Environmental Science & Policy xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Environmental Science & Policy

journal homepage: www.elsevier.com/locate/envsci

A decision framework for Integrated Assessment Modelling of air quality at regional and local scale

G. Guariso[a], M. Maione[b], M. Volta[c,*]

[a] DEIB, Politecnico di Milano, Italy
[b] DiSPeA, University of Urbino, Italy
[c] DIMI, University of Brescia, Italy

ARTICLE INFO

Article history:
Received 16 November 2015
Received in revised form 4 May 2016
Accepted 6 May 2016
Available online xxx

Keywords:
Air quality planning
Policy design
Cost-benefit integration
European IAM database

ABSTRACT

Decision making in the field of air quality and greenhouses gases reductions can nowadays be supported by a clear overall framework and by computer tools that integrate the most relevant aspects of the problem. This approach is particularly important at local scale since new general rules on emission abatement at European level can only marginally modify the most critical hotspots and may be very costly. This paper adapts the general Drivers, Pressures, State, Impacts, Responses (DPSIR) scheme proposed by the European Environment Agency to the specific case of local air quality policies and shows how the most recent scientific developments in impact evaluation and social acceptance can be integrated. The proposed decision framework represents a general methodology to design Integrated Assessment Modelling (IAM) systems aimed at the implementation of effective Air Quality Plans (AQP). An extensive survey across European countries shows the current degree of adoption of these approaches.

1. Introduction

Recent studies on compliance with the Ambient Air Quality Directive 2008/50/EC (EU, 2008) suggest that, despite a general improvement expected for the next decade, some urban areas and some regions will still struggle with severe air quality (AQ) problems and related health effects in the next two decades (*e.g.* Amann, 2014; EC, 2013). These areas are often characterized by specific environmental and anthropogenic factors and will require *ad hoc* additional local actions to complement medium and long term national and EU-wide strategies to reach EU air quality objectives. At the same time, these urban areas are among the territories where most energy is consumed and most greenhouse gases (GHGs) are emitted. Recent reports on the review of the Thematic Strategy on Air Pollution (Amann, 2013; Kieswetter et al., 2013) show the evolution trend of compliance from the base year 2010–2025 (assuming current legislation only), the improvement for the optimised A5 so-called 'Central Policy Scenario' by 2025 and the further compliance achieved in 2030, by implementing all technical measures (Maximum Technically Feasible Reductions, MTFR). The assessment of compliance of the daily PM10 exceedances limit value with respect to the current Ambient Air Quality Directive is shown in Fig. 1.

Some important observations can be derived from these figures:

(i) Comparing the 2010 map with the 2025 Current Legislation (CLE) case, it clearly appears the move away from a general picture of non-compliance (2010) to few limited remaining areas of non-compliance. European wide measures (already mandated) will determine a significant improvement in compliance especially in the EU-15 Member States. What is also clear by comparing the 2025 CLE with the 2025 A5 is the limited potential of further EU-wide measures to improve compliance; this is further underlined by comparing the 2025 A5 scenario with the 2030 MTFR scenario.
(ii) Introducing tougher European-wide measures to address residual non-compliance confined to 10% of the urban zones in Europe (the extent of NO_2 non-compliance according to IIASA in the 2025 CLE scenario) would likely be significantly more costly than directly addressing the non-compliance areas with specifically designed measures based on bottom-up Integrated Assessment (IA) using regional/local data. This has significant implications for the role of regional/local 'bottom-up' approaches to develop effective and efficient Air Quality Management Plans.

* Corresponding author.
E-mail address: marialuisa.volta@unibs.it (M. Volta).

http://dx.doi.org/10.1016/j.envsci.2016.05.001
1462-9011/

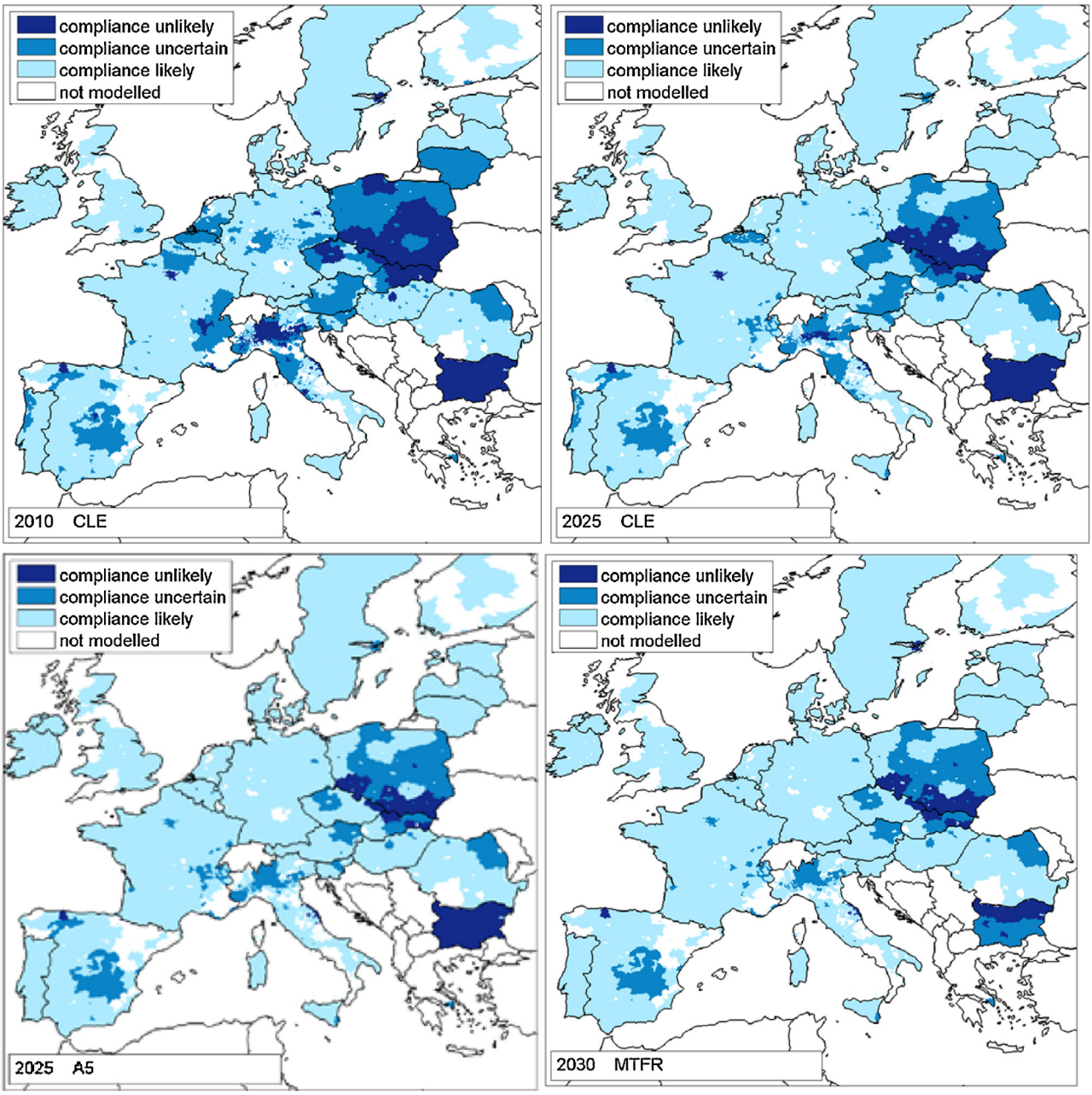

Fig. 1. PM10 compliance assessment *via* GAINS 2013 (Source: Amann, 2014).

(iii) In this regard, regional IA tools such as RIAT (Carnevale et al., 2012), LEAQ (Zachary et al., 2011), *etc.* with their ability to identify cost-optimised local strategies are already available to quantify the cost-effective split between further European wide measures and regional/local measures. They will inevitably find wider application and play an increasing role in these emerging 'discrete islands of non-compliance'.

(iv) A further observation comes from comparing the 2025 CLE case with the 2025 A5 scenario. A5 is a highly ambitious scenario (delivering 75% of the further health benefits of MTFR for the EU as a whole). At this high level, a number of Member States are already forced to deploy all available pollution abatement measures (i.e. MTFR). Yet, from an AQ compliance perspective, this does not substantially change the picture from 2025 CLE. This points again to the key role of local targeted technical and non-technical measures in order to achieve compliance. As already noted, such measures (low emission zones, special fuels for captive fleets, captive fleet retrofitting *etc.*) can only be appropriately designed using 'bottom-up' tools.

These observations motivate the growing interest in IA models and tools for local and regional scale.

Indeed, since the preparatory work of the 2008 EU Air Quality Directive (AQD), new emphasis has been placed on the use of numerical models to evaluate and forecast air quality conditions (*e.g.* Marécal et al., 2015; Cuvelier et al., 2007; Monteiro et al., 2007; Vautard et al., 2007). Many different models have thus been developed at European, regional and local scales and are already in use. They cover different aspects of air quality control, like emission estimates, short-term air pollution forecast, measurement network assessment and the simulation of the effects of alternative emission reduction scenarios. They often use different databases and assumptions so that it is sometimes difficult to

Please cite this article in press as: G. Guariso, et al., A decision framework for Integrated Assessment Modelling of air quality at regional and local scale, Environ. Sci. Policy (2016), http://dx.doi.org/10.1016/j.envsci.2016.05.001