



Special Report on Next Generation Compliance

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Cover photo courtesy of NASA: Satellite view of illegal logging incursions in the state of Mato Grosso, Brazil.

PREFACE

Using infrared sensors to detect dangerous but otherwise invisible gas escaping from a pipe.

Using satellites and drones to monitor logging in a remote forest.

Using your cell phone to measure air quality while you jog.

Using the power of *YouTube* and other video platforms to unmask polluters.

These are just a few of the ways that next generation technologies already are changing how regulators, industry, and citizens are monitoring changes to the environment.

This Special Report on Next Generation Compliance is intended to inspire and stimulate a fresh wave of innovative problem solving and utilization of advanced tools and effective approaches to strengthen environmental performance. Woven into the Special Report are examples of success stories and advanced tools that hold significant promise in meeting today's challenges.

Technological innovation and new approaches to regulatory design and implementation are leading to significant improvements in monitoring and detecting pollution, responding to and mitigating environmental impacts, and communicating results to the regulated community, legislators and the public. Social innovations are facilitating efficient solutions to organizational and managerial challenges associated with compliance assurance. These advances are proving especially valuable as governments respond to increasingly complex environmental issues, such as largely invisible sources of pollution or significant cumulative impacts of small sources. Successful implementation of environmental laws continues to require new and diverse compliance strategies that enhance the traditional enforcement tools that remain the backbone of environmental protection.

Essential to next generation compliance is an emerging range of state-of-the-art technologies that can deliver data that is more accurate, more complete, more immediate, and more relevant. Advanced monitoring represents a group of technologies that include satellite-based remote sensing and ground-based detection systems, such as fence-line monitoring. These tools see what was previously hidden, from invisible benzene leaks at a refinery or methane leaks at oil and gas facilities, to logging and mining incursions in non-permitted areas of remote forests. In addition, sensors are now available to detect black carbon, methane, tropospheric ozone, and hydrofluorocarbons, collectively referred to as short-lived climate pollutants (SLCPs), with a higher level of precision than ever before. Through the rigorous testing of monitoring technologies, regulators can be assured that the data they receive on the environmental impacts of regulated facilities are reliable and accurate.

More accurate and timely data means more persuasive deterrence and creates new opportunities to improve accountability and transparency. New information analysis and reporting tools facilitate real-time sharing of information and help regulators (and the regulated community and public) sort through mountains of data to find relevant information and conduct sophisticated analysis, swiftly accomplishing tasks that would have required weeks of staff time to complete. Getting timely data into the hands of regulated entities often triggers self-corrective measures that minimize the need for interventions by authorities.

Although advanced technology is a key component of next gen compliance, these tools do not provide real utility when standing by themselves. Smarter regulatory design and mechanisms that motivate good behavior still form the backbone of environmental compliance assurance programs. Regulations and incentives that leverage these technologies effectively can secure high levels of environmental compliance by members of the regulated community.

Smart regulation also means more efficient application of finite resources to priority risks, while motivating polluters to take a more active role in compliance. New kinds of programs and management systems connect government authorities and regulated private players in synergies and productive partnerships that help protect the environment. Programs that incentivize compliant behavior and build on the desire for favorable business reputations have also proven to be effective tools for raising levels of environmental compliance.

Today's most formidable environmental threats – including climate change, air pollution, loss of biodiversity, and an increasingly unsustainable use of dwindling water supplies – demand coordination among environmental compliance and enforcement practitioners on local, national and global scales, including through compliance networks. Cumulative impacts often pose challenges that require strategies and approaches that encompass a larger scope and cannot be addressed on a case-by-case basis.

Next gen compliance tools may prove particularly critical to the success of efforts to slow and reduce climate impacts, including in supporting the implementation of laws that reduce non-carbon dioxide climate pollutants (e.g., black carbon soot, ground level ozone, methane, and fluorinated gases) and for laws that protect natural carbon reservoirs, such as forests, wetlands, and other ecosystems rich in biomass. For example, new monitoring technologies have greatly refined the measurement of emissions from methane flaring, while others are helping authorities zero in on illegal timber harvesting. Advances in the detection and prevention of environmental harms can meet climate challenges with the right level of commitment and collaborative problem solving. Incorporating the private sector and the public into this task will be essential to the success of this effort.

The International Network for Environmental Compliance and Enforcement (INECE) is dedicated to collaborating through networks with national governments, like the United States, the Netherlands, and China, and international partners like the Clean Air and Climate Coalition (CCAC) and the United Nations Environment Programme to reduce air, water, and climate pollution. INECE invited colleagues around the world to contribute to this Special Report on Next Generation Compliance, which introduces a range of innovative views, methods and solutions for increasing effectiveness of environmental compliance and enforcement. With this report, INECE seeks to bridge the gap between emergent technologies and practitioners to strengthen compliance with the relevant national, regional, and international laws, such as INECE is currently doing with its work to support the implementation of new air pollution controls in China. We envision INECE's Next Generation Compliance initiative, of which this Report is a part, as a dynamic process and welcome additional submissions of information relating to next generation compliance.

INECE is working with the U.S. Environmental Protection Agency, the Netherlands Human Environment and Transport Inspectorate, The George Washington University Law School, Erasmus University, UNEP, the IUCN World Commission on Environmental Law, the Environmental Law Institute, and others through a collaborative series on Improving Environmental Performance – Application of Next Generation Compliance Technology and Regulatory Design. Through this series, INECE will continue to identify and promote the best next generation technologies and regulatory strategies for environmental compliance and enforcement practitioners.

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This Special Report is available online at
<http://inece.org/topics/next-gen-compliance/>.

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NEXT GENERATION COMPLIANCE: USING ADVANCED MONITORING TECHNOLOGY TO MEET TODAY'S CHALLENGES AND PLAN FOR THE FUTURE

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Protecting air and water and keeping communities safe from pollution is more complex today than ever. Whether it's pollution that is not apparent to the naked eye or large numbers of small sources that collectively have a big impact on the environment, new challenges require us to innovate and improve. EPA and its partners are taking advantage of new tools, technologies and innovative approaches to achieve the intended human health and environmental benefits of federal, tribal and state regulations and permits.

These challenges and opportunities are not limited to environmental protection in the United States. Governments everywhere face similar challenges and opportunities, so it is important to share and learn from each other. This conference series is intended advance that learning process.

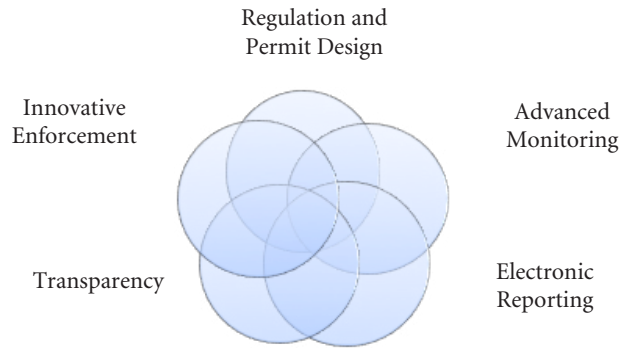
Next Generation Compliance is EPA's integrated strategy to bring together the best thinking from inside and outside EPA on how to structure regulations and permits combined with new monitoring and information technology, expanded transparency, and innovative enforcement to enable us to do our job better in the 21st Century.

Led by EPA's Office of Enforcement and Compliance Assurance (OECA), Next Generation Compliance helps us navigate this era of complex challenges. Using existing and emerging monitoring and information technologies, EPA and states, and the regulated facilities themselves, are better able to find and fix pollution problems. The increased transparency and more comprehensive data that result from electronic reporting and advanced monitoring allow us to develop innovative approaches. Next Generation Compliance assists EPA, States, and Tribes to better identify problems presented by large regulated universes and address those problems with approaches that go beyond traditional single facility inspections and enforcement. These approaches collectively help us better protect public health and the environment, assure a level playing field for businesses that play by the rules, engage communities, and reduce regulatory burdens.

Next Generation Compliance does not replace traditional tough enforcement, which continues to be our top priority. However, these new tools and strategies can help increase the effectiveness and reach of traditional enforcement. And budget uncertainties and constrained resources reinforce the imperative to implement Next Generation Compliance now.

Next Generation Compliance consists of five interconnected components, each designed to improve the effectiveness of our compliance program.

- Design regulations and permits that are easier to implement, with a goal of improved compliance and environmental outcomes.
- Use and promote advanced emissions/pollutant detection technology so that regulated entities, the government, and the public can more easily see pollutant discharges, environmental conditions, and noncompliance.
- Shift toward electronic reporting by regulated entities to help make environmental reporting more accurate, complete, and efficient while helping EPA and co-regulators better manage reported information and improve effectiveness.
- Expand transparency by making the information we have today more accessible, and making new information obtained from advanced emissions monitoring and electronic reporting more readily available to the public.
- Develop and use innovative enforcement approaches (e.g., data analytics and targeting) to achieve more widespread compliance.

Figure 1: Next Generation Compliance Components

The fast-evolving pace of environmental monitoring technology development makes advanced monitoring one of the most dynamic and promising parts of Next Generation Compliance, and this element will be the focus of our conference series. EPA is now using infrared cameras to find emissions leaks that would otherwise be invisible to the naked eye and difficult to detect. We have several vehicles with mobile mounted equipment that can measure and map pollutants from roadways near facilities. EPA has deployed solar-powered buoys to collect and transmit water quality data every 15 minutes in the Charles River and Mystic Watershed. Companies also find that advanced monitoring technologies can help them improve their operations and stay in compliance, by allowing them to find pollution that was “invisible” and transmit warnings to facility managers so they can fix a problem before a violation occurs. Advanced monitoring technology, especially when connected with Internet or cellphone communications technology, has the power to transform how we are able to see, communicate about, and react to pollution to protect human health and the environment.

Years of research, conferences and seminars have helped determine the factors that influence compliance and inform the technology development and program strategies that help improve it. We looked at the experience of regulatory agencies at EPA, States, and in other countries, to see how advances in information and monitoring technology are changing environmental programs, and how to measure improvements in compliance. This has helped forge and strengthen new partnerships to work together to use technology and advanced monitoring most effectively.

EPA has learned that measuring pollution provides a more accurate view than estimations. In two recent Clean Air Act cases, the facilities had used a set of calculations to estimate controls needed to achieve a 98% flare combustion efficiency, and based on those calculations, reported low volatile organic compound emissions. When EPA checked their actual emissions using flare monitors, we found that the emissions were in fact 10 to 25 times higher, meaning that communities were exposed to far more pollution than had been assumed. A few other promising uses of advanced monitoring include:

- The placement of “Village Green” solar-powered air pollution and meteorological monitoring stations in communities, providing real-time air pollution measurements on the web and smartphone app. <http://villagegreen.epa.gov/>
- Geospatial Measurements (GMAP) of air pollution data in real time using vehicle-mounted equipment. Data is displayed on a laptop, overlaid on Google Earth, to show the concentrations of pollutants near a given facility or in any given community. http://www.epa.gov/nrmrl/appcd/emissions/sec_gmap.html
- Water quality measurements from a solar-powered buoy every 15 minutes, providing information on temperature, conductivity, pH, dissolved oxygen, turbidity, chlorophyll, florescent dissolved organic matter, and phycocyanin, thereby allowing EPA to estimate the level of cyanobacteria, a harmful algal bloom. The data is reported via cell phone technology to a secure web site. https://www.neiwpcc.org/neiwpcc_docs/10Faber-MonitoringCharles&Mystic.pdf
- Lights installed on the bank of a river that glow red when there is a combined sewer overflow of raw sewage into the river, and yellow for 24 hours after the discharge, to warn swimmers and boaters to avoid contact with the water.
- The Environmental Defense Fund teamed with Google Earth Outreach to attach sensors to Google Street View cars to measure natural gas levels and thereby create detailed maps of natural gas leaks from utility pipes under city streets. They then worked with natural gas utilities to fix the leaks. <http://www.edf.org/climate/methanemaps/partnership>
- China is using RFID tracking devices, similar to those used for retail inventory control, to track shipments of medical waste.

Where we go in the future depends on what we learn. This is why EPA is collaborating with INECE, The George Washington University Law School (GW Law), the Environmental Law Institute (ELI), and the Netherlands Human Environment

and Transport Inspectorate (ILT) on this new conference series. Only when we reach out broadly, consider different perspectives, and learn from others' thoughts and experience can we craft the best approaches to take now and in the future.

The series will start off with a GW Law conference in March 2015, focusing on the legal aspects of using advanced monitoring in compliance and enforcement programs. Erasmus University, the Netherlands Environmental Inspectorate, and Dutch Association of Supervisors, Enforcers and Regulators (VIDE) will hold the next event in April 2015 to focus on how advanced monitoring can be combined with social and cultural influences to improve environmental performance. EPA plans to lead an event in late 2015 or early 2016 to explore the practical aspects of using advanced monitoring technologies to improve facilities' environmental performance and compliance, monitor compliance and ambient conditions, and when enforcement actions are necessary, to move the regulated entity back into compliance in a way that demonstrates to the agency and the community the facility's path to responsible environmental stewardship.

The EPA event will focus on using advanced monitoring for the practitioner — including testing the performance of advanced monitoring in the lab, gauging its accuracy and ability for replicable measurements, and examining issues that arise from using such equipment in the field. We would like to hear about new opportunities for using advanced monitoring, challenges and possible solutions, and how information from advanced monitoring equipment is being used to improve performance and compliance. We hope to hear from government agencies, industry, and others.

We expect that this event – and the entire conference series – will help EPA, other regulators, industry, academics, and communities:

- Learn what promising new technologies are available now and on the horizon,
- How they can best be used,
- How their value can be multiplied through connections with information and communication technologies, and
- What will be needed of technology users to be able to benefit their programs and the environment most while avoiding pitfalls.

We are looking forward to these exciting new learning opportunities and invite other governments, academics, industries, and communities to learn as well.

1. ADVANCED TECHNOLOGIES

This chapter provides a broad look at the current state of the art of technologies that capture, track, analyze, and share data on the environmental performance of regulated entities. It begins by setting expectations regarding advanced monitoring technology by explaining the uses and limitations of data from sensors that monitor air quality. It then provides a close-up look at three devices that are in use today to detect levels of air pollutants by regulators, members of the regulated community, and members of the public, respectively. Complementing these descriptions are case studies of technologies that are not ready for regulatory use, but which are “waiting in the wings,” poised to offer significant utility to government authorities in the future in detecting pollutants and identifying illegal behavior.

The second half of the chapter consists of articles and a case study that closely examine how technology can be used in practice to carry out government environmental compliance and enforcement functions more effectively. Two articles focus on uses of satellite remote sensing data to efficiently monitor events happening on the ground. The third article examines El Salvador’s comprehensive information system that integrates remote imaging with real-time tracking of the environmental performance of regulated activities and enables multiple government agencies to share information and coordinate tasks. The final section of this chapter presents two additional case studies. The first describes a system used in China for full life cycle tracking of medical waste, from initial collection in hospitals to final treatment and disposal in a distant location. The second case study features an innovative system for tracking and verifying the legality of lumber cut from tropical hardwood forests.

QUALITY CONTROL OF DATA PROVIDED BY AIR QUALITY MONITORS FOR REGULATORY PURPOSES*

* INECE is grateful to Esteban Herrera, Advanced Monitoring Program Coordinator – Office of Enforcement and Compliance Assurance, U.S. Environmental Protection Agency National Enforcement Investigations Center, for his valuable comments and recommendations while reviewing this document.

As a steady number of new advanced air quality monitors becomes available, the accuracy of these devices becomes an important concern, particularly when they are used by regulatory authorities. The reliability of data provided by air monitoring devices falls within a broad range that is dependent on the sophistication of the technology, its intended purpose, and whether the data was collected using a government-approved methodology that meets stringent measurement quality objectives and operational requirements. Some monitoring devices are designed for personal or educational use, providing an approximation of the level of pollutants present at a particular time and location, while other devices are designed to provide hard data that can be used to support assessments of regulatory compliance.

In the United States, federal, state, and local environmental enforcement agencies do not use sensor-collected data to “prove” violations in the legal sense of the word. Instead, advanced monitoring data is used as a screening tool and can provide strong supporting evidence of noncompliance, together with other facts and in conjunction with other monitoring tools and protocols. In most cases, the awareness that government authorities can gather compelling data through the use of these advanced monitoring tools and can identify areas of concern that could lead to additional follow up activities (e.g., on-site inspection) is sufficiently persuasive for regulated entities to cooperate with regulatory agencies when potential violations occur. Nevertheless, rigorous quality control by government authorities is necessary to ensure that a consistent, fair, and reliable basis exists for evaluating the level of environmental compliance of regulated activities and for collecting evidence when a polluting entity has exceeded allowable emissions levels for an air pollutant, which could be used to support enforcement efforts if the need for litigation arises.

In the United States, the Environmental Protection Agency (EPA) has a rigorous program for testing the accuracy of air pollutant targeting and screening tools. These tests are followed up with protocols that specify the precise conditions under which the EPA deems air quality data to be accurate. The EPA’s Federal Reference and Equivalent Methods Program provides a definitive method for measuring six “criteria pollutants” to determine if the area in which an activity takes place is in compliance with the National Ambient Air Quality Standards of the Clean Air Act.¹

The EPA’s National Exposure Research Laboratory publishes a list of air quality monitoring devices that use the approved “reference methods” and “equivalent methods” for measuring ambient concentrations of specified air pollutants and are designated as acceptable for air quality surveillance by state and local authorities.² For each pollutant, the document lists specific monitoring instruments (manufacturer, model number, model name, e.g., “PM_{2.5} Ambient Fine Particle Sampler”), the specific pollutants and operating parameters for which the equipment is approved, and a reference to the federal regulation that specifies the applicable performance requirements.

The following links provide additional background information:

- US EPA, List of Designated Reference and Equivalent Methods, June 18, 2014, <http://www.epa.gov/ttn/amtic/criteria.html>.
- US EPA, QA Handbook for Air Pollution Measurement Systems: Volume III: Stationary Source Specific Methods <http://www.epa.gov/ttn/amtic/qalist.html>.
- US EPA, Air Sensor Guidebook, <http://www.epa.gov/airscience/docs/air-sensor-guidebook.pdf>.
- National Air Quality Reference Laboratories and the European Network, AQUILA: Roles and Requirements for Measurement Traceability, Accreditation, Quality Assurance/Quality Control, and Measurement Comparisons, at National and European Levels. Chapter 4: Type Approval Testing and Product Certification of Automated Instruments used for Ambient Air Quality Monitoring. <http://ec.europa.eu/environment/air/quality/legislation/pdf/aquila.pdf>.
- Department of Environment and Conservation, Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales, <http://www.epa.nsw.gov.au/resources/legislation/07001amsaap.pdf>.

REFERENCES

¹ The criteria pollutants are ozone (O₃), particulate matter (PM), carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), and lead (Pb).

² Federal Reference Methods (FRM) are methods, samplers, or analyzers that utilize measurement principles and a calibration procedure specified in the Code of Federal Regulations, 40 CFR Part 50. Federal Equivalent Methods (FEM) are methods that have been tested in accordance with 40 CFR Part 53 and designated by EPA as an FEM under Part 53.

AIR MONITORING DEVICES FOR DIFFERENT USERS AND PURPOSES

Air quality monitoring may at times seem distant and abstract. This section is included to make this topic more tangible, by providing examples of air sensing devices that are actually in use by three types of users: regulators, plant owners (self-monitoring), and members of the public. The featured equipment is only intended to provide a representative selection of devices and does not indicate any preference by INECE.

1 FOR REGULATORS: A PORTABLE SAMPLER FOR MONITORING FINE PARTICULATE MATTER

One important area of technological innovation is the development of air quality monitoring devices that can provide government authorities with highly accurate data that can be used for compliance monitoring – measuring emissions of pollutants from regulated installations during audits and inspections.

The **BGI PQ200A Ambient Fine Particle Sampler** by Mesa Labs is a portable air quality monitoring device approved by the US EPA to detect airborne particulate matter finer than 2.5 micrometers in diameter (PM_{2.5}).

The instrument is capable of collecting data on PM_{2.5} over continuous 24-hour sample periods. Applications for its use include:

- air sampling that conforms to EPA’s Federal Reference Methods.
- fence line monitoring.
- remediation projects.
- remote site monitoring.

Users can recover measured data, as well as identify flags that could indicate anomalies, by downloading a summary of any sample to a laptop or handheld computer.

As with all air monitoring devices which the EPA has determined to be compatible with approved methodologies, the PQ200A is rated by the EPA to provide accurate data when used within specifically prescribed parameters, including explicit design specifications, type of filter, sample flow rate, line voltage, and temperature range.

For more information, see <http://www.bgiusa.com/aam/pq200.htm>.



Photo courtesy of Mesa Labs

2 FOR FACILITY OPERATORS: ACCURATE AND RELIABLE SENSORS FOR CONTINUOUS MONITORING AND REPORTING OF EMISSIONS FROM STATIONARY SOURCES



Photo courtesy of Horiba International Corporation

An equally important example of next generation compliance technology tools are monitoring devices that help members of the regulated community comply with air quality regulations and standards. Plant managers must constantly monitor emissions from power plants, factories, and other stationary sources to provide early detection of problems and to track compliance on a day-to-day basis for reporting purposes.

The **AP-370 series** by the HORIBA International Corporation are advanced stationary monitors that can detect and automatically report the presence of specific gases at parts per million (ppm) levels. Each monitor is designed to detect a specific type of airborne pollutant with an extremely high level of sensitivity.

For example, Horiba’s **APNA-370 Ambient NOx monitor** takes continuous measurements of NOx, NO, and NO₂ at concentrations as low as 0.1 ppm. The EPA has determined this monitor to be compatible with approved methodologies and has rated the APNA-370 to provide accurate data when used within specified parameters.

For each gas measured, the systems provide four types of data. These monitoring instruments are capable of continuously transmitting measured values, alarms, and other data to a remote computer via TCP/IP protocol through the systems' serial ports. Each system features automatic compensation for ambient pressure, which assures that data is reliable regardless of the weather or the monitor's location.

For more information, see <http://www.horiba.com/process-environmental/products/ambient/>.

3 FOR CITIZENS: CITIZEN MONITORING THROUGH AIRCASTING



Photo courtesy of HabitatMap

A third important area of technological innovation is the development of new generation of low cost air monitoring technologies designed to address a growing interest by citizen scientists, educators, students, and others in monitoring air quality on an individual or community level.

One example is **AirCasting**, an innovative platform for members of the public to record, map, and share health and environmental data through their smartphones.

A handheld **AirBeam** Air Monitor measures particulate matter ($PM_{2.5}$), as well as temperature and relative humidity, and transmits them to the **AirCasting App** on the user's smartphone via Bluetooth technology.

A network of citizens then can share data via the monitoring technology's **CrowdMap** feature, creating a continuously updated picture of the levels of pollutants at numerous locations throughout a city. Collectively the use of systems by citizens provides an informal but highly informative snapshot of hotspots and changes in $PM_{2.5}$ within ranges commonly encountered in an urban environment.

For more information, see <http://aircasting.org/>.

WAITING IN THE WINGS: ADVANCED TECHNOLOGY WITH FUTURE POTENTIAL TO FACILITATE REGULATORY ENVIRONMENTAL COMPLIANCE AND ENFORCEMENT

The following case studies are provided to illustrate innovative ways that nongovernment organizations have been pioneering comprehensive technology systems for detecting and tracking pollutants and human activities that have adverse impacts on the environment. Each of these mechanisms is a highly developed system that has potential for future regulatory use if additional features are added to ensure the integrity of the data and securely tie into the information systems used by regulatory agencies.

CASE STUDY: INTELLIGENT RIVER® : A TECHNOLOGY-DRIVEN WATERSHED MONITORING NETWORK

SUMMARY

This case study provides an example of advanced technology for detecting and tracking the distribution of water pollutants throughout an entire river basin.

EXPLANATION

In river basins around the world where human activities are present, it can be extremely difficult for environmental authorities to identify sources of pollutants, understand the dynamics of their disbursement, and determine the measures needed to conserve and restore natural resources. A new program undertaken by Clemson University's Institute of Computational Ecology¹ is testing an extensive watershed-monitoring technology network that is designed to comprehensively fill these information needs.

The National Science Foundation's Major Research Instrument (MRI) program has awarded \$3 million dollars to Clemson University to research, develop, and install a network of computerized sensors that will monitor water quality along the entire 312-mile length of the Savannah River, which flows between the states of South Carolina and Georgia in the US. The network, which is part of the Intelligent River® Research Enterprise, will provide real-time data on water quality and flow rate on an unprecedented scale. A steadily increasing demand for drinking water, industrial production, hydroelectric power, and recreation is driving a critical need for data that can be used in developing better water resource management practices.

The network consists of battery-operated computers (known as "MoteStacks") fitted inside of buoys that are anchored to the river bottom. External sensors on the buoys will collect data on the temperature, flow rate, turbidity, and oxygen levels of the water, as well as detecting the presence of pollutants. The MoteStacks will process and transmit the data to a high performance computer system at Clemson University for recordkeeping and analysis. Although data collected initially will not be sufficiently robust for regulatory compliance purposes, the project will provide a powerful demonstration, at scale, of a system that gathers detailed information on conditions throughout an entire river basin and that can pinpoint where pollution or other environmental disturbances occur.

During the research period, federal, state, and local authorities will have the opportunity to pilot the use of the data. Before the MRI system can meet regulatory requirements for the collection of data that is legally defensible, however, a number of additional barriers will need to be cleared. These include using EPA-approved collection and analysis methods, establishing a system for calibrating all probes and meters on a daily basis, conforming to a Department of Health and Environmental Control Quality Assurance Program Plan, and other measures for ensuring data integrity.²

For more information, see www.clemson.edu/appliedecology/savannah.

ENDNOTES

¹ Clemson University's Institute of Computational Ecology is located in North Charleston, South Carolina, USA.

² NSF MRI Deployment Planning Workshop, Breakout Group Presentations (June 2012) http://www.clemson.edu/public/ecology/savannah/downloads/irworkshop_breakoutday1.pdf.

CASE STUDY: GLOBAL FOREST WATCH: USING BIG DATA TO TACKLE THE CHALLENGES OF DEFORESTATION

SUMMARY

The following case study demonstrates how high-resolution satellite imagery can be integrated with data uploaded by members of the public and industry groups to provide near real-time monitoring of human activities that adversely impact forests.

EXPLANATION

Around the world, the unimpeded clearing of tropical forests through unsustainable land use and timber harvesting is causing the loss of vast areas of natural habitat and is a key driver of climate change. Yet until now, lack of reliable data has been a major obstacle to efforts aimed at curbing deforestation and forest degradation. Global Forest Watch (GFW), a powerful information platform developed by the World Resources Institute (WRI) and over 40 major partners, is poised to help change that by providing robust data in near real-time on forest changes that are happening on the ground.¹

GFW is designed for free and open sharing of forest data among governments, non-governmental organizations, companies, and the public. It incorporates ultra-high resolution satellite images from NASA and other sources to provide dynamic pictures that can be “tagged” by users that wish to contribute additional data on local site conditions, land ownership boundaries, logging concessions, and illegal activities. A feature of particular interest to environmental enforcement authorities is GFW’s alert system, which they will be able to configure to track changes in specific areas they select and see changes in forest cover as they occur.

Although GFW promises to provide great utility to environmental authorities and other stakeholders, challenges remain. A central challenge is that governments and private sector companies are sometimes reluctant to share data, out of fear of losing control, reputational harm, or self-incrimination. Creating a global culture of openness is a challenge that will not happen overnight or uniformly around the world.

A recent WRI article notes that despite challenges to sharing information, some groups, such as the Roundtable on Sustainable Palm Oil, have started to actively support the open and transparent sharing of forest data, including maps of authorized areas where activities take place.² GFW now has detailed data on concessions in Indonesia’s West Kalimantan, Liberia, Congo Basin countries, and Colombia. The fact that some governments have shown a willingness to permit open access to environmental data is demonstrated by Indonesia’s cooperation in encouraging greater data transparency, including promoting stakeholder access to free infrared satellite maps.³ Similarly, the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) has made it a key goal to allow public access to satellite imagery that is used to monitor and control deforestation in the Amazon.⁴

A second challenge encountered in the launch of GFW was public participation. In attempting to build a rich dataset, WRI found that active engagement with stakeholders was needed motivate significant numbers of individuals to upload their own data. WRI has been working with crowdsourcing⁵ platform TomNod,⁶ which has demonstrated the potential of GFW in Indonesia by attracting hundreds of thousands of “tags” on high-resolution images of sensitive ecosystem areas by individual contributors. Intensive engagement of this type will now need to be expanded to other countries and regions around the world to fulfill the platform’s goals.

A third challenge observed by the WRI article is the lack of consistency among countries and experts concerning the interpretation of key terms, such as “forest.” Noting that the word “deforestation” has over 800 competing definitions, it was recognized that important data might be misinterpreted or deemed irrelevant. The article recognized that clarification and continuous improvement of terminology would be critical to GFW achieving its potential across a wide range of geographic contexts.

Despite the challenges that GFW must overcome in the short term in accumulating a sufficiently deep level of data, this powerful platform has significant potential and opportunity to make a real impact on monitoring deforestation.

ENDNOTES

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² Ibid.

³ World Bank, *Indonesia's Government and Civil Society in Partnership to Encourage Greater Data Transparency*, (September 5, 2014) <http://www.worldbank.org/en/news/press-release/2014/09/05/indonesia-government-and-civil-society-in-partnership-to-encourage-greater-data-transparency>; Knight Foundation, *Indonesia: open infrared maps and the environment*, <http://opengov.newschallenge.org/open/open-government/inspiration/applying-open-infrared-maps-to-indonesia-s-environment>.

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⁵ Crowdsourcing is the process of obtaining data, comments, and content by soliciting contributions from large numbers of people, particularly from an online community.

⁶ TomNod, <http://www.tomnod.com/>.

CASE STUDY: TREETAG TIMBER TAGGING AND TRACKING SYSTEM

A digital solution to illegal logging that improves transparency and monitoring across the supply chain.

SUMMARY

The following case study demonstrates how satellite remote sensing can be combined with algorithms for biometric tree identification to create a tracking system that distinguishes legally harvested logs from timber that is illegally cut.

EXPLANATION

In countries around the world with tropical hardwood forests, government authorities are severely challenged in trying to constrain a thriving black market for illegally cut timber. Fueled by organized crime,¹ the illegal logging industry has developed a sophisticated global supply chain that is sustained through fraud and corruption.

TreeTAG Technologies, Inc. has developed a new infrared and GPS-based system that creates a unique biometric record of individual trees that have been legally authorized for harvest and uses a smartphone app to transmit data to a tracking system. The technology will enable manufacturers to track the wood they buy from ‘forest to factory’. The system is designed to circumvent opportunities for bribes and falsification of data that allow the trade in illegally cut timber to flourish.

Using proprietary algorithms, TreeTAG generates a one-time code that captures precise data on the potential maximum yield of each tree, as well as the species, time, date, and exact location where each tree is felled. If a tree is cut outside of a government-authorized logging concession, the system will not generate a “tag.”

The TreeTAG generator app does not require an Internet connection to generate codes that track the logged trees. Internet connectivity is needed only for periodic uploading of the information to TreeTAG’s servers. The app is designed to accommodate local government regulations and can be programmed to stop generating tags should certain protocols be breached.

As each tree moves along this digitally secure supply chain, it passes multiple points (such as bark removal and preliminary milling of wood) where the “tagging” of the logs must be verified. Each step involves a maximum specified range of change in volume tied to the maximum potential yield of the tree and its component parts. Transporters and processors have no access to this data and cannot game the system.

TreeTAG is currently testing their system in a pilot project in Peten, Guatemala, partly funded by the World Resources Institute. This pilot will see a sustainably harvested mahogany tree tracked from the point of logging, through milling and export / import to final delivery to the Two Old Hippie guitar company in Bend, Oregon.

Phase II of the TreeTAG developments will involve the launch of an Earth observation strategy that will see a ‘remote piloted system’ (RPS), equipped with an array of sensors, that will be capable of identifying trees on a tree by tree, species by species basis and of calculating the volume and carbon value of trees contained within any forest under the REDD program.²

The system can also be configured to assist law enforcement with the detection of illegal poachers that often manage to operate unseen under the rainforest canopies.

The TreeTAG systems can be accessed by various government agencies, allowing them to confirm that each tree in the system carries proof of its authorized source. Using the intelligence gathered, government authorities will be able to suspend logging permits and prosecute parties that excessively log areas or attempt to circumvent the TreeTAG system.

The Phase III plan for the TreeTAG system is the launch of a dedicated satellite that will travel on an equatorial orbit, allowing up to 16 passes per day over tropical forests. The larger dataset generated will provide significantly greater detail on tree harvesting activities occurring at multiple times during each day.

TreeTAG does not purport to promise an end to the illegal timber trade, but as increasing numbers of consumers, manufacturers, and governments alike demand sustainably, legally sourced wood, the company hopes to move the logging industry closer to a “no tag, no tree” policy.

ENDNOTES

¹ United Nations Environment Program, *Green Carbon, Black Trade: Illegal Logging, Tax Fraud and Laundering in the World's Tropical Forests* (2012) http://www.unep.org/pdf/RRALogging_english_scr.pdf.

² Reducing emissions from deforestation and forest degradation (REDD) is a mechanism for mitigating climate change that has been negotiated under the framework of the United Nations Framework Convention on Climate Change (UNFCCC). The objectives of REDD are the reduction of greenhouse gas emissions and sequestration of greenhouse gases through enhanced forest management in developing countries.

CASE STUDY: MONITORING EMISSIONS OF SHORT-LIVED CLIMATE POLLUTANTS FROM GAS FLARING

1 INTRODUCTION

Flaring is a method used by oil extraction and refinery facilities in the US and other countries around the world to vent and burn away hazardous air pollutants, waste gases such as methane, that are byproducts of the oil production process. Flaring may convert some or most of these pollutants to carbon dioxide and water, but in many cases large amounts of methane, black carbon, and other short-lived climate pollutants (SLCPs) are released into air.¹ Although SLCPs remain in the atmosphere for a much shorter time than carbon dioxide, they have a climate forcing effect that is more than twenty times as potent. The U.S. Environmental Protection Agency (EPA) has strongly expressed its intent to strengthen and enforce U.S. regulations aimed at minimizing the release of SLCPs from flaring during the oil extraction process.² The EPA has also engaged in partnerships with many other countries to study and seek technological solutions to the significant climate impacts caused by flaring.

Determining the amount of pollutants in a flare plume is inherently a difficult task. The monitoring technologies that have been available to date have provided poor approximations of methane and black carbon emissions. Individual flares can be affected by a number of factors, including site-specific composition of gases, the intermittent flow of waste gas, environmental conditions, and variations in manufacturers' flare designs.³ In addition, the EPA reports that emission estimates based on assumed combustion efficiency (CE) of 98% are not reliable and that actual emissions of pollutants could be dramatically higher.⁴

2 EXISTING FLARE MONITORING TECHNOLOGIES

Technologies that have become available during the last decade have provided significant improvements over previously used monitoring methods, such as extractive sampling, which measures only selected, representative points in a flare plume. All of these technologies have shortcomings, but they represent the existing state of obtainable tools for current regulatory use.

Active Open-Path Fourier Transform Infrared (OP-FTIR) is a flare monitoring technology that measures contaminants in a flare plume by focusing a light beam on a flare before passing it through the flare plume to a device (retroreflector) that measures and interprets the precise optical distance to points in the flame. A specially modulated light beam is then sent back through the flare to be measured for contaminants and onto a detector that records variations in the light.⁵ The technology manipulates the recorded signal using an algorithm, called a Fourier transform, to produce a spectrum of values that can be interpreted to identify specific SLCPs and other pollutants and their concentrations. While useful as a tool, OP-FTIR has a limited range for measuring flare plume dynamics and can only operate at low temperatures, where it is vulnerable to atmospheric interferences.

A variation on OP-FTIR is Passive Fourier Transform Infrared (PFTIR), which can be used when it is not possible to place monitoring instruments on two sides of a flare.⁶ PFTIR involves aiming the monitor at a specific region of the flare plume and sampling a representative path through the flare plume. PFTIR is less sensitive than OP-FTIR and requires a greater temperature difference between the target flare plume and the background to allow for accurate measurement.⁷ Variations in the flare plume, long data acquisition cycles, and a need to operate at lower temperatures make this technique unreliable.⁸

The solar occultation flux (SOF) method involves monitoring from a moving vehicle rather than from a stationary platform. It combines stationary flare plume modeling with dispersion measurement. Using the sun as the light source, it utilizes optical spectroscopic technologies to directly identify and quantify pollutants present in a gaseous emission plume.⁹ An SOF system has three principal components: an FTIR spectrometer that captures variations in solar radiation, a sun tracker that continuously maintains the orientation of the device, and a GPS that accurately measures the location of the monitor relative to the flare plume. The gas dispersion measurements (fluxes) are obtained by multiplying the mass across a vertical slice of the plume with the wind speed.

3 NEXT GENERATION FLARE MONITORING

However, a new technology that is the product of a current EPA-funded research project promises to provide quantum improvements in the accuracy of flare measurement. The project has demonstrated the feasibility of a real-time Flare

Efficiency Monitoring System (FEMS) that continuously creates two-dimensional data maps of the entire flare plume and has a data rate that is at least 20-30 times faster than the most reliable technology that has been available until now – Passive Fourier Transform Infrared monitoring or PFTIR.¹⁰ FEMS utilizes an infrared imager to determine relative concentrations of CO₂, CO, and hydrocarbons (including methane) in the flare plume and then calculates combustion efficiency in real-time. A working prototype of FEMS is currently being completed for field tests and a calibration device.

While FEMS is designed to measure the effective burning of methane, “Sky-LOSA”¹¹ technology developed by Carleton University (Ottawa, Canada) has been engineered to measure black carbon, which is often distributed well past the part of a flare plume that is visible to the naked eye. Although gas flaring is estimated to account for only 1 to 8% of global black carbon emissions, it has been found to produce roughly half of deposited black carbon in the Arctic, where it darkens snow and accelerates warming.¹² Sky-LOSA is designed to directly quantify flare-generated black carbon in the field and is capable of supporting mitigation projects where quantified results are necessary. Like volatile gases, measurement of black carbon is challenging. Sky-LOSA uses specialized algorithms to quantitatively account for distortions of light from the sky and the sun to reduce uncertainties across a range of atmospheric conditions. Like FEMS, Sky-LOSA is still in the testing phase and not ready for regulatory compliance use at this time.

Finally, satellite-based measurement of flares for regulatory use is another area in which important progress is being made. The technologies available to date have not provided data that is sufficiently robust or detailed to be usable for compliance monitoring purposes.¹³ Nevertheless, improvements in Visible Infrared Imaging Radiometer Suite (VIIRS), a technology that has been used for global weather and climate monitoring, offers improvements over previous satellite remote sensors.¹⁴ The National Oceanic and Atmospheric Administration (NOAA) in the United States has been using nighttime observations by VIIRS to provide increasingly accurate estimates of the size and temperature of individual oil fields and gas flares.¹⁵

4 CONCLUDING REMARKS

Continued investment in research and development will be necessary before accurate and reliable flare monitoring technologies are commercially available on the market. In the meantime, regulatory authorities will need to use existing technologies to approximate the levels of contaminants emanating from flaring. Given the urgency of reducing SLCPs to achieve short-term climate mitigation goals, the stated ambitions of the US EPA, as well as nongovernmental initiatives such as the World Bank’s Global Gas Flaring Reduction public-private partnership (GGFR),¹⁶ there is significant impetus to deploy the next generation flare monitoring technologies in the near future.

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⁵ US EPA, Technology Innovation Program, *Open Path Technologies: Measurement at a Distance*, <http://www.clu-in.org/programs/21m2/openpath/op-ftir/>.

⁶ *Id.*

⁷ *Id.*

⁸ US EPA, Final Report, *Supra* note 4.

⁹ US EPA, *EPA Handbook: Optical Remote Sensing for Measurement and Monitoring of Emissions Flux*, <http://www.epa.gov/ttn/emc/guidlnd/gd-052.pdf>, pp.164-165

¹⁰ PFTIR technology only measures a selected “path” through a flare. The device requires a user to aim at a specific region of the flare plume and assume that the length of the line of sight to the plume during data acquisition remains constant. Constantly changing flame dynamics and relatively long data acquisition cycles render the data obtained unreliable.

¹¹ Sky-LOSA = Line-Of-Sight Attenuation of sky-light

¹² Carlton University, *Supra* note 3.

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USING EARTH OBSERVATION TECHNOLOGIES FOR BETTER REGULATORY COMPLIANCE AND ENFORCEMENT OF ENVIRONMENTAL LAWS

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ABSTRACT

Weaknesses in conventional mechanisms of implementation and enforcement of environmental laws, coupled with pressures to develop smarter and more resource-efficient regulatory approaches, suggest that there are real opportunities for the greater use of earth observation (EO) technologies as a regulatory compliance tool in environmental law. Technological improvements in the capabilities of satellites and associated EO technologies mean these could become increasingly relevant for those working in the environmental law sector. New high-resolution satellites can now produce pictures of near photographic quality and what we can observe from space is changing dramatically. Using these new technologies for observing and providing evidence of environmental compliance could provide significant opportunities in monitoring and enforcing some types of legislation. This article considers the relevance of these dramatic step-changes in EO technologies to contemporary challenges of effective environmental law enforcement.

A full version of this article is available at <http://inece.org/topics/next-gen-compliance/>

ENFORCING AQUACULTURE IN SOUTHERN CHILE THROUGH SAR IMAGERY

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1 INTRODUCTION

The challenge: How does Chile's Superintendency of the Environment (SMA) enforce such a massive area of projects located in the Patagonia region?

Chile's aquaculture industry represents an important activity in terms of number of projects and facilities related to farming, fattening and processing of hydrobiological resources (mostly salmon and mussels). In fact, within more than 14,000 activities that requires an Environmental Qualification Resolution to be developed (RCA¹ onwards, according to its Spanish acronym), around 3,400 (almost 24% of total) are aquaculture-related activities.

Eighty percent of such activities are clustered within two administrative regions of southern Chile, specifically in Coastal Patagonia, which covers 240,000 km² and geographically composed largely by islands, channels, and fjords.²

In this vast region, environmental impact caused by these activities includes a decreased oxygen concentration in water column and oxygen-reduced sediment affected by fecal material and unconsumed food pellets,³ structural solid facilities (i.e., fish cages, nets pontoons and others), and use of chemical substances for cleaning, sterilizing and disease control.

One important aspect - regarding environmental compliance - is the authorized location of these farms, where the environmental impact assessment was carried out in the first place. Each authorization is defined by the vertexes of the permitted activity area. A project located in a different area, where Impact assessment was not conducted, is understood as an activity that involves more uncertainty and therefore more environmental risk.

2 TECHNOLOGY: CURRENT USE AND STATE OF THE ART

The SMA is the institution in charge of enforcement and compliance in Chile, including enforcement of aquaculture activities. To accomplish that task, the Superintendency has implemented a practical method for detection of location authorization nonconformities, through Synthetic Aperture Radar (SAR) remote sensing techniques. This techniques were used successfully to map aquaculture facilities.^{4,5}

A Synthetic Aperture Radar (SAR) is a sensor that captures the return of energy portions from wave signals that it has emitted. That is to say, it is an active sensor able to produce an echo and to process the information returned by colliding objects on earth's surface.

As the signal bounce depending on the shape, roughness and object's material, it is possible to identify and differentiate between different surface coverage. In this case, water will be very dark in images because it absorbs most of the electromagnetic signal transmitted by the radar and because calm water (such as Patagonian's fjords have) present a flat surface, the signal bounce once and points at one straight direction, while the structures (cages, network lines, boats, ships, pontoons, silage, etc.) will shine in contrast with the water, since edges of these structures will bounce the signal several times and in several directions. Figure 1 shows an explanatory diagram.

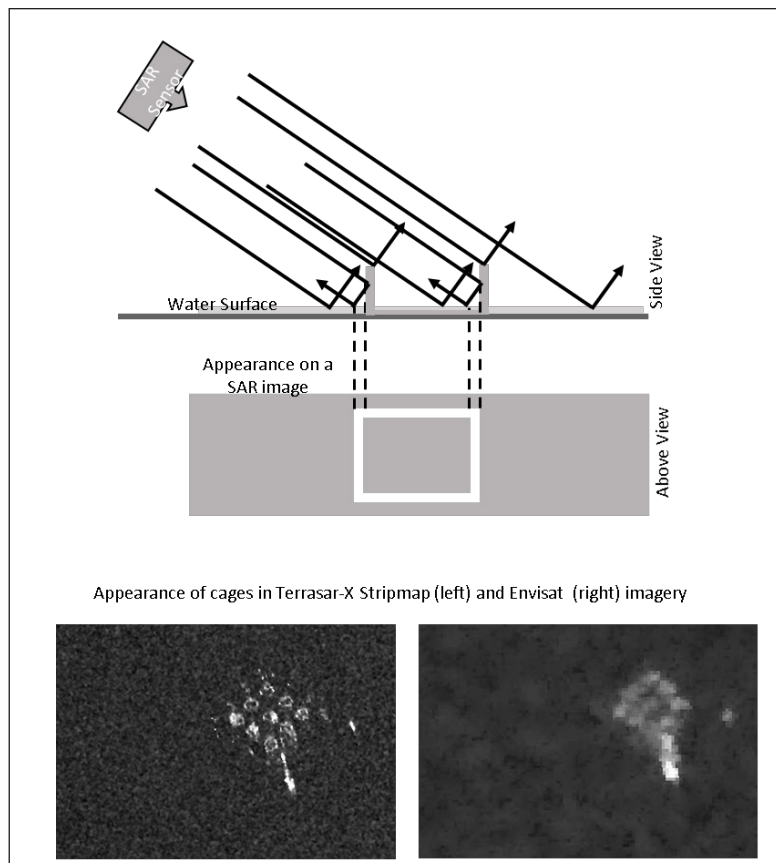


Figure 1: Interaction of SAR waves and fish farms. The fish farm pictured is an actual project inspected during 2013 located near Puerto Montt, Chile.⁶ Scheme adapted from Travaglia et al (2007) *Mapping Coastal Aquaculture and Fisheries Structure by Satellite Imaging Radar, Case Study of the Lingayen Gulf Philippines*.

It is interesting to use this method in such cases, because unlike optical sensors, which capture solar energy reflected by the earth's surface, SAR is not affected by the cloudiness of the troposphere, a common meteorological condition in Coastal Patagonia.

3 COSTS AND BENEFITS ANALYSIS

In relation to the above, since the cloud cover is a common situation in southern Chile, SAR is the technological alternative for the low-cost monitoring of the right location of the productive activities of the aquaculture industry. In a cost-benefit or cost-efficiency analysis, it is necessary to clarify the costs associated with the scenarios of having the technology and the absence of these tools.

First, we will define some aspects. It is common among environmental enforcement and compliance agencies to design programs that allow strategic control of available resources in a way that has an impact on the regulated community, is impartial, and therefore encourages compliance.

Once the program is defined, costs are mostly operational, including stipends for in field expenditures, plane tickets, transfers by sea and land, and the man-hours spent in planning of field inspection, inspection and reporting.

An interesting feature of this technological approach is its potential to design a more efficient inspection program. A common design of the inspection program for aquaculture facilities (*circa* 4,000 facilities) in Southern Chile assumes a normal concentration in the spatial distribution and therefore a regular use of resources. However, as we stated before, aquaculture facilities location means a huge cost of displacement.

Strategy	Costs	Horizontal Accuracy	Coverage/ Swath	Certainty	Violation detection probability
Programming without satellite imagery analysis	US\$5.000 each/ US\$75.000 whole region	Below meter	Local	Low	Low
Programming with satellite imagery analysis, expensive option ⁷	US\$450.000 whole region	3-5 m	30 * 50 km each scene	High	High
Programming free option ⁸	US\$75.000 region	5-10 m	80 km wide	High	High

4 CONCLUSIONS

Therefore, investment in satellite imagery, in addition of the technical benefits of images, allows continuous, periodical monitoring that captures 1,500 km² in each image, with which we can generate areas with major number of limits violations. This permits monitoring efforts to be economically and operationally efficient, while increasing the probabilities of findings, sanctions and the public acknowledgement, which enhance the deterrent power of the agencies and are excellent incentives for the permit-holder's compliance.

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- ⁷ Using Terrasar-X Stripmap imagery.
- ⁸ Using brand new Sentinel-1 Stripmap imagery.

NEXT GENERATION ENVIRONMENTAL IMPACT ASSESSMENT, PERMITTING AND ENFORCEMENT IN EL SALVADOR

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SUMMARY

Successive Ministers in El Salvador's Ministry of Environment and Natural Resources (MARN) requested a full review of environmental impact assessment (EIA), permitting and enforcement processes. The resulting road map for reform sets in motion a new vision, law reforms and implementation mechanisms that make full use of next generation technology. El Salvador's President will launch the program in November of 2014 inaugurating a process of engagement within governments at all levels, with investors, and with the public to prepare for full implementation next year.

Ten elements of the next generation reforms described below offer the potential to revolutionize the permit, EIA and monitoring/enforcement process through greater access, transparency, accountability and ultimately both improved environmental results and efficiencies:

- 1) Public access to the NEPAssist¹ GIS² web-based analytical application.
- 2) Autofill of permit applications with information from VIGEA-NEPAssist.
- 3) Online permit applications with built-in categorization and streamlined requirements.
- 4) Pre-construction permits for all impact levels beyond those requiring EIA.
- 5) Automated permits for lower level impact projects.
- 6) Municipal issued permit for low impact projects.
- 7) Public consultation in all permit issuance, not limited to EIA process.
- 8) Monitoring self-reporting formats issued with the permits for automated reporting.
- 9) Transparent, linked Web-based tracking and document access for permitting, EIA review, monitoring, complaints; and enforcement.
- 10) Compliance oriented enforcement authorities with new financial tools.

1 NEXT GENERATION REFORMS

1.1 Public access to the NEPAssist GIS Web-based analytical application

The United States Environmental Protection Agency (EPA) developed the NEPAssist application, a GIS-driven Web-based analytical tool to provide instantaneous access to distributed environmental, social and economic data via web services, spatial integration and analysis reports with answers to yes-no questions to help reviewers and preparers of EIA documents. El Salvador is one of seven countries with which EPA has shared the application for its use and adaptation to its own servers, design, data and analytical questions. It includes land use plan information and in a pilot region linked to zoning rules. El Salvador will launch public access to VIGEA, the name of the NEPAssist application given by MARN to help investors and their consultants as well as the public and other Ministries review and understand the context for proposed projects.

1.2 Autofill of permit applications with information from VIGEA-NEPAssist

For the first time, the NEPAssist application will be used to autofill the permit application. Categorization of whether a proposed project, activity or works has a low level impact (Group A), a moderate level impact (Group B.1) or requires an EIA (Group B.2) currently involves a complicated set of criteria including whether a proposed project: a) is located in a sensitive area, a risk area or involves hazardous materials, b) changes current land use, c) is significant in size or scope. NEPAssist is first and foremost a screening tool that can provide much of this information using available data from reliable sources. Users will be cautioned that the applicant is responsible for confirming the accuracy of the information in the field.

1.3 ONLINE PERMIT APPLICATIONS WITH BUILT-IN CATEGORIZATION AND STREAMLINED REQUIREMENTS

A priority of the reform program is the creation of a single online permit application form. There were 23 different permit applications and all applicants had to travel to San Salvador to handle the paperwork. Having an online form will enable investors to apply wherever they are in the country and speed processing of information. Other opportunities for streamlining the process were identified in the process of consolidating application forms.

1.4 Pre-construction permits for all impact levels beyond those requiring EIA

In El Salvador, the requirement for an environmental impact study (EIA) has been interpreted as the basis for a pre-construction permit. Even though low impact projects did not require submission of an application, investors have requested documentation from MARN to take to the bank as proof they did not need to do more. Further, if it was determined that an environmental management plan was sufficient and an EIA would not be required there was no permit and no further accountability. The EIA was therefore over-used in the absence of an alternative mechanism, resulting in unnecessary workload, cost and delays to gain the same results and there were no environmental protections for lower level projects since municipalities and others lacked capacity and permit programs.

1.5 Automated draft permits for lower level impact projects

Another feature of the reform effort will be automated permit generation for low impact proposal projects. This feature will ensure that MARN and the municipalities can deliver the permit quickly and efficiently. Autofill permits will include prepared auditable language associated with the type of measure that the applicant chooses to use to address sanitation, drinking water, solid waste and water runoff/sedimentation and erosion into water bodies. This will provide both consistency and flexibility.

1.6 Municipal permit issuance for low impact projects; Minister authority to further delegate

In El Salvador, municipalities have responsibility for environmentally-based land use plans and local permits but few have the capacity to carry out this function. The new system will provide the municipalities with automated permits for low impact issues noted above and can add provisions for other direct impacts at a local community level to address issues of noise, traffic, and compatibility with adjacent economic activities.

1.7 Public consultation in all permit issuance including those which did not involve EIA

Public consultation has been an opportunity only if an EIA is required and then only for 10 days after the EIA submitted to MARN was considered complete. In addition, the Terms of Reference issued by MARN required the consultant to conduct public scoping of issues. For the new permit system, public consultation would be offered by whichever authority was responsible for the permit issuance thereby increasing opportunities for a broader set of eyes and ears to hold both project proponents and government officials accountable.

1.8 Monitoring self-reporting formats issued with the permits for automated reporting

Permits generally include requirements for self-monitoring and reporting to support compliance with requirements. Plans for improved permit follow up include attachment of tailored standard forms for reporting. This will serve both to focus permit writing on the essential elements of required performance and also to ensure administrative data systems have the capability to utilize these reports for follow up enforcement actions where needed. It will eventually include the ability to report electronically. Automating submission of monitoring results helps with data integrity and enables the tracking systems to highlight problems like late or failure to submit monitoring reports, or to compare results to permitted levels of pollution etc.

1.9 Transparent, linked Web-based tracking and document access for permitting, EIA review, monitoring, complaints; and enforcement

An existing web based tracking system for the EIA permit process will be enhanced in several ways to provide: a) additional tracking for compliance monitoring and enforcement; b) the capability to post and access key documents such as permit applications, environmental management plans and environmental impact studies, c) support the generation of communications such as letters that could then be further tailored by the staff as appropriate. Most importantly, functions will

be linked for a given facility with common codes so that information could be shared from a point of entry service window, EIA review, submission of monitoring reports by the project proponent, follow up audits and inspections and citizen complaints.

1.10 Compliance oriented enforcement authorities with new financial tools

Enforcement has been stymied in El Salvador due to factors including: a) authorities geared to compensation for actual damage and harm, not compliance; b) permits lacking auditable conditions; c) a compliance process focused release financial guarantees following audits after construction without continued accountability during operation or closure. The environmental law reforms will include compliance oriented penalty authorities. Enhanced enforcement and compliance should also result from improved tracking and drafting of permit conditions, and inclusion of most projects in the system.

2 CONCLUDING REMARKS

Necessity is the mother of invention and perhaps there is no more need than the system of environmental governance that has been a fragmented set of failed handoffs from an environmental impact assessment to a permit to monitoring performance to enforcement to results. The introduction and use of new web-based tools has the potential for revolutionizing this process through greater access, transparency, accountability and ultimately both improved environmental results and efficiencies. At this writing El Salvador is several months away from realizing a first effort, but has set itself on the path to do so.

3 ENDNOTES

¹ The US EPA's NEPAassist application is a web-based analytical tool that uses a nonproprietary software to facilitate the EIA review process and project planning as they relate to environmental considerations. NEPAassist accesses environmental data from the EPA's geographic information system databases and web-based services and provides immediate screening of environmental assessment indicators for geographic areas of interest, parameters, and assumptions defined by the user. Other countries adapt and customize NEPAassist using their own names, interface, and data sets. For more information, see <http://www.epa.gov/compliance/nepa/nepassist-mapping.html>.

² GIS is an acronym for "geographic information system," a technology-driven system for capturing and analyzing spatial and geographical data.

CASE STUDY: TRACKING AND MANAGEMENT OF MEDICAL WASTE IN CHINA THROUGH RFID TECHNOLOGY*

SUMMARY

This case study illustrates the use of radio frequency identification technology to electronically label, track, and communicate to multiple government authorities the precise status of transported hazardous waste materials from the source to the disposal site.

EXPLANATION

A new application based on radio frequency identification (RFID) technology is helping China track and manage medical waste during the full lifecycle of these hazardous substances, from waste collection, storage, transportation, and treatment to disposal. The technology addresses the challenge of an increasing variety and quantity of medical waste that is creating significant health threats resulting from lax monitoring and improper disposal. Since medical institutions are geographically scattered, monitoring the transfer of medical wastes in a centralized manner is inherently difficult.

The Environmental Protection Department of China has researched and designed an RFID system, which, combined with mapping and other advanced technologies, has established a real-time monitoring system to track medical waste transport vehicles, storage and disposal facilities, and medical waste containers.

In the RFID system, information on medical waste is gathered at the time the waste is collected. An application that uses a RFID handset captures medical waste information and encodes it in an electronic label. The information in the label, which is adhered to the waste container, includes basic information on medical institutions, the quantity of medical waste, packaging time, carriers, and transport time. At the same time, relevant medical waste information is uploaded to the background system center over the network. After being electronically notified of the collection of the medical waste, the appropriate environmental protection departments will begin to monitor the whole process.

After the packaging and electronic encoding of waste, transportation units collect the waste from the medical institutions, scanning the electronic labels affixed to the containers using an RFID reader. This information is then automatically uploaded to the central database, providing timely notification to the appropriate environmental departments that medical waste is in transit. Using mapping technologies, these departments can locate and check the geographical locations of transportation vehicles at any time, as well as track the entire transportation routes that will be used. In this manner, the entire process of medical waste transfer is comprehensively monitored.

When medical waste arrives at disposal units, it is weighed using an RFID electronic scale, which automatically enters the data into the tracking system and compares it with that entered before the transfer. If the difference between estimated final weight and actual weight surpasses a preset value – indicating a loss or problem during transit, an early warning will be triggered and the relevant information will be simultaneously uploaded to the central database, triggering an immediate investigative response.

* Information abridged from “Introduction to the Application of RFID Technology to the Medical Waste Management” by Shenzhen Environmental Enforcement Branch and Shenzhen Boanda Science and Technology Limited Company, with permission from the Ministry of Environmental Protection, Peoples’ Republic of China.

2. REGULATORY DESIGN

Next generation environmental regulatory design encompasses strategies and approaches for maximizing the effectiveness of laws, standards, and compliance promotion and assistance programs in helping to achieve desired outcomes. Now that many countries have had the opportunity to undergo several generations of refinement in how they regulate activities that impact the environment, it is useful to look at issues that may shape the further development of smart environmental governance. The chapter begins by inquiring how government can leverage what the private sector is already doing to ensure sustainability in areas that are beyond government reach – companies operating overseas and not subject to home country regulations. The second article looks at the issue of self-regulation: how and where it can be used to supplement government oversight, and what its practical limitations are. The third article previews the next generation of regulatory performance by examining how Australia's *Regulatory Capability Development Programme* coordinates a wide range of government oversight functions across a range of operations and processes.

PRIVATE ENVIRONMENTAL REGULATION

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Complex, multi-level international supply chains are now an integral part of the world economy. As companies, especially in the United States and the European Union, have increasingly outsourced manufacturing or moved manufacturing offshore, these operations have become for the most part beyond the reach of national environmental laws. The facilities may be located in countries that have either weak environmental laws or weak enforcement of existing laws. National governments typically have little leverage over the extra-territorial operations of multi-national companies. Further, a number of aspects of product manufacturing, including greenhouse gas emissions, energy use, and reuse/recycling design requirements, remain outside the regulatory system even in countries with sophisticated programs. Thus, as nations increasingly focus on sustainability as a desired societal goal, achieving better environmental outcomes increasingly depends upon private regulatory and enforcement mechanisms to drive environmental conduct.

As a result, in today's globalized economy achieving the goal of sustainable development requires new governance mechanisms that incorporate, but also reach well beyond, traditional regulatory programs. These new forms of governance cannot simply rely on regulations to drive behavior; instead they must incorporate economic and social behavioral drivers. Supply chain management implicates both internal corporate economic drivers and social norms. When a company makes a decision to exceed baseline environmental regulatory requirements or to incorporate sustainability into their planning, the decision might be viewed as resulting from organizational values or corporate social responsibility (CSR). While organizational values can have an impact on environmental behavior, especially as manifested through senior managers who are committed to environmental performance or even to the concept of sustainability, more often CSR is based upon underlying economic considerations that have changed significantly over the last decade.

These 'internal' economic drivers include: reputation; customer desires or requirements; investor pressure; lower operational risk; liability mitigation; the ability to attract and retain employees; insurance cost and availability; community license to operate; lender concerns or requirements; government and public relations; enhanced ability to plan operations and anticipate or even shape future regulatory standards; access to markets; product differentiation; green procurement standards; industry codes of conduct; international environmental standards such as ISO 14000; and operational efficiency.

Supply chain requirements are derived from a number of sources. They may include adoption of pre-existing certification programs such as the Forest Stewardship Council's Sustainable Forestry Initiative program, the Marine Stewardship Council certification for sustainable fisheries, or the German government Blue Angel program. They may also be based on contract specifications or codes of conduct developed by an individual company, by industry associations such as the Electronic Industry Citizenship Coalition (EICC) or the Consumer Goods Forum, or by international organizations such as the United Nations' Food and Agriculture Organization Code of Conduct for Responsible Fisheries. Finally, supply chain requirements may be developed by individual companies or commercial sectors to address particular supply chain issues, or to address a broad set of environmental issues important to the companies' bottom line.

A key study conducted by Professor Michael Vandenbergh found that "In some cases this new form of private governance transfers pressures created by public entities, but in many cases it bypasses public entities altogether, transferring demands for social amenities directly from the citizens of one country to the firms operating in another. This private governance exists as a network of private standards and agreements that influence the behavior of firms on issues sovereign states are unwilling or unable to address."¹

Private enforcement tools such as those described herein can be successful only if there is some form of internal compliance mechanism in place. In addition to guidelines and frameworks, sustainability tools kits should also have internal mechanisms that guide the process of compliance and provide sanctions—direct or indirect—for noncompliance. Some examples of green supply chain management-specific compliance strategies include supplier auditing, direct sourcing, life cycle monitoring systems and cradle-to-grave or zero-waste systems. Although these strategies may have different names,

commonalties among top performing companies include regularly tracking performance, utilizing technology solutions to enable improvements and track results, and having a designated executive leader for their green supply chain initiatives. This article has noted how evolving internal economic drivers, globalization of the economy, and outsourcing of manufacturing and the changing nature of societal values have stimulated the development and deployment of a wide variety of green supply chain mechanisms. While the specific impact of private supply chain requirements are not as predictable as the results of well-enforced government regulation, they nevertheless have the potential for producing environmental outcomes that are essential to sustainability. One course of action would be to leave to the marketplace the continued evolution of green supply chain requirements and, in fact, much of this development likely will remain in the private sector with varying degrees of public transparency. However, there is a role that governments can play in promoting green supply chain management. The following discussion explores ways that government may direct this movement towards the use of stronger tools that are both enforced and more transparent to the public. Michael Vandenberg has noted that ‘a policymaker not only has traditional regulatory and economic tools at her disposal, she also can seek to stimulate private environmental contracting in supply-chain, credit, corporate asset, insurance, and other markets.’

I believe there are a number of ways that government compliance and enforcement programs could support and leverage supply chain management. Enforcement programs have, for some time, encouraged company voluntary efforts that are designed to prevent pollution such as EPA’s WasteWise program, deploy better environmental management systems such as ISO 14001, and promote environmental auditing, all of which can have an impact on internal economics and on values. But enforcement officials typically have not assessed the extent to which their programs can and should strategically take into account internal economics and societal values in general, and supply chain regulation and enforcement specifically, as part of the larger effort of environmental agencies to achieve sustainable outcomes. Just as they have done with other pollution prevention and compliance assistance efforts, compliance and enforcement officials should find ways to encourage green supply chain management by developing and disseminating information on the most successful approaches to supply change management. Enforcement officials could also encourage green supply chain management practices through settlement agreements similar to the approach enforcement officials have taken in cases where part of an enforcement settlement includes a requirement to develop an effective environmental management system.

Governments can also stimulate greener supply chains by making clear issues that are of concern but that are not yet regulated. Creating a transparent “regulatory agenda” would allow companies to build these issues into their supply chain requirements before regulatory action occurs resulting in earlier environmental improvements and perhaps helping companies to shape the nature of the government activity or regulation. The use of hydro fluorocarbon (HFC) refrigerants provides an interesting example. HFCs replaced CFC as a refrigerant because of the dramatic, adverse effect CFCs had on stratospheric ozone depletion. However, HFCs have a greenhouse gas potential that is 1,400 times higher than carbon dioxide and make up 1.5 percent of total global warming potential. Recognizing that HFCs were likely to eventually be subject to regulation, the Consumer Goods Forum (made up of several of the World’s largest consumer goods companies including Pepsico, Nestle, Coca-Cola, Tesco, Wal-Mart, Unilever and Heineken), through the organization’s sustainability initiative, in 2011 established a goal of begin phasing out HFCs by 2015. These companies are a major user of refrigerants around the World.

This foresight involved in the HFC phase out initiative is underscored by the fact that the United States and China announced in early September, 2013 that they would seek to end the use of HFCs using the Montreal Protocol as a vehicle. The anticipatory move made by the Consumer Goods Forum will give the participating companies some advantage in making the move to a new generation of refrigerants by having more time to find alternatives. Government agencies could perhaps accelerate supply chain management innovation by more clearly articulating issues or materials that are of particular concern for sustainability even if those issues or materials are not likely to be subject to immediate regulation.

It is clear that green supply chain management is a growing part of business and equally clear that these private environmental regulatory mechanisms are an essential element of any effort to achieve sustainable development. Supply chain approaches, however, vary greatly from one company to another and from one material to another. Since green supply chain management is likely here to stay it is important that companies, NGOs and regulators better understand the various forms of green supply chain management and the impact of these variations on the ability to assure green supply chain management requirements can produce actual environmental results. This will require more in-depth understanding of the actual contractual language imposing the requirements, non-contractual arrangements that impact supply chains, the arrangements between companies and their suppliers to provide suppliers with the support needed to meet the requirements, and the oversight mechanisms that are used to assure compliance with the supply chain requirements. In the interim and as more information becomes available on the efficacy of supply chain interventions, governments can

play an important role in encouraging the adoption of strong and enforceable supply chain requirements that can augment government regulatory efforts.

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UNDERSTANDING COMPLIANCE MANAGEMENT: OPENING THE BLACK BOX OF SELF-REGULATION

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SUMMARY

Regulators are facing several challenges. The expectations from society regarding public regulators have increased substantially in recent years. On one hand the duties and responsibilities of regulators are expanded, on the other hand they are expected to work effectively and with fewer failures. At the same time, resources available for regulators are limited. Regulators are therefore increasingly looking for innovative forms of regulation. Scholarly thinking about regulation has traditionally been dominated by legal and economic paradigms. But if a regulator approaches regulated companies with policies and instruments stemming from legal and economic paradigms, is it strange that the regulated community responds consistently, i.e. with calculating and formal behaviour? The problem with this behaviour is that it requires intensive external stimuli and control because it does not enhance intrinsic motivation to act responsibly.

More recent scholarship points at the possibilities to innovate regulation with the use of insights from other fields like the social and behavioural sciences. One of the promising approaches is to find out under what conditions the self-regulative potential of regulated parties can be used to assure environmental protection. This implies that regulators should be able to (a) identify and assess effective self-regulation and (b) learn to influence the effectiveness of self-regulation.

1 SELF-REGULATION AND COMPLIANCE MANAGEMENT

There is a vast amount of governance codes, policy statements, codes of conduct, etc. that regulated businesses and institutions (hereinafter referred to as “companies”) use as vehicles for commitments regarding compliance management and risk control. Unfortunately, these statements do not always reflect what actually happens in the real world. Within the population of companies having adopted such policies formally, we see significant differences in the level of implementation of those policies. Even external assessment through certification does not seem to be a very effective approach to identify such differences.¹

The basic question with regard to self-regulation is whether companies can be trusted to walk their talk. Regulators seem not to agree on this question and tend to take an extreme stand. They seem to be either in favour or against self-regulation. Both groups throw arguments to each other to prove they are right. What is striking in both lines of argument is that they are based on generalization. Of course it is not true that no single company can be trusted. Nor is it true that all companies can be trusted. Likewise, the claim that self-regulation (or command-and-control) is the solution to all problems is just as legitimate as the claim that a bicycle is the ultimate means of transport in all situations.

As mentioned, there are companies with well implemented compliance management systems, but also there is a lot of window dressing. “Window dressing,” in the academic world referred to as “decoupling,” is undesirable even more so because it is not easily identified by external supervisors; not only by certifying bodies but also by regulators.

2 DECOUPLING AND RECOUPLING

The good news is that there are serious indications that the reverse process of decoupling – recoupling – also occurs. Different phenomena may explain this process of recoupling. Stucke² argues that intrinsic motivation is essential for effective compliance and ethics programs. Intrinsic motivation is a prerequisite for tight coupling. When decoupling takes place, internal tensions and frustration grow because the workforce cannot accept this hypocritical behaviour. Also, as a consequence of the adoption of formal policy, sooner or later demographic changes occur within the organization. New employees are hired who get more influence and thus may fuel the process of recoupling.³ Recoupling however, is not an automatic consequence which can be waited for. MacClean⁴ warns that organization members may exploit the gap between form and substance instead of lessening this gap.

3 OPPORTUNITIES FOR REGULATION

An interesting question with regard to the phenomena of de- and recoupling is to what degree and how the external regulator can influence these processes. Scholars argue that the intrinsic motivation for self-regulation is supported by surveillance, but is impeded by explicit coercion or sanctions.⁵ Also, inspectors notice counterproductive effects on intrinsic motivation of sanctions if these are perceived as not fair.⁶

If regulators can come to comprehend the black box of self-regulation, they might not only be able to distinguish window dressing from tightly coupled systems. They might also be able to develop tools enabling them to influence the effectiveness of such systems, thus improving self-regulation. Research is going on with regard to all kinds of different aspects of this notion such as the assessment of compliance management systems, the use of moral messages, the influence of penalties on self-regulation, the communication between internal supervisors and external inspectors, and much more. Although the concept of self-regulation is not new at all, more research has to be done to understand how self-regulation works and how regulators may interpret and influence it. The promise this research holds is in the leverage to make regulation more effective to recognize and stimulate self-regulation.

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BUILDING NEXT GENERATION REGULATORY PERFORMANCE: THE REGULATORY CAPABILITY DEVELOPMENT PROGRAMME

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SUMMARY

The spectrum of regulatory delivery¹, including compliance and enforcement, involves a complex series of operations and processes. Effectively addressing the broad diversity of environmental regulatory and crime types requires a high level of coordination across these operations and processes.

The Australian Government's Department of the Environment (DoE) has established the *Regulatory Capability Development Programme* (RCDP) as a means of achieving this coordination.² The RCDP involves a cross-cutting, whole-of-agency, and multi-year series of projects. The intent is to build a new level of consistency and integration for the implementation and governance of DoE's fifteen pieces of environmental regulatory legislation.³

1 ESTABLISHING THE PROGRAMME

In late 2013, DoE initiated an internal audit of its regulatory compliance delivery and activities. The resulting audit report presented a series of recommendations for improvement.

A key feature of DoE's management response to the recommendations of the audit was the development of the RCDP. This was seen as a necessity for moving DoE to a more strategic, transparent and consistent approach to its regulatory responsibilities and to ensure these responsibilities were met in an effective, efficient, strategically prioritised, risk-based manner.

2 PROGRAMME STRUCTURE

The RCDP comprises six project streams conducted in three phases (Table 1). Phase one is concluding at time of writing. Table 1 provides an overview of the RCDP.

Table 1: The RCDP: Project Streams, Outcomes and Scope

Project Stream	Project Stream outcomes	Project Stream scope
Organisation and culture	Adoption of a systemically supported regulatory posture. Staff have appropriate knowledge and confidence to manage risks and resources	<p>Phase 1: revise Departmental regulatory strategy</p> <p>Phase 2: build awareness of the regulatory strategy translating it into business and operational plans</p> <p>Phase 3: develop an expanded strategic plan covering the Department's entire regulatory spectrum</p>
Regulatory design	Design elements meet policy, while legislative instruments deliver on intent. Review and monitoring of existing regulatory systems are also conducted according to this goal	<p>Phase 1: re-establish regulatory governance structures and reporting mechanisms</p> <p>Phase 2: disseminate regulatory design framework checklist and procedures for use by all policy areas involved in regulatory regime design, ensuring design is consistent with whole-of-Government obligations</p> <p>Phase 3: progress outcomes-focused assessment guidance</p>
Regulation	Regulation is conducted consistently, transparently, proportionally and in an accountable manner according to clear Department-wide policy	<p>Phase 1: initial base-line risk rating for all regulatory legislation administered by the department.</p> <p>Phase 2: undertaking a strategic risk review of all regulatory provisions, including the development of a harms-based, risk ranking of the regulatory provisions and development of risk based metrics</p> <p>Phase 3: support resource allocation and transition to the harms-based approach, and implementation of risk based regulatory performance assessment</p>
Regulatory compliance	Compliance activities are targeted and proportional	<p>Phase 1: update the Regulatory Compliance Manual (RCM) to include material identified in the gap analysis against the Australian National Audit Office Better Practice Guide <i>Administering Regulation</i>.</p> <p>Phase 2: provide awareness sessions and roll out workshops on the RCM for building better departmental regulatory capability</p> <p>Phase 3: the RCM is subject to annual review as part of continual improvement</p>
Litigation and enforcement	Enforcement actions are appropriate, within the scope of authority and according to the rule of law	<p>Phase 1: reform the Departmental case management forum, the Compliance Management Panel (CMP), including panel membership, Terms of Reference, panel guideline and lodgement documentation</p> <p>Phase 2: undertake sanction mapping for all Departmental regulation and regulatory areas within the context of Departmental strategic policy and fiscal priorities</p> <p>Phase 3: Establish minimum criteria for inspections; ensuring inspections accord with departmental tactical, operational and strategic priorities</p>
Awareness, communication and education	Staff accept, value and implement RCDP components and participate in awareness and education activities; internal communication is effective	<p>Phase 1: establish Regulatory Communications Strategy and incorporate into Departmental policies</p> <p>Phase 2: develop and conduct awareness sessions on responsibilities under the departmental policies</p> <p>Phase 3: expand education and development activities to include integration with external professional networks in other governmental and international agencies.</p>

3 A PROGRAM PROJECT - THE REGULATORY COMPLIANCE MANUAL (RCM)

The *Regulatory Compliance Manual* (RCM) is the Departmental repository of regulatory expertise and guidance, first published in 2011. It was developed over a number of years, informed by the provision of bilateral advice to line areas commencing in 2008. The RCM covers the spectrum of regulatory delivery from regulatory regime design to litigation and enforcement.⁴

Revising the second version of the RCM is a Phase one RCDP project that is nearing completion at the time of writing. The second version of the RCM is compatible with recent and foreseeable developments in the field of regulation and regulatory delivery. Of note, the scope of the RCM has also been expanded by approximately 60%.

The revised RCM now covers:

- policy development and the legislative process;
- implementation planning;
- provision of advice and guidance;
- licensing and permitting;
- regulatory performance auditing.

Through extensive internal and external consultation, including with peer and partner regulators,⁵ the revised RCM now has increased functionality. It provides guidance and can be used as both a self-assessment tool and in developing benchmarks for performance and training material.

4 ANTICIPATED BENEFITS OF THE PROGRAMME

The current operating environment of tight fiscal policy and organisational reviews demands that regulators are innovative in both in regulatory design and the application of delivery mechanisms.⁶

The RCDP, as an innovative program of activities, is expected to bring practical and tangible improvements for regulatory staff. The RCDP requires project participants to respond to organisational changes and take up opportunities as they arise. It provides a platform for DoE to take a more active role in terms of regulatory delivery.

The program allows DoE staff to share experiences and learn lessons with other regulators across the Australian Commonwealth (federal level), with state and territory environmental agencies (provincial level), and beyond (regionally and internationally). Program and project delivery uses interactive mechanisms to encourage participation in co-design and shared ownership of the RCDP components. In taking this approach, the RCDP benefits from accessing multiple sites of knowledge and skill.

One of the key results will be that DoE's regulatory stance and posture become more clearly defined, communicated and implemented. In delivering the RCDP, the DoE will progress towards becoming a leader in the regulatory field across the Commonwealth of Australia.

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3. ISSUES TO CONSIDER IN FORMULATING NEW REGULATORY APPROACHES

This chapter presents three topics that government regulators should take into consideration when planning ways to make laws work more effectively to achieve environmental goals. A common theme of each article is that government authorities must work within limits – sometimes constrained by budgets, sometimes imposed by national institutional contexts, and sometimes dependent on the skills and capacities of existing government staff. One key consideration faced by regulators is how to deploy finite resources to do the maximum good. Noting that some private sector actors are taking steps proactively to manage their environmental performance, some environmental compliance and enforcement regulatory strategists have inquired how this trend can be harnessed to allocate resources more strategically and flexibly, channeling them to where they have the greatest impact. The first two articles explore this challenge, first by looking at what happens when governments take an overly mechanical approach to resource allocation and then examining how a more dynamic approach might be modeled.

Another important consideration in improving regulatory effectiveness is the institutional structures and political realities. In some regions, alternative regulatory mechanisms may offer more feasible ways to obtain favorable environmental outcomes. For example in the Asia-Pacific region, judiciaries are helping to fill a void, forcing environmental compliance and enforcement authorities to increase their performance where political will to do so is lacking. The third article highlights the accomplishments of certain courts in exerting pressure “upstream” to enforce when legislators are lagging in this role.

CHOOSING APPROPRIATE INTERVENTIONS ALONGSIDE INSPECTIONS

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SUMMARY

This article examines how a project by an intergovernmental organization in the European Union is looking beyond traditional environmental compliance and enforcement paradigms to explore an approach that tailors the use of environmental regulatory mechanisms to the circumstances of specific regulated entities. The project has provided a toolkit that includes a model approach for choosing appropriate interventions, a decision support tool, the Regulatory Evidence Network, and other effective instruments.

1 IMPROVING THE ENVIRONMENT IN EUROPE

The European Union’s 7th Environmental Action Plan sets out environmental priorities and outcomes up to 2020. But success in achieving these outcomes depends on member states and organisations having the right means to deliver them including legislation and tools.

Environmental regulation has achieved a lot using traditional methods such as permitting, site inspection and enforcement. But if we want to do more to improve compliance and environmental performance, using these methods may not be the only, or the most effective, means.

Smarter environmental regulation aims to protect or enhance the environment with the limited resources available to regulators while still encouraging economic growth. An important aspect of smarter regulation is to apply appropriate interventions which will bring about compliance of regulated businesses with European environmental law and help achieve environmental outcomes.

The European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL) represents 33 member states and 47 environmental authorities in Europe, all with a different environmental legacy, culture/society and regulatory capacity. IMPEL has recognized that the process of choosing interventions is a difficult task because:

- the success of particular interventions is dependent on particular circumstances;
- the evidence available about each intervention is limited and difficult to find;
- the “systems” in which regulators operate are complex and multivariable.

2 CHOOSING APPROPRIATE INTERVENTIONS PROJECT

The Choosing Appropriate Interventions project is part of IMPEL’s work program to help its members to deliver environmental legislation more effectively.

The project has sought to provide a practical tool for environmental regulators to help them make the right choice of intervention. And it has sought to encourage IMPEL members to share good practice and experience in choosing, using and evaluating interventions.

The project has posed this question: even if we know about different types of intervention, how can we choose the right ones according to circumstances and what might we use to help us make those decisions?

This document summarises how the project has developed a toolkit to help environmental practitioners make the right decisions and choose the most appropriate interventions. The toolkit comprises:

1. A model approach for choosing interventions.
2. IMPEL iDepend decision support tool.

3. User Guide which sets out how to use the IMPEL iDepend tool.
4. Webinar to introduce IMPEL iDepend and explain how it works.
5. Regulatory Evidence Network and other supporting resources.

3 CHOOSING INTERVENTIONS ACCORDING TO CIRCUMSTANCES

Regulators have applied numerous interventions to improve compliance and/or achieve wider environmental aims. Typical examples include:

- Direct regulation: relatively certain outcome but potentially costly, need to be targeted according to risk, e.g., Environmental Permitting regime, the EU Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).
- Economic instruments: less certainty of outcome but greater flexibility for businesses to choose least cost options, e.g., Landfill Tax.
- Information based approaches: uptake dependent on customer/supply chain interest, e.g., EU Ecolabel.
- Co-regulation: can encourage rapid action, flexible to changing circumstances, but may struggle to capture small businesses, e.g., Courtauld Commitment.
- Self-regulation: action motivated by financial, customer/supply-chain or reputational influences e.g. ISO14001.
- Support and capacity building: impact may depend on credibility and trust.

The project developed a model approach for choosing interventions according to circumstances.

Figure 1: Interventions Model



4 IMPEL iDEPEND – AN AID TO DECISION MAKING

Although the model approach appears straightforward, the task of choosing interventions according to relevant circumstances is not easy. Trying to assimilate and relate information on all the factors affecting the environmental performance of an organisation, or a sector, requires a systematic and structured approach.

IMPEL iDepend is a decision support tool which uses an approach called dependency modelling. iDepend is based on the concept of a ‘belief net’- effectively a mind map - of factors on which your goal depends (the dependencies). The tool allows you to build a model based on your ‘mind map’ or ‘belief net’ with the following benefits:

1. Shows the likelihood of achieving goals or outcome in various scenarios.
2. Helps you develop a logical framework to assemble and map dependent factors.
3. Helps identify the dependencies (factors) most critical for success.
4. Supports decision making to choose and compare interventions.
5. Enables you to keep a record (audit trail) of the inputs and predicted outputs.
6. The tool can be applied at different levels, for example to help develop national strategies or to formulate site-based action plans.

5 IMPEL iDEPEND USER GUIDE AND WEBINAR

A guide has been developed by the IMPEL project team and the iDepend developer, Cambrensis, setting out how to use IMPEL iDepend to help choose the right types of intervention to improve environmental compliance and performance. The Guide provides all the information you need to build a dependency model using IMPEL iDepend. You can see a dependency model being built in a recording of a webinar to demonstrate the iDepend tool, online at <http://goo.gl/luyWgi>.

6 IMPEL iDEPEND PORTAL - REGULATORY EVIDENCE NETWORK

The Regulatory Evidence Network (REN) is administered by England's Environment Agency and the UK Department for Environment, Food & Rural Affairs (DEFRA) to support evidence-based approaches to regulation. Membership is open to anyone in the UK or internationally with a professional interest in the theory and practice of better regulation for the environment. The network can be found online at <https://connect.innovateuk.org/web/evidence>.

The REN supports IMPEL iDepend by providing:

- a point of access, or portal to iDepend and user guidance, online at <https://connect.innovateuk.org/web/evidence/idepend>.
- a discussion forum for iDepend users to share work on choosing interventions.
- an instrument selection guide produced by DEFRA.
- a library of 'better regulation' evidence publications from national governments, OECD, INECE, and various university based groups.
- scientific literature on choosing and designing interventions.
- a list of interventions and supporting evidence on using them.

7 ADDITIONAL RESOURCES AND POINT OF CONTACT

1. For more information, the IMPEL project summary, reports and information is online at <http://impel.eu/projects/choosing-appropriate-interventions-phase-3>.
2. Advanced guidance and tips for dependency modelling can be found at <http://www.cambrensis.org>.
3. For more information, please contact Duncan Giddens, IMPEL Choosing Appropriate Interventions project manager at duncan.giddens@environment-agency.gov.uk.

ASIAN JUDICIARIES INFLUENCING ENVIRONMENTAL ENFORCEMENT AND COMPLIANCE

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Effective environmental governance plays a key role in ensuring environmental protection and the maintenance or recovery of the earth's natural capital.¹ Such governance requires effective compliance and enforcement of environmental and natural resources law. It is a function of the effectiveness of the entire enforcement chain – the executive, legislature, administration, and judiciary. The judiciary is relevant because natural resources, land, water, minerals, flora, and fauna lie at the core of many environmental conflicts and disputes, including pollution cases that end up in the courts.

The judiciary performs a central role in influencing the legal system and environmental compliance and enforcement by shaping normative interpretations of legal and regulatory frameworks, promulgating rules that direct court priorities and manner of adjudication, and molding judicial education.² It affects not only the courts but also the overall perceptions of natural capital issues and the rule of law in a country and, hence, influences private sector investment in related sectors.³

One innovative example of courts influencing environmental compliance by taking an active role in environmental quality is the *writ of continuing mandamus* or “rolling review.” Under such *writ*, a Court compels government agencies to take certain actions, requires them to report back to the court on the progress of such actions, and allows the court to make a series of incremental court orders to facilitate the quest for solutions to the problem and to keep the case moving until a particular end result is achieved.

In 2008, the Philippine Supreme Court applied such *writ of continuing mandamus* in a water pollution case filed by concerned residents against several government agencies tasked by law to maintain the water quality of Manila Bay, a historic sea resource and recreational spot in the country.⁴ Through the *writ*, the Court ordered the agencies to clean up, rehabilitate, and restore the bay's waters to acceptable legal standards within a definite period, and to submit quarterly progressive reports of compliance with the Court's directives. The Court also created an advisory committee to verify the reports.

In a similar case, the Lahore High Court issued the *writ* in a public interest action seeking access to clean drinking water and challenging the disposal of untreated wastewater into the Ravi River, a historical and cultural icon in Pakistan.⁵ The court in this case appointed *amicus curiae* from which a commission of experts - the River Ravi Commission - was formed to study international case law on treating wastewater flowing into rivers and to propose solutions to address the problems raised.

Finally, the Philippine Supreme Court later issued its *Rules of Procedure for Environmental Cases*,⁶ which adopted the concept of the *writ of continuing mandamus* in the Manila Bay case. The *Rules* also introduced procedural innovations to allow potential parties easier access to specific environmental remedies, including the *writ of “kalikasan”* (or nature), an extraordinary remedy that may be obtained on behalf of any person whose environmental rights are violated or threatened by an unlawful act or omission by any individual or entity in cases involving environmental damage of enormous magnitude as to prejudice the life, health, or property of inhabitants in two or more cities or provinces. In practice, the writ has increased the number of environmental petitioners coming to the Supreme Court and so increased access to environmental justice. These rules are serving as important examples to other regional courts under the Asian Judges Network on Environment and sub-regional and national judicial programs.

Because of the important role the judiciary plays in the enforcement and compliance process, ADB has supported the role of judges in environmental protection and preserving natural capital, focusing on strengthening judicial capacity and sharing knowledge on environmental adjudication and governance by establishing regional and sub-regional judicial environmental networks in Asia, and supporting national programs that strengthen the capacity of judges to decide environmental cases.⁷

In 2010, ADB convened the first *Asian Judges' Symposium on Environmental Decision Making, the Rule of Law, and Environmental Justice* that gathered chief justices, senior judges, and legal stakeholders from across and beyond the Asia and the Pacific to share knowledge on environmental adjudication. The Symposium resulted in the start of an informal Asian Judges' Network on Environment to continue to share knowledge and best practices. ADB supported the initiation of the network through work in sub-regional Chief Justices' Roundtables (described below).⁸ In 2013, ADB convened a second *Asian Judges' Symposium on Natural Capital and the Rule of Law* to promote wider understanding among the judiciary of natural capital as a relevant concept for informing decision-making and how it can best serve the needs of Asian judiciaries. The Asian Judges' Network on Environment was formally launched at that meeting, despite the extensive work done before.⁹

Under the Network, sub-regional judicial initiatives operate in Southeast Asia and South Asia: the ASEAN Chief Justices' Roundtables on the Environment have occurred in Indonesia (2011), Malaysia (2012), and Thailand (2103). Judicial roundtables have occurred in Pakistan (2012), Bhutan (2013), and Sri Lanka (August 2014) and will convene in Vietnam in December 2014.¹⁰ The Roundtables defined the sub-regional judiciaries' common vision on environment, drafted action plans, and formed a working group to accelerate the realization of the vision and enhance collaborative efforts to strengthen environmental adjudication through knowledge sharing, capacity building, and other innovations.

Beyond the work done by the Philippines and Pakistan judiciaries, other important progress gathered from these capacity building and knowledge sharing activities are the innovations that some judiciaries have done to promote environmental justice in their respective countries. These include the designation of green courts (the Philippines and Malaysia),¹¹ green benches (Thailand),¹² and certification programs (Indonesia),¹³ and issuance of procedural rules that enable the courts to effectively decide increasingly complex environmental cases and address systemic enforcement challenges. This is reinforced by proactive members of the judiciary who, within the ambit of judicial power, creatively address specific environmental challenges brought to their courts.

Asian countries will increasingly continue to face common environmental challenges that require effective governance to resolve. As guarantors of rights and the rule of law, Chief Justices and the Senior Judiciary can have the status, credibility, and direct and indirect influence to lead the legal profession and law and law enforcement community to more effective environmental enforcement and compliance.

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² Id.

³ Metro Manila Development Authority, et.al. v. Concerned Residents of Manila Bay, G.R. Nos. 171947-48 (18 December 2008)

⁴ *Public Interest Litigation Association of Pakistan, etc. v. Government of Punjab, etc.* The interim and final orders of the green bench in this case may be viewed at http://lhc.gov.pk/?page_id=2050 .

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⁶ ADB. 2009. Regional Technical Assistance for Strengthening Judicial Capacity to Adjudicate Upon Environmental Laws and Regulations (RETA 7474). Also, ADB. 2010. Regional Technical Assistance for Building Capacity for Environmental Prosecution, Adjudication, Dispute Resolution, Compliance, and Enforcement in Asia. (RETA 7735). Manila.

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⁸ <http://www.asianjudges.org/>

⁹ Copies of the roundtable proceedings are available at: <http://www.adb.org/publications/inaugural-asean-chief-justices-roundtable-environment-proceedings>; <http://www.adb.org/publications/second-asean-chief-justices-roundtable-environment-proceedings>; <http://www.adb.org/publications/south-asia-conference-environmental-justice>.

¹⁰ Supreme Court Administrative Order No. 23-2008; See also, Justice Dato' Hasan Lah, Federal Court of Malaysia, *Green Benches and Environmental Rules*, Presentation during the 2nd Asian Judges Symposium on Environment: Natural Capital and the Rule of Law, 3-5 December 2013.

¹¹ ADB. 2013. *Second ASEAN Chief Justices' Roundtable on Environment: The Proceedings*. Manila. p. 13

¹² Chief Justice Decree on Certification of Environmental Judges No. 134/KMA/SK/IX/2011.

COMPLIANCE MANAGEMENT: CHANGE, BECAUSE IT MUST HAPPEN AND CERTAINLY CAN

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SUMMARY

This article is written with the Dutch structure of environmental inspections in mind. In The Netherlands, we have in many cases a classic way of doing our inspections. Mostly we are only looking at the output. For a couple of years, the Province of Noord-Brabant along with the Omgevingsdienst Midden- en West-Brabant (Inspection Agency) and The Erasmus University, School of Management, have been running an European IMPEL project about Compliance Assurance through Company Compliance Management Systems.¹ This article is written in a personal capacity.

1 THE ILLUSION OF COMPLIANCE

Society is changing continuously and rapidly. We are more outspoken, empowered and we get more (and especially faster) information through various channels. Everybody is involved in any discussion nowadays. The danger of this is that assumptions and facts tend to get confused. In the world of supervision, this can lead to inhibition of innovative developments because innovations benefit from facts rather than assumptions and myths. In addition, techniques change so rapidly that inspection agencies have a hard time keeping up. This is especially true if one takes into account that budgets (and therefore the number of supervisory hours) are increasingly reduced. There is barely time for training, so competencies of inspectors tend to erode instead improve.

In times when there are no disasters, supervision is not perceived that necessary in the eyes of the politics and society. As a result, budgets are limited. In times when disasters occur, politicians and society emphasize that public supervision should be strengthened and receive more resources. In many cases, the quantity of inspections should yield to a smaller number of higher-quality inspections.

This is all understandable, but this does not mean this ad-hoc approach is effective. If a company is constantly in operation it runs for 8760 hours a year. The average inspection frequency (at a larger company) is approximately 80 hours (or even lower). This means that only 1.1% of the time that a company is operating it is physically inspected. If that time is spent on traditional inspections, then the inspectorate only has a snapshot of (a limited part) of the company.

If we keep practicing that every company should be physically inspected at least once a year, which is no doubt at the expense of the number of supervisory hours, then we must realize that we only fall back. The bottom line is that the level of inspections is roughly negligible. The inescapable conclusion is that a more effective approach is needed.

We don't live in a risk-free society. Even well-designed management systems are subject to human error. An offense can therefore easily happen, even if a company still does their best, and even if you, as a government, have prepared appropriate licensing requirements. It's about what you do to prevent those violations, and how to deal with it if they occur. And *that* you can't find out in the 1.1% time – as mentioned above. So, you have to use smart ways of supervision.

2 PROACTIVE POLICY AND ENGAGEMENT WITH THE REGULATED COMMUNITY

The government should, in my opinion (where it is viable), move away from simply applying the so-called “output-oriented” supervision. And, if they do not have the will or politically cannot, they must at least let the society know that there are gaps in supervision. You can't continue (politically) to base your policy on responses to environmental incidents.

To put through changes, however, requires two parties: both the government and businesses. As a government, you should use the governance structure and the management systems of the companies in a smarter way. You should study this

matter in a collaborative dialogue. Companies must be open and transparent, public authorities (governments) should not fall into a crisis at every single incident. They should maintain continuous dialogue about violations, as well as risks and risk management. Government monitoring data could be used to analyze and determine partly on this basis how authorities should relax or tighten inspection regimes. So government authorities should make use of risk-based supervision (compliance assurance through company compliance management systems that are more system oriented) on a more regular basis.² It must be a combination of both output and system supervision in which the assurance of compliance with legislation and regulations plays a prominent role. If companies perform well managing their own compliance and this can, on the basis of track records, indicate a level of justified confidence, then authorities can save a lot of time and focus more on the frontrunners who just need that push to perform better (at compliance). Many companies are open to productive engagement with regulatory authorities, especially regarding this approach. Therefore, making use of this potential opens up new ways of leveraging supervision policies. The prerequisite is that the inspectorate is a consistent and reliable partner.

Companies should stop mistrusting the government, and they should seek dialogue with the government much earlier than usual. They should adopt a more pro-active stance. They should take the necessary measures and communicate these to the government and society. Show which management measures you will find to reduce the risks and be transparent when changes are made in the management of business/production with an effect on compliance. Companies should communicate that you no longer accept the bad compliers in your industry. Try, together with the industry associations, to come with an effective pro-active approach that can make level playing field even more valuable. Furthermore it is recommendable to share the benefits companies might get for taking responsibility of effective compliance assurance.

Finally, there is an interesting open question where both parties (may) have part of the answer.³ Should private certification play a role in supervision? And if so, in what role and how? Can the government actually take a step back? And if so, do they dare do it? Are companies willing to share information obtained from a certification audit with the government? And if not, what is needed to achieve that balance?

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DEVELOPMENTS IN INNOVATIVE ENVIRONMENTAL COMPLIANCE ASSURANCE IN THE NETHERLANDS

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In the decades since the onset of environmental policy development in the eighties and nineties of the last century, the world has changed in many ways. Technologic, scientific and economic development, globalization and increased pressure on natural resources have resulted in people and organizations having to respond to a very different and more complex reality than in the past.

Authorities involved in compliance assurance activities have to keep pace with the developments in society. They cannot apply the tools and instruments of yesterday to the issues and challenges of today and tomorrow. Therefore, on a continuous basis, there is a need to innovate and adapt approaches in order to achieve effective implementation of environmental law and regulations.

In this perspective, for the Netherlands, two developments can be highlighted.

Firstly, when developing views on the roles of government and enterprises in implementing environmental policies, arrangements will have to be designed in which regulatees fully undertake their role and responsibility to comply with environmental regulation in a sound, responsible, transparent and accountable way. When regulated entities have a good track record with regard to compliance behavior, and have proven qualified environmental management provisions in place, authorities may have a validated trust that compliance by the regulated entities is well achieved and that effective mechanisms of self-correction are in place in case of infringements. Under those circumstances, the regulatory body may choose to relieve the inspection regime of such entities. This approach is laid down in a covenant between the regulator and the regulated entity. In the covenant, the mutual conditions for the agreement are specified. If, despite the mechanisms and provisions which the regulatee has put are in place, infringements of regulations occur, it is his duty and obligation to demonstrate that effective and systematic measures will be taken to prevent reoccurrence of the same problem. Of course, the regulator keeps his right to pursue appropriate enforcement actions if the corrective response of the company is insufficient.

A second developing issue is the illegal trade in environmentally hazardous products via the Internet. With its increasing penetration, the Internet more and more becomes a marketplace, also for illegal commodities. On one hand, appropriate tools, instruments and skills have to be developed in order to effectively investigate and counteract the internet-based illicit activities and to identify the offenders on the basis of their digital and other traces. On the other hand, effective communication with regard to information and awareness about the hazards of the illegal trade has to be embarked on. The associated risks are not only a potential threat to the buyers, but also to those involved in the logistical process of transport and delivery of the illegal goods. Hence, to identify effective interventions, the whole (international) chain of actors between supply and demand has to be taken into account in these approaches. To this end, appropriate models for international cooperation have to be further explored.

PROMOTION OF COMPLIANCE ASSISTANCE FOR NAIROBI RIVER BASIN ENTERPRISES

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SUMMARY

The Nairobi river basin has three rivers, namely the Ngong, Mathare and Nairobi. This basin is home to 80% of Kenya's manufacturing and service industry.¹ The basin is polluted with industrial effluent, sewage and solid wastes from enterprises along the rivers. Enterprises have not been finding it easy to comply with environmental regulation for different reasons such as costly effluent treatment plants, sewerage treatment facilities not designed to handle industrial wastes, industries are scattered, and high enforcement costs (regulatory authorities spend much more chasing on compliance). The regulators have been using "push" methods to force regulated communities in the basin to comply. However, this has not been bearing the required results. There is need to change tactics into innovative ways of achieving compliance and scale up the results.

1 WHAT IS THE INITIATIVE?

The program is an initiative of the National Environment Management Authority (NEMA) in collaboration with the Kenya National Cleaner Production Centre (KNCPC). The purpose is to reduce unauthorized discharges of industrial pollution from enterprises within the Nairobi river basin while promoting efficiency of water, energy and raw material use through the application of cleaner production technologies and techniques (providing a "cure," not "treating" a symptom). The project borrows heavily from the ongoing World Bank funded program that has reduced pollution in Lake Victoria Basin. NEMA, in collaboration with KNCPC, launched the program on 1 July 2014 at NEMA headquarters in Nairobi. The industries in this program are:

- | | |
|---|-----------------------------------|
| 1. Athi River Mining Ltd | 11. East African Breweries Ltd |
| 2. Kenya Meat Commission | 12. British American Tobacco |
| 3. Atlas Copco Eastern Africa Ltd | 13. Chandaria Industries Ltd |
| 4. Blue Triangle Cement | 14. Twiga Chemicals Manufacturing |
| 5. Mombasa Cement | 15. Osho Chemicals |
| 6. Savanna Cement | 16. Somochem Africa (K) Ltd |
| 7. Bamburi Cement | 17. Ecolab East Africa (K) Ltd |
| 8. East African Portland Cement Co. Ltd | 18. Bidco Oil Refineries Ltd |
| 9. London Distillers | 19. Leather Industries of Kenya |
| 10. Kapa Oil Refineries | 20. Nyonagara Slaughter House |

2 OBJECTIVES OF THE INITIATIVE

The objectives of the initiative are to strengthen compliance assistance efforts in 20 enterprises in the Nairobi river basin through the promotion and implementation of Resource Efficient and Cleaner Production.

Specific objectives are to:

- Generate baseline pollution intensities from these industries (carry out effluent sampling from the factory discharges).
- Develop informational material on applicable regulations and Resource Efficient and Cleaner Production.
- Conduct training for the industries on environmental regulations and policies.
- Conduct industry training on applicable Resource Efficient and Cleaner Production solutions.
- Conduct in-plant assessments and recommend improvement measures for compliance and efficiency.
- Develop a monitoring and evaluation system to successfully measure the outcomes of compliance assistance activities and resources.

4 ACTIVITIES

Activities that will be undertaken under this initiative include:

- a. Geo-mapping: identifying and mapping industries within the Nairobi river basin that have a direct or indirect pollution impact on the basin.
- b. Sampling: taking samples from the effluent discharges for analysis for water quality parameters including chemical oxygen demand, biological oxygen demand, total nitrogen, and total phosphorus levels. This will form the baseline for each industry.
- c. Training of trainers from industries and regulatory agencies: 2 people from every sampled industry will be trained for 3 days in Resource Efficiency and Cleaner Production. Officers from regulatory agencies will also be trained on the same. This will form a core team to implement the program on either side.
- d. In-plant assessment: a 2 day assessment of each industry on resources used, processes and products.
- e. Generation of Resource Efficiency and Cleaner Production options for implementation – identify energy efficiency energy options and waste minimization options on the basis of the assessment. Each industry will have a factory-specific Resource Efficiency and Cleaner Production management plan for adoption and implementation. The regulatory bodies will monitor the pollution intensities.
- f. Resource Efficiency and Cleaner Production Awards – NEMA will recognize the best performing industries during World Environment Day celebrations.

5 TIMEFRAME AND EXPECTED RESULTS

This is a work-plan activity to be implemented in 12 months from 1 July 2014. It is therefore expected the desired results will be seen within this period though the activities might go beyond this period.

The expected results of this project are:

- a. Reduced pollution per unit production and therefore a cleaner environment.
- b. Less resources to produce goods and services.
- c. Financial and social gains.
- d. Easier compliance with environmental standards.

6 REFERENCE

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CASE STUDY: INNOVATIONS IN ENVIRONMENTAL INSPECTIONS: OUTCOMES OF A BOTTOM-UP BRAINSTORM IN THE NETHERLANDS

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SUMMARY

Nowadays, inspectors are faced with inspection policies, risk based programs, procedures, instructions and checklists, as well as checks and balances, all of which should ensure that the inspector works in an accountable way and achieves predictable results. The outside world compared to the inside world?? however, is often unpredictable. New developments and challenges sometimes show up relatively unforeseen, and tackling these with traditional instruments is just not good enough. Therefore, the inspectorate felt the need for innovation to complement our regular approach to inspections, deliberately leaving the beaten track. To this end, inspectors, planners and managers joined a series of inspectorate -wide conversations with one basic rule: come up with as many new ideas for the broad field of inspecting – anything goes, no limits.

1 INNOVATIVE APPROACHES

Here are some highlights of the results of this forward thinking process:

1.1 Follow the money

In addition to the regular selection of inspection objects (e.g., which substances are most hazardous in combination with their application), look at issues from a financial point of view. In which way are business activities financially driven? Do financial streams between supplier and buyer correspond with the actual deliveries? Which companies are not financially sound or have problems paying taxes? All these could be too indicators for risk, and reason for further inspection.

1.2 Inspect at logistic junctions

In addition to inspections on the company site, use inspections on logistic junctions, such as harbours and other transfer and distribution points. All goods travel from one company to the next, passing several logistic junctions on the way. At such junctions a lot of information and goods come together, which could make inspections very efficient and effective. Are the logistic operations logical, or are strange operations happening?

1.3 Home delivery: not just for pizza, but for data as well!

Instead of going to companies in order to collect data for monitoring, risk analysis or inspections, let the companies deliver the data to you. For example, an e-file is an Internet -based application in which the company can file all relevant data and open specific subsets for different government inspections. This could also take the form of an Internet-based self-assessment of the company's compliance. Another example is an e-survey, an Internet survey which requests data for a risk analysis. Of course, safeguards have to be implemented in order to receive reliable data. Another idea is to use data that are collected by companies themselves, like the EU-PRTR reports (Pollutant Release and Transfer Register). In this way, one could get a view of waste streams that tend to stay out of sight, e.g. because they are (illegally) exported as 'green list' waste, i.e. waste not subjected to stringent procedural and control procedures.

1.4 Use key players

Use key players in a given business sector to get a quick insight in a market, or to sway markets into compliance. For example, one company holds a more than 50% share in the residual waste market in the Netherlands. An in-depth inspection of this company could provide insights for the whole sector. In addition, if one could make this company compliant, it would establish a standard for other companies in the same sector or for companies they do business with. Another example is to address the corporate office of an (inter)national firm. By informing them of regulations they could make their local branches comply.

1.5 Move from the physical market place to the virtual market place

Apart from good weather, anything you want you can probably buy on the Internet. As a consumer, we know that. As inspectors however, we tend not to include the Internet in our inspections on a regular basis. Some companies will not be listed in the yellow pages, but one will find them more and more in the virtual market place. Inspecting in that virtual space requires different techniques and tools. For example, if a company notices an inspection organisation surfing its website (and they will notice you!) they could easily remove any illegal goods from their site, or even close their online store by pressing one button and disappear, leaving without evidence of illegal trade, and without identification or address. To perform effective inspections on the Internet, one will have to re-invent the art of inspection to a substantial degree.

1.6 Extend your view: spend some time at your neighbours

In order to achieve better inspection results, one often speaks of collaboration as experts and as organisations. To that end, we organize all kinds of joint activities, collective discussions and letters of intent, but the end result will not always be as expected. A very simple way of improving collaboration is by doing an internship or staff exchange at your local inspectorate or at another government body linked to your area of work. By spending some time at each other's working environment, we can share best practices and knowledge with regard to the regulated community and effective inspection approaches.

1.8 Let somebody else intervene

Instead of going through the motions yourself in order to make a company comply, let somebody else do that for you! For example: we were faced with webshops selling illegal, hazardous consumer fireworks. The goods were shipped in unmarked boxes by regular mail, leaving the postal workers without a clue as to what they were handling. After informing the postal service of these practises, they started inspecting packages themselves for fireworks, thereby in essence stopping this illegal trade and reducing risk for society.

Another way to go is to make sure quality control systems ensure compliance. Suppliers of such systems usually sell the same product to different buyers in the same sector. Changing the design according to new regulations will promote the compliance of all buyers of this software. Hence it pays to be in contact with those designers/suppliers.

1.9 Last but not least: just do it!

Exploring new ways is not always easy. It implies venturing into the unknown, and undeniably making mistakes along the way. Don't let that stop us from trying. To this end, organizations could appoint dedicated small entities in which new approaches are further developed and tested. As an ancient Chinese saying goes, "a long journey starts with one single step."

4. NEXT STEPS IN NEXT GENERATION COMPLIANCE

This Special Report introduced advances in technology that increase the detail, breadth, and accuracy of environmental compliance data. These advances are changing the way the information used by environmental compliance and enforcement practitioners is gathered and distributed in connection with regulatory functions. Although these technologies have significant potential to streamline and prioritize important tasks, many are likely to further improve with continued development and refinement. Open and publicly accessible information systems, “big data,” citizen participation through crowdsourcing, and hyperspectral remote imaging devices all represent technologies that are likely to improve the effectiveness of environmental compliance and enforcement practice.

Another area where further development is needed is in the *use* of data. Awareness that regulators have more and better information provides a strong deterrent to noncompliance. It also raises issues of admissibility of evidence in courts of law and the extent of the data’s probative value. Privacy and confidentiality issues will no doubt be raised by members of the public who feel they are collateral victims of unprecedented scrutiny of adjacent regulated installations and project sites. However, improvements in technology also allow private sector actors more opportunities to improve their compliance management efforts, through real-time monitoring that detects problems as they happen and provides opportunities for rapid responses by regulated entities.

Finally, this Report examined innovative ways to stimulate members of regulated communities to take ownership of managing their environmental performance, including legal compliance. Supporting proactive companies through better rules, standards, and recognition of performance will continue to play an important role. This effort could be supplemented through the skillful use of social media to promote compliance – another area that is just beginning to be explored.

As continued advances in environmental monitoring technologies, managerial approaches and regulatory design play a greater role in environmental compliance and enforcement systems, INECE will remain engaged with practitioners in many fields – from satellite-based forensic scientists to experts in emerging jurisprudence and social sciences. There are a multitude of new issues for which experience and expertise will need to be shared, and further research and development is required. Accompanying these advances are unprecedented opportunities to see clearly what is happening on the ground, by whom, before or as it happens. Environmental compliance and enforcement practitioners will be able to use information and approaches more effectively to prevent harms and support the next phase of sustainable development.

BOOK REVIEW

Next Generation Environmental Compliance and Enforcement

Authors: LeRoy C. Paddock and Jessica A. Wentz, Editors*

The field of environmental law is dynamic, growing to face new scientific realities and evolving to incorporate technological advances. In December 2012, the Environmental Law Institute (ELI) co-sponsored a two-day conference with The George Washington University Law School and the Center for Law, Energy and the Environment (CLEE) at UC Berkeley Law School, along with the Goldman School of Public Policy (GSPP) at UC Berkeley that focused specifically on how environmental compliance and enforcement can utilize new technological tools and next generation approaches to ensure higher levels of compliance with environmental laws currently in place.

Following the conference, ELI published “Next Generation Environmental Compliance and Enforcement” written by LeRoy C. Paddock, Dean for Environmental Law Studies at GW Law and Jessica A. Wentz, former Visiting Associate Professor and Environmental Law Fellow at GW Law. Next Gen is a compilation of forward-thinking articles on environmental compliance and enforcement with an opening chapter from the Cynthia Giles, the Assistant Administrator for the Environmental Protection Agency’s Office of Enforcement and Compliance Assurance (OECA).

In the opening chapter, Giles observes that we are at a crossroads in environmental protection that requires the informed and effective use of technological advances, such as real-time electronic information and emissions monitoring, to deter non-compliance and make it easier for companies to comply with environmental law than to violate it. Giles proposes five strategies to achieve her goals for what she terms Next Gen compliance: 1) rules with compliance built in, 2) advanced

pollution monitoring, 3) electronic reporting, 4) increased transparency, and 5) innovative enforcement strategies. The genius of these five strategies is that they are complementary, as Giles explained at a recent ELI organized book launch held at GW Law School on October 2, 2014.

At the launch, ELI President John Cruden introduced the Next Gen book to an audience of environmental lawyers, professionals and students. Cruden then turned the stage to Giles who explained that the foundation of regulatory success comes from well-written rules balancing flexibility and simplicity. Giles explained how accurate and mobile pollution monitoring linked into electronic reporting can facilitate compliance with the rules and can help provide transparency for the public impacted by pollution. It became clear that Next Gen approaches will help the agency to develop innovative enforcement strategies in the future.

ELI's book goes beyond Giles's introduction. The book includes twelve chapters that explore topics such as the relationship between regulators and the regulated community, coercive versus cooperative enforcement approaches, the economic and societal drivers that support compliance and beyond-compliance behavior, adaptive management, international approaches and much more. The book is a must-read for anyone who wants to learn more about evolving methods of compliance assurance in the US and beyond.

To purchase a copy of this book, go to: <http://www.eli.org/eli-press-books/next-generation-environmental-compliance-and-enforcement>]

As the idea of Next Gen grows, so does its reach. The International Network for Environmental Compliance and Enforcement (INECE) will partner with ELI, EPA, the Netherlands Environment Ministry and GW Law on an upcoming conference in March 2015.

*Special thanks is given to Jessica Werber, Director of Professional Education, Environmental Law Institute, for contributing her review of this book.

INFORMATION ON CONFERENCES IN THE SPRING OF 2015

2015 J.B. & Maurice C. Shapiro Environmental Law Symposium

George Washington Law School, the U.S. Environmental Protection Agency (EPA), the Environmental Law Institute (ELI), Erasmus University, Rotterdam, Netherlands, and INECE will co-sponsor a program on “The Role of Advanced Monitoring, Remote Sensing, and New Forms of Information Gathering, Analysis, and Disclosure in Environmental Compliance and Enforcement.” The symposium will be part of the law school's ongoing collaboration with the EPA and other institutions to explore and evaluate next generation approaches to environmental compliance and enforcement. This event will be convened at George Washington University Law School in Washington, D.C., on 26-27 March 2015.

For more information, look for updates on the INECE Next Generation Compliance web page, <http://inece.org/topics/next-gen-compliance/>.

2015 Erasmus conference

In the next phase of our work program, INECE will focus further on the societal behavioral change aspects of promoting environmental compliance, starting with a workshop in the Netherlands. As a continuing part of the Next Generation Compliance series, a sister conference will be hosted by Erasmus University. **Innovating Environmental Compliance Assurance: Novel Insights and Approaches from Social Sciences** will be held 21-22 April 2015 in Rotterdam, the Netherlands. The conference is a joint effort of Erasmus, the Netherlands Environmental Inspectorate, and Dutch Association of Supervisors, Enforcers and Regulators (VIDE).

To support the conference, Erasmus has announced a Call for Papers on the conference theme. Abstracts should be sent to mbree@rsm.nl by 1 January 2015.

<http://inece.org/2014/11/11/new-call-for-papers/>.

INECE's Goals

INECE's goals are to:

- Improve enforcement and compliance through better cooperation.
- Strengthen capacity throughout the regulatory cycle to implement and secure compliance with environmental requirements.
- Raise awareness of the importance of environmental compliance and enforcement to sustainable development.



Environmental compliance and enforcement play a fundamental role in building the foundation for the rule of law, good governance, and sustainable development

INECE develops and implements practical and innovative activities that strengthen environmental compliance and enforcement at all levels of governance – local, national, regional, and international. INECE builds the capacity of compliance and enforcement stakeholders to contribute to the rule of law and good governance in areas that advance sustainable development.

The Network is comprised of environmental regulators, investigators, prosecutors, judges, and employees of international environmental and development organizations. Officials from customs, the police, non-governmental organizations, academia, the media, and business also participate.

Founded in 1989, INECE is the only global organization focused exclusively on achieving compliance with environmental law through effective compliance promotion and enforcement strategies, including administrative, civil, criminal, and judicial enforcement. INECE works on both national implementation of domestic environmental laws and on improving the effectiveness of multilateral environmental agreements.

INECE communicates that environmental compliance and enforcement play a fundamental role in building the foundation for the rule of law, good governance, and sustainable development.

To collaborate with INECE on its work on next generation compliance and other initiatives, please contact Durwood Zaelke (zaelke@inece.org) or Ken Markowitz (kjm@earthpace.com) to learn more about current projects and opportunities.

<http://inece.org/>

Excerpt from INECE's *Special Report on Next Generation Compliance*.

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Please visit <http://inece.org/resource/next-gen-report/> for the full text of the *Special Report on Next Generation Compliance*.

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