Results of a survey on international best practice in load forecasting

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- SC C1 System Development and Economics

- Working Group C1.32 established in 2014

"**Establishing best practice approaches for developing credible electricity demand and energy forecasts for network planning**"

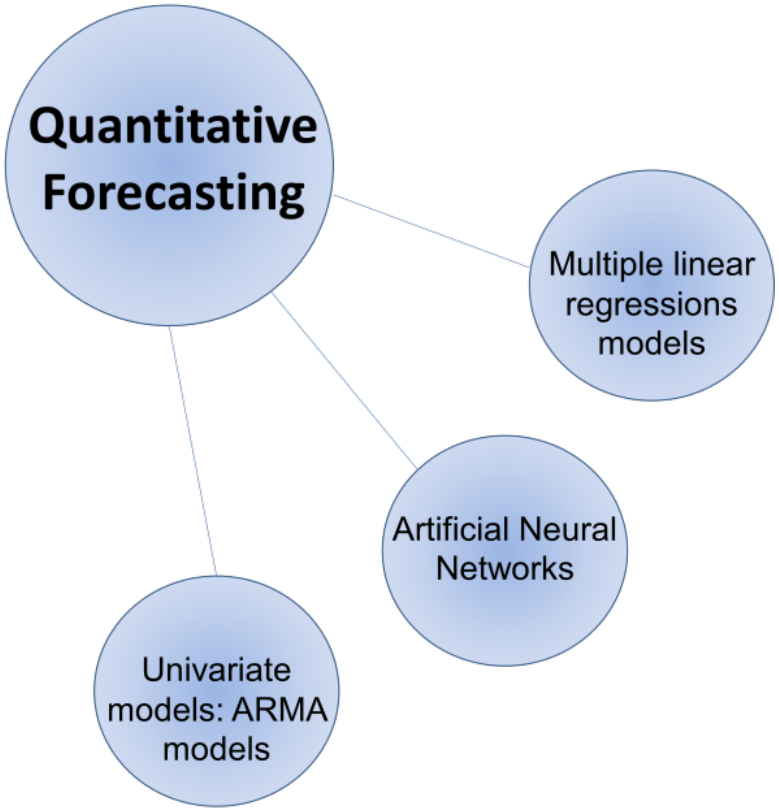
- Working Group has 20 members from 16 Countries

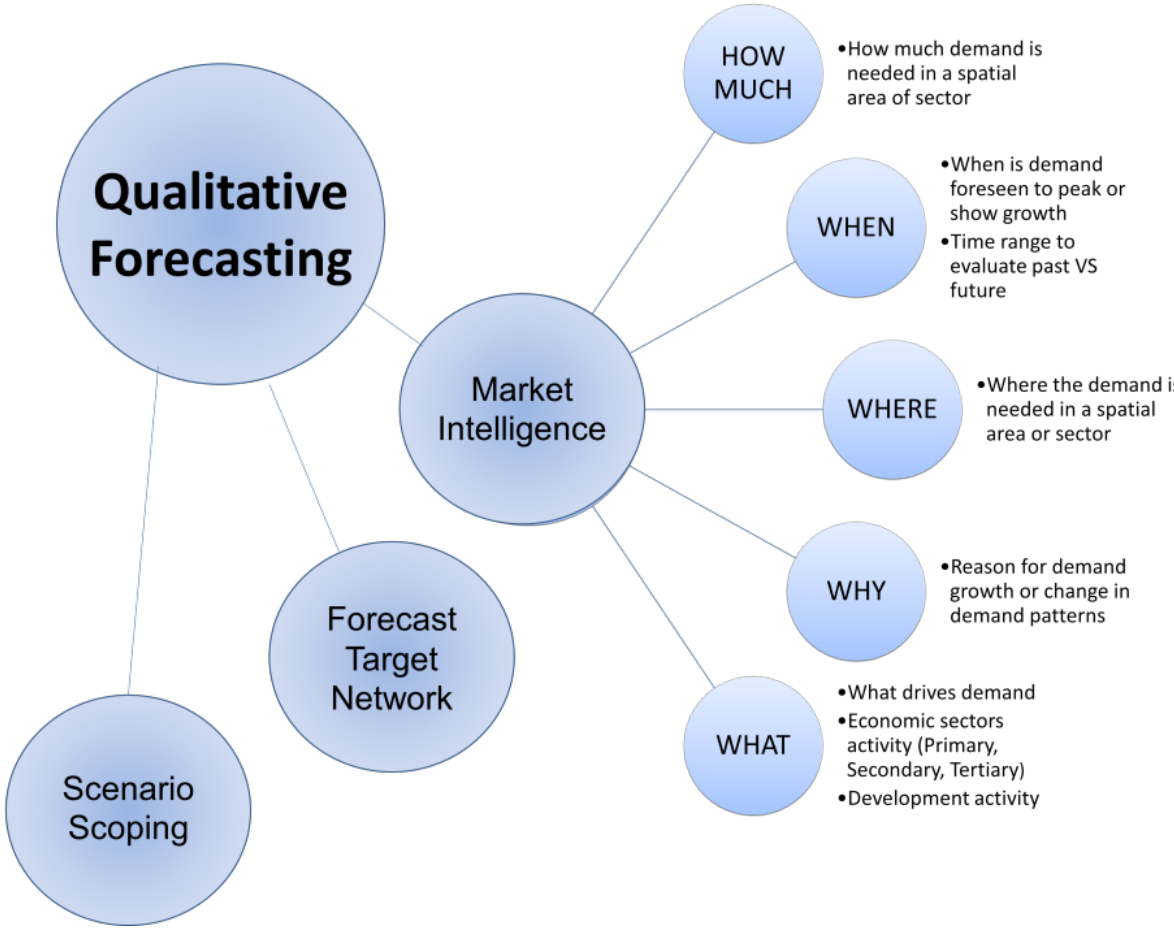
WG C1.32 Establishing best practice approaches for developing credible electricity demand and energy forecasts for network planning

- **Scope**: This working group aims to examine the demand and energy forecasting techniques currently being employed by network companies around the world. The scope will be addressed by developing and executing an electronic survey of network companies to identify current forecasting issues and best practice approaches.
- Terms of reference: http://www.cigre.org/Diaporama/CIGRE-active-Working-Groups
- **Deliverables** : Report to be published in Electra or technical brochure with summary in Electra
- **Time Schedule**:
  - Start : July 2014 Final report : December 2016

Some areas of investigation

- Long term vs short term
- Top down vs bottom up
- Time horizon
- How often methodologies are revised
- What needs to be improved


Quantitative Forecasting
Multiple linear regressions models
Artificial Neural Networks
Univariate models: ARMA models


Qualitative Forecasting
Market Intelligence
HOW MUCH
•How much demand is needed in a spatial area of sector
WHEN
•When is demand foreseen to peak or show growth
•Time range to evaluate past VS future
WHERE
•Where the demand is needed in a spatial area or sector
WHY
•Reason for demand growth or change in demand patterns
WHAT
•What drives demand
•Economic sectors activity (Primary, Secondary, Tertiary)
•Development activity
Forecast Target Network
Scenario Scoping

WG C1.32 Survey

- The final survey was sent around to CIGRE members on October 5, 2015, with the request to respond by November 30, 2015.
- By the end of November 27 members had responded. Following a reminder another 7 responses were received in December and January providing a total of 34 fully completed surveys.
- The respondents represent 18 countries

Africa	3%
Asia	28%
Europe	28%
North America	3%
Oceania	34%
South America	3%

Respondents

Distribution	10%
Independent System Operator	17%
Integrated transmission grid owner and system operator	34%
Transmission and distribution network owner	3%
Transmission grid owner	17%
Vertically integrated distribution & transmission network company	3%
Vertically integrated generation and transmission	10%
Vertically integrated generation, transmission and distribution.	3%

On which geographical or client level do you do the forecast?		
Answer Options	**Response Percent**	**Response Count**
national level	45.5%	15
regional level	48.5%	16
substation level	54.5%	18
client level	18.2%	6
voltage level	6.1%	2
Other (please specify)	18.2%	6
	answered question	**33**
	skipped question	**1**

Short term vs long term forecasts

What is the relationship between forecasting data used for short-term operational planning and long-term grid reinforcement?		
Answer Options	**Response Percent**	**Response Count**
Use of the same historic transmission measured data	58.1%	18
Use of the same data provided by generation	16.1%	5
Use of the same data provided by connected parties (e.g. distribution company)	19.4%	6
Same level of analysis (number of system nodes, substations, ...)	22.6%	7
Similar forecasting methodology	9.7%	3
No relationship	25.8%	8
Please feel free to provide information in addition or explanation of the answers above		12
	answered question	31
	skipped question	3

Do you currently take into account the impact of the following issues? If so, please indicate whether you do so on a local level, national level or both, and briefly explain how in the free text box.

Answer Options	yes - local only	yes - national only	yes - local and national	no	Response Count
the impact of temperature	11	4	9	6	30
electric vehicles	3	4	4	14	25
heat pumps	3	2	2	17	24
heating appliances	4	1	3	16	24
air conditioners	6	0	7	10	23
penetration of renewable energy sources (RES)	10	4	10	4	28
storage	3	2	4	14	23
demand side response management	5	3	2	15	25
increased electric efficiency	4	6	5	12	27
Please elaborate					13
			answered question		30
			skipped question		4

From which external sources do you receive input information for your forecasts?

Answer Options	DSO	Direct client (consumer)	Regulator	Government institution	Private institution	Producer	Other	Response Count
Metering data	14	13	2	0	2	5	2	21
Feedback on the forecast results	7	5	9	5	3	1	5	21
Validation of the accuracy of the source data used	7	2	6	4	3	0	3	16
Client projects (e.g., new client, factory closure or expansion)	7	19	0	1	0	1	2	23
Transfers in the DSO network	14	3	1	0	0	0	1	17
Growth rates on substation or client level	12	7	3	2	0	0	4	19
Sectoral growth rates	2	2	4	10	4	0	5	20
Macro economic growth rates	1	1	2	15	4	0	3	20
Local production	9	4	1	7	2	0	1	15
Population	3	0	1	14	4	0	6	22
External load/energy forecasts	4	7	1	6	4	0	3	18
Weather statistics (historic)	1	0	0	15	3	0	6	22
Weather forecasts	1	0	0	11	4	0	5	19
Other	0	0	0	1	0	0	0	1
Feel free to elaborate								7
							answered question	29
							skipped question	5

Top down vs Bottom up

Which approach do you follow for the load forecast?		
Answer Options	**Response Percent**	**Response Count**
Top-down approach only	14.8%	4
Bottom-up approach only	18.5%	5
A mix of top-down and bottom-up (consolidation of information on micro- and macro-level)	66.7%	18
Feel free to elaborate		7
	answered question	**27**
	skipped question	**7**

What do you believe to be the three most important aspects of your forecasts that you will need to change or incorporate in the next 10 years to improve your forecasts?	
penetration of renewable energy sources (RES)	67%
demand side response management	47%
electric vehicles	43%
storage	43%
electric efficiency	33%
air conditioners	20%
temperature	20%
heat pumps	3%
Other (please specify)	0%

Key observations

- Almost all forecasts are required by regulation, yet mostly the methodology is not prescribed.
- Most respondents used demand forecasting software that was developed in-house.
- Most forecasting teams (66%) consist of a small group up to 5 people.
- The forecast methodology is frequently revised.
  - 53% of respondents revised it in the last 2 years and of this group almost all (88%) are planning to revise methodology again in the next 2 years
  - For those who reviewed the methodology more than 2 years ago most also plan to revise again in the next years .

Key observations

- The most important current aspects to improve in the forecast method are, according to the respondents:
  - Input from external sources (such as economic growth, population, etc)
  - Measurement data.
  - Input from DSO level (such as known future developments on demand side)
- The most important aspects to incorporate in demand forecasts in the coming 10 years
  - Distributed Renewable Energy Sources (RES)
  - Demand side response management
  - Storage and electric vehicles

Recommendations for future work

- Survey of the capabilities and performance of in-house demand forecasting tools

- Development of methods to incorporate the following into demand forecasting.
  - Distributed Renewable Energy Sources (RES)
  - Demand side response management
  - Storage and electric vehicles

Conclusions

- WG C1.32 has carried out an international survey on load forecasting
- Best practice is not evident in all aspects of load forecasting
- Future load forecasting will need to incorporate RES, storage and DSM
- Small distributed RES generation will need to be forecast as generation rather than as negative load.
- The methodologies for forecasting and managing interactions between load and RES will likely evolve rapidly over the coming years.
- Technical brochure published in December 2016