



Gestionnaire
du Réseau de Transport d'Électricité

RÉSEAU
DE TRANSPORT
D'ÉLECTRICITÉ



DEFINITION OF A PROTECTION SYSTEM FOR THE ACTIVES SUBSTATIONS IN RADIAL NETWORK

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EMTP-RV User group Meeting



Summary

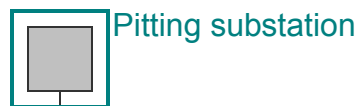
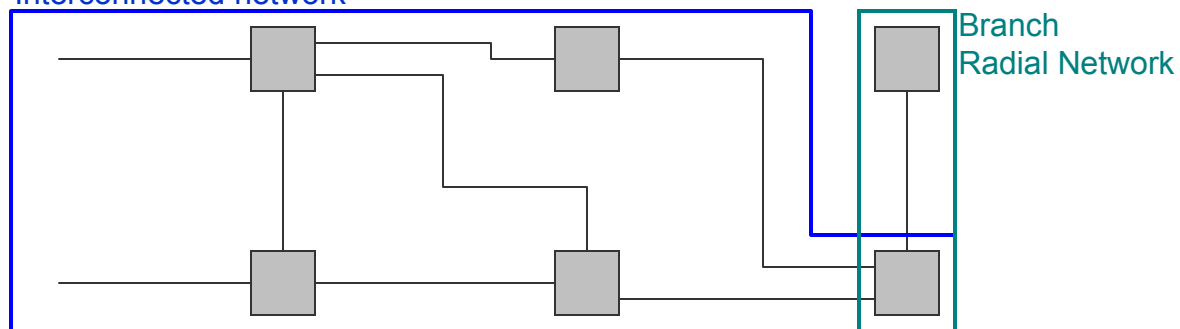
- **Issue**
- **Presentation of the test network**
- **The EMTP diagram**
- **Presentation of the parametric study and its use**
- **Some results**



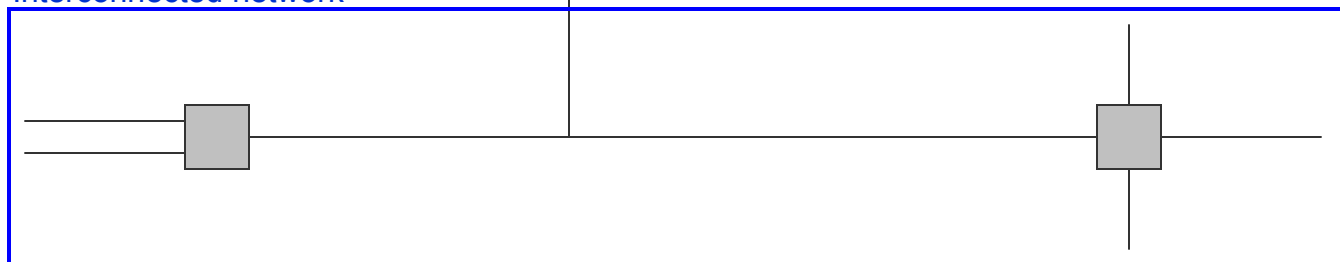
Definitions



Interconnected network

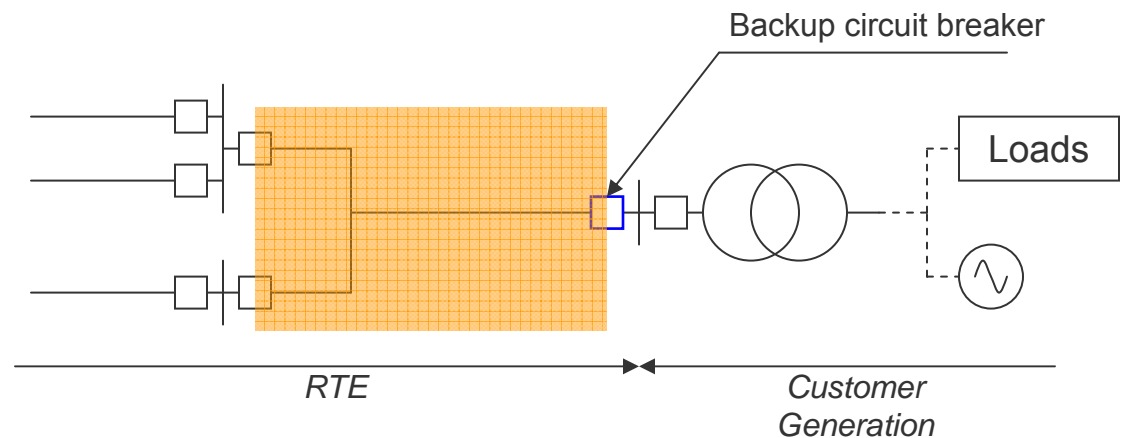
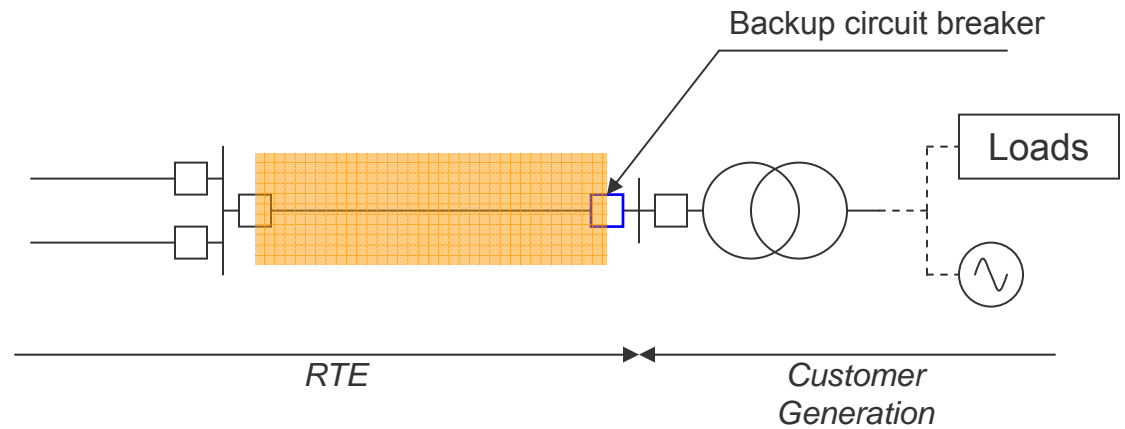


Interconnected network



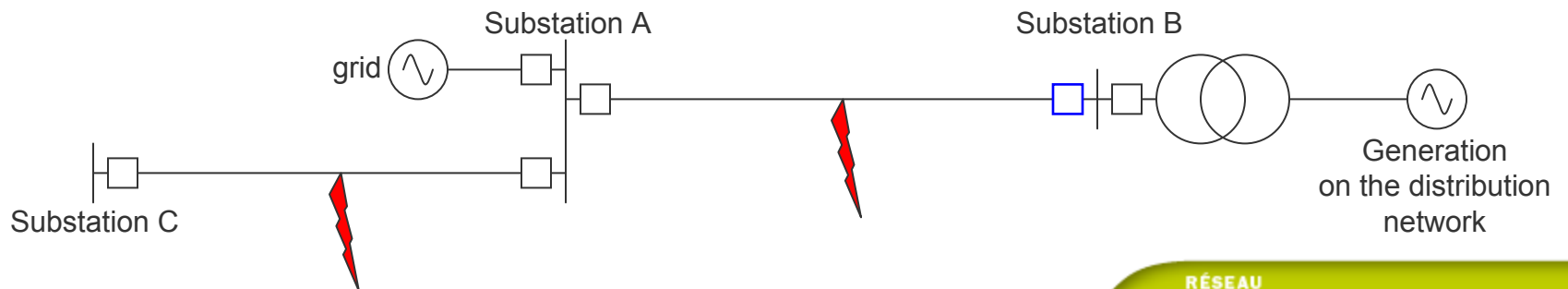
Issue

- Before, many distribution network were only consumers
- Now, some substation become active
 - We have to protect the network
 - The protection of the customer (distribution) can fail
- ➔ RTE has decided to install a backup circuit breaker
- We have to define a protection system for this new circuit breaker
 - ➔ Simple and not expensive



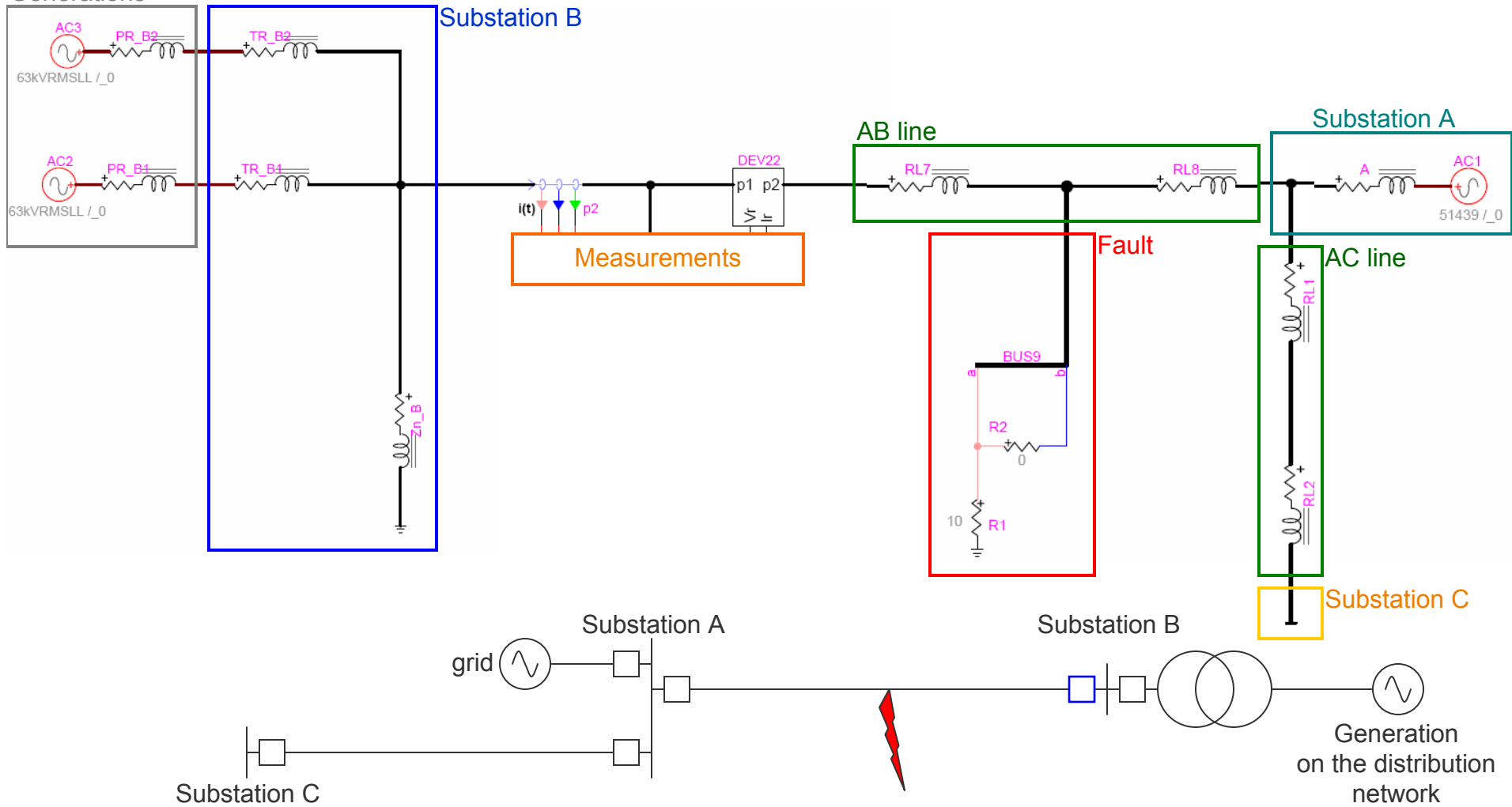
The test network

- Only the radial network will be simulated
- Three substations are represented
- Faults will be applied on AB and AC lines
- The loads on the network are neglected
- Protections and circuits breaker of substations A and C are supposed to be faster than the backup protection in substation B.



The EMTP diagram

Generations



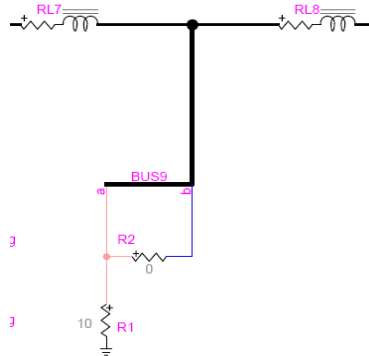


Presentation of the parametric study and its use

- **With this study we have a large number of parameters**
 - Two voltage levels : 63 kV and 90 kV
 - Various connection of transformer : star or delta
 - Two kind of earth connection : floating or directly grounded
 - More than 4 type of faults : single phase, two-phase (to ground or not), three-phase
 - Circuit breaker of substation A open or closed
 - Multiple positions of fault on each line
- **All these cases have to be simulated**
 - It's time consuming...
- **The solution is using an automated parametric study approach**

Presentation of the parametric study and its use

- **Principle**
 - Automated calculation
- **In this study, we vary the position of the fault**
 - One simulation = 10 positions of fault
- **All the results are summarized in an excel file**
- **It's an important saving of time**
- **In the EMTP diagram**



The screenshot shows the 'Liaison' (Connection) dialog box in a software application. The window title is 'Liaison'. The main settings are as follows:

- Liaison:** 63 kV
- Nom:** L1
- Rd:** 1.32 ohm
- Xd:** 7.44 ohm
- Ro:** 6 ohm
- Xo:** 21.4 ohm
- Default:**
- Phase en défaut:** A B C
- Type de défaut:** flottant
- Impédance du défaut:** 0 Ω
- Localisation du défaut:** 100 %

Buttons for 'OK' and 'Cancel' are visible at the bottom right of the dialog box.

Presentation of the parametric study and its use

■ Script developed by S. DENNETIERE of EDF R&D



variableFault.dwj
EMTPWorks JavaScript File
9 Ko

```
//SEBASTIEN DENNETIERE EDF R&D 3 Décembre 2008
//Ce script permet de lancer des simulations paramétriques sur un défaut le long d'une ligne

//Paramètres utilisateur
var faultPositions = 10; // Nombre de défaut le long de la ligne

var meterName = new Array('Uab_mag@control@1', 'Uac_mag@control@1', 'Ubc_mag@control@1', 'Uab_ph@control@1', 'Uac_ph@con
//

//SCRIPT DO NOT MODIFY

//Script used for file management (create, copy and delete)
parseScriptFile('check_my_filename.dwj');
parseScriptFile('make_file_name.dwj'); //always needed

//Script used for starting EMTP simulation
parseScriptFile('program.dwj'); //always needed
parseScriptFile('run_emtp.dwj'); //always needed

cct = currentCircuit();

myLine = cct.devices('Part', 'Liaison');
if(myLine.length != 1) {
    alert('Attention : une seule ligne avec positionnement de défaut peut être placé sur le circuit !!');
    halt();
}

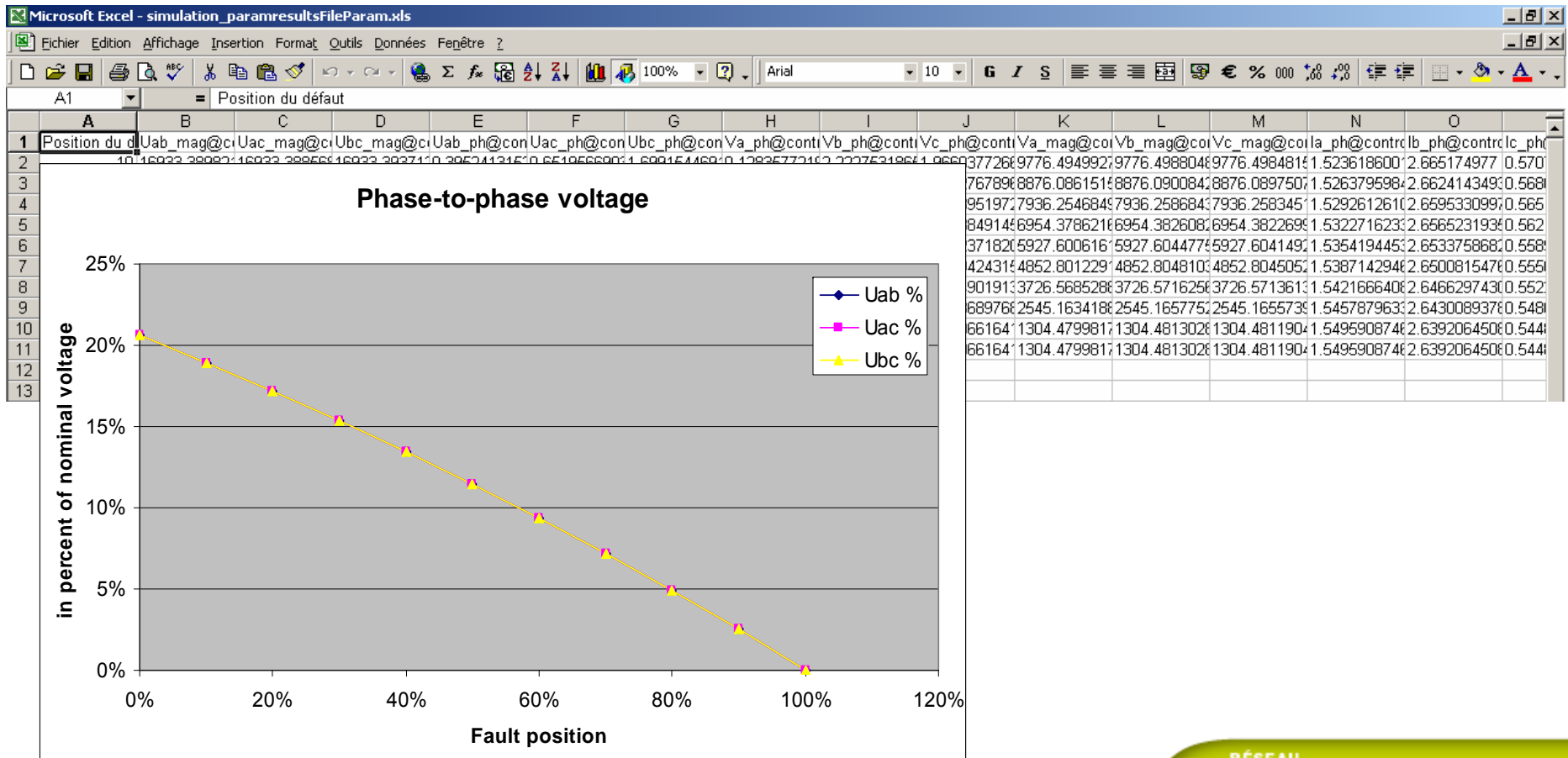
/*Parse all methods for this device
parseScriptFile('liaison_m.dwj');

/*Create the object
oLine = new oDevice_line(myLine[0]);

oLine.ifDefaut = 'ON'
```

Some results

■ Three phase fault





Some results

■ **After the study** : Detection insured ?

	Polyphase faults	Single phase fault
Low generation on the substation < 20 MW	Phase-to-phase protection	Phase-to-phase and a zero sequence protections
High generation on the substation > 20 MW	Phase-to-phase protection	?

- **Problem with single phase faults**
 - because it depends on the grounding of the network
- **We have to use an other protection**
 - This protection has to run with all the power generation (0 MW to 50 MW)
 - No distance protection and differential protection
 - ➔ For example a weak infeed protection
- **The protection system is not defined yet at this day**



Conclusion

- **In this study all types of fault were simulated**
 - Others software didn't make success
- **It's an easy study in EMTP but important for the network life**
- **Use of a script in EMTP to save time**
 - It would be interesting to develop a function in the software to make it approachable easily for all the users of EMTP
- **This study was the first on passive branch which become active**
 - More and more substations become actives
- **The next study will used wind farm models in EMTP**
 - RTE have some models

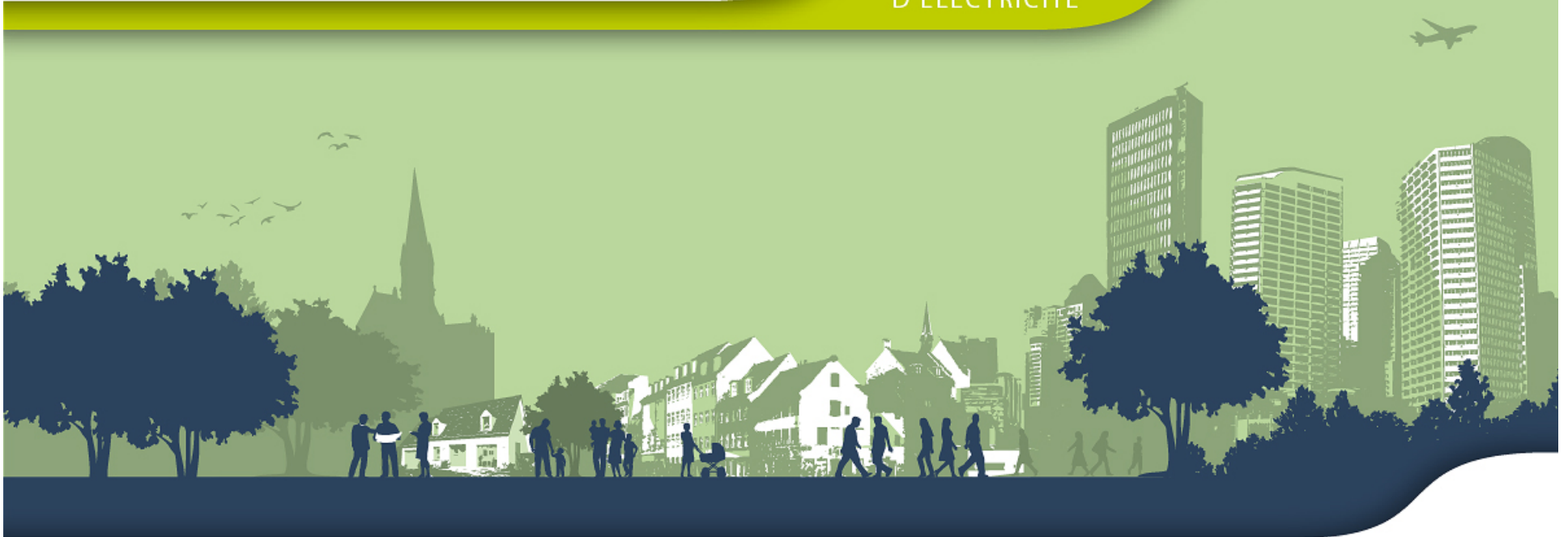


■ *Thank you for your attention*



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