To be published in forthcoming European Council for an Energy Efficient Economy (ECEEE) Summer Study Proceedings June 2013.

The EU Air Quality Review: What role for energy efficiency, clean energy and demand response?

Paper No: 2-145-13
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Abstract

The European Commission (EC) has announced that 2013 is the ñYear of Airò and a comprehensive policy package will be proposed by year end. As part of a decadal review of air quality standards, the ECôs 2013 focus offers significant opportunity to link air quality and energy policies. The EU approach to air policy involves the setting of overarching national emission ceilings and air quality limit values for various pollutants, supplemented by regulation of major sources of these pollutants. However, since the late 1990s, decarbonisation of the EU economy has moved rapidly up the political agenda; the ECôs Low Carbon Economy 2050 Roadmap sets out the magnitude of CO_2 emissions reductions needed by 2030 and 2050 from sectors which supply and use energy: power, industry, transport, residential and services. . This paper suggests that a pathway which prioritises energy efficiency alongside clean, sustainable energy and demand response will simultaneously reduce greenhouse gases (GHGs) and legislated harmful air pollutants to realise significant co-benefits. The latter include benefits for human health and ecosystems, greater energy supply security and power reliability, lower investment costs for new power-related infrastructure and increased competitiveness. This paper assesses the extent to which current development of the EUôs air quality policy is integrating with climate and energy policy and where further integration could be possible, drawing from global examples of best practice.

Introduction

The EU legislative framework for air quality is based on the long term objectives of the 6th Environmental Action Plan[1] (EAP) and the 2005 Thematic Strategy on Air Pollution (TSAP).[2] A substantial body of legislation establishes air quality limits[3] and national ceilings[4] for multiple air pollutants[5], and targets reductions at emission sources (e.g. large combustion plants, industrial processes, fuels, vehicles[6]). These efforts have led to dramatically improved air quality across the EU, particularly for SO_X. However, improvement since 2005 has fallen short of expectations[7]. Air pollution remains a major environmental and health problem across the EU. Ecosystem biodiversity remains under serious threat due to excess nutrient deposition (eutrophication) and

[1] Decision 1600/2002/EC, 6th Community Environmental Action Plan ñEnvironment: Our Future, Our Choiceò, 22 July 2002. The long term objective is defined as *"levels of air quality that do not give rise to significant negative impacts on, and risks to, human health and the environment,"* and is confirmed by the 7th EAP available at: http://www.cc.cec/dgintranet/env/d2/7EAP.htm.
[2] COM(2005) 446 final òThematic Strategy on Air Pollutionò, September 2005.
[3] DIR 2008/50/EC on ambient air quality which describes the basic principles as to how air quality should be assessed and managed in the Member States and sets limits for criteria air pollutants.
[4] DIR 2001/81/EC on National Emissions Ceilings (sulphur dioxide ($SO_{2)}$), nitrogen oxides ($NO_{X)}$), non-methane volatile organic compounds (NMVOC), ammonia ($NH_{3)}$)).
[5] Including SO_2, NO_X, nitrous oxide ($NO_{2)}$), carbon monoxide (CO), benzene, poly-aromatic hydrocarbons (PAH), particulate matter $PM_{10}/PM_{2.5}$, lead (Pb), ozone ($O_{3),}$ NO/NO_2, VOC.
[6] DIR 2009/30/EC for petrol and diesel fuels; EURO standards for light duty vehicles DIR 692/2008/EC, heavy duty vehicles DIR 595/2009/EC, motorcycles 2006/27/EC; Directive 2010/75/EU on industrial emissions.
[7] EEA 2010. The European Environment ï State and Outlook 2010. Synthesis pp. 96-100 via http://www.eea.europa.eu/soer. Also, WHO, Health and Environment in Europe: Progress Assessment (2010), ISBN 978 92 890 4198 0.

ground-level ozone continues to have a negative impact on vegetation. Between 2008-2010 more than 90% of the EU population was exposed to concentrations of $PM_{2.5}$ and O_3 (the most harmful pollutants to human health) above EU and WHO reference levels for the protection of human health[8]. Both these pollutants have precursor gases which include: SO_2; NO_x; NH_3; VOC including methane (CH_4); CO. Domestic emissions from the combustion of fossil fuels provides the most important contribution to the formation of these pollutants, where important sources are stationary and mobile (including non-road and ships), small (including residential) and large scale. The urgent need for progress has prompted the Commission to conduct a review of EU air quality legislation. This was initiated in 2011 with the Commissionøs publication of a working paper which sets out key issues and next steps for its comprehensive review[9].

The review will complete in 2013 during the EUøs themed ñYear of the Airò and a comprehensive air quality policy package will be proposed in autumn[10]. At the same time the European Commission has initiated the process to develop a post 2020 climate and energy package. Thus, there is a significant opportunity to link air quality and energy policies. Structural change to the energy system involving energy efficiency and the replacement of fossil fuelled energy generation by renewable energy coupled with demand response, simultaneously reduces both greenhouse gases (GHGs) and harmful air pollutants, often achieving multiple policy objectives at less cost compared with end-of-pipe solutions. This paper sets out the case for prioritising energy efficiency as an air quality policy measure, the evidence which supports better integrating energy and air quality policy, the progress and challenges for the EU and suggestions for how to progress further integration.

Air quality: The case for energy efficiency first

The benefits of integrating air quality policy with energy and climate change policy are well documented[11] and include:

- concurrently reducing GHGs and harmful air pollutant emissions, with implementation costs less than end-of-pipe cleaning technologies which address GHG and air pollution policy objectives separately, so limiting increases to consumer power bills and more cost-effectively improving public health and the environment;
- reducing the risk of stranded assets where power plants are fitted with cleaning technologies but at a later date become uneconomical because: some cleaning technologies need energy to run so increasing operating costs; and/or increasing stringency of future air pollution or GHG related legislation requires further investment and removes the possibility of recouping the original investment.

The interplay of different air pollutants and their effect on the environment needs to be assessed more holistically in order to achieve desired policy outcomes efficiently and without unintended consequences. Control measures that address only local air quality can lead to increased greenhouse gases, and vice versa. A recent study of potential reductions from integrated policy action in Western Europe and China[12] found that a dual focus on GHG and local air pollution results in greater reductions in local air pollution and GHGs compared with focusing on either alone. A UNEP study[13] evaluated how control of short-lived climate forcers (SLCF) - black carbon, methane and tropospheric ozone - can simultaneously address climate and air quality. It estimated that about 50% of black carbon and methane reductions could be achieved through energy efficiency measures that provide net cost savings. However, such action will need to be motivated. Review of the national emissions ceilings (NEC) Directive presents an opportunity to reduce these emissions.

Absent commercially available carbon capture and storage, GHG emissions reductions can only be achieved through end-use efficiency improvements, fuel-switching and changes in the overall energy resource portfolio.

[8] EEA 2012, òAir Quality in Europe ï 2012 reportò, EEA Report No. 4/2012, retrieved 03.03.2013 from http://www.eea.europa.eu/publications/air-quality-in-europe-2012
[9] EC, SEC(2011) 342 final, ñEC Working Paper on the implementation of EU Air Quality Policy and preparing for its comprehensive reviewò, 14 March 2011.
[10] EC website for the review of EU air policy: http://ec.europa.eu/environment/air/review_air_policy.htm
[11] A sampling includes: Ren, Wan-Xia, et al; ñPursuing Co-Benefits in Chinaøs Old Industrial Base: A Case of Shenyangò, Urban Climate, volume 1, 2012, pp. 55-64. Bollen, J.C., et al ñCo-Benefits of Climate Policyò, Netherlands Environmental Assessment Agency, PBL Report no. 500116005, February, 2009. ICF International, ñEvaluation of the Air Quality Co-Benefits of Local Greenhouse Gas Reduction Measures: A Case Study of San Franciscoò, prepared for US EPA, Region 9, February 2012.
[12] J. Bollen et al. òLocal Air Pollution and Global Climate Change: A Combined Cost-Benefit Analysisò. Resource and Energy Economics, v. 31, 2009, pp. 161-181.
[13] UNEP, ñNear-term Climate Protection and Clean Air Benefits: Actions for Controlling Short-Lived Climate Forcersò, 2011. See http://www.unep.org/pdf/Near_Term_Climate_Protection_&_Air_Benefits.pdf

These measures often reduce multiple legislated air pollutants, though synergies and trade-offs must be identified and managed[14]. An explicit multi-pollutant approach can help ensure optimisation of investment in new energy resources as well as pollution control equipment, and is the most effective way to ensure compliance with multiple, often-changing EU Directives and Regulations.

The full value of energy efficiency is rarely quantified in impact assessments for energy or air quality policy. If it would be, cost benefit analyses would look rather different because avoided energy use is merely a fraction of energy efficiencyọs full value. A comprehensive valuation carried out for the US state of Vermont shows that the value of energy efficiency may be five times the energy savings alone if the following are also evaluated: emissions to air and water; production, transmission and distribution capacity; line losses; reserve requirements; non-energy benefits such as operations and maintenance, health and safety, and water use[15].

The Energy Efficiency Directive[16], adopted in 2012, aims to close the gap toward the EUọs targeted 20% energy savings by 2020 relative to 2005. Member States (MS) will need to implement this Directive and develop their own 2020 energy savings targets. MS thus have an opportunity to develop energy efficiency policies programmes which would align with policies to improve air quality. Where upfront investment is needed for their funding, EU Emissions Trading Scheme (ETS) auction revenues could be used.

Integrating EU air quality and climate/energy policy

Over the past decade or two there has been clear evidence of some integration of EU air pollution policy and energy policy. From the 1970s through to the 1990s EU action on air pollution was largely source-focussed. During the 1990s, EU air policy adopted an increasingly quality and outcome orientated approach, resulting at the end of the decade with the adoption of the EUọs Air Quality Framework Directive for the management of air pollution and Daughter Directives setting air quality limit values for various air pollutants. This was followed by the National Emissions Ceilings Directive in 2001 which placed national caps on the key pollutants SO_2, NO_x, NMVOCs and NH_3. Meanwhile the EU15 began to focus on achieving its commitments agreed under the UNFCC Kyoto Protocol which required reducing GHGs on average by 8 % between 2008 and 2012 compared to 1990. This contributed to reducing air pollutants such as SO_2. IIASA analysis shows that around 25% of the SO_2 reductions in the EU15 between 2000 and 2010 was achieved by ñend-of-pipeò, while about 50% was achieved through fuel mix changes (coal/gas) and 25% by energy intensity improvements[17].

In the first half of the 2000s, climate and energy rose rapidly up the political agenda culminating in the adoption of the ñclimate and energy packageò[18] in 2008 which paved the way for further GHG emissions reductions to be achieved by 2020. The package became law in 2009 through four pieces of complementary legislation: a revision and strengthening of the Emissions Trading System (ETS); an ñEffort Sharing Decisionò which set binding national GHG emissions targets from sectors not covered by the EU ETS of 10% by 2020 compared with 2005 levels; binding national renewable energy targets of 20% by 2020 relative to 1990; and a legal framework to promote the development and safe use of carbon capture and storage (CCS). The development of the climate and energy package benefited from considerable inter-DG internal coordination[19]. And, in an attempt to ensure policy coherence, a joint integrated impact assessment[20] was carried out for the Directives on the emissions trading scheme and renewable energy. This was a considerable step beyond the usual approach of conducting separate impact assessments for each new piece of legislation. This comprehensive, single assessment covered a multitude of impacts, including air pollution (costs and benefits), energy supply security, generation costs, electricity prices, and energy costs per sector.

Importantly, the package then led to the development of the EU Low Carbon Economy Roadmap 2050[21] and the consequent Energy Roadmap 2050[22]. The latter sets out long term and interim sectoral GHG reduction targets.

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[14] For useful discussion and data on air quality and climate change trade-offs, see: ñAir Quality and Climate Change: A UK Perspectiveò by the UK Air Quality Expert Group, produced for Defra, SE, WGA, DoE of NI.

[15] See RAP presentation by Richard Cowart and Chris Neme, January 2012, Brussels: ñEnergy Efficiency: Power Markets, System Benefits and Key Design Issuesò http://www.raponline.org/event/rap-presents-at-energy-efficiency-workshop-in-brussels-power-markets-system-benefits-design

[16] DIR 2012/27/EU on energy efficiency, October 2012.

[17] IIASA, TSAP No.2 ñFactors determining recent changes of emissions of air pollutants in Europeò, June 2012.

[18] COM(2008)30final, ò20 20 by 2020, Europeọs Climate Change Opportunityò, 12.01.2008.

[19] RAP Global Power Best Practice Series, òIntegrating Energy and Environmental Policyò, Jan 2013, page 13.

[20] SEC(2008)85, Vol. II EC Staff Working Document ï Annex to the impact assessment. Document accompanying the package of Implementation measures for the EU's objectives on climate change and renewable energy for 2020.

[21] COM(2011)112final, ñA roadmap for moving to a competitive low carbon economy in 2050ò, 08.03.2011.

The 6th EAP, confirmed by the 7th EAP, provides ultimate objectives for EU air policy. While TSAP quality targets for health and ecosystems exist for 2020**[23]**, the Commission has yet to update pollutant ceilings and ambient air quality limits to achieve this. However, in its second consultation on options for revision of the EU TSAP and related policies, launched in December 2012, the explanatory notes[24] set out the intention to update ceilings for 2020 in order to align with the recently adopted UNECE Gothenburg Protocol, which introduced a new ceiling for PM2.5. These notes and the consultation survey itself provide some promising indications that efforts will be made to better integrate energy and air policies in the revised TSAP. The notes acknowledge that in the past synergies were not optimally managed and environmental trade-offs were not effectively managed.

Indeed, there are many examples where EU legislative text addressing greenhouse gases does not acknowledge or consider the co-benefits for air pollution and vice versa[25]. Examples where the selection and framing of legislation has not been optimal for reducing both harmful air pollutants and GHGs at least cost includes:

- the IPPC/IED Directive excludes energy efficiency or GHGs, justified by the Commission so as not to encroach upon operation the EU ETS, thus application of end-of-pipe solutions has increased GHGs;
- further abatement measures for diesel engines were put off on the grounds that they could reduce energy efficiency gains with the consequence that diesel engines are now the largest source of NOx in Europe while the WHO recently formally classified diesel exhaust as carcinogenic;
- the rise in bioenergy encouraged through climate and energy policy has resulted in biomass becoming a dominant source of fine particles in Europe; and
- a low EU ETS carbon price which causes operators to dispatch inefficient coal fired power plants ahead of more efficient and flexible gas fired power plants.

Going forward, the Commission states - in its explanatory notes to the consultation (page 9) - that a long-term vision could help *"further improve the overall coherence of EU policy".* The survey poses questions about interactions of the revised TSAP with the upcoming 2030 climate and energy package being developed by DG ENER and DG CLIMA during 2013. The survey also asks whether the EU should take action on SLCFs, specifically methane (ozone precursor) and black carbon.

Key challenge: coordinating regulation through the decarbonisation transition

The Commissionôs Energy Roadmap 2050 (page 6) foresees a particularly important role for the electricity sector in a decarbonised future:

"All scenarios show electricity will have to play a much greater role than now (almost doubling its share in final energy demand to 36-39% in 2050) and will have to contribute to the decarbonisation of transport and heating/cooling. .... Final electricity demand increases even in the high energy efficiency scenario. To achieve this, the power generation system would have to undergo structural change and achieve a significant level of decarbonisation already in 2030 (57-65% in 2030 and 96-99% in 2050). This highlights the importance of starting the transition now and providing the signals necessary to minimise investments in carbon intensive assets in the next two decades."

Several aging European coal-fired power plants will soon retire, accelerated by the Industrial Emissions Directive (IED)[26], growth in renewable energy generation driven by EU and national policies and reduced energy demand. The ECôs ambitious decarbonisation targets for 2050 and policy direction to minimise new investment in carbon intensive assets will promote further disinvestment. Achieving decarbonisation without negatively impacting reliability or usersô power bills will require timely investment in new, low-cost, clean energy resources that are sufficiently flexible to balance increasing shares of variable energy[27]. Market rules will

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[22] COM(2011)885final. ñEnergy Roadmap 2050ò, 15.12.2011.
[23] COM(2005) 446 final òThematic Strategy on Air Pollutionò, September 2005.. The strategy sets the following quality targets: 47% reduction in loss of life expectancy as a result of exposure to PM; 10 % reduction in acute mortalities from exposure to ozone; reduction in excess acid deposition of 74% and 39% in forest areas and surface freshwater areas respectively; 43% reduction in areas or ecosystems exposed to eutrophication.
[24] See pages 8 and 9 of the explanatory notes to the second consultation for the EU Review of Air and TSAP. Retrieved 03/03/2013 from website http://ec.europa.eu/environment/air/review_air_policy.htm
[25] The European Federation of Clean Air and Environmental Protection, ñLinking Air Pollution and Climate Change: A Challenge for European Legislationò, March 2010. EFCA Policy Initiative No. 2 www.efca.net
[26] DIR 2010/75/EU on industrial emissions (integrated pollution prevention and control), 21.12.2007.
[27] The Regulatory Assistance Project, ñBeyond Capacity Markets: Delivering capability resources to Europeôs decarbonised power systemò, Meg Gottstein and Simon Skillings, March 2012. Also, ñWhat Lies Beyond

need to be modified and investment signals strengthened. Demand side energy resources, including existing loads and new loads such as electric vehicles and heat pumps, could make a significant contribution. Currently, however, market barriers in most Member States prevent full participation of demand side energy resources[28].

Without specific long-term policy direction to energy markets, great uncertainty exists for investors in new energy resources. Nevertheless, the current policy landscape is moving toward market integration, full demand-side participation, the uptake of electric vehicles, greater penetration of energy efficiency and continuing air and water quality improvement. This changing landscape is complex, set against considerable economic and technological uncertainty, and it faces an accelerating carbon clock set by evolving climate science.

To ensure that unacceptable trade-offs and unnecessary costs are avoided, clear objectives (e.g., power system reliability, consumer protection, minimised investor and environmental risk) need to underpin each of the inter-related policy developments now underway or soon to be. This necessitates coordinated policy development, effective collaboration between the responsible regulators and should involve co-design of integrated policies at the earliest stage. The policy framework needs to be coherent, robust and resilient.

High level commitment exists, but translation to policy is not always consistent

Adopting an integrated approach to the EU air quality review appears to have been supported at the highest level within the Commission from the start[29]:

"In the PRESIDENT's view, this revision would have to be based on an impact assessment involving the entire Commission, in order to develop the maximum possible number of synergies between different policies, and could be modelled on the virtuous circle that had led to the adoption of the European climate and energy strategy."

A preference for integrated approaches is also evident in the ECôs March 2011 staff working paper on the Air Quality Review[30]. Within the priority transport sector[31], for example, several of the short term actions - prioritised to support urban hotspots where air quality limits are exceeded - effectively integrate local air quality and energy e.g. facilitating the implementation of the Directive on clean and energy-efficient road transport vehicles; supporting European municipalities in formulation and development of Sustainable Urban Mobility Plans; launching of EU-wide electro-mobility demonstration projects.

In considering the way forward, another section of this staff working paper (*Creating co-benefits with climate change policy)* constructively cites important inter-linkages between air pollution and climate change policies and suggests that synergies can be reaped and trade-offs managed and minimised. However, it is silent about how policy measures can be designed or prioritised to simultaneously reduce both GHGs and legislated air pollutants, closing down discussion of any such options with the assumption that EU climate change policy has already exploited all possible measures to 2020:

"The current EU climate change policy is however not likely to be sufficient to ensure that the TSAP objectives are fully met and additional air pollution control measures will therefore be needed."

This conclusion could have been much stronger had it recognised the benefits of moving in parallel on climate/energy policies and air pollution control measures, the synergies that exist between the two, and the economic benefits achievable by further integrating these two paths.

Brief references to long-term cross-cutting strategies for transport, resource-efficiency and innovation are incorporated, and they help to draw air and climate/energy policy together. Unfortunately, however, references to fostering innovation focus narrowly on end-of-pipe solutions, failing to acknowledge or quantify innovation in clean energy or energy efficiency let alone their broader societal and economic benefits.[32] This narrow focus is at odds with the wider EUôs Innovation Union strategy[33].

Capacity Marketsò, Mike Hogan and Meg Gottstein, August 2012. These papers explain the need for more flexible energy resources and how existing markets can adequately value and reward these resources.

[28] SEDC (Smart Energy Demand Coalition), ñThe Demand Response Snapshotò, September 2011.

[29] PV(2011)1944final. Minutes of the 1944th meeting of the EC, Strasbourg, 26 January 2011.

[30] EC, SEC(2011) 342 final òImplementation of Air Quality Policy and preparing for its comprehensive review,ò

[31] Non-attainment of air quality objectives has been largely attributed to the transport sector due to increases in transport volume, a significant gap between regulated emission limits in type approval for vehicles and their "real world" emissions, and a slow down in the turnover of the EU vehicle fleet.

[32] Ibid.

[33] http://ec.europa.eu/enterprise/policies/innovation/policy/innovation-union/index_en.htm

Air/energy modelling is critical to integrated policy

IIASAôs GAINS model[34] continues to be used by the EC to model emission baselines and scenarios for different policy options and their related impacts. The GAINS model is particularly useful for the development of integrated air and climate/energy policy because it explores synergies and trade-offs between local/regional air pollution control and mitigation of GHG emissions.

Analyses conducted for the EU of particular note include:

- for the 2005 TSAP strategy, IIASA estimated that co-control of pollutants could decrease the cost of local air pollution reduction sufficiently to pay for 40% of GHG mitigation costs;[35]
- for the proposal to increase the EU GHG reduction target from 20% to 30% for 2020,[36] IIASA estimated that the costs of reaching the 2005 TSAP objectives would be reduced by around ú3 billion in 2020 and bring additional health benefits of ú3.5 to 8 billion in 2020 (unfortunately these co-benefits were not included in deliberations on increasing the GHG target to 30%);
- for the 2012/13 Air Quality Review,[37] IIASA found that reductions of SO_2, NO_x and PM emissions (on top of current legislation[38]) using available end-of-pipe technologies could also be achieved with an accompanying 80% cut in GHG emissions in the EU by 2050 through energy efficiency improvements, current plans for nuclear energy and electrification of the transport sector.

Modelling is crucial to understanding the interrelated impacts of various policy scenarios on air quality, GHG emissions, competitiveness, consumer bills and electricity reliability. Sensitivity analyses exploring the boundaries of decarbonisation are necessary, including least-cost pathways reflecting aggressive energy efficiency, full participation of demand side energy resources in energy markets (including intra-day) and accelerated roll out of zero emission vehicles. Modelling for post-2020 air quality and energy policy should be coordinated.

Multi-pollutant and integrated approaches to air quality planning

The EC continues to address air quality through exposure limits, ceilings for pollutant concentrations, standards for products and emission limits for pollution sources. MS cannot rely solely on EU source regulations to achieve air quality goals, however, and must adopt additional plans and measures to ensure attainment of air quality objectives. European Environment Agency (EEA) data indicate that MS are struggling to achieve interim objectives; there are many infringements[39] and fewer than half of the 27 Member States are on track to achieve their GHG targets by 2020 solely through current domestic measures[40].

Legislation, policies and plans require very long planning and implementation time horizons, as does the infrastructure build and market transformation necessary to phase in cleaner technologies. Joint planning, where air and energy regulators and planners share assumptions, system constraints and ways to achieve energy and environmental objectives, can help to minimise unintended consequences, evaluate trade-offs and optimise policy mix and implementation timeframes to achieve the best outcomes for society. Within the EU, responsibility for policy implementation relating to air quality and energy is sometimes spread across many different government departments, agencies or organisations at different governance levels. In its explanatory notes for the second consultation, the Commission points to MSô subsidiarity approach producing inefficiencies

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[34] Website for IIASAôs GAINS model: http://gains.iiasa.ac.at/index.php/gains-europe

[35] Markus Amann et al. òCost Effective Emissions Reductions to meet the Environmental Targets of the Thematic Strategy Under Different Greenhouse Gas Constraints,ò 2007. Available online at http://webarchive.iiasa.ac.at/rains/CAFE_files/NEC5-v1.pdf

[36] EC, COM(2010)265, òAnalysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakageò.

[37] IIASA, Markus Amann et al., TSAP Report #1, ñFuture Emissions of Air Pollutant Emissions in Europe ï Current legislation baseline and the scope for further reductionsò http://gains.iiasa.ac.at/images/stories/reports/TSAP/TSAP-BASELINE-20120613.pdf

[38] Measures are available that could reduce SO_2 emissions by 35% beyond current legislation. Advanced controls on all new sources could reduce NO_x by 80% in 2050 relative to 2005, and primary emissions of $PM_{2.5}$ by up to 40%. Available measures could cut NH_3 and VOC emissions by about 30% beyond current legislation.

[39] For example, the EC reports (SEC(2011) 342 final) that some 20 Member States face infringement procedures for failing to meet the limit values for particulate matter in one or more zones and a number of Member States are expected not to achieve compliance with the 2010 ceilings of the NEC Directive.

[40] European Environment Agency, ñGreenhouse gas emission trends and projections in Europe 2012 - Tracking progress towards Kyoto and 2020 targetsò, Report No 06/2012, October 2012.

that prevent progress. While MS have delegated responsibilities down to regional, local and city level, the extent to which responsibilities come with the means to act varies substantially across MS. The Commission goes on to accuse some MS of not tapping into measures available at national level which are more cost-effective than those available at local level. The EC also reports that some MS are taking positions at EU-level on cost-effective measures which *"are often also at odds with the needs expressed by national technical bodies and local authorities"*[41]. Not only is improved coordination between governance levels essential, which may need to become legislated requirements, but a multi-pollutant approach must also connect those responsible for air quality with those responsible for energy.

The primary challenge for policymakers is to ensure that energy efficiency and decarbonisation are core elements of any air quality management strategy selected. Air quality plans must also be attentive to long-term public health and climate objectives (not just interim objectives), electricity reliability and cost. This requires a multi-pollutant approach covering all legislated pollutants and GHGs, assessed within a comprehensive, robust process underpinned by sound principles (see Table 1).

Table 1: Key principles for integrated multi-pollutant approach[42]

Institutional	• Coordination is necessary between climate, air, environment and energy (including utility) regulators and their activities/programmes on all levels: EU, MS, regional, local. This requires political leadership, structure and funding. • Identify, record and share best practice: identify champions; create and coordinate centralised data and assumptions and keep updated.
Policy	• Establish process framework for air quality planning based on a multi-pollutant approach underpinned by long-term objectives and integration of climate/energy policy. • Place emphasis/priority on measures which simultaneously reduce legislated air pollutants and GHGs at least cost and provide greatest net benefit to society. • Develop and maintain a policy measures database which includes effectiveness of measures in reducing multiple pollutant emissions and cost/benefits. • Develop and communicate air quality planning guidance.
Technical	• Develop models to evaluate energy, environmental and economic attributes of policy measures that can be implemented to reduce pollution. • Implement sequencing of emissions control measures, including equipment installed to capture legislated pollutants and measure emissions.

A process template is currently being developed by the Regulatory Assistance Project (RAP) in the U.S. called ñIntegrated, Multi-Pollutant Planning for Energy and Air Quality (IMPEAQ)ò[43] (see Table 2 below). This effort is designed to assist authorities in comprehensively and simultaneously reducing all air pollutants in the least-cost manner. Full IMPEAQ implementation will require the development of an optimisation model and an underlying database of emission reduction measures. The database would include data (ideally performance data and costs/benefits) for end-of-pipe solutions, efficiency and renewable energy options, and other policies, programs and technologies. EU policymakers could use the IMPEAQ process to assess the adequacy of MS air quality management plans.

Specifically, IMPEAQ and other multi-pollutant integrated processes for developing air quality management plans can assist in answering questions such as: How clean do policymakers want the air to be and by when? How can air pollution be regulated the way that humans, animals and plants experience it, i.e., from a multi-pollutant perspective? How can MS comply with National Emission Directives while minimising their limitations? And how can costs be optimised while complying with environmental requirements and energy system reliability needs?

Other templates may exist for jointly developing energy and air quality plans, but IMPEAQ leads from a premise of efficient energy consumption and internalises electric reliability considerations. Although initially designed for the power sector, it could be applied across all sectors given a broad database of control options. Similarly, its optimisation can incorporate other issues of concern, such as water and land use.

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[41] Page 6 of explanatory notes for EC second consultation of EU Review of Air Policy: http://ec.europa.eu/environment/air/review_air_policy.htm

[42] Adapted from ñClimate-Friendly Air Quality Management Strategies for Co-Controlò, by Christopher James and Rebecca Schultz, Regulatory Assistance Project (RAP), November 2011.

[43] James, C., and Colburn, K., The Regulatory Assistance Project, òIntegrated, Multi-pollutant Planning for Energy and Air Quality (IMPEAQ)ò, October 1, 2012 ï DRAFT paper. http://www.raponline.org/document/download/id/6440

Table 2: The IMPEAQ Process - Integrated, Multi-Pollutant Planning for Energy and Air Quality

Step	Responsible party	Process step description
1	Air quality planners (either at national, regional or city level).	Determine current air quality levels, including hot spots, from a review of the ambient monitoring network.
2	Air quality planners lead, but elicit input on assumptions from energy and transport planners.	Use air quality models to calculate the tons of emissions to be removed to reach desired ambient concentrations for each pollutant of concern (e.g., current or future ambient air quality standards).
3	Air quality planners lead, but involve energy and transport planners on assumptions.	Run optimisation modelling against a multi-pollutant database of emission reduction options ï or if unavailable, collaborate with energy regulators ï to determine energy savings (and co-benefits) achievable through cost-effective energy efficiency (EE), distributed resource (DR), and renewable energy (RE) measures.
4	Energy savings data need to come from energy planners. Both energy and air planners need to agree on the relevant avoided emissions factors (which will vary by Member State and energy market).	Translate EE, DR, and RE energy savings into emission reductions.
5	Air quality planners.	Sum emissions reductions achieved by EE, DR, and RE; repeat from Step 3 until sums reach tonnage targets established in Step 2.
6	Air quality planners, who would consult with/elicit input from energy (and other planners and the public) as in any normal regulatory process.	Conduct regulatory processes necessary to adopt and implement the measures identified in Step 3.

Regrettably, actual experience in using multi-pollutant approaches to develop air quality plans is limited. In September 2010, the Bay Area Air Quality Management District (BAAQMD) in California[44] adopted the first comprehensive multi-pollutant clean air plan of its kind in the US. In doing so, it developed a Multi-Pollutant Estimation Method tool (MPEM) to assist in the process[45]. MPEM integrates improving air quality and reducing GHG emissions to achieve public health goals by developing a value ï including co-benefits ï for each ton of pollution reduced[46]. The plan covers legislated air pollutants and GHGs and incorporates 55 control measures, many of which address root causes of emissions and simultaneously reduce both.

New York State is also using a multi-pollutant approach for its air quality planning[47, 48], working with NESCAUM[49] and the US Environmental Protection Agency (EPA) to identify a set of policies to jointly reduce air pollutants (including mercury) and GHGs. Comprehensive modelling provides regulators with information about the costs and benefits of proposed policies, their impacts and benefits on the energy sector, local economic effects and reductions in ambient concentrations of fine particulates and ozone. EPAôs participation will inform its development of guidance for other jurisdictions to use in preparing air quality plans in time to meet 2013-2014 deadlines for state plans to reduce ozone and fine particulates[50].

[44] BAAQMD is the regulatory body that develops and implements air quality plans for the San Francisco Bay Area of California, a seven-county jurisdiction with a population of approximately seven million.

[45] James, C., and Colburn, K., The Regulatory Assistance Project, òIntegrated, Multi-pollutant Planning for Energy and Air Quality (IMPEAQ)ò, October 1, 2012 ï DRAFT paper. http://www.raponline.org/document/download/id/6440

[46] The full Bay Area 2010 Clean Air Quality Plan and Executive Summary are available at http://www.baaqmd.gov/Divisions/Planning-and-Research/Plans/Clean-Air-Plans.aspx

[47] New York State Department of Environmental Conservation. òA Conceptual Model for the Development of an Air Quality Management Plan for the State of New York.ò Final Draft, January 2009. Available at http://www.epa.gov/air/aqmp/pdfs/may2009/CMNewYork.pdf.

[48] This example is quoted in ñClimate-Friendly Air Quality Management Strategies for Co-Controlò, by Christopher James and Rebecca Schultz, Regulatory Assistance Project (RAP), November 2011.

[49] NESCAUM (Northeast States for Coordinated Air Use Management) coordinates air policy among eight Northeastern US states.

[50] John Graham, NESCAUM. òApplying the Northeast Regional Multi-Pollutant Policy Analysis Framework to New Yorkò. Presentation to NYSERDA EMEP Conference, October 14, 2009.

Conclusions

The year 2013 provides the EU with a golden opportunity to integrate its energy and air quality policy through an aligned and time-coordinated long term vision with supplementary milestones for all key air pollutants, including GHGs. This paper illustrates that the EC is cautiously progressing with the integration of energy and air quality policy through the EU Review of Air Policy. The ECÕs conservatism may be a reflection of the sentiment of its stakeholders, particularly MS reluctance to agree to new policy developments which will raise costs considering the current economic climate and/or which are perceived to conflict with the subsidiarity principle. It is also perhaps a reflexion of EU institutional culture and constraints as well as uncertainty about how to proceed more effectively. To contribute to the latter this paper has outlined some solutions, summarised below:

- improve collaboration and coordination between Commission DGs responsible for inter-related policy areas including air quality and energy, particularly at the earliest stages of the policy development process;
- conduct impact assessments which pay closer attention to policy interactions and sensitivities, power system reliability, costs to the energy consumer, and broader societal and environmental values;
- model sensitivity scenarios that explore impacts of least-cost decarbonisation ï incorporating aggressive energy efficiency and renewable energy policies with full participation of the demand side in energy markets, including intra-day ï to reduce all emissions in ways that minimise cost and maximise energy system reliability;
    - take or promote action in areas that could contribute to or support achievement of air quality and energy policy goals, even if not policy lead (e.g. enabling participation of the demand side in energy markets);
- improve coordination and cooperation of regulators and planners at all governance levels responsible for air quality, GHG mitigation, energy and power grid/system operation;
- provision of a process template for development of long-term air quality management plans which prioritise cost-effective measures, particularly energy efficiency and clean renewable energy, which simultaneously reduce legislated harmful air pollutants and GHG emissions;
    - build on and complement existing component tools to assist MS to develop, adapt and pilot optimisation model(s) and databases necessary to conduct multi-pollutant integrated planning; and
    - demonstrate to MS how multi-pollutant planning can be conducted through coordination, update and dissemination of best practice in development and implementation of multi-pollutant integrated air quality management plans.