## Standards for Energy Industry Use of Metadata: Initiative Overview

**Version:** Standards for Energy Industry Use of Metadata: Initiative Overview; Version 1.0

**Abstract**

This document presents to stakeholders in the energy industry an opportunity to improve operational efficiency within the community through pragmatic and judicious adoption of metadata standards and best practices. It promises a future in which all stakeholders exploit a common set of metadata standards and guidelines to enable efficient cataloging, discovery, evaluation, and retrieval of available information resources, regardless of whether those resources are hosted internally or externally to their organization.

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Energy Industry Metadata Standards Work Group and Energistics

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## Document Information

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<td>Development of abridged version of full Roadmap version of the position paper following its revision based on feedback from Work Group Active Participants.</td>
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<td>Final version as published on the Metadata Work Group area of Energistics' web site, <a href="http://www.energistics.org">www.energistics.org</a>.</td>
<td>Lisa Derenthal, Steve Richard, Scott Hills, Grant Tucker, Alan Doniger, David Danko, Robert Graham</td>
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### Change Forecast

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Executive Summary

This overview paper summarizes an opportunity to stakeholders in the energy industry for improved operational efficiency through judicious adoption of metadata standards and best practices. The adoption of a common set of practical metadata standards and guidelines will enable efficient cataloging, discovery, evaluation, and retrieval of information resources, regardless of whether those resources are hosted internally or externally to an organization. The target stakeholder community includes energy companies and consortia, data and service providers, software vendors, and energy-related government and academic organizations. Engagement on multiple levels is invited from stakeholders who recognize the value of the opportunity to their organization’s business.

This vision seeks to address three major opportunities for improvement:

1. Improving productivity and staff efficiency by reducing the amount of time spent searching for data and information
2. Minimizing errors and bad business decisions based on incomplete, inaccurate, or obsolete content
3. Eliminating wasted resources associated with duplicate acquisition of data and redundant business activities by standardizing metadata attributes and language

Capturing these opportunities requires a solution both relevant to a broad stakeholder community and applicable to a wide range of information resource types, including structured and unstructured data, online services, and physical assets. A key attribute common to the vast majority of these resources is the spatial location which they describe. Thus, the initial focus is on structured and unstructured information resources that contain explicit spatial coordinates, including GIS and subsurface application datasets, as well as spatially-enabled services, field data, and documentation. The intent is to develop a standard that can be expanded over time to support additional content types, place name locations, and other segments of the energy industry.

The initiative has several major deliverables – this overview paper and the associated roadmap document, a requirements analysis and existing-standards assessment, and the metadata standard or “energy profile” itself. Publication of the finalized profile (v1.0) will follow a stakeholder review period expected in the first half of 2010.

Energistics will provide the legal and organizational context for the development phase of this initiative, as well as collaboration and facilitation support, and will publish results. The results will be freely available for public use, subject to the constraints of Energistics’ Intellectual Property Policy document and the Product Licensing Agreement. Energistics will subsequently act as the custodian of the standards and guidelines, responsible for their adoption as well as on-going evolution and maintenance.
Document Description
This document is an overview of the metadata standardization opportunity described in detail in the associated position paper

Roadmap for Implementing Energy Industry Metadata Standards v1 (September 2009) (see page 16, Additional Reference Materials). The objective of the overview is to present the major aspects of the opportunity (Section 2) and the proposed development plan (Section 3). Supplemental information on the background for this effort is in Section 4, and introductory technical background material is included in Section 5. This document is intended for technical managers in the energy industry with sufficient knowledge of their organization’s operational needs to gauge the relevance of the opportunity presented herein to their business. The purpose of the document is to provide a quick understanding of the benefits to be gained and the effort required to take advantage of the opportunity. Readers seeking a more complete discussion of technical issues should obtain the Roadmap Document.

The reader of a printed copy of this document is advised to verify that the printed copy is the current version by checking the Energistics web site, http://www.energistics.org, and locating the document

Energy Industry Metadata Standards Initiative Overview v1 (September 2009) in the Metadata Work Group area under the Asset and Data Management SIG community.

Opportunity Description
The adoption of metadata standards and best practices presents an opportunity to improve operational efficiency in the energy industry. Adopted standards could be implemented in individual metadata repositories, but more significant benefit will be realized if the standards are widely used to support metadata exchange. Feedback is sought about the alignment between the position presented in this paper and stakeholder’s requirements, particularly recommendations to improve the value of the products delivered to capture the opportunity.

Vision
The future this opportunity promises is one in which stakeholders in the energy industry exploit a common set of metadata standards and guidelines to enable efficient cataloging, discovery, evaluation, and retrieval of available information resources, regardless of whether those resources are hosted internally or externally to their organization. The user communities that stand to benefit include energy companies and consortia, data and service providers, software vendors, and government and academic organizations. To achieve this vision the standards and guidelines must be widely used, relevant to a wide range of resource types, and capable of supporting internal metadata management processes as well as the exchange of metadata between organizations.

The standards and guidelines will be managed, supported, and evolved in a methodical, value-oriented manner taking into account incremental staging based on justifying each step forward by its added value to the industry compared against the cost of upgrading. An incremental approach is proposed that will allow scope expansion over time and will have the flexibility needed to support versioning of the metadata standards and linkage with other specifications being used by individual companies or by sectors of users in the industry.
The standards and guidelines within the scope of this vision include those that enable the discovery, evaluation, and retrieval of datasets, documents, and other physical and intellectual materials. The long-term vision for this effort is to address all types of resources with geographic references, whether through explicit spatial coordinates or place names. The initial focus is proposed to be on structured and unstructured information resources that contain explicit spatial coordinates, including GIS vector and raster datasets, subsurface application datasets, and CAD maps. Recommendations will be associated closely with leading related technologies and standards, such as ISO standards, national standards, and other industry specific standards.

The recommended practices will address controlled vocabularies and the metadata attributes to which they apply, taking into account both semantics and ease of use. Special attention will be given to defining the subject classification vocabulary, given the rich breadth and depth of its values and the historical differences in usage due to different regions, organizations, disciplines, etc. Other than subsets of attributes with well-defined dependency relationships, attributes will be defined to be orthogonal (see §5.2.2). Requirements for mandatory and recommended attribute content will be evaluated based on the net benefit to cost, following the incremental approach outlined above.

These standards, guidelines, and recommended practices will serve operational work processes as well as company and regulatory auditing purposes. The scope includes exchange of metadata both within and between organizations. There will be recommendations and illustrations of effective means of pre-selecting and generating much of the metadata content associated with new and updated business items where possible.

Business Case
The business case for metadata and metadata standards centers on productivity improvements through increased efficiency in producing metadata, better data inventory, and more efficient location and selection of the best information resources using this metadata. Studies across the industry continue to estimate significant loss of productivity associated with the search for data and information. According to a white paper released by International Data Corporation (IDC) in 2008, revised estimates show that by 2011, the amount of electronic data created and stored will grow to 10 times the 180 exabytes that existed in 2006, reflecting a compound annual growth rate of almost 60%. The study, "The Diverse and Exploding Digital Universe," also found that the rate at which electronic containers for that data — files, images, packets and tag contents — is growing 50% faster than the data itself. In this situation, timely identification and evaluation of information resources relevant to a particular question is becoming progressively more and more problematic. Users spend excessive amounts of time searching for information, and ultimately make decisions based on information of questionable quality.

Identification of information resources involves both efficient discovery and evaluation of those resources, tasks well supported by metadata. In fact, metadata are often the only means of evaluating the quality of both structured and unstructured information, and significantly improve the likelihood that structured information, in particular, is discovered at all. Metadata also provides a mechanism for integration of unstructured and structured content. Unfortunately, the capture and maintenance of metadata is currently costly and inefficient, and investment in metadata acquisition is uncommon. An opportunity to improve the efficiency with which metadata are captured and maintained would thus directly translate into enhanced user productivity by improving both the efficiency of discovery and evaluation of information resources. This in turn would improve
the quality of decisions to which these resources contributed, and minimize wasted resources related to duplicate data acquisition and content generation.

Adoption of appropriate metadata standards and guidelines in the energy industry is expected to reduce the investment required to capture and maintain metadata to the point that acquisition become routine. The result would be more accurate and readily available metadata to support information discovery, evaluation, and access. The justification for this conclusion is as follows:

- An open standard encourages and accelerates wider adoption across industry participants including data producers, consumers, and providers of application software that handle those data.
- Adoption by data producers allows capture of metadata by the organization most knowledgeable about the associated data, improving metadata accuracy. Incorporating standard metadata with data at its point of origin minimizes data consumer effort required to incorporate and use those metadata. Capturing metadata at the source results in a more efficient exchange process and produces more accurate metadata.
- Adoption by data processing and management application software developers will minimize time-consuming, unsustainable, manual management of metadata associated with application data. The metadata created by one product can be passed with the associated data to the next application used in a workflow. Products that automatically enrich the metadata, such as “geotagging” applications (i.e., those capable of converting place names to geographic coordinates) could seamlessly be inserted into these workflows. Portability of software modules will reduce software development costs.
- Adoption by consumers will decrease costs to train users to locate resources, and increased user familiarity and expertise will improve the efficiency and effectiveness of searches to locate and evaluate information resources, both internal and external to an organization.

**Illustrative Use Cases**

Below are some scenarios illustrating the range of business needs which this initiative seeks to address.

**Data Discovery and Recall:**

**Discovery:** A user starting a project wishes to discover and identify relevant data from sources outside their company. Information about datasets is required to evaluate fitness for use and maximize its value. Standard metadata associated with the data enables users to search and discover data to locate appropriate, available resources without knowledge of the locations, organization, or naming conventions of the repositories in which the data are stored.

**Recall of Existing Data:** A user new to the organization is asked to revisit an old project, and must gather and evaluate the data collected for the project given only information such as the area of interest (AOI) or project name.

**Data Evaluation:**

**Evaluation of Data / Fit for Purpose:** A user is reviewing prospect information and needs to evaluate data used to develop the prospect using criteria such as vintage, source, quality, accuracy, lineage, etc. Without metadata describing these, the user must seek out others who may be knowledgeable about the data, or make assumptions about data that may or may not be correct.
On-going Data Updates: The velocity model used to process a seismic line is updated based on a new processing method, and all derivative cross sections and maps using the data need to be updated. In this case, updating the dependent data set requires knowledge of the processing lineage, including the complete hierarchy of relevant ancestors, as well as tools, methods, and parameters used to process the data.

Data Sharing: A user receiving data from a joint venture partner must be able to evaluate and determine the appropriate use of shared data. To accomplish this, the receiving organization must receive associated metadata along with the data for attributes such as status or quality.

Data Access:
Use Constraints: A knowledge worker needs to know the conditions under which they are permitted to access and use a particular dataset. Such conditions might include commercial licenses, or government regulations. Metadata to standardize documentation of such use constraints would facilitate access to the information, encouraging and enabling compliance.

Appropriate Use: A user needs to understand the intended or recommended use for a given dataset. Examples of this kind of metadata include scale-appropriateness and vintage.

Scope of this Initiative
This initiative envisions metadata standards that facilitate metadata creation, and resource discovery, evaluation, and access for a broad range of information resource types relevant to the energy industry. To ensure this vision can be realized in a timely fashion, development will be phased to incrementally increase the scope. Table 1 presents information resource types targeted for inclusion in the first two versions of the deliverables from the initiative. To compensate for the breadth of its vision it is necessary to constrain the scope of metadata attributes included in the standards to those that are both 1) needed to support information discovery, evaluation, and access; and 2) common to most, if not all, information resources relevant to the energy industry. The standard metadata attributes will be general purpose rather than discipline- or business process-specific.

In contrast to the metadata attributes, the values assigned to characterize a specific information resource will often be discipline- or business process-specific. A phased approach will also be used to develop necessary controlled lists of those values. Initial focus will be on development of generalized controlled lists of values for attributes required for basic information discovery, evaluation, and access. Domain specific lists included in this initial phase will be limited to support for resources related subsurface exploration and production activities that have geospatial coordinates associated them. Subsequent development will broaden the scope of activities relevant to the energy industry beyond subsurface exploration and production.
Table 1 Representative information resources considered in-scope, grouped into four resource categories, and according to the planned version of the energy industry metadata standards that will support them.

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<th>Type</th>
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<td><strong>Type</strong></td>
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* Profile version: Resource types in-scope for version 1 have associated, explicit geospatial coordinates.

**Development Plan**

**Deliverables**

This initiative has several major deliverables including this overview, the associated and more detailed position paper (see page 16), a requirements analysis, assessment of existing standards, and the specification or “energy profile” itself.

**Overview and associated roadmap paper**

The purpose of these papers is to articulate to stakeholders in the energy industry an opportunity to improve operational efficiency within the community through adoption of metadata standards and guidelines. The
documents describes the background of previous work, a description of the opportunity, the context within which the opportunity will be pursued, and details of the deliverables and development plan. The overview paper is an abridged version of the roadmap designed for quicker consumption.

**Requirements Analysis and Existing Standards Assessment**

The requirements gathering and gap analysis effort includes engaging stakeholders to compile a list of resources to be cataloged and the required metadata attributes for each, leading to a requirements document to be distributed for review by the community. These requirements will then be evaluated against existing standards to determine if a standard specification can be leveraged as is or can serve a foundation for the energy industry standard. This evaluation will lead to recommendations on the applicable standards and profiles of those standards.

**Specification Development**

Based on the requirements and recommendations from the gap analysis, a metadata profile specification will be developed. The specification will consist of documents presenting recommended standards and best practice guidelines for energy-industry metadata content. Preliminary analysis of existing metadata specifications by the Work Group suggests that this specification can take the form of a formal profile of ISO 19115:2003 intended for use by the energy community worldwide. This approach recognizes the mature nature of this standard, its widespread adoption, and its convergence with the FGDC CSGDM specification in the form of the ISO 19115:2003 North American Profile, and is favored to minimize duplicate effort, maximize compatibility with existing standards and tools, and produce a specification that can be adopted for both U.S.-based and international use.

**Timeline and Milestones**

The timeline and plan for the initial phase of development and adoption is about 18-24 months. The initial proposal and industry workshop was held in the spring of 2009. The development of the profile is expected to be complete by the end of 2009, and a planned stakeholder review period is expected to occur in the first half of 2010. Publication of the finalized profile (v1.0) is expected in the 2nd quarter of 2010. The Gantt chart that follows shows a high level view of the project plan. See the full position paper (see p. 16) for a more detailed Gantt chart and task breakdown.

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<td>16 days</td>
<td>Wed 7/10</td>
<td>Thu 10/29</td>
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**Adoption and Maintenance Processes**

The development of the industry metadata standards and guidelines will be focused on capabilities that are important to stakeholders for relevant business-oriented use cases. Development will be iterative and progressive, guided by a roadmap, liaisons with stakeholder groups, open processes, and focus on business requirements. The Work Group will use a layered participation model and collaborative communication methods to maximize input and stakeholder participation. Decisions will be made on the basis of seeking consensus. Activi-
ties will hold to published timelines and milestones in order to maximize the value of participation and to ensure progress. Energistics methods and facilities will be used to support these activities.

The adoption of the industry metadata standards and guidelines will be supported using explanatory material presented through web sites, collaboration facilities, papers, oral presentations, exhibits, demonstrations, tutorials, and toolkits. Conformant uses of the metadata standards and guidelines, whether by software or by professionals, will be identified based on a suitable certification and testing programs. Mappings will be developed for interfacing with other standards, for version to version upgrading, and for interfacing with more detailed taxonomies used by some companies and groups.

The first pilot project identified to test and implement the metadata standards and guidelines will involve the NSF-funded GIN (Geoscience Information Network) Project (see usgin.org). This project is a partnership of the Association of American State Geologists (AASG - state geological surveys) and the U.S. Geological Survey (USGS) to develop a national framework that will provide standardized services to make data resources of the state and federal geological surveys accessible online in a distributed network.

Background
In 2006, and again in 2009, workshops and meetings were initiated in conjunction with the ESRI Petroleum User Group (PUG) GIS conference. The events, which were well-attended by representatives of many energy companies, focused on the need to identify a “minimum set” of geospatial metadata attributes and industry-standard keyword facets. The agreed-upon vision was to establish metadata standards for the industry to enable effective and efficient discovery, evaluation, and retrieval of information resources – both geospatial and other. These standards provide support for internal use in industry companies and uses for exchange between companies.

Principles and Resources

Governing Principles
The development and maintenance of industry guidelines, profiles, and mappings for the use of metadata will be:

- Open and inclusive in order to be relevant and usable
- Strongly pragmatic, to achieve maximum net effectiveness with minimal disruption of current practices
- Industry-focused and business relevant to ensure value
- Version managed with version-to-version mappings and tools to remain current
- Effectively managed based on sound concepts
- Incremental in scope growth, beginning with an achievable scope, with development cycles less than one year in duration and develop-adoptions cycles targeted at two to three years
- Competently facilitated to achieve maximum progress from available resources in minimal elapsed time and total effort
- Supported by effective awareness, training, and support activities to maximize the rate of growth of adoption and use

**Organization**

**Custodian – Energistics**

As custodian for this activity, Energistics will provide the legal and organizational context. Energistics provides collaboration and facilitation support, and will publish results. The results will be freely available for public use, subject to the constraints of Energistics’ Intellectual Property Policy document and the Product Licensing Agreement (see www.energistics.org). Energistics currently publishes and supports a broad set of E&P Catalog Standards. It is anticipated that there will be interaction between this activity and those standards, leading to partial or full integration of concepts and operational details. Energistics also publishes and supports several families of data exchange standards, including the WITSML Standards for drilling, completions, and interventions. These standards include provision for a common metadata segment in every data object schema and instance. It is anticipated that the structure and content of this metadata segment will evolve to align with the results of this activity.

**Work Group**

Since early 2009, an ad hoc group composed of industry organizations and Energistics carried out the formative activities which lead to this initiative. As of release of this position paper to the community for comment, development of the metadata standards and guidelines will be carried out by the Energistics Energy Industry Metadata Standards Work Group organized within the Asset and Data Management Special Interest Group (ADM SIG).

Individuals engaged in the initiative are expected to come from many sectors of the energy community, but all fall into one of three groups based on their level of interest:

- **Steering Team:** The Work Group will be led by a Steering Team of approximately 6 to 8 persons that will provide technical and organizational leadership for the initiative.
- **Active Participants:** Those who commit to a continuing and active role in the Work Group will be known as the Active Participants. Approximately 8 to 20 Active Participants will be needed. The Active Participants represent their respective organizations, providing input to the process and deliverables.
- **Interest Parties:** Those who wish to follow progress and make infrequent contributions will be known as Interested Parties. This role will remain open to all industry stakeholders and has no maximum size.

Formal Energistics Work Group membership for Active Participants and for individuals on the Steering Team will become a requirement as of January 2010. This requires, in turn, Energistics membership of the organization which each individual represents. For more information about Energistics membership, please review the Energistics Membership Agreement on www.energistics.org.

**Call for Participation and Support**

This position paper seeks to engage representatives of stakeholders in the energy industry with sufficient knowledge of their organization’s operational needs to gauge the relevance of the opportunity presented herein to their business. We seek engagement on multiple levels:
• Feedback about the alignment between the positions presented in this paper and stakeholder organizational needs. Most important is feedback that identifies changes to improve the alignment and the value of the products delivered to capture the opportunity.
• Contributing to development of the requirements, and/or the standards and guidelines themselves.
• Review and testing of the proposed standards and guidelines after they have been published for community comment.
• Piloting and adoption of the standards and guidelines following final approval.
• Readers who have the time and energy to contribute to this initiative are encouraged to contact any of the authors of this position paper.
Appendices

Terminology and Definitions

In this section, the important terms and definitions introduced and used are presented. These terms are chosen based on the intended audience and assumptions about their background and knowledge.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Attribute</td>
<td>A characteristic associated with some entity which takes a particular value for each instance of the entity. Eye color is an attribute of people, for example, while location is an attribute of information resources.</td>
</tr>
<tr>
<td>Domain</td>
<td>1) The content of a particular field of knowledge; 2) The set of valid values assignable to a particular metadata attribute.</td>
</tr>
<tr>
<td>Facet</td>
<td>A distinct feature or element of a problem or knowledge domain.</td>
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<tr>
<td>Geographic</td>
<td>Located with respect to the Earth; geospatial.</td>
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<tr>
<td>GIS</td>
<td>Geographic Information System. A system of hardware and software used for storage, retrieval, mapping, and analysis of geographic data.</td>
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<tr>
<td>Information resource</td>
<td>A resource with information content.</td>
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<tr>
<td>ISO *</td>
<td>Registered short name for the International Organization for Standardization (<a href="http://www.iso.org">www.iso.org</a>).</td>
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<tr>
<td>Keyword</td>
<td>A term significant enough as a descriptor for a particular information resource that it is appropriate for use in discovery and evaluation of that resource.</td>
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<tr>
<td>Lineage</td>
<td>The succession of information resources and processes applied to them which lead to and produced the particular information resource in question.</td>
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<tr>
<td>Metadata</td>
<td>Information that describes an information resource for the purpose of locating and evaluating that resource.</td>
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<tr>
<td>Orthogonal attributes</td>
<td>A collection of attributes for which assignment of a value to one attribute provides no information to constrain or allow prediction of the value assigned to another attribute in the collection. Independent variables.</td>
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<tr>
<td>Profile</td>
<td>In the context of a standard specification, a customized version of that standard tailored to suit the needs of a particular community.</td>
</tr>
<tr>
<td>Related attributes</td>
<td>A collection of attributes for which assignment of a value to one of the attributes constrains the value of one or more other attributes. Dependent variables.</td>
</tr>
<tr>
<td>Resource</td>
<td>An entity used in the creation of a product.</td>
</tr>
<tr>
<td>Structured data</td>
<td>Digital data stored in a precise format that enables association of specific, known meaning with each data element to enable processing of the data by computer algorithms. Data elements may be defined by fixed fields in a record or file, or by machine-interpretable tags. Relational databases and spreadsheets are examples of structured data, as are XML documents.</td>
</tr>
<tr>
<td>Subject classification</td>
<td>Categories used to classify different knowledge domains.</td>
</tr>
<tr>
<td>Taxonomy</td>
<td>A collection of terms representing discrete categories, usually expected to be disjoint, that are used to classify items or concepts. The categories often organized into a hierarchy.</td>
</tr>
</tbody>
</table>


### Term | Definition
--- | ---
Theme | A general term for the subject or topic of a communication or information resource.
Unstructured data | Digital data not stored in structured format, and which therefore require additional information to elucidate the meaning of each data element. Free-form text in a word processing document is a typical example.
Value | A numeric or qualitative quantity associated with an attribute.
XML | (Extensible Markup Language) is a general-purpose specification for creating custom markup languages. XML's purpose is to aid information systems in sharing structured data, to encode documents, and to serialize data.

### Additional Reference Materials
For more information and details about this initiative, the interested reader is directed to Energistics’ web site ([www.energistics.org](http://www.energistics.org)), and in particular to the full position paper:

*Roadmap for Implementing Energy Industry Metadata Standards v1 (September 2009)*

Both the more detailed position paper and this overview document can be located on Energistics’ web site and downloaded from the Metadata Work Group area under the Asset and Data Management SIG community.