%	- 28	95	52.85%	-35.15%	-23.00%	17.69%
		2030	NOT SET						- 30	94		-36.97%	-24.19%	15.88%
		2050												
	Peniche	2020	NOT SET			369	242	NOT SET	- 71	298	52.85%	-29.43%	-19.25%	23.42%
		2030	NOT SET						- 89	280		-36.97%	-24.19%	15.88%
		2050												
	Torres Vedras	2020	-20%	Energy Consumption	2009 (27915 tep)	325	212	-20%	- 65	260	52.85%	-30.57%	-20.00%	22.28%
		2030	NOT SET						- 118	206		-55.76%	-36.48%	-2.92%
		2050												

ANNEX 2: TOTAL NET EMISSION HISTORICAL DATA AND INDEX

Total Net Emissions [Mt CO2 eq]

	Country					
Year	EU-27	France	Greece	Italy	Netherlands	Portugal
1990	4,657	535	104	517	233	61
1991	4,526	561	103	503	241	63
1992	4,410	553	104	504	242	63
1993	4,332	528	104	510	244	60
1994	4,309	526	107	492	245	60
1995	4,346	531	109	512	246	66
1996	4,412	543	113	505	257	60
1997	4,349	536	118	521	249	62
1998	4,300	548	124	536	250	69
1999	4,218	539	123	533	238	76
2000	4,234	550	127	540	236	78
2001	4,262	543	128	531	236	75
2002	4,264	528	127	531	234	80
2003	4,370	530	132	560	235	85
2004	4,352	525	133	559	237	79
2005	4,335	526	136	560	231	90
2006	4,311	513	132	550	226	75
2007	4,315	503	137	566	225	69
2008	4,190	495	132	535	224	65
2009	3,867	484	124	475	218	62
2010	3,963	491	118	481	229	60
2011	3,858	465	115	477	216	59
2012	3,776	464	112	466	211	60
2013	3,691	463	104	416	211	59
2014	3,578	438	102	395	204	57
2015	3,643	448	95	405	212	62
2016	3,656	447	91	406	212	65
2017	3,725	454	96	421	210	84
2018	3,630	437	93	403	205	65

Total Net Emissions, Index base 1990 [percentage]

	Country					
Year	EU-27	France	Greece	Italy	Netherlands	Portugal
1990	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1991	97.2%	104.9%	99.5%	97.4%	103.4%	103.1%
1992	94.7%	103.4%	100.7%	97.6%	104.1%	102.6%
1993	93.0%	98.7%	100.1%	98.8%	104.6%	98.2%
1994	92.5%	98.2%	103.4%	95.2%	105.1%	98.6%
1995	93.3%	99.2%	105.2%	99.0%	105.5%	107.1%
1996	94.7%	101.5%	108.7%	97.6%	110.4%	97.7%
1997	93.4%	100.1%	113.7%	100.7%	107.1%	101.6%
1998	92.3%	102.5%	119.4%	103.7%	107.6%	112.5%
1999	90.6%	100.7%	119.1%	103.1%	102.0%	123.9%
2000	90.9%	102.8%	122.6%	104.4%	101.3%	127.2%
2001	91.5%	101.4%	123.0%	102.7%	101.4%	121.7%
2002	91.6%	98.6%	122.6%	102.8%	100.6%	129.6%
2003	93.8%	99.0%	127.2%	108.3%	100.9%	138.5%
2004	93.4%	98.2%	128.0%	108.2%	101.7%	128.1%
2005	93.1%	98.3%	130.9%	108.4%	99.4%	145.9%
2006	92.6%	95.8%	127.3%	106.4%	97.2%	122.2%
2007	92.7%	93.9%	131.8%	109.6%	96.6%	112.5%
2008	90.0%	92.5%	127.1%	103.5%	96.3%	106.4%
2009	83.0%	90.5%	119.9%	92.0%	93.5%	101.2%
2010	85.1%	91.7%	113.9%	93.0%	98.5%	98.5%
2011	82.8%	86.8%	111.1%	92.2%	92.6%	96.6%
2012	81.1%	86.7%	107.7%	90.2%	90.7%	97.2%
2013	79.3%	86.5%	99.9%	80.5%	90.7%	95.6%
2014	76.8%	81.9%	98.4%	76.3%	87.5%	93.1%
2015	78.2%	83.8%	91.3%	78.5%	91.3%	101.7%
2016	78.5%	83.5%	88.2%	78.6%	91.1%	105.4%
2017	80.0%	84.9%	92.4%	81.5%	90.4%	137.5%
2018	78.0%	81.7%	89.8%	78.0%	88.2%	106.4%

Figure 12: Total Net GHG emissions per Country and EU-27 [kt CO_2 eq], yearly change [percentage], and index (base 1990)

ANNEX 3: FINAL ENERGY CONSUMPTION HISTORICAL DATA AND INDEX

Final Energy Consumption [TWh]

	Country					
Year	EU-27	France	Greece	Italy	Netherlands	Portugal
1990	11,073	1,585	171	1,254	533	139
1991	11,073	1,685	175	1,289	561	144
1992	10,771	1,693	176	1,290	556	149
1993	10,785	1,677	176	1,297	577	151
1994	10,715	1,650	180	1,278	569	158
1995	10,933	1,671	184	1,334	590	162
1996	11,399	1,747	197	1,346	639	171
1997	11,300	1,721	203	1,358	607	178
1998	11,364	1,768	213	1,398	608	190
1999	11,335	1,782	213	1,449	608	198
2000	11,392	1,800	218	1,452	606	209
2001	11,659	1,859	225	1,467	616	212
2002	11,582	1,825	229	1,471	617	217
2003	11,931	1,848	241	1,551	626	217
2004	12,053	1,871	239	1,556	635	220
2005	12,103	1,862	244	1,596	629	221
2006	12,162	1,835	252	1,578	625	218
2007	11,961	1,789	257	1,566	617	220
2008	12,055	1,812	249	1,562	627	215
2009	11,403	1,739	239	1,467	601	212
2010	11,907	1,791	222	1,495	644	211
2011	11,448	1,735	220	1,433	601	202
2012	11,424	1,786	198	1,417	603	186
2013	11,401	1,817	178	1,379	604	184
2014	10,919	1,691	181	1,318	554	183
2015	11,147	1,726	193	1,352	568	186
2016	11,371	1,749	195	1,348	580	188
2017	11,510	1,737	191	1,340	584	193
2018	11,509	1,708	185	1,353	589	196
2019	11,438	1,692	188	1,342	580	199

Final Energy Consumption, Index base 1990 [percentage]

	Country					
Year	EU-27	France	Greece	Italy	Netherlands	Portugal
1990	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1991	100.0%	106.3%	102.1%	102.8%	105.4%	103.8%
1992	97.3%	106.9%	102.8%	102.9%	104.4%	107.6%
1993	97.4%	105.8%	103.0%	103.4%	108.3%	108.7%
1994	96.8%	104.1%	105.1%	101.9%	106.9%	113.6%
1995	98.7%	105.4%	107.7%	106.4%	110.7%	116.4%
1996	102.9%	110.3%	115.3%	107.4%	120.0%	123.1%
1997	102.0%	108.6%	118.7%	108.3%	113.9%	128.1%
1998	102.6%	111.6%	124.8%	111.5%	114.1%	136.7%
1999	102.4%	112.4%	124.4%	115.5%	114.2%	142.4%
2000	102.9%	113.6%	127.6%	115.8%	113.7%	150.5%
2001	105.3%	117.3%	131.7%	117.0%	115.6%	152.6%
2002	104.6%	115.2%	134.1%	117.3%	115.8%	156.5%
2003	107.7%	116.6%	141.2%	123.6%	117.5%	156.2%
2004	108.8%	118.0%	139.7%	124.1%	119.2%	158.7%
2005	109.3%	117.5%	143.0%	127.2%	118.0%	159.3%
2006	109.8%	115.8%	147.1%	125.8%	117.4%	157.1%
2007	108.0%	112.9%	150.3%	124.8%	115.8%	158.9%
2008	108.9%	114.4%	145.8%	124.5%	117.7%	154.6%
2009	103.0%	109.7%	140.0%	117.0%	112.8%	152.8%
2010	107.5%	113.0%	129.6%	119.2%	120.8%	152.1%
2011	103.4%	109.5%	128.8%	114.2%	112.8%	145.5%
2012	103.2%	112.7%	116.1%	113.0%	113.1%	134.4%
2013	103.0%	114.7%	104.4%	109.9%	113.4%	132.8%
2014	98.6%	106.7%	106.0%	105.1%	103.9%	132.1%
2015	100.7%	108.9%	112.7%	107.8%	106.6%	134.1%
2016	102.7%	110.3%	114.0%	107.5%	108.9%	135.6%
2017	103.9%	109.6%	111.7%	106.8%	109.7%	138.8%
2018	103.9%	107.8%	108.3%	107.9%	110.6%	141.4%
2019	103.3%	106.7%	110.1%	107.0%	108.9%	143.6%

Figure 13: Final Energy Consumption [GWh], change since 1990 [percentage], Index base 1990 [percentage]

ANNEX 4: FINAL ENERGY CONSUMPTION REFERENCE SCENARIOS

Primes Scenarios 2007 of Final Energy Consumption [ktoe]

Country	1990	1995	2000	2005	2010	2015	2020	2025	2030
EU-27 (right axis)	1070684	1066881	1,112,182	1166880	1237040	1302036	1347807	1382755	1405680
France	136,214	141,436	152,315	156,523	163,626	170,499	174,433	177,684	179,434
Greece	14,509	15,801	18,513	20,742	23,034	24,684	25,899	26,535	26,780
Italy	107,160	113,709	123,254	134,080	145,970	155,074	162,631	167,950	171,973
Netherlands	42,924	47,670	50,125	51,588	53,843	56,289	57,622	58,781	59,663
Portugal	11,208	13,042	16,937	18,654	20,251	21,758	23,232	24,493	25,289

Figure 14: Complete figures of Primes Scenarios REF2007 for Final Energy Consumption, used to set 2020 efficiency targets at EU level.

Primes Scenarios 2016 of Final Energy Consumption [ktoe]

Country	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
EU-27 (right axis)	1,129,427	1,186,370	1,155,879	1,133,457	1,133,797	1,106,322	1,081,368	1,065,407	1,067,769	1,077,083	1,085,865
France	154,639	160,337	155,397	155,251	156,459	151,206	147,426	144,700	144,604	144,546	145,352
Greece	18,676	20,958	19,197	17,486	17,105	16,398	15,635	15,677	15,739	15,720	15,657
Italy	125,579	134,544	124,781	122,385	122,484	119,189	115,857	114,419	114,885	116,344	116,607
Netherlands	50,505	51,654	51,835	50,854	50,357	48,018	45,953	44,373	44,460	44,854	45,371
Portugal	17,919	19,009	18,022	16,789	16,831	16,655	16,266	15,964	15,804	15,654	15,574

Figure 15: Complete figures of Primes Scenarios REF2016 for Final Energy Consumption, used to set 2030 efficiency targets at EU level.

ANNEX 5: TARGETS PARAMETERS AND TARGET TYPES OVERVIEW

		Emission Reduction Targets			Renewable Energy Targets		Energy Efficiency Targets		
		Base year	Parameter	Target Type	Parameter	Target Type	Base year	Parameter	Target Type
	EU27	1990 (2005)	GHG Emissions (ETS, non ETS)	Base year goal (1)	RES share in final energy consumption, electricity from RES	Target year goal (3)	2007 projections to 2020, 2016 projections to 2030	Energy Efficiency (= reduction in primary and final energy consumption)	Trend scenario goal (4)
	France	1990, 2005	GHG Emissions (ETS, non ETS, with/without LULUCF, without the use of carbon offsetting)	Base year goal (1)	RES share in (gross) final energy consumption, electricity from RES	Target year goal (3)	2007 projections to 2020, 2012 for 2030 and 2050 targets	Final energy consumption	Fixed level goal and trend scenario goal (2, 4)
ALTE69 - France	CCMDL	2015	GHG Emissions	Base year goal and fixed level goal (1, 2)	Renewable Energy Production	Fixed level goal and target year goal (2, 3)	2015	Final energy consumption	Base year goal and fixed level goal (1, 2)
ALTE69 - France	CCSB	2013	GHG Emissions	Base year goal and fixed level goal (1, 2)	Renewable Energy Production	Fixed level goal and target year goal (2, 3)	2013	Energy consumption	Base year goal and fixed level goal (1, 2)
ALTE69 - France	COR	2015	GHG Emissions	Base year goal (1)	Renewable Energy Production	Fixed level goal and target year goal (2, 3)	2015	Energy consumption	Base year goal and fixed level goal (1, 2)
ALTE69 - France	SOL	2015	GHG Emissions	Base year goal and fixed level goal (1, 2)	Renewable Energy Production and energy positive	Fixed level goal and target year goal (2, 3)	2015	Energy consumption	Base year goal and fixed level goal (1, 2)
	Greece	1990, 2005	CO2 Emissions (+ phase out lignite)	Base year goal (1)	RES share in (gross) final energy consumption	Target year goal (3)	2007 projections to 2020, 2016 projections to 2030	Primary energy consumption and energy savings	Fixed level goal and trend scenario goal (2, 4)
SCN - Greece	Oichalia	2011	CO2 Emissions	Base year goal (1)	Renewable Energy Production	No target, but fixed level projection (5)	2011	Final energy consumption	No target, but fixed level projection (5)
SCN - Greece	Ierapetra	2010	CO2 Emissions	Base year goal and fixed level goal (1, 2)	Renewable Energy Production	No target, but fixed level projection (5)	2010	Final energy consumption	No target, but fixed level projection (5)
SCN - Greece	Korinthos	2011	CO2 Emissions	Base year goal and fixed level goal (1, 2)	Renewable Energy Production	No target, but fixed level projection (5)	2011	Final energy consumption	No target, but fixed level projection (5)
SCN - Greece	Vari-Voula-Vouliagmeni	2010	CO2 Emissions	Base year goal and fixed level goal (1, 2)	Renewable Energy Production	No target, but fixed level projection (5)	2010	Final energy consumption	No target, but fixed level projection (5)
SCN - Greece	Messinis	2012	CO2 Emissions	Base year goal and fixed level goal (1, 2)	Renewable Energy Production	No target, but fixed level projection (5)	2012	Final energy consumption	No target, but fixed level projection (5)
	Italy	2005	GHG Emissions (ETS, non ETS)	Base year goal (1)	RES share in gross final energy consumption	Target year goal (3)	2007 projections to 2020, 2016 projections to 2030	Final energy consumption	Fixed level goal and trend scenario goal (2, 4)
UCSA - Italy	Palma Campania	2008	CO2 Emissions	Base year goal and fixed level goal (1, 2)	Renewable Energy Production	No target, but fixed level projection (5)	2008	Final energy consumption	No target, but fixed level projection (5)
UCSA - Italy	San Giuseppe Vesuviano	2008	CO2 Emissions	Base year goal and fixed level goal (1, 2)	Renewable Energy Production	No target, but fixed level projection (5)	2008	Final energy consumption	No target, but fixed level projection (5)
UCSA - Italy	Striano	2008	CO2 Emissions	Base year goal and fixed level goal (1, 2)	Renewable Energy Production	No target, but fixed level projection (5)	2008	Final energy consumption	No target, but fixed level projection (5)
	The Netherlands	1990	GHG Emissions (ETS, non ETS), climate neutral, water resilient and full circular economy	Base year goal and fixed level goal (1, 2)	RES share in gross final energy consumption, 100% RES heating and carbon neutral electricity	Target year goal (3)	2012 and 2016 projections to 2030	Primary and final energy consumption	Base year goal, fixed level goal and trend scenario goal (1, 2, 4)
CNNL - The Netherlands	Groningen	2015	GHG Emissions	Fixed level goal (2)	RES Installed capacity	Target year goal (3)	2018	Energy consumption	Base year goal and fixed level goal (1, 2)
CNNL - The Netherlands	Assen	2015	GHG Emissions	Tacit fixed level goal (2b)	RES share in (gross final) energy consumption	Target year goal (3)	2014	Energy consumption	No target, but fixed level projection (5)
CNNL - The Netherlands	Emmen	1990 (2014)	GHG Emissions	Base year goal (1)	RES share in (gross final) energy consumption	Target year goal (3)	2014	Energy consumption	No target, but fixed level projection (5)
CNNL - The Netherlands	Leeuwarden	2015	-	-	RES share in (gross final) energy consumption	Target year goal (3)	2010	Building sectr energy consumption	Base year goal and fixed level goal (1, 2)
	Portugal	2005	GHG Emissions (ETS, non ETS)	Base year goal (1)	RES share in final energy consumption	Target year goal (3)	2007 projections to 2020, 2016 projections to 2030	Primary energy consumption	Base year goal and fixed level goal (1, 2)
Oeste Sustentável - Portugal	Alcobaça	2009	CO2 Emissions	Base year goal and fixed level goal (1, 2)	-	-		-	-
Oeste Sustentável - Portugal	Alenquer	2009	CO2 Emissions	Base year goal and fixed level goal (1, 2)	-	-		-	-
Oeste Sustentável - Portugal	Arruda dos Vinhos	2009	CO2 Emissions	Base year goal and fixed level goal (1, 2)	-	-		-	-
Oeste Sustentável - Portugal	Bombarral	2009	CO2 Emissions	Base year goal and fixed level goal (1, 2)	-	-		-	-
Oeste Sustentável - Portugal	Caldas da Rainhas	2009	CO2 Emissions	Base year goal and fixed level goal (1, 2)	-	-		-	-
Oeste Sustentável - Portugal	Nazaré	2009	CO2 Emissions	Base year goal and fixed level goal (1, 2)	-	-	2009	Energy consumption	Base year goal and fixed level goal (1, 2)
Oeste Sustentável - Portugal	Óbidos	2009	CO2 Emissions	Base year goal and fixed level goal (1, 2)	-	-	2009	Energy consumption	Base year goal and fixed level goal (1, 2)
Oeste Sustentável - Portugal	Peniche	2009	CO2 Emissions	Base year goal and fixed level goal (1, 2)	-	-		-	-
Oeste Sustentável - Portugal	Torres Vedras	2009	CO2 Emissions	Base year goal and fixed level goal (1, 2)	RES share in final energy consumption	Target year goal (3)	2009	Energy consumption	Base year goal and fixed level goal (1, 2)

LEGEND

Target Types	Definition
Base year goal (1)	Percentage reduction/increase compared to base year by target (single) year.
Fixed level (2)	Fixed value by target (single) year.
Tacit fixed level goal (2b)	Sector carbon neutrality by target (single) year, without disclosing correspondig value.
Target year goal (3)	Percentage of given parameter by target (single) year.
Trend scenario goal (4)	Percentage reduction compared to trend scenario for target (single) year
No target, but fixed level projection (5)	No commitment to any target, but a projecion for the target year.
-	No target was set.

Figure 16: Targets parameters and units of measure overview showing how even after harmonization, some targets remain incomparable.