



# Data Format and Communication Standards to Support Forecasting Services

Forecasting Session 3: IEA Wind Task 36 Joint Session: Updates in Best Practices/Tools

Subtask 2.4: Collaboration on standardization with IEC, standardization needs for forecast vendor / user interaction

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# Data Format and Communication Standards to Support Forecasting Services :: Outline

- What is IEA Task 36, Work Package 2, Subtask 2.4?
- What problem are we trying to solve?
- What has been done to date?
- Examples
- Current approach and work
- Future work and how to participate

# What is IEA Task 36 Work Package 2?

Power and Uncertainty Forecasting:  
Separated into four sub-tasks:

1. Update of the IEA Recommended Practice on Forecast Solution Selection, including benchmarking.
2. Uncovering uncertainty origins and development through the whole modelling chain.
3. Set-up and dissemination of benchmark test cases and data sets
4. Collaboration on standardization with IEC, discussion of standardization needs for forecast vendor / user interaction

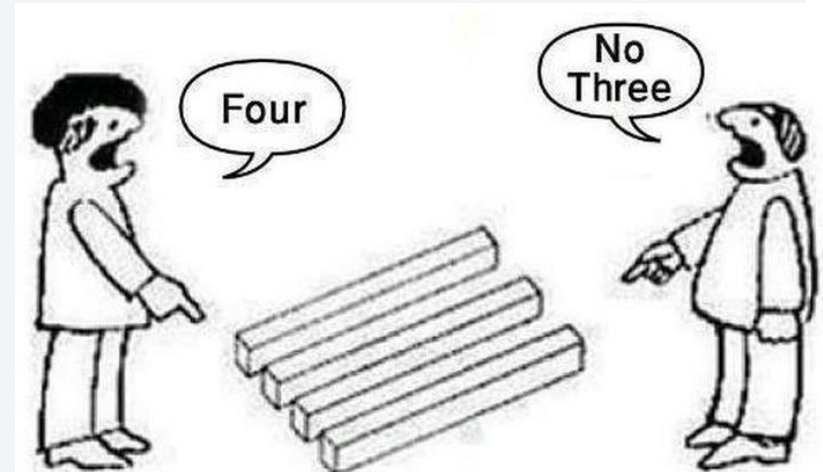
**Objectives and description of effort:** <https://www.ieawindforecasting.dk/work-packages/workpackage-3/task-3-3>

# Data Format and Communication Standards to Support Forecasting Services

## What Problem Are We Trying To Solve?

Current situation between forecast providers and forecast users:

- No clear terminology and definitions  
*e.g., Hour-ending, Forecast horizon*
- No standard way of exchanging data  
*e.g., REST-API, FTP, email, thumb-drive*
- Miscommunication and Rework  
Risk: **high**
- Time Consuming



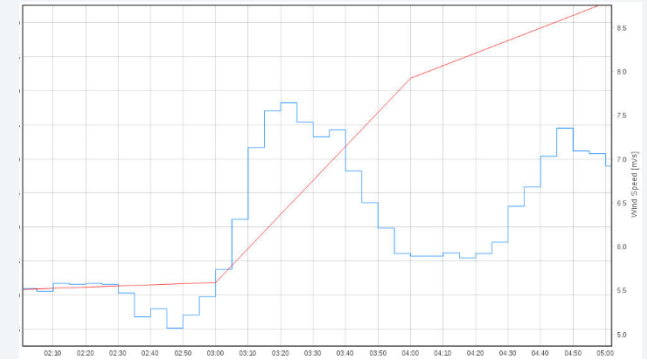
*Ultimately, we are trying to reduce bottlenecks so we can further bring down the costs of integrating renewables on the electricity grid*

# Data Format and Communication Standards to Support Forecasting Services

## Example of the challenge –

How would you succinctly and effectively describe in words the **time series date-time interval**?

- Is it indicating the leading- or ending-period?
- Is it the instantaneous or an average value?
- Should the resolution of the interval be articulated the same for measurement and forecast time series?



***Enumeration and examples of the product type help define the parameter, but a common information model is required.....***

# Data Format and Communication Standards to Support Forecasting Services

## What has been done to date?

| Organization/Effort                                                          | Strengths                                                                                                                                                                                      | Weaknesses                                                                                                                                                                                  |
|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ENTSO-E:</b><br>Weather process and energy prognosis implementation guide | <ul style="list-style-type: none"><li>• Very detailed guide for TSOs</li><li>• Uses IEC standards including Common Information Model (CIM)</li><li>• Already in use by European TSOs</li></ul> | <ul style="list-style-type: none"><li>• Not practical (too expensive) for smaller forecast users to implement</li><li>• Requires certain level of programming skills to implement</li></ul> |
| <b>IEC 61400-12:</b><br>Power performance of wind turbines                   | <ul style="list-style-type: none"><li>• Great model to follow for establishing wind energy industry standard</li></ul>                                                                         | <ul style="list-style-type: none"><li>• Not applicable to renewable energy forecasting (for resource assessment)</li></ul>                                                                  |
| <b>IEA Task 36 Phase I:</b><br>Designing and executing benchmarks and trials | <ul style="list-style-type: none"><li>• Applicable to energy forecasting</li><li>• Provides guidelines for metadata and sample schemas for data exchange</li></ul>                             | <ul style="list-style-type: none"><li>• Lacks details on data structure, definition and units</li><li>• No link or reference to existing standards (e.g., IEC, ENTSO-E)</li></ul>           |

# Data Format and Communication Standards to Support Forecasting Services

## What has been done to date?

| Organization/Effort                                                                        | Strengths                                                                                                                                                                                                                                                                   | Weaknesses                                                                                                                                          |
|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DOE SFIP2:</b> Open Source Evaluation Framework for Solar Forecasting (“Solar Arbiter”) | <ul style="list-style-type: none"><li>• API framework for data format and exchange</li><li>• Applicable to energy forecasting</li><li>• Extensible to wind</li><li>• Publicly available (open source)</li><li>• Well documented and easy to understand</li></ul>            | <ul style="list-style-type: none"><li>• Continued support and maintenance uncertain</li><li>• Data model not mapped to existing standards</li></ul> |
| <b>SAREF ontology:</b> Smart Appliances REference)                                         | <ul style="list-style-type: none"><li>• Uses ETSI and EU industry standards for demand-response energy communications</li><li>• Highly extensible – forward looking</li><li>• “Interconnect” project funding includes grid interoperability and energy management</li></ul> | <ul style="list-style-type: none"><li>• Not as known in the utility, ISO/TSO space</li><li>• Geared for distributed generation currently</li></ul>  |

# Data Format and Communication Standards to Support Forecasting Services

## Example 1: ENTSO-E Weather process and energy prognosis – implementation guide (2017)

Table 1 – Weather configuration document dependency table

| Attribute                                  | Value                                                                                                                                     |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| WeatherConfiguration_MarketDocument        |                                                                                                                                           |
| Type                                       | A95 = Configuration document                                                                                                              |
| sender_MarketParticipant.marketRole.type   | A04 = System operator                                                                                                                     |
| receiver_MarketParticipant.marketRole.type | A43 = Weather analyser                                                                                                                    |
| status                                     | A14 = Creation<br>A15 = Update<br>Note: a document may be either a creation or an update.                                                 |
| Location                                   |                                                                                                                                           |
| mRID                                       | The identification of the location being described.                                                                                       |
| coordinateSystem.mRID                      | A01 = ED50<br>A02 = OSGB36<br>A03 = WGS84<br>A04 = GTRF<br>Refer to ENTSO-E code list for having more description about coordinate system |
| start_DateAndOrTime.date Date              | The date that the regional                                                                                                                |
| end_DateAndOrTime.date Date                | The date that the regional                                                                                                                |
| positionPoints.xPosition                   | Latitude                                                                                                                                  |
| positionPoints.yPosition                   | Longitude                                                                                                                                 |
| positionPoints.zPosition                   | Altitude                                                                                                                                  |

Attribute type and value maps to codelist definition document

Table 9 - Codelist CoordinateSystemType

| Code | Title  | Description                                                                                                                                                                                                                                                                                                                                                    |
|------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A01  | ED50   | ED 50 (European Datum 1950) is a geodetic datum which was defined after World War II for the international connection of geodetic networks.                                                                                                                                                                                                                    |
| A02  | OSGB36 | Ordnance Survey Great Britain 1936. The Ordnance Survey (OS) devised the national grid reference system, and it is heavily used in their survey data, and in maps (whether published by the Ordnance Survey or commercial map producers) based on those surveys.                                                                                               |
| A03  | WGS84  | The World Geodetic System version 1984, for use in cartography, geodesy, and navigation including by GPS. It comprises a standard coordinate system for the earth, a standard spheroidal reference surface (the datum or reference ellipsoid) for raw altitude data, and a gravitational equipotential surface (the geoid) that defines the nominal sea level. |
| A04  | GTRF   | Galileo Terrestrial Reference Frame                                                                                                                                                                                                                                                                                                                            |

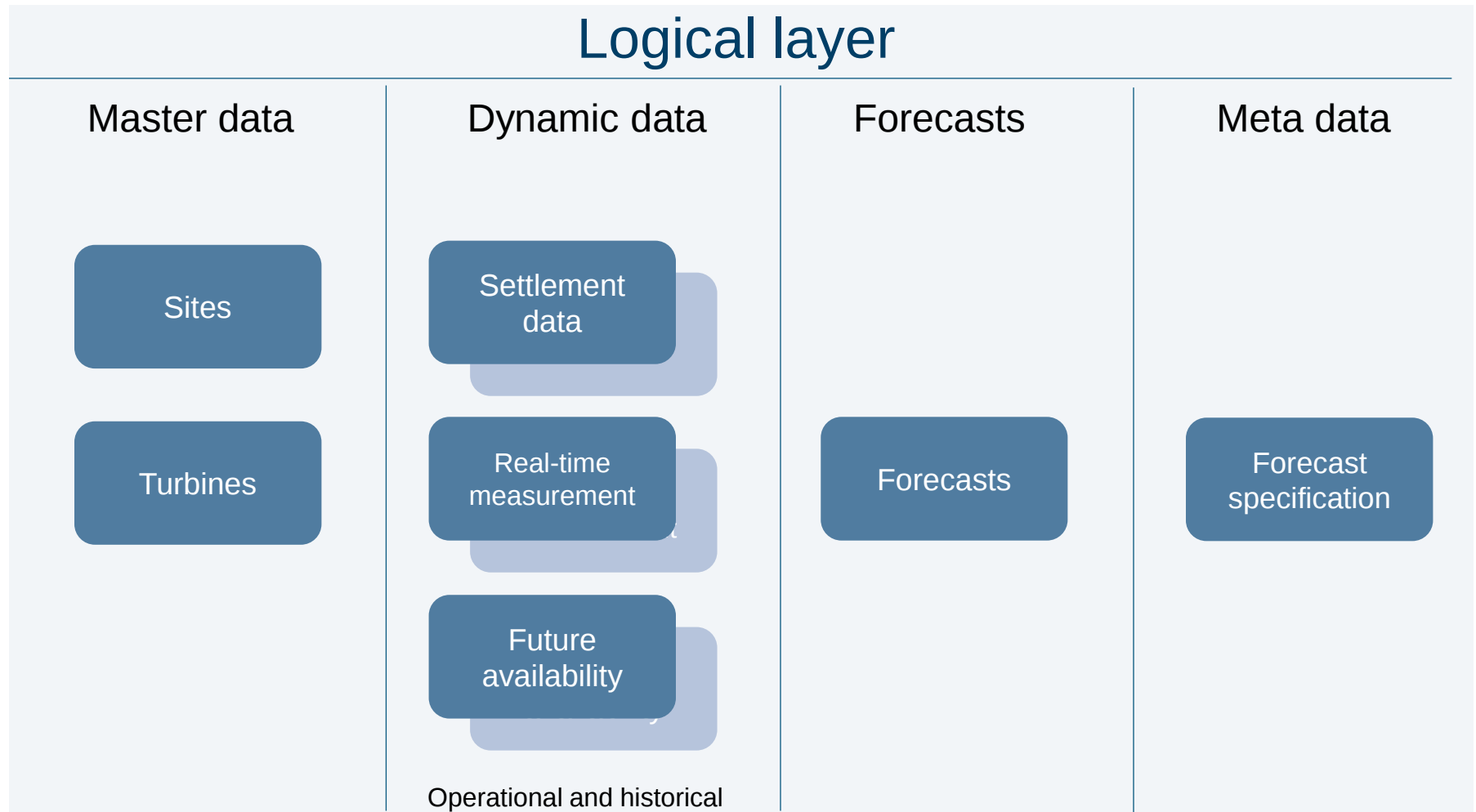
# Data Format and Communication Standards to Support Forecasting Services

## Example 2: IEA Task 36 WP 2, Sub-Task 2.1 recommended best practice document

```
<xs:element name="WindSCADA">
  <xs:complexType>
    <xs:sequence>
      <xs:element maxOccurs="unbounded" name="WindPark">
        <xs:complexType>
          <xs:attribute name="ID" type="xs:string" use="required" />
          <xs:attribute name="Time" type="xs:dateTime" use="required" />
          <xs:attribute name="Mw" type="xs:decimal" use="required" />
          <xs:attribute name="Availabilty" type="xs:decimal" use="optional" />
          <xs:attribute name="CurrentActivePower" type="xs:decimal" use="optional"/>
          <xs:attribute name="Curtailment" type="xs:string" use="optional" />
          <xs:attribute name="WindSpeed" type="xs:decimal" use="optional" />
          <xs:attribute name="WindDirection" type="xs:decimal" use="optional" />
          <xs:attribute name="AirTemperature" type="xs:decimal" use="optional" />
          <xs:attribute name="AirPressure" type="xs:decimal" use="optional" />
          <xs:attribute name="Outage" type="xs:decimal" use="optional" />
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

**XML Schema Definition Example from forecast trial and benchmark execution**

# Data Format and Communication Standards to Support Forecasting Services



***There has to be a clear delineation between different data layers since similar data parameter will appear in multiple layers (e.g., weather measurement and forecast)***

# Data Format and Communication Standards to Support Forecasting Services

## Current Approach and Work

### Two levels of standardization

#### Level 1:

High Level / Std terms

- ✓ Detailed documentation
- ✓ Data type definitions (e.g., metadata, dynamic data)
- ✓ Data Exchange Options

#### Level 2:

Repeatable / Scalable

- ✓ Level 1 + ....
- ✓ Units defined and articulated
- ✓ Attribute / Value tables are extensible to other renewables
- ✓ Will use IEC 63235 Energy market CIM standard

| 1. Forecast System Specifications |                                                                |       |                                                  |
|-----------------------------------|----------------------------------------------------------------|-------|--------------------------------------------------|
| Data field                        | Description                                                    | Value | Example                                          |
| Power unit                        | Which power unit do you want for the forecasted values?        |       | V,...                                            |
| Time zone                         | What should be the time zone of the forecasted values?         |       | EST,...                                          |
| Forecast update frequency         | How frequent do you want to update the forecast?               |       | every 4 hours                                    |
| Forecast granularity              | What is the time interval between two forecasted values?       |       | 60 min<br>(one prediction every hour)            |
| Forecast horizon                  | What is the maximum horizon you want us to forecast? In hours. |       | 168 hours<br>(predictions up to 168 hours ahead) |

**EXAMPLE – Level 1 Data Standard**

***Two-level approach captures most renewable energy forecast consumers and establishes or borrows from common industry terminology***

# Data Format and Communication Standards to Support Forecasting Services

## Current Approach and Work – Development

- ✓ Forecast providers and forecast users (utilities, market participants) are invited to contribute knowledge, use cases, recommendations
- ✓ Core working group as well as reviewers and followers
- ✓ Structured process for developing, reviewing and releasing new best practice version
- ✓ Further review of existing and related standards
- ✓ IEA Task 36 review process
- ✓ Coordinate with other relevant groups and initiatives (e.g., IEC 63043, SFIP2, ETSI, ESIG)

***Success will be measured by the adoption of recommended practices by Forecast Providers which will trickle to Consumers***

# Data Format and Communication Standards to Support Forecasting Services

## Future More “Ideal” Scenario

- Well defined terminology and definitions
- Standard way of exchanging data that is adaptable/abstracted from existing and dynamical systems (e.g., agnostic to changing IT security constraints)
- Publicly available practices / standards easily discoverable
- All parties more satisfied with outcomes
- Free up time for Forecast Providers to focus on:
  - Modeling and accuracy improvements
  - More complex and atypical business requirements
- Forecast Consumers can easily test and determine value of forecast product



***Ultimately, improved forecast quality and lower costs can be achieved through recommended practices and standards***