

Recommendation

ITU-T L.1384 (08/2024)

SERIES L: Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant

Energy efficiency, smart energy and green data centres

Implementation of a virtual micro power station at base station sites

ITU-T L-SERIES RECOMMENDATIONS

Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant

OPTICAL FIBRE CABLES	L.100-L.199
Cable structure and characteristics	L.100-L.124
Cable evaluation	L.125-L.149
Guidance and installation technique	L.150-L.199
OPTICAL INFRASTRUCTURES	L.200-L.299
Infrastructure including node elements (except cables)	L.200-L.249
General aspects and network design	L.250-L.299
MAINTENANCE AND OPERATION	L.300-L.399
Optical fibre cable maintenance	L.300-L.329
Infrastructure maintenance	L.330-L.349
Operation support and infrastructure management	L.350-L.379
Disaster management	L.380-L.399
PASSIVE OPTICAL DEVICES	L.400-L.429
MARINIZED TERRESTRIAL CABLES	L.430-L.449
E-WASTE AND CIRCULAR ECONOMY	L.1000-L.1199
POWER FEEDING AND ENERGY STORAGE	L.1200-L.1299
ENERGY EFFICIENCY, SMART ENERGY AND GREEN DATA CENTRES	L.1300-L.1399
ASSESSMENT METHODOLOGIES OF ICTS AND CO2 TRAJECTORIES	L.1400-L.1499
ADAPTATION TO CLIMATE CHANGE	L.1500-L.1599
CIRCULAR AND SUSTAINABLE CITIES AND COMMUNITIES	L.1600-L.1699
LOW COST SUSTAINABLE INFRASTRUCTURE	L.1700-L.1799

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T L.1384

Implementation of a virtual micro power station at base station sites

Summary

Recommendation ITU-T L.1384 provides technical specification on how to utilize the energy storage system installed in base station sites to realize a coordination optimization to participate in power grid dispatching as a virtual power plant.

This solution helps the site owner to build a virtual micro power station with a telecommunication base station energy storage system, in this way the site owner can significantly reduce the construction and operation cost of the power feeding system for the base station sites, contribute to reduce the carbon emissions of energy sector improving the integration of renewable sources in a grid, and achieve optimal energy scheduling.

History*

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T L.1384	2024-08-29	5	11.1002/1000/15998

Keywords

Base station power management system, lithium battery, VMPS.

* To access the Recommendation, type the URL <https://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, and information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents/software copyrights, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the appropriate ITU-T databases available via the ITU-T website at <http://www.itu.int/ITU-T/ipr/>.

© ITU 2024

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

Table of Contents

	Page
1 Scope	1
2 References.....	1
3 Definitions	1
3.1 Terms defined elsewhere	1
3.2 Terms defined in this Recommendation.....	1
4 Abbreviations and acronyms	2
5 Conventions	3
6 Basic requirements on a virtual micro power station	3
6.1 VMPS architecture	3
6.2 Power supply system in base station requirements	5
6.3 VMPS basic requirements	8
7 Standard flow of communication base station site accessing VMPS	10
7.1 Access application	10
7.2 Verification and testing of response ability	11
7.3 Review of response capability	11
7.4 New resource management.....	11
7.5 Signing agency agreement.....	11
8 VMPS operation and maintenance requirements	11
8.1 Maintenance arrangement	11
8.2 Exception handling.....	11
8.3 Regulation and operation management	12
9 Software level requirement.....	12
9.1 Aggregation platform	12
9.2 General	12
9.3 Software requirement	12
9.4 Base station power management system	12
9.5 Lithium battery energy management system.....	13
10 Hardware level requirement	14
10.1 AC meter requirements.....	14
10.2 Battery requirements	14
Appendix I – Elisa use case	15
Bibliography.....	18

Introduction

The implementation of renewable energy sources providing electricity energy to the grid arrive in these years at more than 10% of total electrical energy at the worldwide level as reported by the International energy agency (IEA) in Figure 1 [b-IEA]. The percentage is different from country to country; in EU countries it is reported that considering the year 2022, 22% of the EU's electricity was generated from wind and solar [b-Energy monitor]. Figure 2 shows the percentage of electrical energy sources for different EU countries and this percentage will increase in future following the goal of the EU to move to net zero. "In March 2023, the EU agreed on stronger legislation to increase its renewables capacity, by raising its binding target for 2030 to a minimum of 42.5%, up from the current 32% target, with the ambition to reach 45%. This would almost double the existing share of renewable energy in the EU"¹.

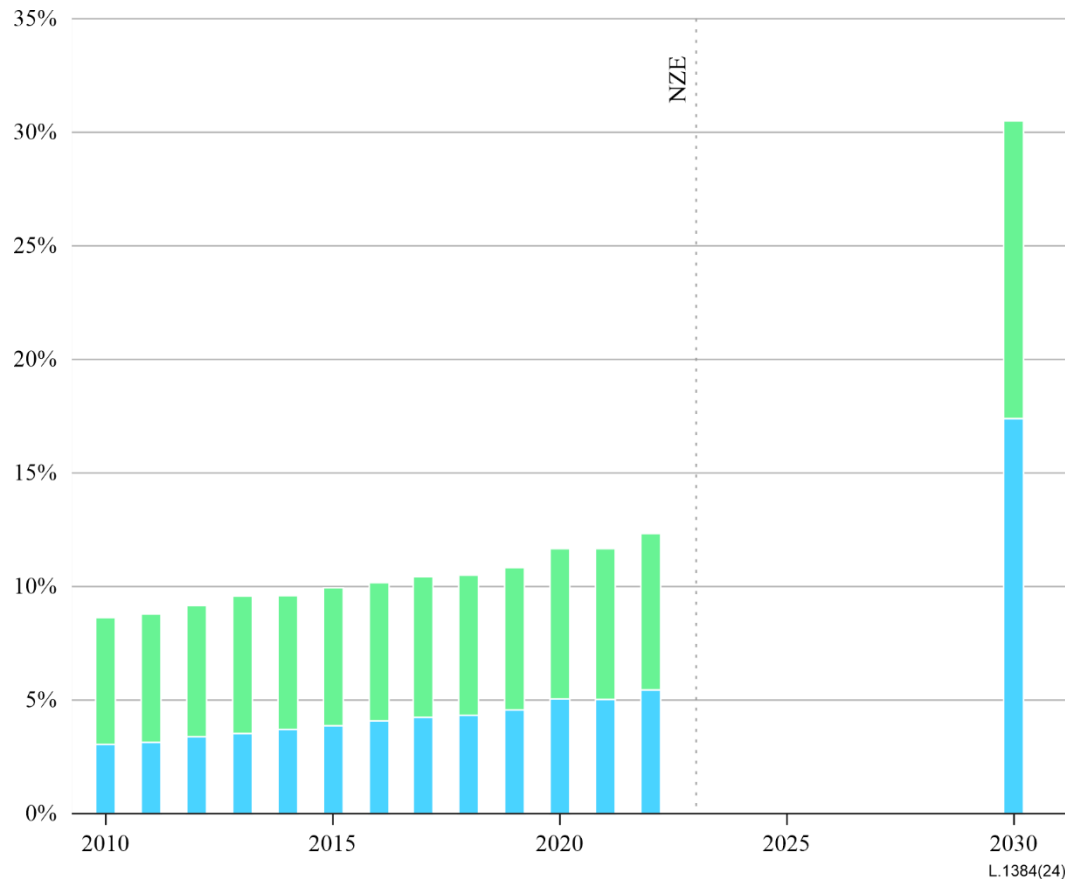


Figure 1 – Renewables share of total energy supply in the net zero scenario, 2010-2030

¹ https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

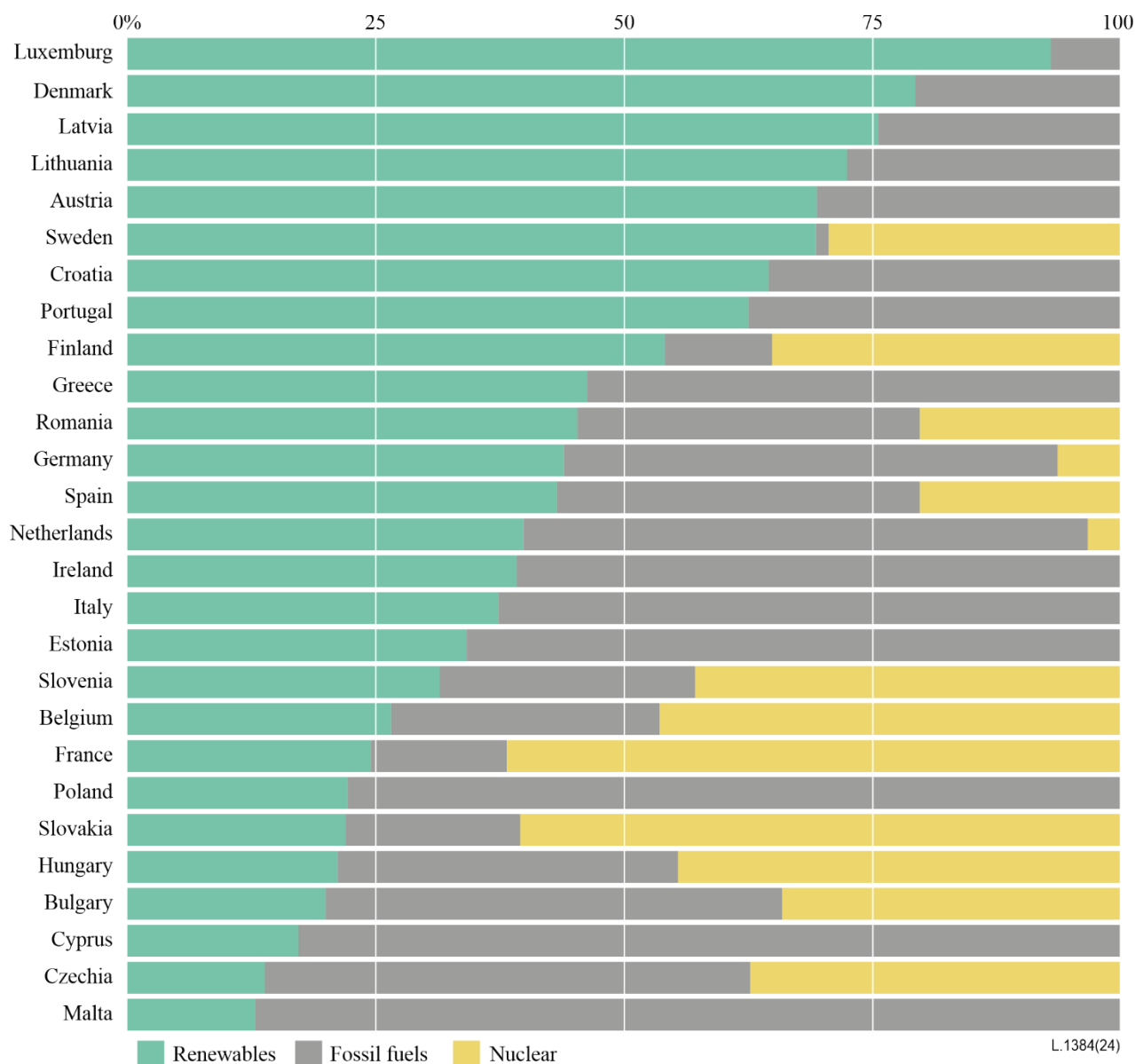


Figure 2 – Net electricity generation in the EU by fuel type (2022) [b-EU electricity]

This creates a possible risk on grid stability due to the unpredictable and stable generation from renewable sources and the increase of distributed generation of electrical energy, in particular solar.

In order to work properly, power grids need to maintain a frequency of 50 Hz or in some countries 60 Hz with a fixed tolerance. If they surpass a certain threshold (+0.2 Hz), or even a blackout can follow voltage reduction, the three possible conditions of the grid network depending on the load and generation are reported in Figure 3 electric grid balance.

The system operators are responsible for maintaining the grid frequency and use balancing services. To keep the grid frequency stable, it needs to be in balance at all times. Up to now, power plants that can be controlled well and switched fully automatically, such as pumped-storage power plants or gas turbines, are the main providers of secondary reserve production and consumption traditional; but in the future, the percentage of energy from traditional power will decrease and the energy from renewable sources will increase.

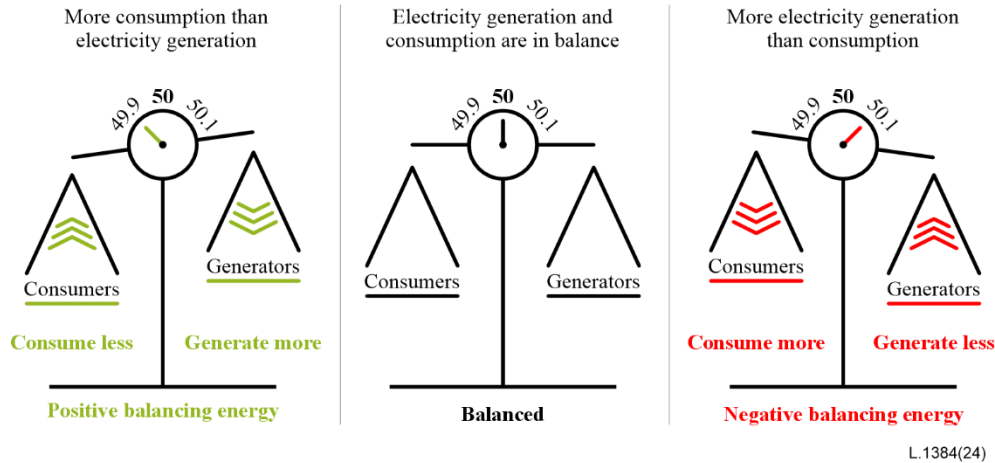


Figure 3 – Electric grid balance

Normally two types of regulation are considered in the grid domain: See Figure 4 balancing services according to the European network of transmission system operators (ENTSO-E).

- Primary regulation acts automatically on each production unit, accelerating or slowing down the speed of rotation and, consequently increasing or decreasing the power generated: each production unit is characterized by a kind of inertia called "regulating power" (which depends on how it is built) defined as the power provided for a frequency change of 1 Hz.
- The regulating power in turn defines the "statism", the percentage of frequency variation divided by the percentage of power output variation.
- Secondary regulation is instead orchestrated centrally by the transmission system operator (TSO) which sends a signal directly to the generators, it varies its output by drawing on the so-called "participation half-band", i.e., the share of power which the operator cannot sell but must keep available for this purpose.

If these forms of adjustment fail to bring the frequency back to the operating range, more drastic measures can be triggered such as:

- peaking (activation of the "peak" generators);
- load shedding (scheduled detachment of loads according to a predetermined order of priority);
- blackouts (when machine protections intervene, causing a progressive and catastrophic detachment of loads).

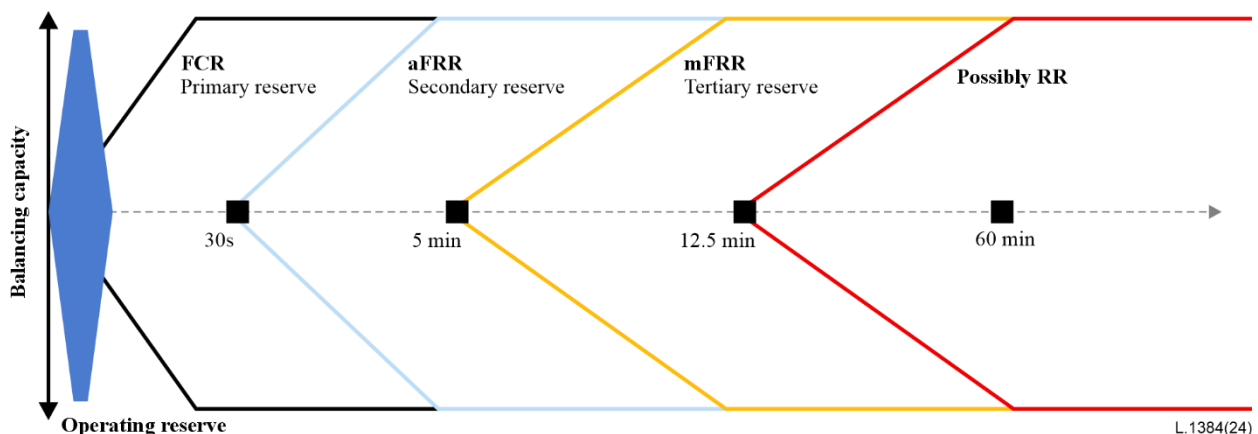


Figure 4 – Balancing services according to ENTSO-E

A solution like virtual power plant can support this need providing the possibility to decrease the load on the grid contributing to having a good balance on the network.

Market design and rules for providing frequency regulation vary around the world. Grid owners use this service from different providers based on the remunerative fees and based on the availability of the solution and energy provided.

Consider a typical telecommunication network based on many sites spread in a territory with different power sizes, it is possible to think about using it to support the grid during the peak of energy consumption. This will create a distributed regulation of the grid. These sites are small sites, from energy value size, that can cooperate to arrive at the amount of energy requested by the grid around some MW.

In a virtual power plant, decentralized units in a power network are linked and operated by a single, centralized control system. Those units can be either power producers (e.g., wind, biogas, solar, combined heat and power (CHP), or hydropower plants), power storage units, power consumers, or power-to-X plants (such as power-to-heat and power-to-gas). When integrated into a virtual power plant, the power and flexibility of the aggregated assets can be traded collectively. Thus, even small units get access to the markets (like the market for balancing reserve) that they would not be able to enter individually. Any decentralized unit that consumes, stores, or produces electricity can become a part of a virtual power plant.