出國報告（出國類別：考察）

臺法工業合作之智慧電表及智慧電網應用研習

服務機關：經濟部能源局
姓名職稱：李君禮組長
派赴國家：法國
出國期間：104 年 7 月 19 日至 7 月 26 日
報告日期：104 年 9 月 11 日

行政院及所屬各機關出國報告提要

出國報告名稱：考察法國智慧電表及智慧電網應用研習

頁數 21 含附件：□是■否

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出國類別：■1 考察 □2 進修 □3 研究 □4 實習 □5 其他

出國期間：104 年 7 月 19 日至 7 月 26 日

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出國地區：法國

分類號／

關鍵詞:智慧電網、智慧型電表基礎建設、需量反應 (Smart Grid、AMI、Demand Response)

內容摘要：

行政院於 99 年 6 月 23 日核定「智慧型電表基礎建設(AMI)推動方案」,正式啟動我國智慧電表建設,台電公司嗣於 102 年完成全數(2.4 萬戶)高壓及 1 萬戶低壓智慧電表建置，並於 103 年配合試行時間電價及需量反應方案，於今(104)年檢討 1 萬戶低壓智慧電表建置成效，重行檢視低壓智慧電表後續推動作法。有鑒於此，法國已完成第一階段 30 萬戶低壓智慧電表建置，並啟動後續大規模建置計畫，可供我國政

策推動參考。本次法國考察行程，以法國配電公司(ERDF)之智慧電表建置計畫及法國政府補助之智慧電網相關專案計畫為重點：

1、參訪法國配電公司 ERDF 之 Linky 測試實驗室及展示館：為確保大規模建置之廠商供貨品質，廠商生產之電表交貨時，需進行抽測監控廠商供貨品質。建置智慧電網教育展示館，以宣導智慧電表推動可便民生活，及推廣電動車建設。

2、訪問法國環境及能源管理局(ADEME)：於 2015 年投入 5 億 9 千萬歐元推動能源與環境議題之研究，就智慧電網方面，由 EDF、ERDF 等電業提供需求，補助經費由專業團隊執行示範計畫，如 GREENLYS、ENERGY POOL、Smart Electric Lyon 等。

3、訪問智慧電網相關廠商：如施奈德投入家庭自動化服務、THB Alliance 專營用電可視化(IHD)服務、SAGEMCOM 提供智慧電表及電網資安服務等。

4、參訪智慧電網示範計畫：如 Smart Electric Lyon、GREENLYS 等示範計畫，推動智慧電網相關應用情境，以探尋智慧電網效益。

目　錄

圖　目　錄

壹、 出國緣起

一、 出國目的

行政院於 99 年 6 月 23 日核定「智慧型電表基礎建設推動方案」，正式啟動我國智慧電表建設，台電公司嗣於 102 年完成全數(2.4 萬戶)高壓及 1 萬戶低壓智慧型電表建置，並於 103 年配合試行時間電價及需量反應方案，於今(104)年檢討 1 萬戶低壓智慧型電表建置成效，重行檢視低壓智慧型電表後續推動作法。有鑒於此，法國已完成第一階段 30 萬戶低壓智慧電表建置，並啟動後續大規模建置計畫，可供我國政策推動參考。

法國早期與臺灣相同，屬於單一電力公司，經配合電業自由化政策，推動廠網分離，即發電廠與輸電網切割成為 EDF、RTE 及 ERDF 等間主要電力公司，其中境內第一大配電公司為 ERDF (Electricité Réseau Distribution France)，目前已擁有 35 萬公里架空輸電網、27 萬公里地下電纜線、3,500 萬用戶、25 個供電區域、1,000 個營運據點，並為國有持股 95%的民營化公司，2012 年投資約 30 億元進行電網更新建設，已完成再生能源超過 1,500MW(相當於 1 座核能發電廠的容量)、30 萬戶智慧電表及 15 個智慧電網示範案等。

就智慧電表推動而言，法國自 2007 年 7 月開放電業自由化後，電力公司面臨強大競爭，除需提升本身經營效能，更需提供客戶更多服務。法國配電公司 ERDF 推動智慧型電表建置計畫，主要係因 2007 年法國能源監管機構(CRE)要求 ERDF 開始進行智慧型電表規劃，故 2008 年在 CRE 支持下與相關利益團體(電力供應商、當地政府、業者、用戶代表等)進行研商，並對智慧電表的功能及配套方案進行研擬，在 2010 年 2 月由 CRE 通過推動法國智慧電表系統的決議，並於 8 月頒布法令施行，預計至 2018 年完成 90%電表更換（電表總數約 3,700 萬個），就推動時程上，亦可配合 2009 年歐盟指令要求於 2020 年智慧電表覆蓋率達到 80%的目標。

實際上法國已於 2012 年完成 30 萬戶智慧電表系統建置，經 2013 年效益評

估後預計推動後續智慧電表建置工作，規劃 2016 年前建置 300 萬戶、2021 年完成 3,500 萬戶建置。法國配電公司 ERDF 推動智慧電表有 6 家參與廠商，包含 Switzerland's Landis+Gyr (蘭吉爾電表公司)、Germany's Elster (德國電表公司)、Spain's Ziv (西班牙電表公司)、French group Cahors' unit Maec (法國電表公司)及 Sagemcom(法國通訊商)，協助測試智慧電表通訊及系統效能，進而研究高度資訊化之衍生配套方案(如資訊安全、法規調整及操作制度)。因此，法國配電公司 ERDF 在智慧電表的推動經驗，非常值得臺灣前往考察與學習。

另外，法國的智慧電網示範案已有 15 個示範案在推動中，包含 Linky projects(智慧電表系統建置)、Issy Grid(智慧電網、智慧水網、智慧停車管理系統及系統整合等)、Infini Drive(電動車整合應用)、Smart Electric Lyon(能源管理系統標準與技術測試)、Smart Grid Vendée Project(再生能源及能源管理系統)、SOGIRD(智慧電網通訊試驗專案計畫)、Greenlys projects(再生能源、智慧電表及電動車之技術整合)、 IGREENGrid projects(義大利、法國、西班牙、德國、奧地利、希臘等國之 255MW 再生能源整合)等。其中智慧電網相關專案主要由法國環境及能源管理局(ADEME)補助推動，且由民間業者共同投入資源。

由於法國在智慧電表及智慧電網的投入較我國多元化，有較多的企業投入共同研究，因此，在推動策略與步驟、技術面臨問題及建置等已有相關經驗，故本次出國計畫實際考察法國智慧電表及智慧電網參與單位，並建立相關連繫窗口，將有助於我國智慧電表後續推動規劃及智慧電網整合情境參考。

二、 行程紀要

(一) 研習日期：104 年 7 月 19 日至 104 年 7 月 26 日，共計 8 日。

(二) 研習內容：本次出國訪問法國環境及能源管理局(ADEME)；法國配電公司 ERDF，及其 AMI 測試實驗室及智慧電網展示室；智慧電網相關廠商如施奈德公司、SAGEMCOM、TBH Alliance；智慧電網示範計畫如 Energy POOL、GREENLYS、Smart Electric Lyon，行程包含測試實驗室、技術展示館、業者及政府部門等單位，透過雙方人員訪談等方式進行政策及技術交流，以瞭解法國智慧電表及智慧電網推動方式及經驗

(三) 出國行程：

	日期	時間	研修內容	單位、講師	研修地點
1	7/19	往程			
2	7/20	14:00-18:00	**ERDF Linky project** 1. Overview of Linky Program 2. Equipment and Lab 3.The meter functionalities 4. Smart metering system : Linky architecture 5. IT Security 6. Focus G3-PLC 7. 意見交流	ERDF Marc DELANDRE (Metering Division Director)	ERDF Linky Lab (European Regional Development Fund)
3	7/21	10:00-12:00	施奈德公司 1.施奈德公司簡介 2.Smart grid and smart metering (promotion, operation and experiences maintenance) 3.Renewable energy connection 4.意見交流	施奈德公司 Isabelle ZHANG (Director Business Development)	施奈德公司 巴黎總部

		14:00-16:00	ERDF 智慧電網介紹 Linky 專案展示室介紹 Linky 未來應用介紹(家庭應用及電動車充電資訊應用)	EDF Marc Boillot (ERDF 國際行係主任及 EDF Senior Vice President, Regional Action, 及 G3 主席)	ERDF 教育展示中心。
4	7/22	10:00-12:00	**SAGEMCOM** 1. SAGEMCOM 公司介紹 2. Linky meter / G3-PLC 3. 意見交流:	SAGEMCOM Jean-Philippe Sacriste (能源部副總) Kaveh Razazian (能源部 CTO) Nabil Sahri (業務主任)	SAGEMCOM OFFICE
		13:30-14:30	**TBH ALLIANCE** 1. TBH 組織簡介 2. 臺灣 AMI Pilot 概況介紹 3. User-end analysis and education 4. 意見交流	TBH Jacques Allard(總裁) Paul Rossines(副總) Remy Marot(發展部主任)	TBH Office
		15:00-17:00	ADEME 1. 法國能源政策簡報 2. 臺灣智慧電網及 AMI 政策介紹 3. 雙方能源政策交流	Dominique Campana(國際公關主任) Martin Regner(智慧電網專案經理)	ADEME Office

5	7/23	移動 巴黎→里昂			
		13:30-15:00	**EnR PooL** 1. Introduction to Demand Response and aggregation 2. EnR-Pool project : How to integrate better renewable energies into the electric system 3. Load management program/Demand Response projects in Taiwan	業務經理 Benoit Duretz R&D 專案經理 Martin Daronnat	EnR PooL Office
		15:30-17:00	**GREENLYS Show Room** 1. 里昂 ERDF GREENLYS 展示館簡介 (1) 里昂 20 萬戶 Linky 專案簡介 (2) GREENLYS 系統整合及應用介紹 (3) GREENLYS Show Room 參觀 2. 臺灣及法國實際建置經驗交流	ERDF 智慧電網專案經理 Paul Morel-Bury	GREENLYS Show Room
6	7/24	13:30-17:00	**SMART ELECTRIC LYON** 1. 里昂 EDF SMART ELECTRIC LYON 展示館簡介 (1) 里昂 20 萬戶 Linky 用戶宣導介紹 (2) SMART ELECTRIC LYON 次世代用戶衍生應用介紹(強調產業參與應用)。 2. SMART ELECTRIC LYON 展示館參觀及技術觀模	EDF 專案經理 Pierre Soubirou	SMART ELECTRIC LYON Show Room

			3. 未來推廣策略交流		
		移動 里昂→巴黎			
7	7/25 7/26	返程			

貳、 研習內容

一、 參訪法國配電公司 ERDF 智慧電表實驗室

為瞭解法國配電網路現況、智慧電表系統及法國電業環境之近況，故訪問法國配電公司 ERDF 計量部門(metering department)，討論法國電力系統架構、智慧電表建設及發展現況、系統效能及後續服務等。法國配電公司 ERDF 是實際負責民眾用電的供電單位，透過電業觀點瞭解法國智慧電表現行制度及相關問題。訪問行程及重點紀錄如下：

1、 ERDF 公司簡介
2、 Linky 計畫
3、 實驗室規模及測試重點介紹
4、 電表功能討論
5、 智慧電表系統架構
6、 資訊安全
7、 國際 PLC 技術討論及 G3-PLC 測試比較
8、 意見交流

法國的電力市場中發電與供電是屬於開放市場，輸電與配電則是屬於管制市場(如圖 1~2 所示)，電網分別為法國電力集團 EDF (Electricite De France)其 100%轉投資的子公司 RTE 與 ERDF 所掌控，而法國政府又持有 85%的 EDF 股權，因此法國的電力公司類似臺灣電力公司。ERDF (Électricité Réseau Distribution France)為法國最大的配電公司，擁有法國 95%的配電網路(120 萬公里)與 3,500 萬個用戶。

目前法國電業自由化後之電力市場架構可劃分成發電業（Producer）、輸電業（Translator）、配電業（Distributor）及售電業/供應商（Retailer/Supply）等 4 部分，其略述如下：

1、發電業：主要為 EDF 公司，電廠總裝置容量占全國 85%，其餘 Suez 等 4 家公司占 6%，餘 9%為工業大用戶自發自用。

2、輸電業：僅有 1 家 RTE（Reseau de Transport d`Electricite）公司，屬 EDF 集團。

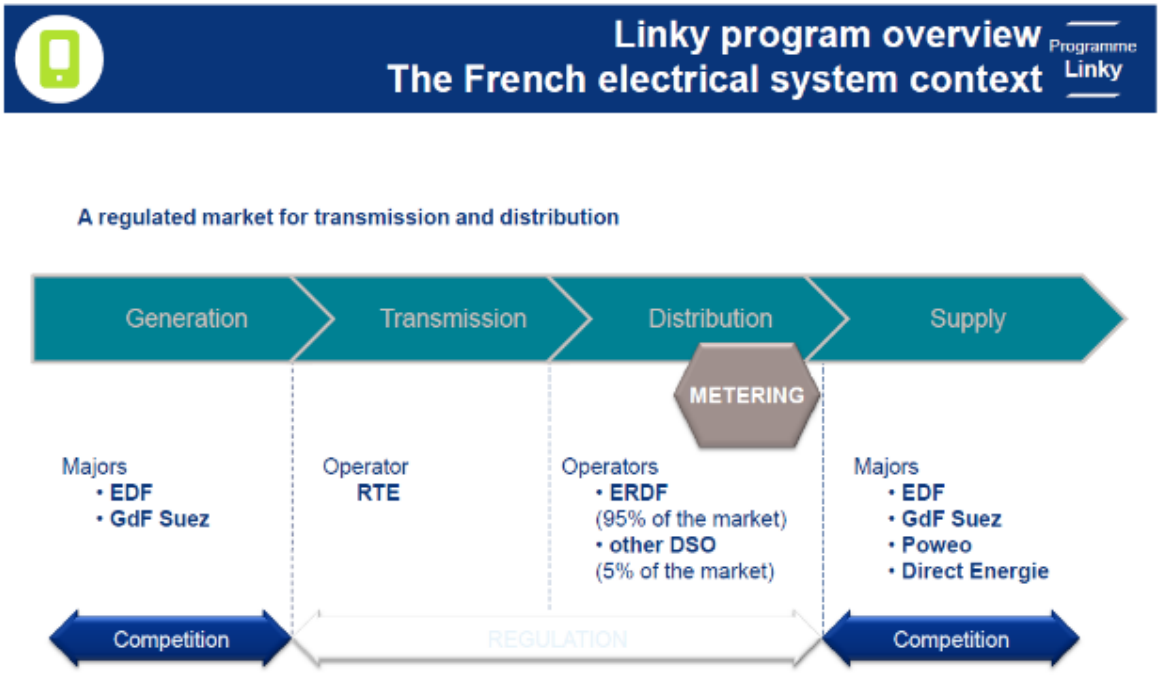
3、配電業：主要為 ERDF（Electricité Réseau Distribution France）公司，屬 EDF 集團，配電業務占全國 95%，其餘約 157 家地區公司，配電業務總和僅占全國 5%。由

於電表業務歸屬配電業負責，故 ERDF 推動智慧電表設置，幾可代表全法國智慧電表推動狀況。

4、售電業/供應商：包含 EDF Blev Ciel 公司（售電業務占全國 98.1%，屬 EDF 集團）、GDF Suez、Direct Energy、Poweo 等約 20 家。

資料來源：ERDF 資料，本報告整理

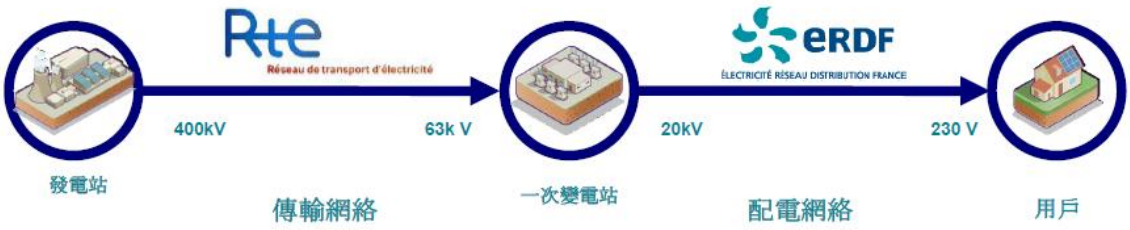
圖 1　ERDF 在法國電力市場的定位



資料來源：ERDF 簡報，本報告摘錄

圖 2　法國電力市場分工與定位

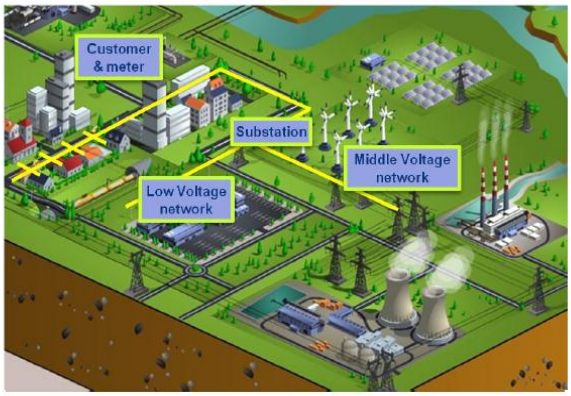
如圖 3 所示為法國輸配電網之架構圖，法國輸電部分超過壓為 400kV、特高壓為 225kV、90kV、63kV，而配電就是 20kV/220V 等。目前法國電表數為 3,500 萬用戶，約臺灣的 3 倍，且近年來法國完成 30 萬戶智慧電表建置後，現在又啟動 300 萬戶建置計畫，預計於 2016 年完成，後續再推動 3,500 萬戶全國建置計畫，預計 2021 年完成。



ERDF is the main Distribution System Operator in France (95%)

100% owned by EDF Group (subsidiary since January 2008)

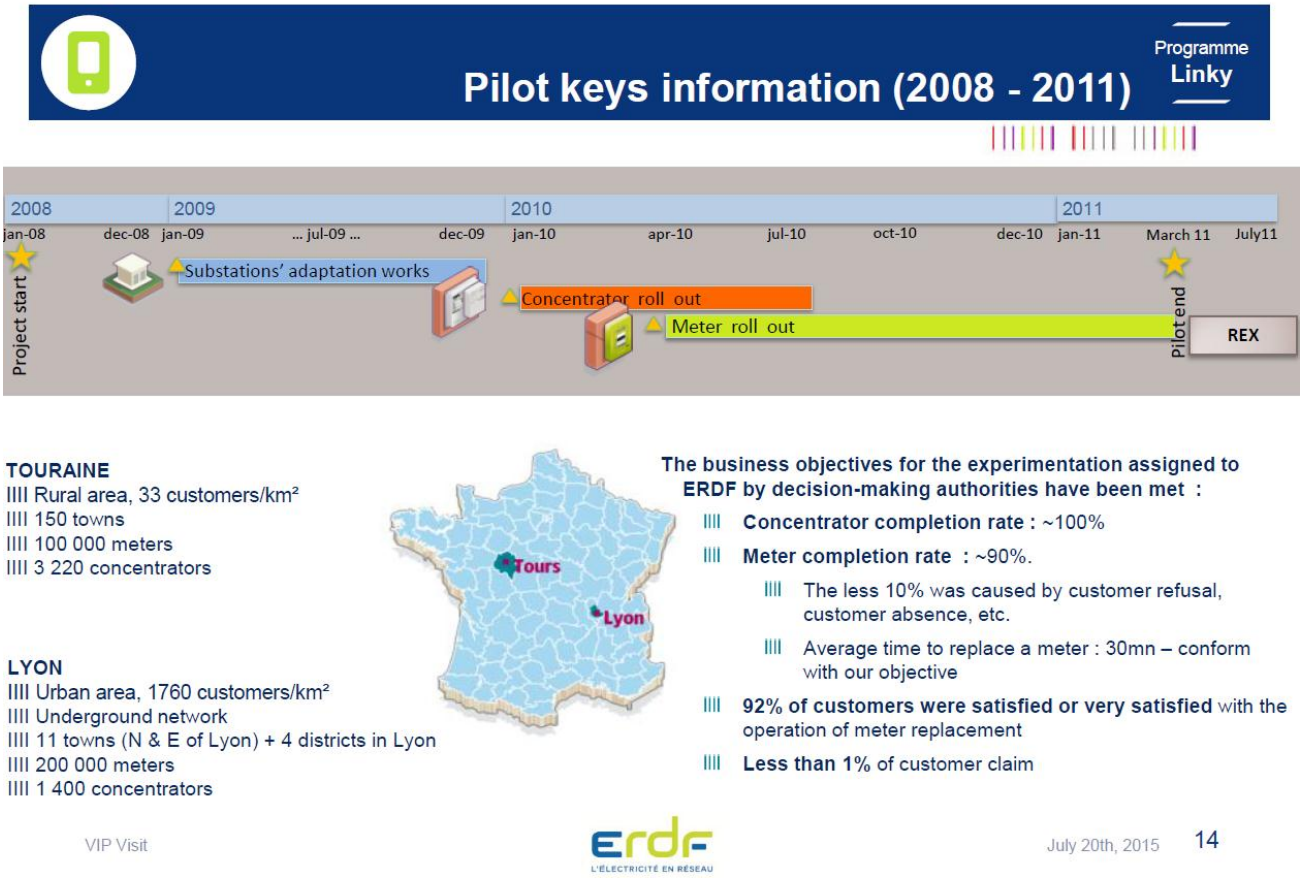
- 36.000 employees
- 1,3 million kilometers of MV/LV distribution lines
- More than 35 million residential (and small C&I) customers and 500.000 C&I
- 13.8 B€ total income (2013)
- 3.2 B€ investments (2013)
- Guarantees non-discriminatory access to the network for suppliers



資料來源：ERDF 提供，本報告整理

圖 3　法國配電網路

法國的智慧電表建置計畫名稱為 Linky project，源自於 2009 年歐盟的一道命令，要求其成員國在 2020 年之前智慧電表的覆蓋率須達 80%以上，於是 ERDF 於 2009 年 4 月成立智慧電表推動規劃專案(Linky project)，如圖 4 所示為第一階段推動 30 萬智慧電表的技術驗證建置(約總用戶數的 1%)，第一階段測試都會區與鄉村兩種型態，試點分別選定 Lyon (20 萬用戶)與 Touraine (10 萬用戶)進行。在 Lyon 都會區建築較密集，只要 1,400 個集中器即可達測試效果，在 Touraine 則需要 3,220 個集中器，故 PLC 技術將因電力線分佈狀況而影響集中器的數目。另外，就建置經驗，因為法國智慧電表係由用戶自由選擇是否安裝，此情況下約有 10%的民眾拒絕安裝，因此，法國對智慧電表的宣傳已有相關規劃，如 Linky 教育展示館的建置。



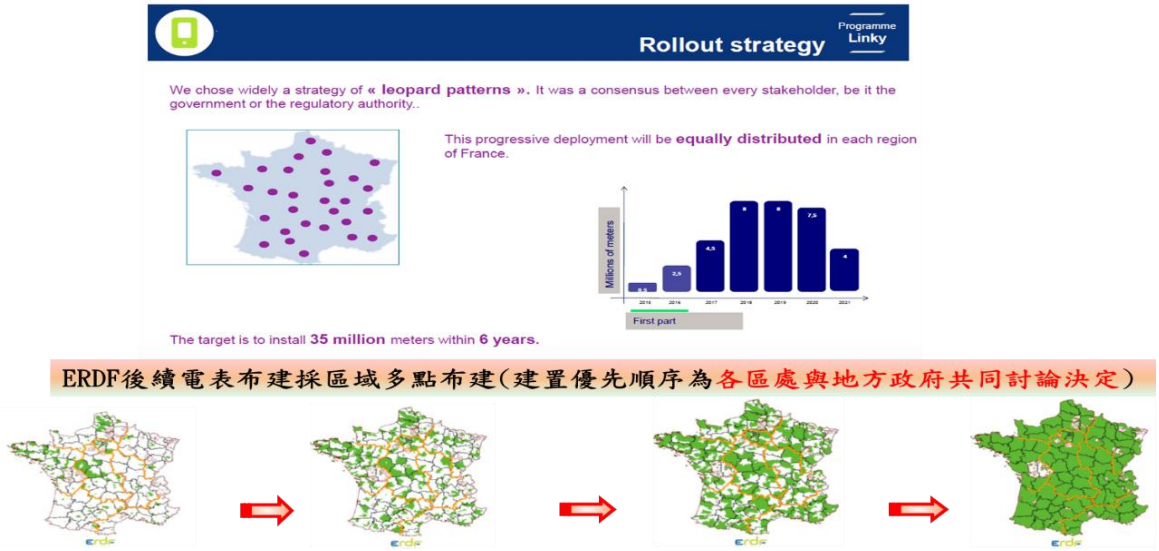
資料來源：ERDF 提供，本報告整理

圖 4　法國 Linky Project pilot(30 萬戶)時程規劃

法國智慧電表測試實驗室主要管控 ERDF 所建置之 Linky 系統品質問題，因此已與廠商合作討論品管流程的合作模式，主要是 ERDF 確認產品規格，而委由廠商生產雛型後供 ERDF 確認規格，經調整後製作一定的批量，確認預量產的產品品質後，再做大規模量產，以減少智慧電表推動後，因產品品質的關係而影響 ERDF 後續運維的困擾。但經過這樣的過程，ERDF 需要對測試的功能很深入的瞭解，並需要相關對應的測試設備，以利進一步驗證廠商交付的產品品質問題及功能是否正確無疑。故 ERDF 已在巴黎建置 Linky 專案測試實驗室。

法國智慧電表的基本功能含顯示、操控、時間電價控制開關、用戶資訊輸出介面(IHD 輸出介面)、保險絲等。細部功能如電表計量暫存器數目(supplier 模式有 10 組、producer 模式有 20 組)、負載紀錄檔(load profile)可為 10/15/30/60 分鐘等設定值、支援電力品質(停電、電壓紀錄等)，其他遠端功能包含斷/復電控制功能、時間電價開關操控、最大額定功能控制等。

ERDF 智慧電表建置主要採 G3 電力線通訊技術(G3-PLC)，該技術主要為窄頻 PLC 通訊技術標準之一，經法國針對國際上常見的窄頻 PLC 技術做比較，G3-PLC 應用 FCC 調變技術且頻寬選擇性較佳，因此法國採用這種通訊技術，且 Linky 針對讀表也定義了一套 IPv6 的通訊層定義，採用 DLMS 等歐規讀表規範，整體而言相當完整。圖 5 所示為法國後續全國 3,500 萬具電表建置規劃情形，採區域多點布建進行，規劃 6 年內完成，先推動 300 萬戶、再進行後續 3,500 萬戶電表建置工作。



資料來源：ERDF 提供，本報告整理

圖 5　法國 Linky 電表分 6 年完成全國規建規劃

二、 參訪施奈德電機公司 (Schneider)

施奈德公司目前已轉型為能源管理公司，公司產品包含配電自動化、工廠節能、商辦節電範疇，如圖 6 所示，透過展示牆說明施奈德公司之工控設備及其開發之監控系統 X-BOX，適用於工業/商業服務及家庭服務。

施奈德公司開發之 Zigbee 模組可支援 Linky 電表之家庭(對內)通訊埠，而與 X-BOX(Home Gateway)互連，進而控制家庭電器設備，達到家庭自動化之能源管理目標。對內通訊有 2 個實體輸出點，採用一個 KNX 協定。

施奈德公司亦配合法國政策在推動電動車投入相關開發，如圖 7 所示施奈德與電動車商合作開發了一套電動車充電管理系統，可支援 GPS 之配電系統圖資，清楚瞭解市區電動車充電站數目及是否有閒置的充電樁可用，另也開發了電動快充技術，一併於本展示館展示。

圖 6　施奈德公司工業/商辦及家庭節電技術展示

圖 7　施奈德公司電動車充電系統整合展示

三、 參訪配電公司 ERDF 之教育暨公關中心

在法國推動智慧電表屬於大型重大投資，且與改變民眾生活息息相關，將由原來人工抄表改由自動讀表機制，縮短計費週期，增加電業之現金流，並提供時間電價及需量反應之推動工具。配電公司 ERDF 在推動過程中，相當重視用戶反應，故除重視廠商交付之電表需要經過嚴格的品管程序外，更注重民眾的認知及使用觀感，以減少民眾對陌生產品有所誤解，同時也建立民眾對於智慧電表對家庭用電的生活便利性及加值服務性等知識，因此建立 Linky 智慧電表及智慧電網教育展示館。

在參訪的過程中，我們可以深切的感受到 ERDF 對民眾教育做出許多積極的努力，其教育展示目的在於強調現在電網與未來電網的差別說明，如圖 8 所示，說明人員在解說未來智慧電網與再生能源及配電網自動化(目前法國配電自動化 15%)的關係，提供電業維護人員更先進的工具以維護電網，提供民眾更高供電品質。Linky 電表中有預留一組通訊介面與家庭互通，可供民眾自行選擇/自行建置家庭自動化介面，該介面可採用施奈德所開發的家庭自動化(能源管理系統)解決方案，如此可向民眾推廣智慧家庭的概念以增加 Linky 專案的效益。

圖 8　　ERDF 說明智慧電網之再生能源及自動化輸配電網概念

四、 參訪 SAGEMCOM

SAGEMCOM 參訪重點包含兩部分，分別為 G3-PLC 技術介紹及 SAGEMCOM 參與 ERDF 之 Linky 測試經驗說明，該公司參與法國 30 萬戶智慧電表建置案(Linky Project)，採用 2 種晶片(TI 及 MAXIM)進行測試。由於我國亦完成 1 萬戶低壓智慧電表建置，並有採用 PLC 技術，雙方針對 PLC 的實務應用經驗進行技術交流(包含通訊傳輸率、組網、應用情境等)；SAGEMCOM 表示推動智慧電表的過程資訊安全也很重要，未來推動時需要考量。

針對智慧電表的推動效益議題，SAGEMCOM 表示可朝配電自動化整合討論，以法國 Linky 經驗需整合配電資訊系統，以加速停電復電檢修時效，才較有實質效益，另後續資訊安全問題，宜及早研擬相關策略。

五、 參訪 TBH ALLIANCE

TBH Alliance 目前主要從事智慧電表未來應用推廣之民眾教育工作，並自 2014 年 10 月起為期 2.5 年，測試 3,200 戶有 IHD 系統之用戶與無裝 IHD 用戶之節電效果差異分析，目前系統測試中。圖 9 為 TBH Alliance 展示該公司提供用戶 IHD 的功能與服務。經交流該公司主要成員多為 ERDF 或 EDF 退休員工，或長期與電力公司合作之伙伴組成，故瞭解 ERDF 及 ADEME 發展方向，因此透過組織協會方式進行提案申請取得計畫，以促進法國政策 Linky 專案的推動。

圖 9　　與 TBH Alliance 交流討論過程

六、 參訪法國環境及能源管理局 (ADEME)

ADEME 主要負責法國能源議題之研究計畫整合委託研究等工作，研究議題包含電動車、再生能源、資源再利用及智慧電網等，而細部議題含括海洋能、太陽光電、太陽熱能、混合能源、儲能、地熱能、生植能、軌導系統、智慧城市、智慧電力系統、電動車充電系統基礎建設等。

其運作模式主要由 EDF 或 ERDF 提出研究主題需求，供 ADEME 協助整合相關研究議題，並公告辦法由廠商籌組團隊投標參與，經委員會評選後確認執行團隊，包含 TBH Alliance IHD 試驗計畫、Energy Pool 需量反應計畫、GreenLys 及 Smart Electric Lyon 等專案計畫皆為 ADEME 補助範圍內。

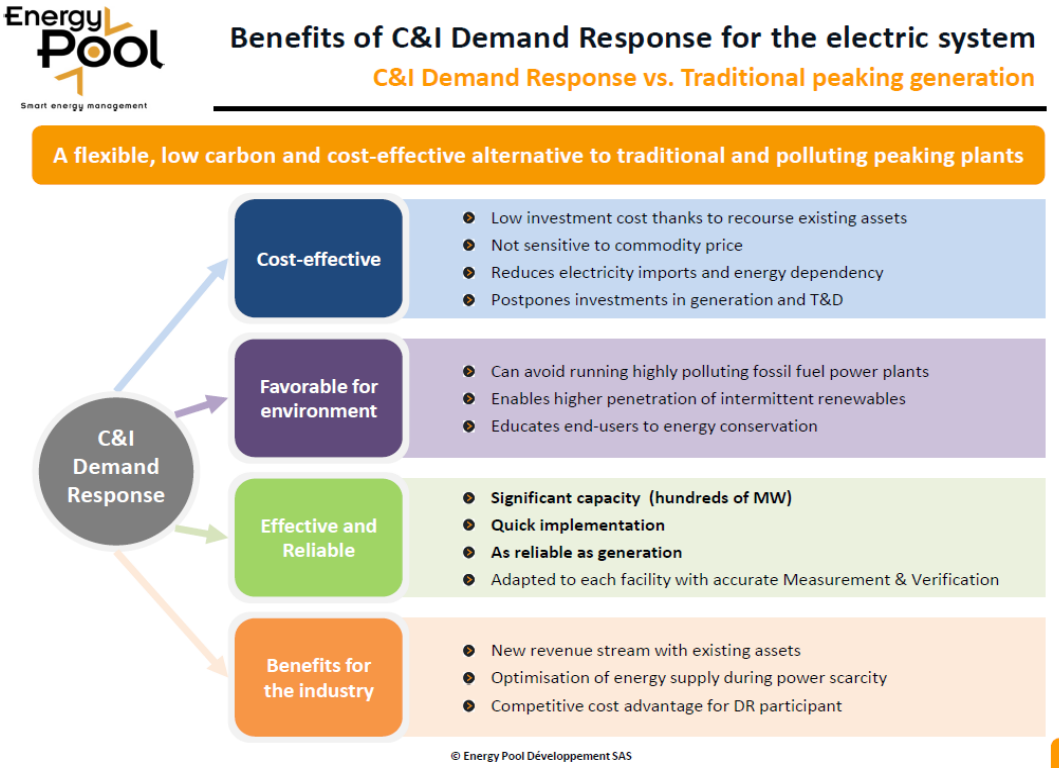
AMEME 在 2015 年計畫預算約 5 億 9 千萬歐元，整體 2010~2020 年的投資計畫約 23 億歐元，包含能源效率、再生能源、資源再利用、空氣品質、噪音防制等議題。整體輸配電、能源傳輸、電網合約制度、電網建設(智慧電表、儲能、電動車等)等高度資訊化電網的方向，皆列為智慧電網發展範疇，目前已有超過 100 個智慧電網專案在執行，包含 20 個技術展示或示範計畫在推動，為歐洲發展智慧電網最多元化的一個國家，法國將智慧電網列為未來新興產業發展之一。

細部示範計畫內容依各區域之特點發展不同的智慧電網示範項目，如里昂已建置 20 萬戶之智慧電表專案(Linky)，所以在里昂推動的 GREENLYS 及 Smart Electric Lyon 皆以智慧電表為主，一個強調與電網整合議題，另一個強調與用戶整合議題，並建置相關示範展館以利推動說明。

七、 參訪 ENERGY POOL 示範計畫

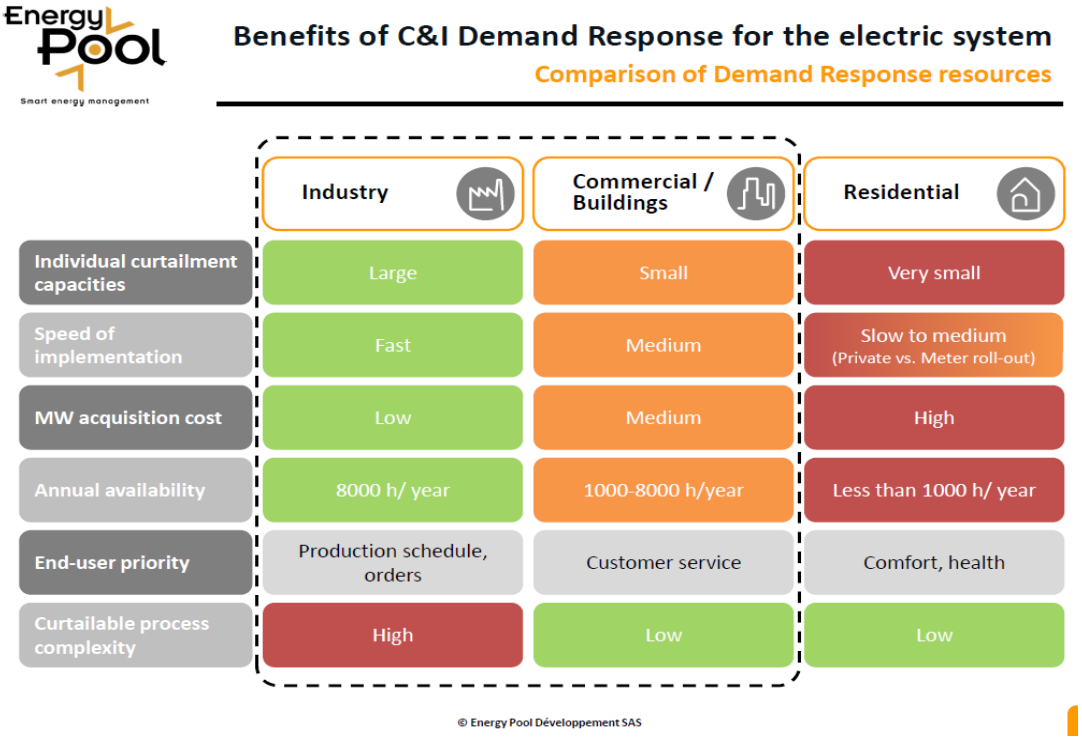
ENERGY POOL 專案計畫之核心範疇，主要提供高壓用戶用電諮詢服務，如用電契約容量簽定、節電排程管理及相關顧問服務等。該公司主要與 EDF、ERDF 等電力公司之調度單位合作，爭取負載需量供調度員可調度之需量管理，其主要強項為負載管理演算法的規劃。因此，該公司已將工商業大用戶需量反應(C&I Demand Response)做基本類型分析，探討相關類型公司可行效益及彈性整理出調度彈性比較表，以利向用戶說明，如圖 10、11 所示，。

就實務應用面討論，ENERGY POOL 與施奈德公司技術合作，推動工商用戶節電服務，協助精算用戶節電策略及推動再生能源系統發展。該組織的推廣模式類似臺灣的 ESCO 服務商的合作模式，但由於法國電價比臺灣高，所以推動節電服務較具誘因。



資料來源：ENERGY POOL 簡報資料

圖 10　ENERGY POOL 針對 C&I 用戶進行案例分析



資料來源：ENERGY POOL 簡報資料

圖 11　ENERGY POOL 針對不同用戶節電潛力進行分析

八、 參訪 GREENLYS 示範計畫

GREENLYS 示範計畫主要由 ERDF 主導，其示範計畫內容包含先進配電網路(操作與監控)、智慧電表建設、電動車充電、分散式電源、聚集型需量反應、新費率及負載管理研究等，主要參與團隊以 ERDF 為主，其他包含施奈德公司、GDF 電力供應商、當地通訊業者等、ALSTOM、ATOS 等；另參與的研究機構包含 Grenoble Scientific university、CEA 等。自 2012~2016 年總投入 4 千 3 百萬歐元(不含智慧電表計畫)，由 ADEME 補助。目前研究重點包含用戶參與反應、聚集型需量反應、配電網路最佳化調度(加入再生能源研究)等。

由 GREENLYS 展示館之智慧電網宣導模型介紹，表示智慧電表可加速智慧電網遠端斷復電的控制，並可透過後台系統整合配電自動化，以縮小停電區域的範圍，並加速派員搶修的時效性，其中也可以透過電價制度改善歐洲較明顯的雙尖峰負載特性問題。

九、 參訪 SMART ELECTRIC LYON 示範計畫

關於 SMART ELECTRIC LYON 示範計畫主要為 EDF 主導規劃，主要參與者包含 ERDF、Schneider、hager、Panasonic、PHILIPS、orange 等公司，EDF 主要和廠商合作發想三個議題，分別為智慧城市、智慧電網、智慧家庭，而廠商主要提供用戶節電解決方案，由 EDF 提供測試電價配套方案及用戶用電分析，以提高用戶參與誘因。測試規模為 2.5 萬戶，其中 200 戶進行家庭能源可視化服務(IHD)，並採用分群試驗比較不同使用情境之節電量分析，EDF 用電分析將提供鄰近用電比較(在近端 1km 附近的鄰近 20 戶用電平均/基線比較)，測試期為 2013 年至 2016 年，用戶可由帳單獲取歷史用電資訊，以更精確計算用電量及更即時瞭解自身用電資訊，可達自發性節電效益，未來全面推廣後更可提供用戶即時更多彈性電價選擇方案。

SMART ELECTRIC LYON 展示館中提供許多用戶加值服務的展現，亦提供廠商產品展示機會，廠商主要聚焦於未來 Linky 專案推動後，民眾有大量的家庭自動化服務可使用，可帶動智慧城市、智慧家庭及物聯網的概念落實。訪談的過程中我們也談及 KNX 標準，KNX 為居家及建築控制的世界標準，已發展多年，並為大樓空調控制的歐洲標準，目前國際上已有許多家庭自動化標準採用這個標準為基礎下發展訂定。智慧電表的推動需要預留一組與用戶家庭互通的介面，才能啟發後續衍生服務的可能性，至於該介面是否採用 KNX 介面可再討論，因為在臺灣 RS485 介面也相當普及，但這個開口應該要保留供衍生服務模式發展使用。

圖 37　Smart Electric Lyon 提供用戶家庭相關服務

參、 感想與建議

一、 感想

(一) 依法國智慧電表(Linky)推動經驗，電表為電業與民眾資訊交面及電價計費的介面，關係到用戶觀感，因此法國配電公司 ERDF 對智慧電表品質上的要求格外小心，成立一個智慧電表 Linky 功能測試實驗室，針對電表品質進行測試管控。

(二) AMI 建置為長期工作，法國政府為增加智慧電表對民眾的服務及減少民眾的誤解，因此建置多個宣導智慧電表系統應用的展示館及相關宣導措施，以協助用戶瞭解 AMI 的貢獻，並強化用戶參與機會，改變用戶用電習慣需要教育與溝通。

(三) 法國智慧電網示範計畫，由大企業帶頭投入，引導相關業者共同研究開發，進行技術整合與應用展示，如 GREENLYS 及 Smart Electric Lyon 等示範計畫，分別由 ERDF 及 EDF 主導，整合 Schneider、Atos、Alstom、Hager、Panasonic 等公司的資源整合，除了使廠商得以驗證產品技術之外，電業亦得以評估應用模式及成本效益等，創造政府與企業雙贏的利基，此合作模式及宣傳成效值得我國學習。

(四) 法國智慧電表(Linky)專案中，為強化與用戶互動結合，在電表上預留一個通道(實體接點)，使電表資料得以運用有線或無線通訊傳送予用戶，除了讓用戶更能掌握用電資訊外，服務業者也能利用此一資訊，提升其加值服務的彈性，如家庭自動化節能服務或工商業自動需量控制等。

(五) 透過 Linky 計畫前期測試評估，法國目前持續推動智慧電表，而為了提升整體效益，系統整合及衍生服務亦在研究規劃中。臺灣推動 AMI 的進程，現階段亦著重智慧電表建置，系統加值服務及電業營運的配套措施仍須持續評估。

(六) 法國政府推動 Linky 計畫時，亦考量民眾配合度。為加強對民眾的教育宣導，透過法國環境及能源管理局(ADEME)補助 TBH 組織(協會)進行用戶節電宣導計畫，提供參與用戶節電建議，同時評估 IHD 對用戶節能成效的影響，此一作法可供住宅部門節電之參考。

(七)法國與臺灣同為能源輸入國，除了持續擴充電力供應能力，也逐步推動負載管理的解決方案。在法國環境及能源管理局(ADEME)的補助下，ENERGY POOL 團隊協助大型用戶進行負載需量的調整,並且在緊急時進行卸載調度，ENERGY POOL 在法國所管理的需量約為 1GW，其商業運行已有相當規模。ENERGY POOL 不但投入法國電力調度市場，亦積極投入國際市場，目前在日本與韓國均有初步成果。

二、 建議

(一) 參考法國推動 AMI 的經驗，電表及通訊系統品質相當重要，以免產生不必要的抗爭，台電公司宜建立智慧電表通訊系統測試實驗室，針對採購案之電表通訊設備進行測試評估，以確保產品品質及互通性。

(二) AMI 為長期建置工作，且建置後需要民眾用電行為的配合，方能發揮智慧電表負載管理的成效，法國建置多個宣導智慧電表系統技術展示館及相關宣導措施，減少民眾對 AMI 的疑慮與誤解。國內智慧電網相關計畫亦應思考如何進行教育宣導，例如建立展示館或於學校教育中導入相關通識課程。

(三) 法國在推動智慧電表建設政策時，已納入產業發展的考量，因此透過法國政策推動時程的驅動力下，以法國 3,000 萬戶智慧電表市場及衍生服務應用做為推動誘因，促使廠商投入資源開發戶衍生服務的技術需求。因此我國 AMI 應持續朝全面推動目標前進，以利國內業者持續投入發展。

(四) 參考法國經驗，在 AMI 推動上應預留用戶所需之資訊，如法國智慧電表上預留一個通道(實體接點/介面)，供業者開發用戶加值服務系統。考量國內電表裝置環境之變異性，以及電表規格與國際之差異，宜由台電公司邀集相關業者，一併檢討電表材規、資料格式、通訊技術及資訊介面等議題。

(五) 參考法國建置 Linky 經驗，除用戶計費改革外，尚可補強法國配電自動化網路的不足，但在臺灣配電自動化網路已相當先進，因此在建置 AMI 的過程，應著重於 AMI 建置後對電網供電調度的資訊整合研究議題,以利提供改善配電網路併聯、轉供等決策參考依據。

(六) 未來 AMI 建置完成後，其負載管理制度進主要在著重於電價方案管理模式。然而，台電公司目前雖已啟動需量競價研究案，但區域性的電價應納入研究，使用戶可志願性選擇電價機制，方可更務實反應 AMI 用戶參與效益。

(七) 法國已展開第 2 階段 300 萬具智慧電表建置，預定 2016 年完成，整體規劃為 2021 年完成 3,000 萬具智慧電表建置。法國配電公司 ERDF 表示不排除其他供應商的參與，因此，宜協助臺灣廠商瞭解法國 G3 PLC 技術及法國 Linky 智慧電表規格，評估下一波的參與機會。

三、 誌謝

本次研習承蒙經濟部國際合作處全額補助來回機票及食宿膳雜費，方得順利成行圓滿完成任務，謹此申謝。

此外，特別要感謝駐法國代表處經濟組賴作松組長及廖健鈞秘書的協助，積極、熱心地聯絡相關機關單位，並幫忙安排拜會行程，令此次參訪能實際拜會許多關鍵單位與負責人員，獲得非常好的成效；同時也要感謝參與本次參訪行程的所有單位，由於他們所提供的安排、協助及接待，使得這次參訪能夠充分瞭解法國智慧電表及智慧電網建置經驗，並充分交流政策規劃及技術進展，對於我國未來相關施政規劃及推動，具有高度之參考價值，謹在此深致謝意。

附件：參訪簡報

Programme
Linky

July 20th 2015

Visit

The Linky Architecture

erdf
L'ÉLECTRICITÉ EN RÉSEAU

Presentation of the agenda

Programme
Linky

Time	Duration	Theme	Department	Facilitator
14h00 – 14h10	**10'**	**Welcome & presentation of agenda**		
14h10 – 14h30	**20'**	**Overview of the Linky Program**		
	10'	*ERDF and the Linky Program*	Programme	Marc Delandre
	10'	*Linky rollout planning and trajectory*	Programme	Marc Delandre
14h30 – 15h30	**60'**	**Equipment and lab**		
	20'	Overview of the equipments department	Equipment dept	Equipment Dept
	40'	Live visit of the lab	Equipment dept	Equipment dept
15h30 – 15h50	**20'**	**The meter functionalities**		
	20'	Functionalities of the meter	CLEF	Laurent Gillard
15h50 – 16h00	**10'**	**Break**		
16h00 – 16h40	**40'**	**A Smart Metering System – The Linky Architecture**		
	15'	*Functional architecture*	CLEF	Laurent Gillard
	10'	*IT Partners overview*	CLEF	Laurent Gillard
	15'	*New services*	CLEF	Laurent Gillard
16h40 – 17h00	**20'**	**IT Security**		
	15'	*Security on every level of the system*	STD	Marc Delandre
17h00 – 18h00	**60'**	**Focus – G3 - PLC**		
	30'	*G3 Alliance*	STD	Marc Delandre
	30'	*G3 – PLC technology*	STD	Hélène Pulce

Marc DELANDRE

Metering Division Director & General Secretary of G3-PLC Alliance

Programme **Linky**

- **Overview of the Linky Program**
  - ErDF and The Linky Program
  - Linky Rollout planning
- Equipment and Lab
- The meter functionalities
- A smart metering system - The Linky Architecture
- IT Security
- Focus – G3 - PLC

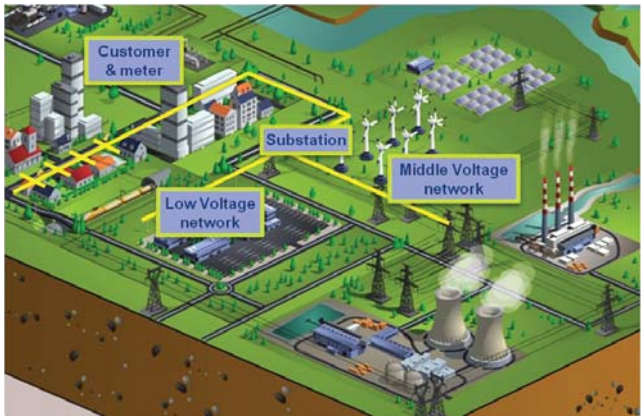
Overview of ErDF

Programme **Linky**

ERDF is the main Distribution System Operator in France (95%)

100% owned by EDF Group (subsidiary since January 2008)

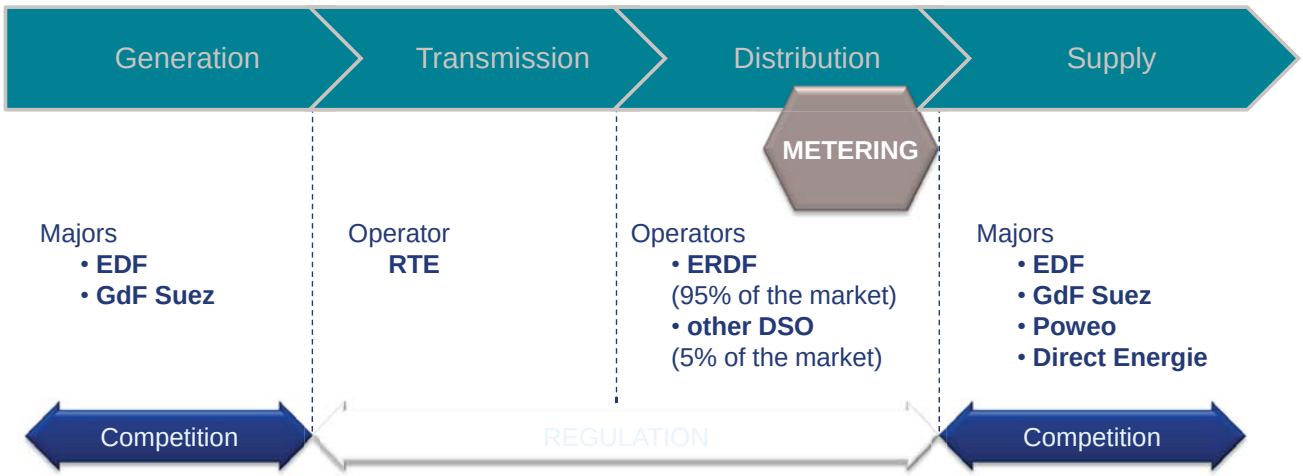
- **36.000 employees**
- **1,3 million kilometers of MV/LV distribution lines**
- **More than 35 million residential (and small C&I) customers and 500.000 C&I**
- **13.8 B€ total income (2013)**
- **3.2 B€ investments (2013)**
- **Guarantees non-discriminatory access to the network for suppliers**



Linky program overview
The French electrical system context

Programme Linky

A regulated market for transmission and distribution



A National Program carried out by ERDF

Programme Linky

Great expectations about smart-metering from the French authorities

Improving DSO* efficiencies about regulated distribution activities

Improving a truly competition amongst electricity suppliers

Enabling energy efficiency and related services promotion

Managing electric grid peak-load

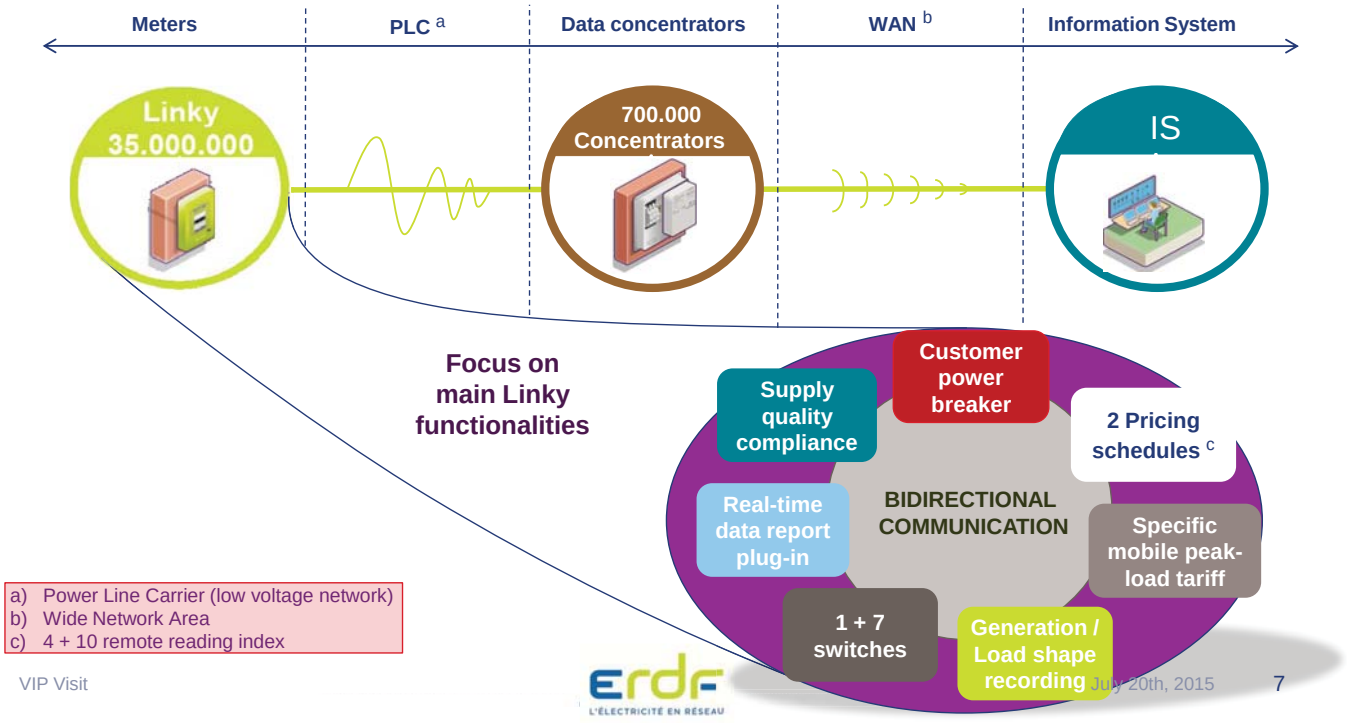
Facilitating integration of distributed energy into the power grid

In this context, ERDF implement an ambitious multi-projects operation called "Linky smart metering and related services program"

* DSO: Distribution System Operator

Linky system at a glance

Programme Linky

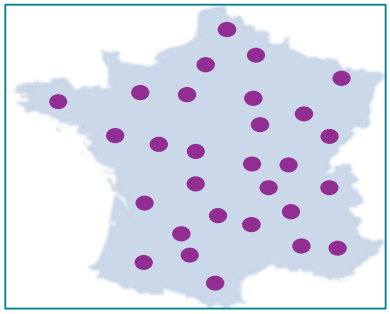


a) Power Line Carrier (low voltage network)
b) Wide Network Area
c) 4 + 10 remote reading index

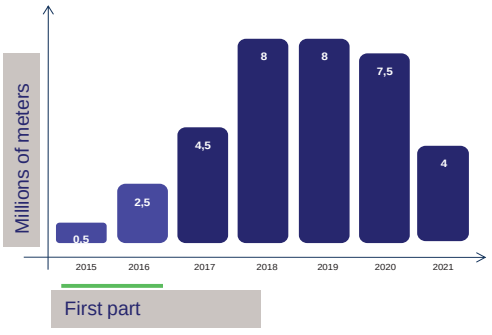
Rollout strategy

Programme Linky

We chose widely a strategy of **« leopard patterns ».** It was a consensus between every stakeholder, be it the government or the regulatory authority..



This progressive deployment will be **equally distributed** in each region of France.

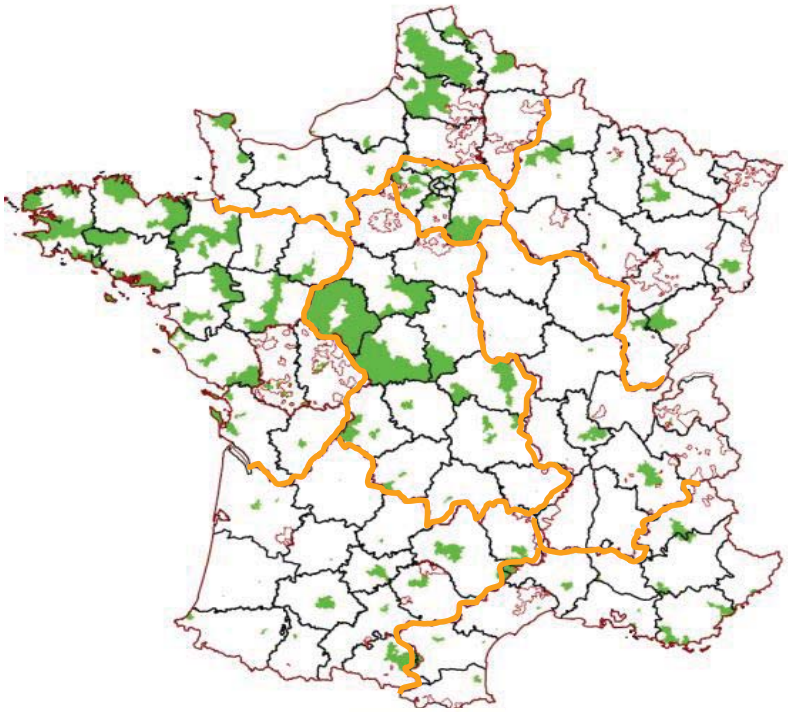


The target is to install **35 million** meters within **6 years.**

Meanwhile, we aim at ensuring progressive growth and decrease in order to take into account the industrialization timeframe and training needs

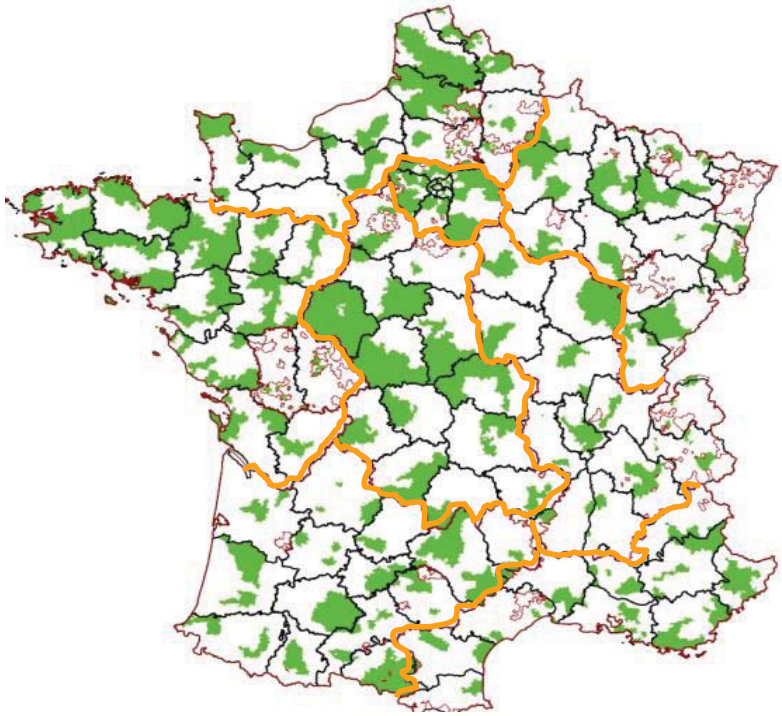
Rollout strategy

Programme Linky



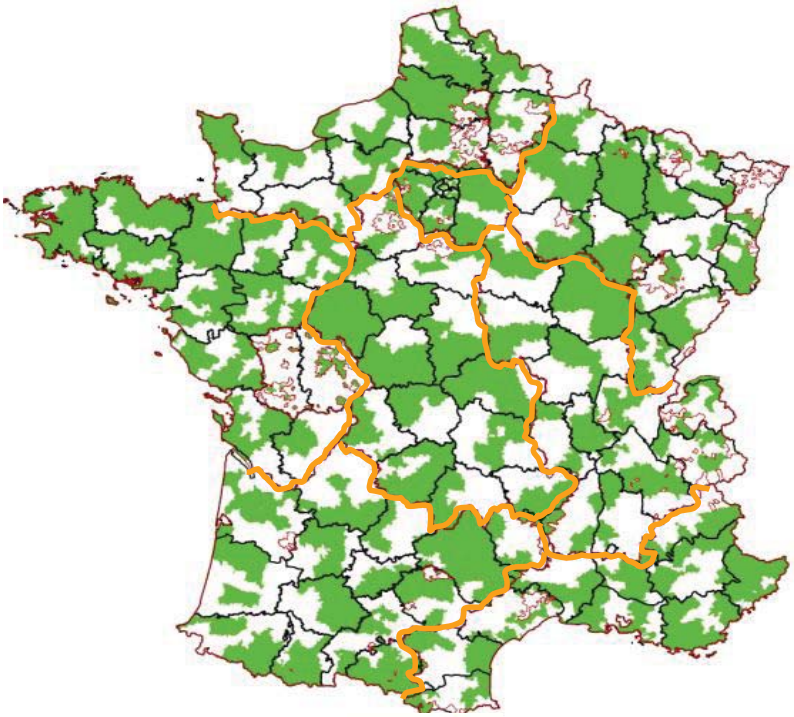
Rollout strategy

Programme Linky



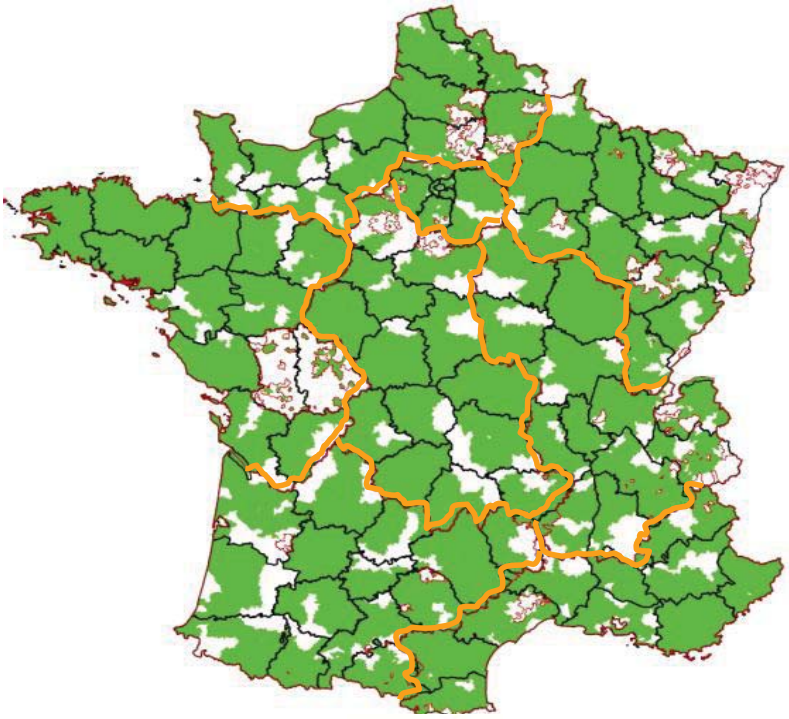
Rollout strategy

Programme Linky



Rollout strategy

Programme Linky

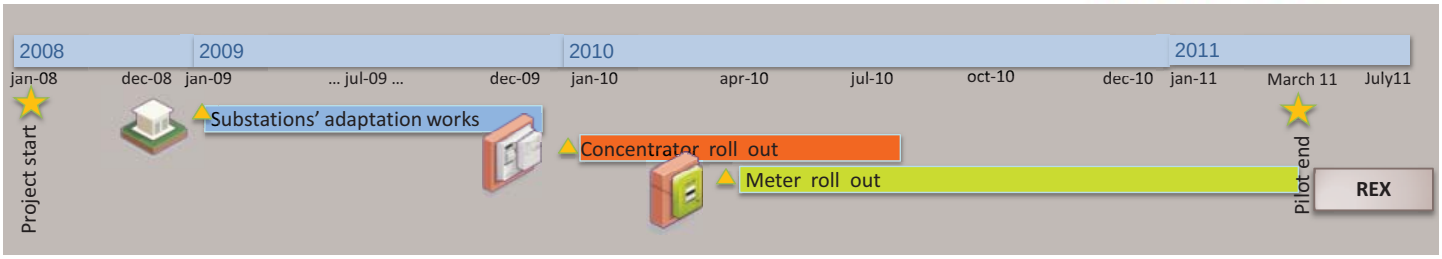


Rollout strategy

Programme Linky

Pilot keys information (2008 - 2011)

Programme Linky



TOURAINE
IIII Rural area, 33 customers/km²
IIII 150 towns
IIII 100 000 meters
IIII 3 220 concentrators

LYON
IIII Urban area, 1760 customers/km²
IIII Underground network
IIII 11 towns (N & E of Lyon) + 4 districts in Lyon
IIII 200 000 meters
IIII 1 400 concentrators

The business objectives for the experimentation assigned to ERDF by decision-making authorities have been met :

- **Concentrator completion rate :** ~100%
- **Meter completion rate :** ~90%.
  - The less 10% was caused by customer refusal, customer absence, etc.
  - Average time to replace a meter : 30mn – conform with our objective
- **92% of customers were satisfied or very satisfied** with the operation of meter replacement
- **Less than 1%** of customer claim

Programme
Linky

Overview of the Linky Program

➲ **Equipment and Lab**

- Equipment département
- Live visit

The meter functionalities

A smart metering system - The Linky Architecture

IT Security

Focus – G3 - PLC

Key figures of the lab

Programme
Linky

40 testers

Surface **1 700 m²**

2 300 DC and meters tested at the same time

Storage capacity **16 000** DC and meters

2 500 FW tests on meters & **1 500** on DC

450 tests racks

7 suppliers

Up to 800 Cluster of meters on one DC

15 campaign tests at the same time

20 years Lifetime of the meter

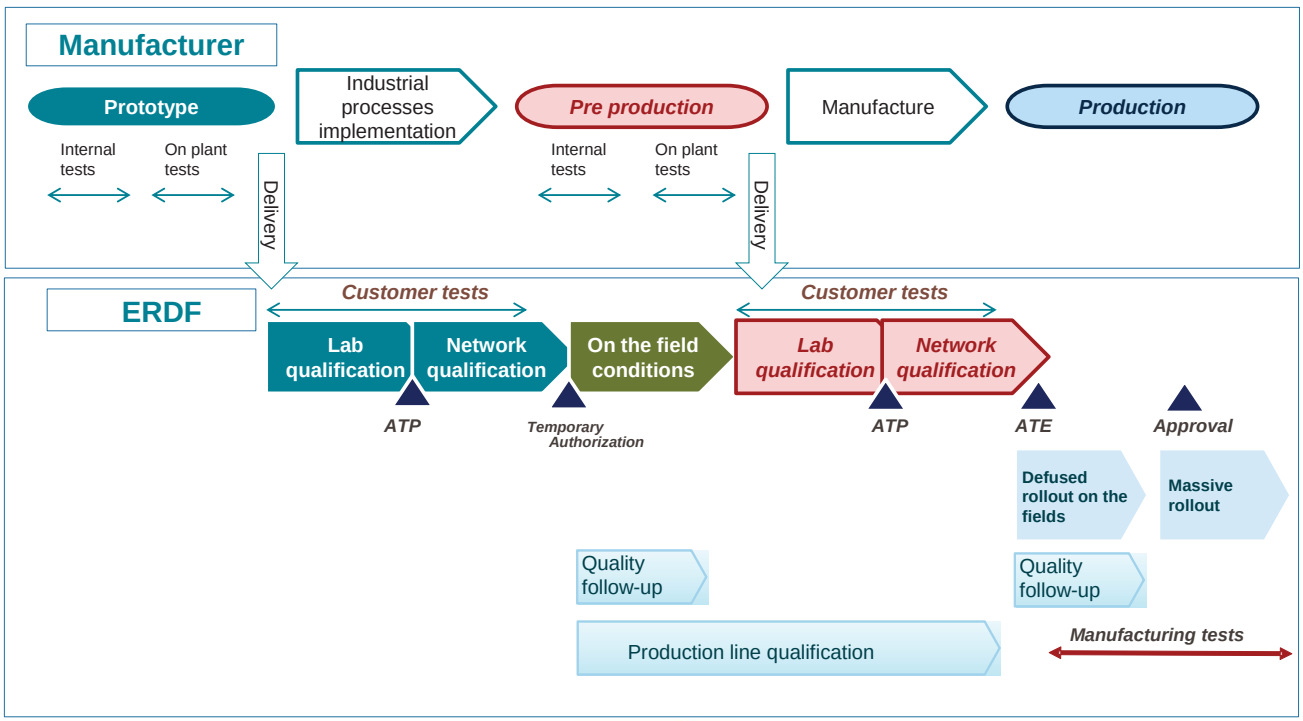
5 labs

Major challenges of the Lab

Programme Linky

Global qualification strategy

Programme Linky



Objectives and missions

Programme Linky

Objectives
✓ Become an industrial reference in terms of qualification
✓ Ensure the supply of meters and concentrators, while taking into account the major milestones of the project, by implementing a partnership with suppliers and an industrial qualification
✓ Prepare the meters and data concentrators of the future by integrating high tech evolutions

Missions	Deliverables
✓ Specify and secure the expertise on meters, data concentrators and other Linky equipment	▪ *Specs* ▪ *HW/FW/PLC Qualification on every phase of qualification* ▪ *ATP/ATE* ▪ *Analysis of each supplier* ▪ *Summary sheet of each project* ▪ *Lab @Crysalis, @AxeSeine*
✓ Monitor the activities of the suppliers	
✓ Qualify on an industrial basis the meters and DC	
✓ Create an industrial qualification lab	
✓ Monitor all the projects	

Qualification entirely carried out and steered by ERDF

Programme Linky

Firmware

Hardware

ERDF

Carried out at the Linky Lab

Unitary testing - Compliance	*DC & meter*
Interoperability	*DC-M & M-M*
Stress tests	*1DC-nM*
Integrated tests	*Système 1DC-nM*
Local interfaces	*DC & M*

Monitor (EMITECH / LCIE / LNE)

CEM	*DC & M*
Environment	*DC & M*
Breaker & TOU	*M*

Monitor (R&D)

Metrology / Functional strength tests	*M*

Our Suppliers

Sagemcom

Meter	Single phase	G3
	Three phase	G3
	Single phase	G1
Concentrator		G3

Landis

Meter	Single phase	G1
	Three phase	
	Single phase	G3
	Three phase	
Concentrator		G1

Itron

Meter	Single phase	G1
	Three phase	

Elster

Meter	Single phase	G3
Concentrator		G3

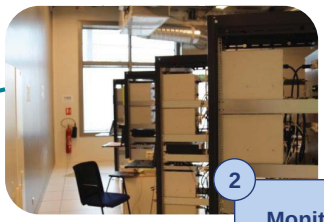
Cahors

Concentrator	G1

ZIV

Meter	Three phase	G1

Live visit of the LinkyLab



Unitary testing

2 Monitoring tools

Resp. : Cédric E Silva

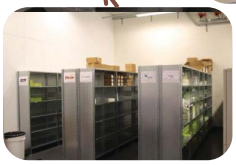
5 Logistics | 4 Integrated tests | On the field conditions | Firmware | 3 Showroom

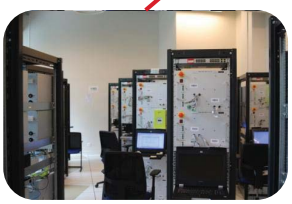
Resp. : Cédric E Silva

Resp. : Cédric E Silva

Logistics

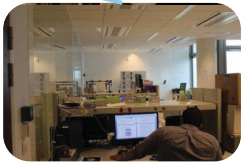
Resp. : Hugo Kuntz





1 Hardware

Resp. : Marc Naudin



Laurent GILLARD

Senior Business Analyst

Programme **Linky**

Overview of the Linky Program

Equipment and Lab

➲ **The meter functionalities**

A smart metering system- The Linky Architecture

IT Security

Focus – G3 - PLC

Key principles : Meter functionalities

Device

1 – Metrological LED (consumption indicator)

2 – Display

3 - Push buttons

4 – Serial number & legal information

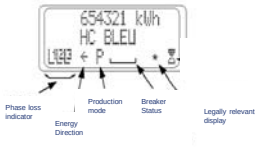
5 - Sealing

6 – LED (indicates if breaker can be switch on by customer)

7 – Time of use switch

8 – Customer Information output

9 - Fuse



Features

Data are collected by the DC (Data concentrator) at a predefined time (at least daily) through PLC

Instanteneous values (recalculated every seconds :

- **10 energy registers (supplier) up to 20 (producer mode)**
- **Producer and consumer load curves (time resolution : 10 / 15/ 30 and 60 min)**
- **Maximum daily power**
- **Status data : breaker logbook, terminal cover opening logbook,…**
- **Quality data : power failure and abnormal voltage logbooks**
- **Status register, error register**
- **Up to 32 display messages**

Remote operations

- **Opening and closing of the breaker**
- **Opening and closing of the TOU switch**
- **Change of maximum allowed power**

Daily data collection: definition and principles

Programme Linky

Data collection refers to the automatic and daily process throughout which the Linky information system collects metering data.

The 4 main objectives of daily data collection are the following:

1. Prevent the risk of congesting the communication network with multiple accesses to metering data, by anticipating its provision
2. Relieve the communication network on daily time slots in order to ensure tele-operations
3. Have, at the earliest, data on the smart meter functioning (monitoring of programmation disparities, schedule drifts, etc.) in order to ensure service levels
4. Allow ERDF businesses to easily access synchronous data records, permitting comprehensive analyses

General functioning of daily data collection

Programme Linky

The daily data collection process works in 3 steps:

- **The LAN data collection**, aiming at collecting data from each meter of the cluster, through the concentrator.
- **The WAN data collection** aiming at gathering the concentrator collection reports in order to provide them to the Linky information system.
- **The integration of data in the Linky information system**, aiming at receiving, integrating and completing the collected data transmitted through the WAN (register contextualization, calculation of the quality data status, etc.).

Data collection through CPL between 0:05 and a time slot defined by the NOC (<8:00)

The concentrator gathers the collected data and send them to the NOC through GPRS during the time slot defined by the NOC

The information system integrates the collected data and prepares the sharing with IT partners

Laurent GILLARD

Senior Business Analyst

Programme **Linky**

Overview of the Linky Program

Equipment and Lab

The meter functionalities

➲ **A smart metering system- The Linky Architecture**

- Functional architecture
- IT Partners overview
- New Services

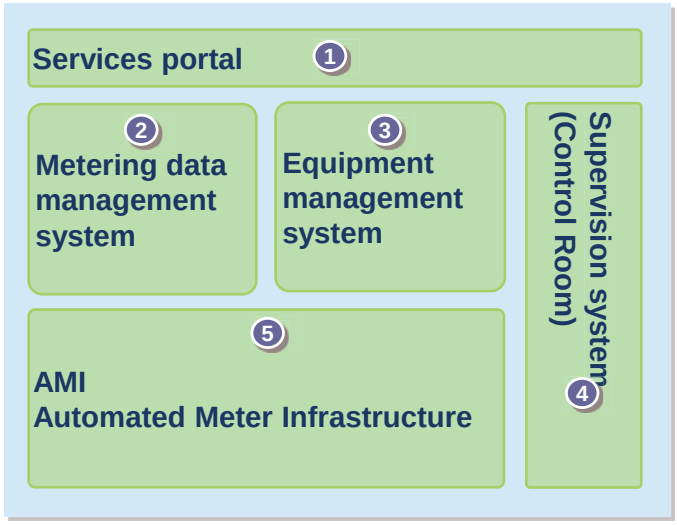
IT Security

Focus – G3 - PLC

Architecture of the system

Programme **Linky**

Linky IS is based on 5 main functional blocks

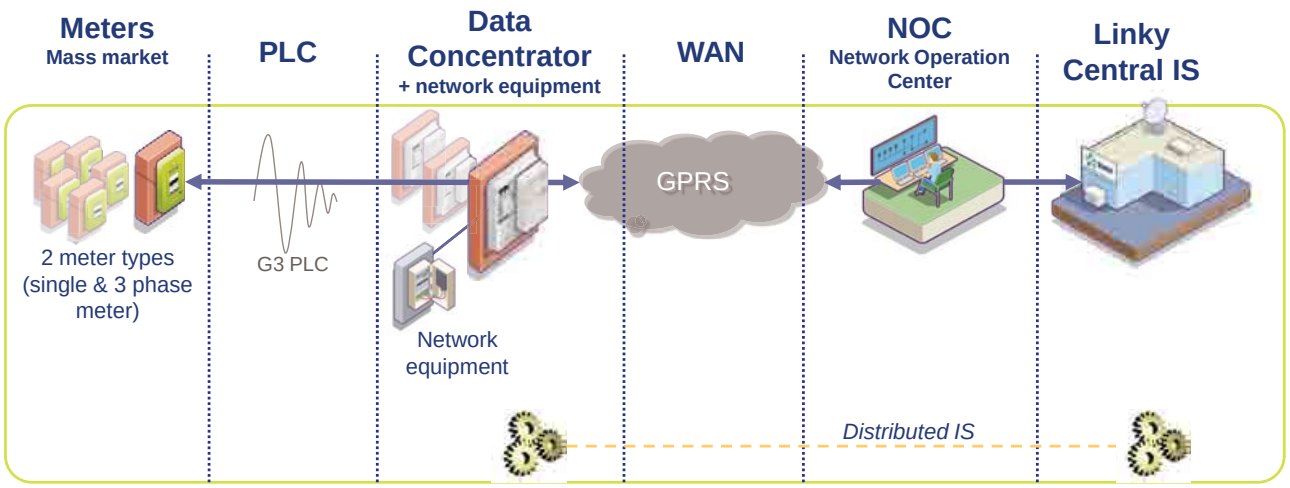


Description of functional blocks

1. Service interface with other ERDF IS : receives, qualifies and traces demands, prioritizes demands
2. Stores, analyzes and provides metering data
3. Manage metering device objects and their attributes and execute commissioning process
4. Supervision of infrastructure and inter-IS exchanges, reporting
5. Demands transmission, data collection, follow-up and storage of meter pool events .
   Management of data exchanges between meter and concentrator

Architecture of the system

Programme Linky



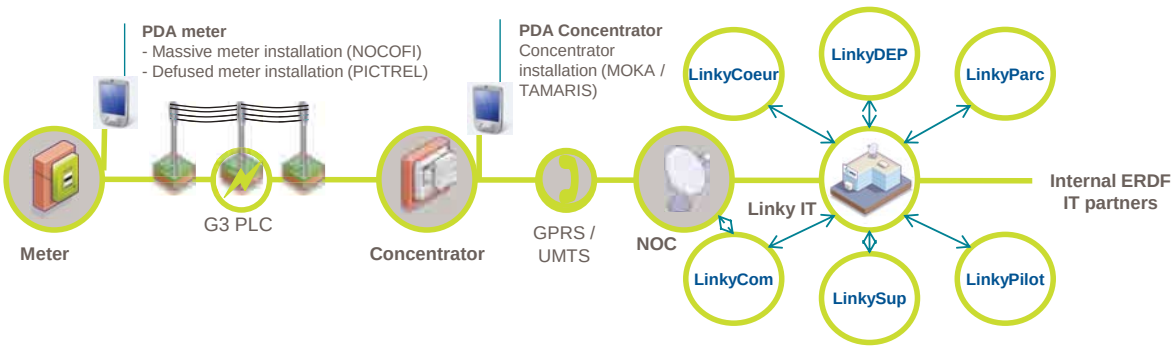
Key feature of Linky architecture : An evolutive approach

Linky Central IS is distributed to the data concentrators

- ❑ A unique downloaded software, distributed to all concentrators
- ❑ Imposed formats and LAN & WAN exchange protocols, based on market standards (Linux, Java, DLMS/Cosem, data model)

Functional architecture

Programme Linky



- ➲ **LinkyCoeur :** Data exchange functions with the meter processes — **Remotely operates equipment**
- ➲ **LinkyParc :** Asset management (point of delivery), supply chain management (meter and data concentrator) — **Manages metering equipment**
- ➲ **LinkySup :** Control room IT system in charge of events management — **Supervises and administrates system**
- ➲ **LinkyDep :** Rollout IT system in charge of massive field operations — **Massively deploys equipment**
- ➲ **LinkyPilot :** Business Intelligence — **Produces reporting**

Functional architecture

Programme Linky

The five jobs related to the Linky program are covered by an IT system :

Rollout entities - LinkyDEP -

- Rollout planning and management
- Follow up

Logistics entities - LinkyParc -

- Supply management and follow-up
- Defects and warranty follow-up
- Field operation reports

Monitoring team - LinkySup -

- Quick detection of events
- Maintenance operations management

Steering entities - LinkyPilot -

- Decision making systems follow up
- Planning adjustments
- Reporting

Installation technicians and maintenance entities - - Mobility tools -

- On the field programming and operations on meters and concentrators
- Proper information giving for interventions (addresses, technical data, etc)
- Real time defaults diagnosis

Laurent GILLARD

Senior Business Analyst

Programme Linky

Overview of the Linky Program

Equipment and Lab

The meter functionalities

➲ **A smart metering system- The Linky Architecture**

- Functional architecture
- IT Partners overview
- New Services

IT Security

Focus – G3 - PLC

IT Partners overview

Programme Linky

Client / Supplier

- **GINKO** (Supplier invoicing system)
- **ODM GINKO** (Migration tool)
- **SGE** (Distributor and supplier exchange system)
- **DISCO** (Historical invoicing and customer management system)

Publication

- **STM** (ERDF Main data repository)

Supply chain management

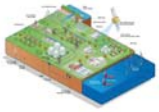
- **SERVAL**
- **PGI**

Network

- **SEQUOIA** (Supervision)
- **SIT-R** (SCADA)
- **PINGLINKY** (Call centers)
- **MERCATOR** (GIS)
- **ERABLE** (Network Planning tool)
- **OKOUME** (Network quality tool)

Deployement & field operation

- **TAMARIS** (Network field operation planner)
- **MERCURI-K** (Concentrator installation and maintenance tool)
- **PICTREL** (PoD operation tool)
- **CINKE-O /CINKE-Y** (via GINKO)



Smart Grid Experiments

- **SIMILY** (Interface between the Linky information system and the Smart Grid Experiments IT partners)

Finances

- **IRIS** (Depreciation and fixed assets management)

Local distributors

- **FASE SEI** (French West Indies, Corsica)
- **FASE ESR** (Strasburg City Electricity)

Laurent GILLARD

Senior Business Analyst

Programme Linky

Overview of the Linky Program

Equipment and Lab

➲ **A smart metering system- The Linky Architecture**

- Functional architecture
- IT Partners overview
- New Services

IT Security

Focus – G3 - PLC

The smart metering system for new customer services

Programme Linky

For the supplier

- Supply demand
- Billing Statement based on real consumption
- Publication of consumption data
- Customer outlet for data

For local authorities

- Voltage quality reports
- Assets reports

For the customer

- Publication of consumption reports
- Customer portal
- Pricing schedules
- Time of use / Off Peak

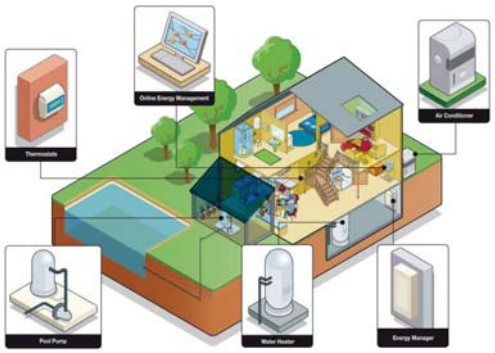
New customer services due to G3 – PLC technology

Programme Linky

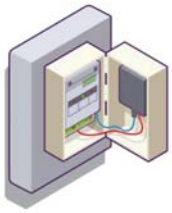
G3 – PLC is not limited in terms of applications, thus facilitating creation of new services :

Electric cars – communication with electric terminals

MV communication



Smart homes : communication inside homes



Smart grids : communication on LV network

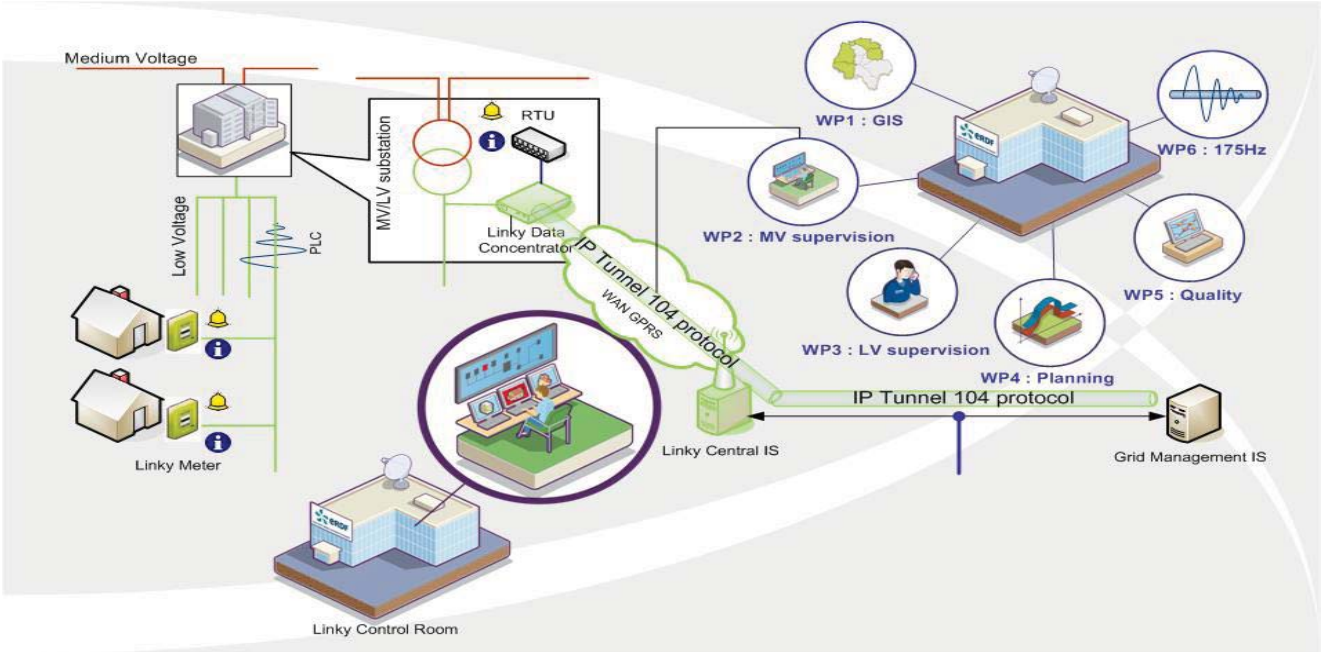
Smart cities : communication inside cities

Types of services

Système Linky offers 2 main types of services :

	Remote operations	Data providing
Roll-out	• Linky Repository initialization • Installation report	• State of meters • Security certificate demand
Suppliers	• One-off meter reading for billing • Power and tariff change • Remote Breaker switching	• State of meters • Fast register reading
Grid management	• Quality data (voltage drop/power failure) reading • Phase connection when change detected • POD connection analysis	• State of meters • Daily and one-off reading of load curves and registers
Field maintenance	• Field maintenance demand • Field operation report	• Security certificate demand to access DC • Equipment repository reading
Data management	• Scheduled metering data reading	• Metering data for repository update
Finance Department		• List and number of installed/uninstalled equipments

Linky offers services for Smart Grid



Linky offers services for Smart Grid

Programme Linky

GIS

Enhancement of the reliability of customer fastenings on the grid using the links between meters and data-concentrators

New information for the GIS (phase and GPS of meter)

MV Supervision

Location/detection of MV outages and anomalies in MV/LV substations

Bidirectional communication between RTU and Grid Management IS

LV Supervision

Alarms on LV outage detection (overvoltage, etc.)

Checking of the devices connectivity (on demand)

Planning power cut in case of overload

Planning

Analysis of the grid load to plan evolutions/investments using load curves (consumption/generation)

Phases load balancing using daily maximal power and the phase detected by Linky.

Quality

Periodical remote reading of slow voltages variations and power outages in order to identify customers with supplying troubles

175 Hz replacement

Linky replaces the « 175 Hz » regulation system for domestic uses with a dedicated meter functionality

A study is on going for the public lightening system

Marc DELANDRE

Metering Division Director & General Secretary of G3-PLC Alliance

Programme Linky

Overview of the Linky Program

Equipment and lab

The meter functionalities

The Linky Architecture

➲ **IT Security**

Focus – G3 - PLC

Focus – Security on every level
External Requirements

Programme Linky

CNIL

•Ensures the Linky system does not interfere with the private life of individuals.

•ANSSI is the french national security agency.
•Attached to prime minister
•Its role is to guarantee a high level of global security for the system. ANSSI makes sure the system does not breach national security.

COMMISSION DE RÉGULATION DE L'ÉNERGIE

•Ensures the Linky System is compliant to ERDF commitments in terms of protection of critical business information.

Focus – Security on every level
Internal Requirements

Programme Linky

PSSI

erdf L'ÉLECTRICITÉ EN RÉSEAU

•ERDF IT security policies
•Requirements to be applied in order to guarantee efficiently security for IT systems
•PSSI is composed of a main document and a large panel of detailed security policies (e.g : Mobil devices)

EBIOS

Analyse de risque du système Linky

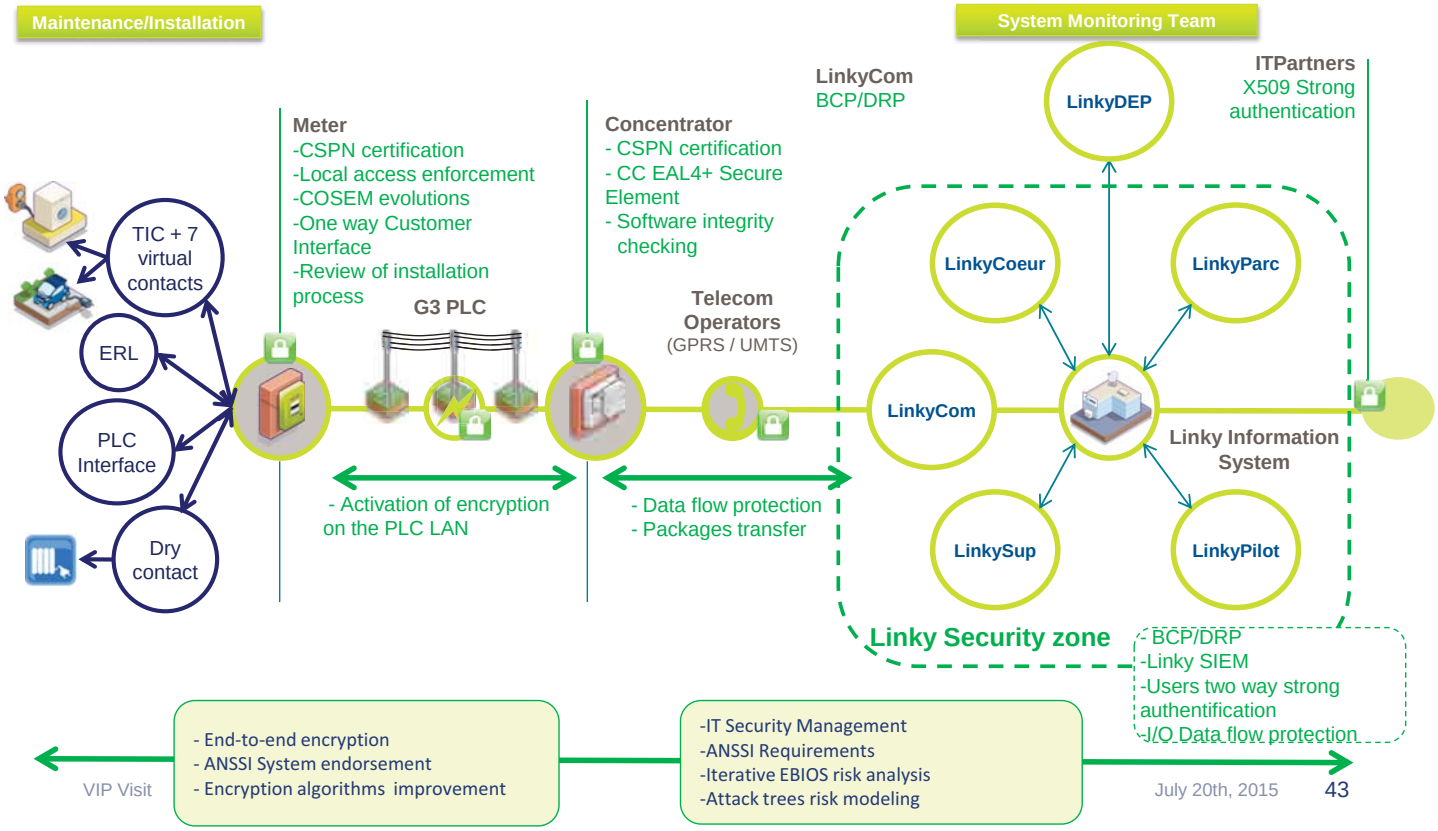
• An IT risk assessment method, developed by ANSSI, based on 5 modules

• This method is used to get a transversal vision of IT risk

• These risks also cover impacts on business (unavailability of the system…)

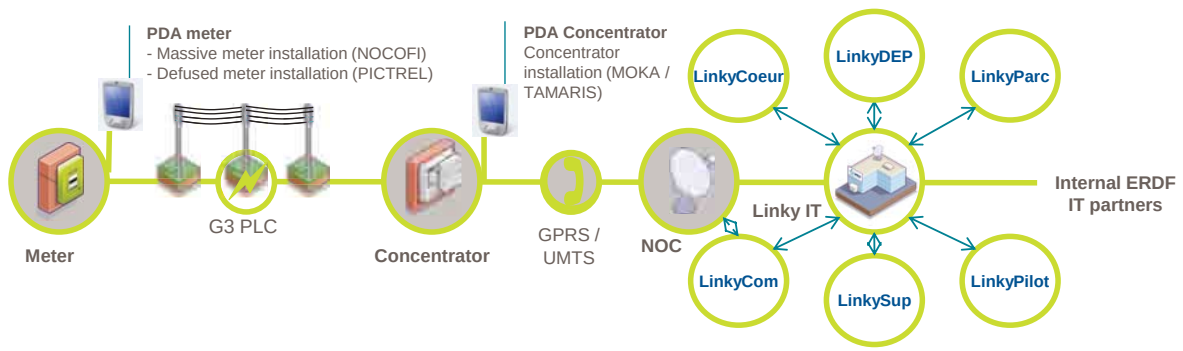
Focus – security on every level
Security on the smart metering chart

Programme Linky



Focus – Security on every level
IT architecture

Programme Linky



LinkyCoeur	LinkySup	LinkyParc	LinkyCom	LinkyPilot	LinkyDep
• RHEL • Oracle • Weblogic • BPEL • Apache	• RHEL • Oracle • Weblogic • JBOSS • Hadoop	• RHEL • IBM Maximo • Oracle	• RHEL • Oracle • ActiveMQ • DynParkLive	• RHEL • Tableau • Hadoop	• RHEL • AIX • Weblogic • RabbitMQ

Hélène PULCE
Head of the G3 - PLC team

Programme **Linky**

- Overview of the Linky Program
- Equipment and lab
- The meter functionalities
- The Linky Architecture
- IT Security
- Interoperability and suppliers
- **Focus – G3 - PLC**

Our suppliers for G1 and G3 Technology

	G1 Field Experimentation			G3 Field Experimentation			Mass Roll-Out					
	Single-Phase Meter	Three-Phase Meter	Concentrator	Single-Phase Meter	Three-Phase Meter	Concentrator	Single-Phase Meter		Three-Phase Meter		Concentrator	
	G1	G1	G1	G3	G3	G3	G1	G3	G1	G3	G1	G3
Landis+Gyr	■	■	■	■			■		■	■	■	
elster				■		■		■				
Sagemcom				■	■	■	■	■		■		■
Maec			■								■	
Itron	■	■	■				■		■			
ZIV									■			
ISKRAEMECO	■											

■ Single-Phase Meter ■ Three-Phase Meter ■ Concentrator

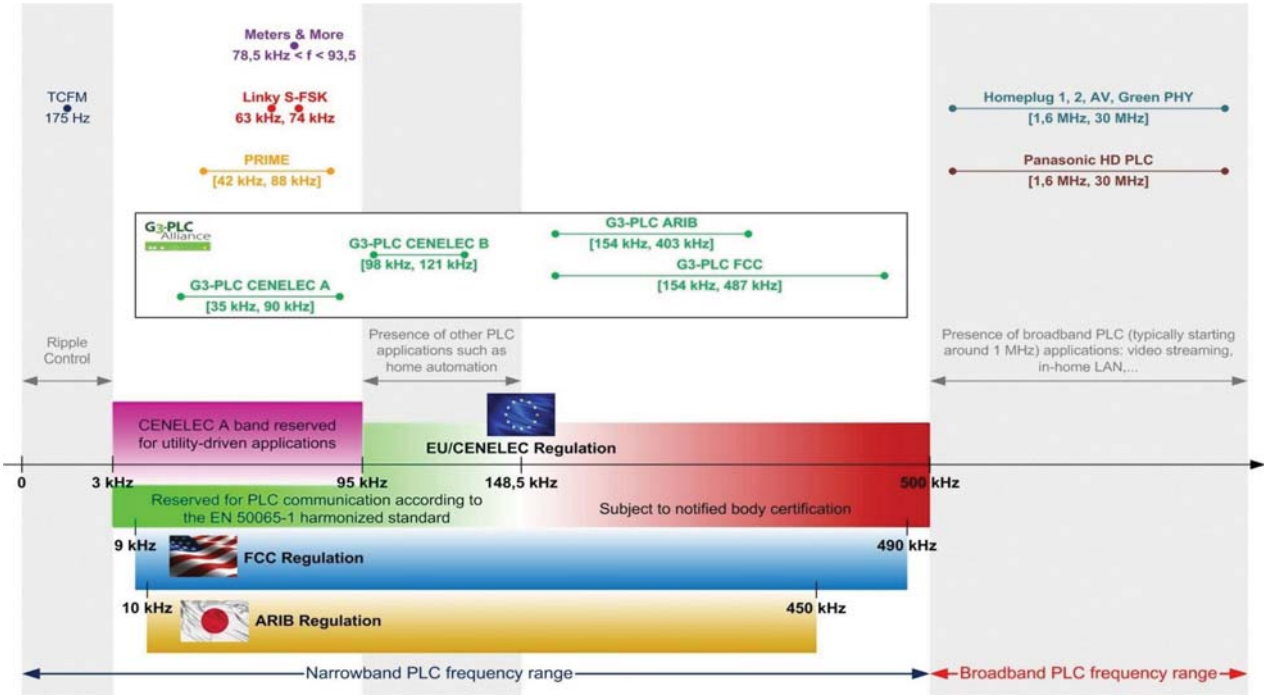
Key Features about G3 - PLC

Back to 2007 a tender was launched to define a new PLC protocol. It gave birth to G3-PLC.

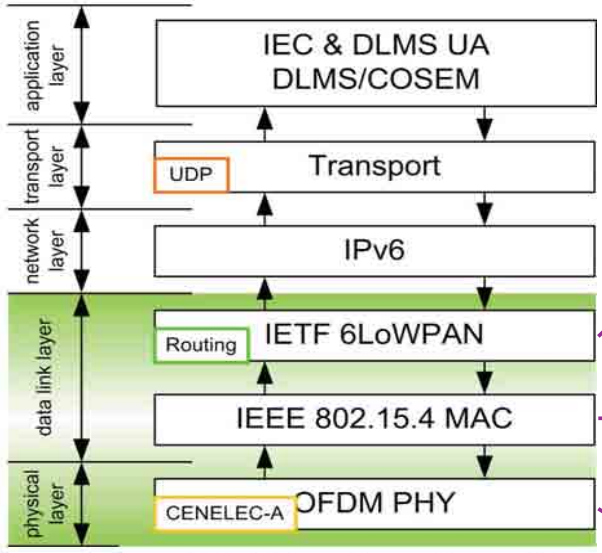
Initial requirements were:

Requirements	G3 Features
To be able to communicate in a reliable manner in a rough environment	**Robustness** • Forward Error Correction • Mesh networking
To be able to answer future needs	**Future proof** • IPv6 native • Ability to download firmware over the power line • Ability to accommodate future applications
To be able to operate with clusters from 2 to 1500 nodes	**Scalability** • Forwarding layer at level 2 or 3 • Mesh network
Multisourcing and open solutions	**Interoperability** • Reuse whenever possible already existing standards • PLC G3 is now an international standard (ITU) served by a community of silicon and meter vendors (G3-PLC Alliance), which ensures a better competitiveness.

Frequency context



Linky Smart Metering Purposes



G3-PLC-based metering profile

Validation process

ERDF PLC team experts are monitoring the G3-PLC performances, step by step

« G3-PLC 2000 ERDF field test »

Programme Linky

Sagemcom & maxim integrated™

1 690 smart meters

28 data concentrators

Lyon
(1008 SM + 7 DC)
Tours
(682 SM + 21 DC)

Sagemcom & Texas Instruments

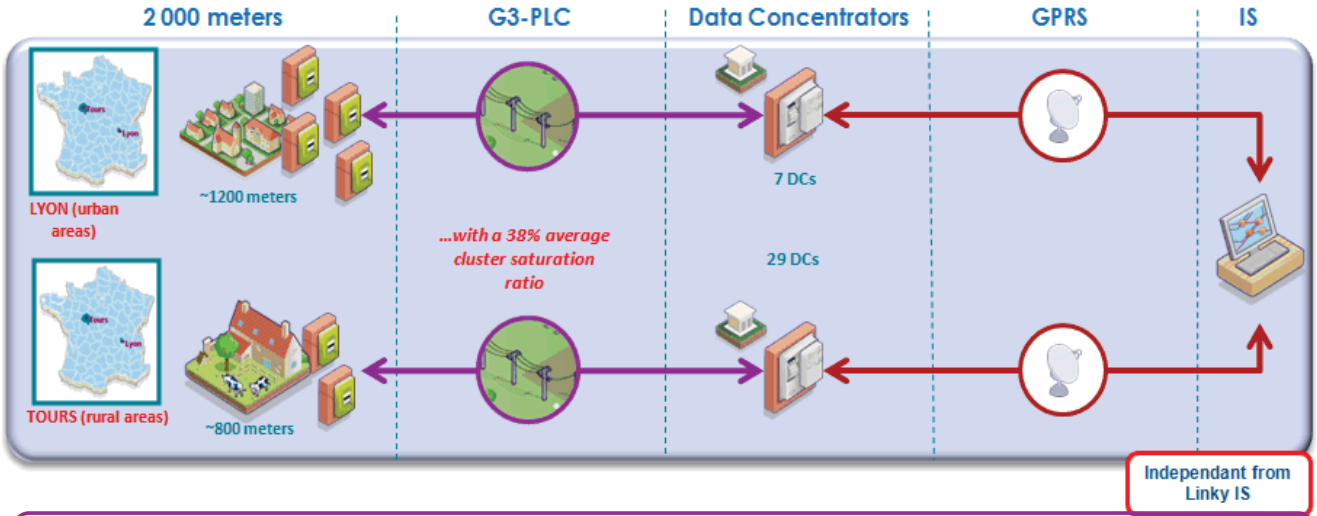
157 smart meters

3 data concentrators

Tours
(157 SM + 3 DC)

IT architecture for the 2000 G3-PLC ERDF field test

Programme Linky



Single phase meters only,
Single meter manufacturer, without interoperability,
Full Sagemcom IS for administration and monitoring purposes, not linked to the ERDF Linky IS

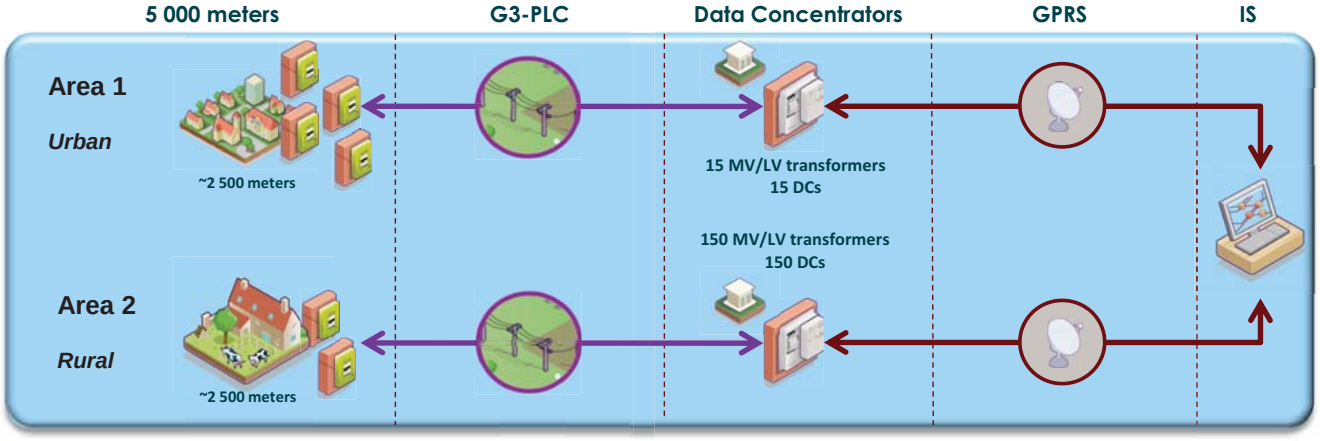
Performance on the field

	Sagemcom-Maxim	Sagemcom-TI
Ping	2,1s	3,1s
Alarm notification	2,8s	7.0s
Index Reading	6,5s	13,2s
Periodic collection	38,7s	35,59s
Firmware downloading	4,7mn – 13,4mn	5,4mn – 27,2 mn
Average flow	4,17kb/s	3,73kb/s

/!\ Average PLC time obtained on the DC-SM link, on-site, w/o 2G and IS processing time

2015 - The second ERDF G3 field test

- Target ➔ **interoperability** in the field



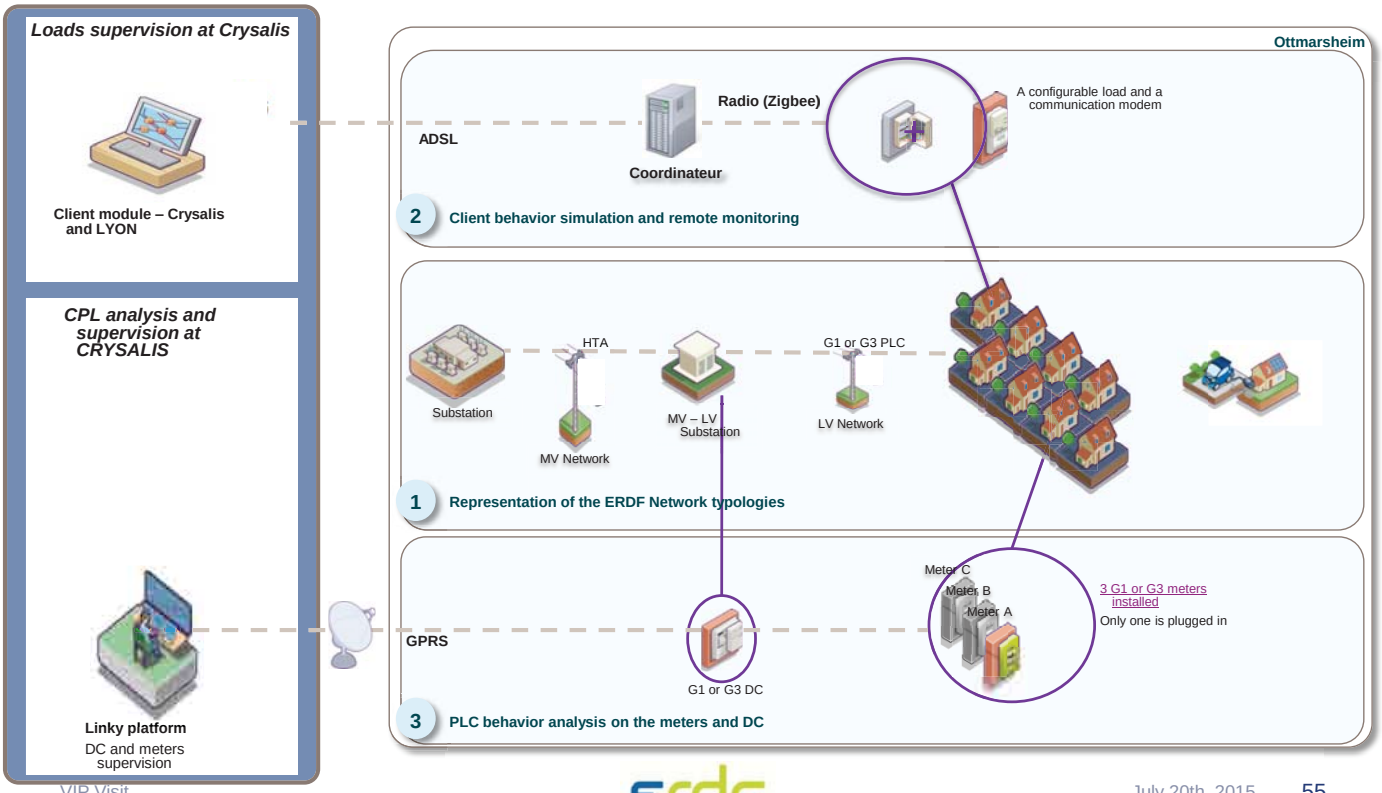
Single phase and Polyphase meters produced by 3 different manufacturers
Lab tests and field conditions tests very effective
Roll out in interoperability conditions: on-going
All the meters and DC are connected to the Linky IT System: integration validation on going

=> Results coming soon…

The « Otmarsheim Testing Grid »

A new ERDF testing tool for PLC performances in real network conditions

Programme Linky

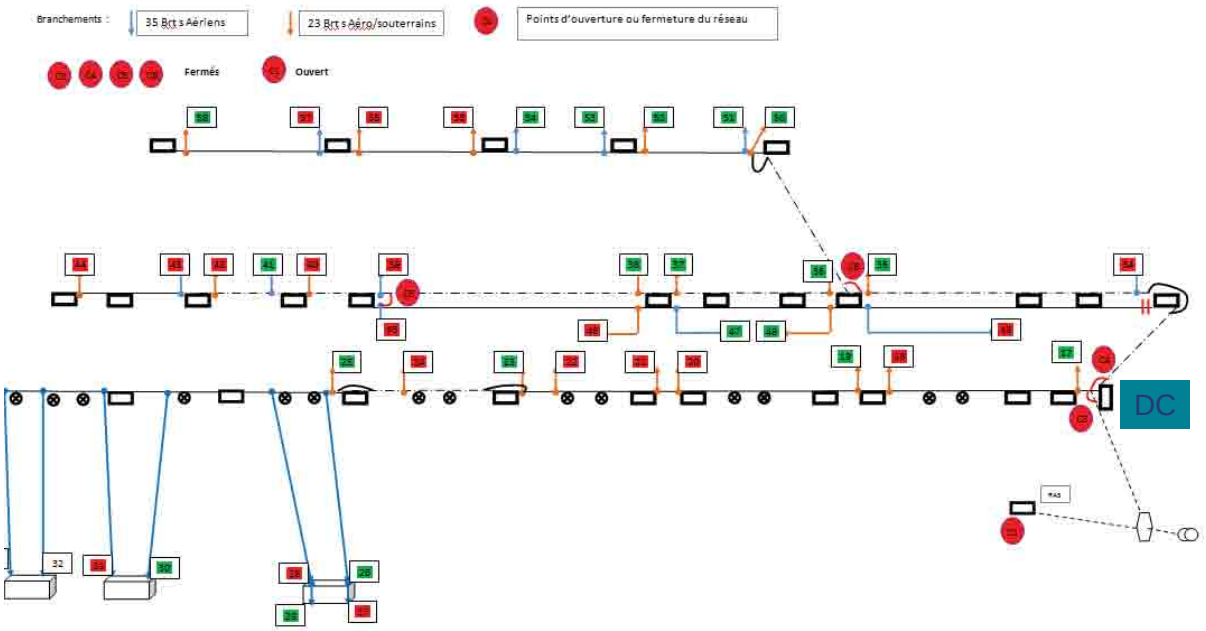


The « Otmarsheim Testing Grid »

First G3-PLC test campaign

Programme Linky

Electric scheme of the network



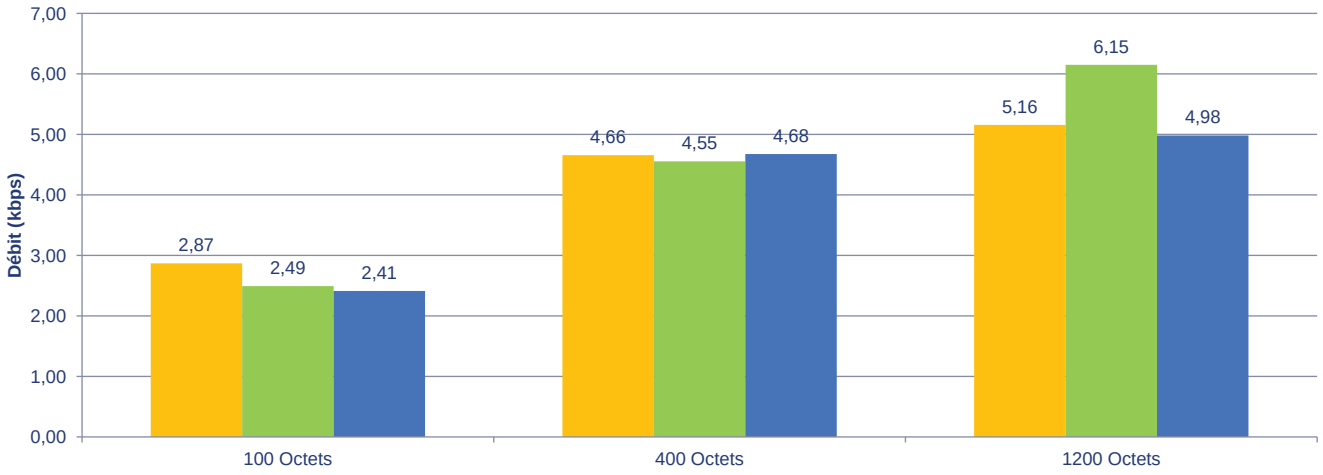
40 meters on more than 1 km, maximum distance between meter and DC : 300m

ERDF 5k G3 Pilot: few first results

Programme Linky

G3-PLC Communication tests: 99,5% of success!

Average Debit Rates vs size of data (by manufacturer): measurements achieved on the « Field conditions Lab »

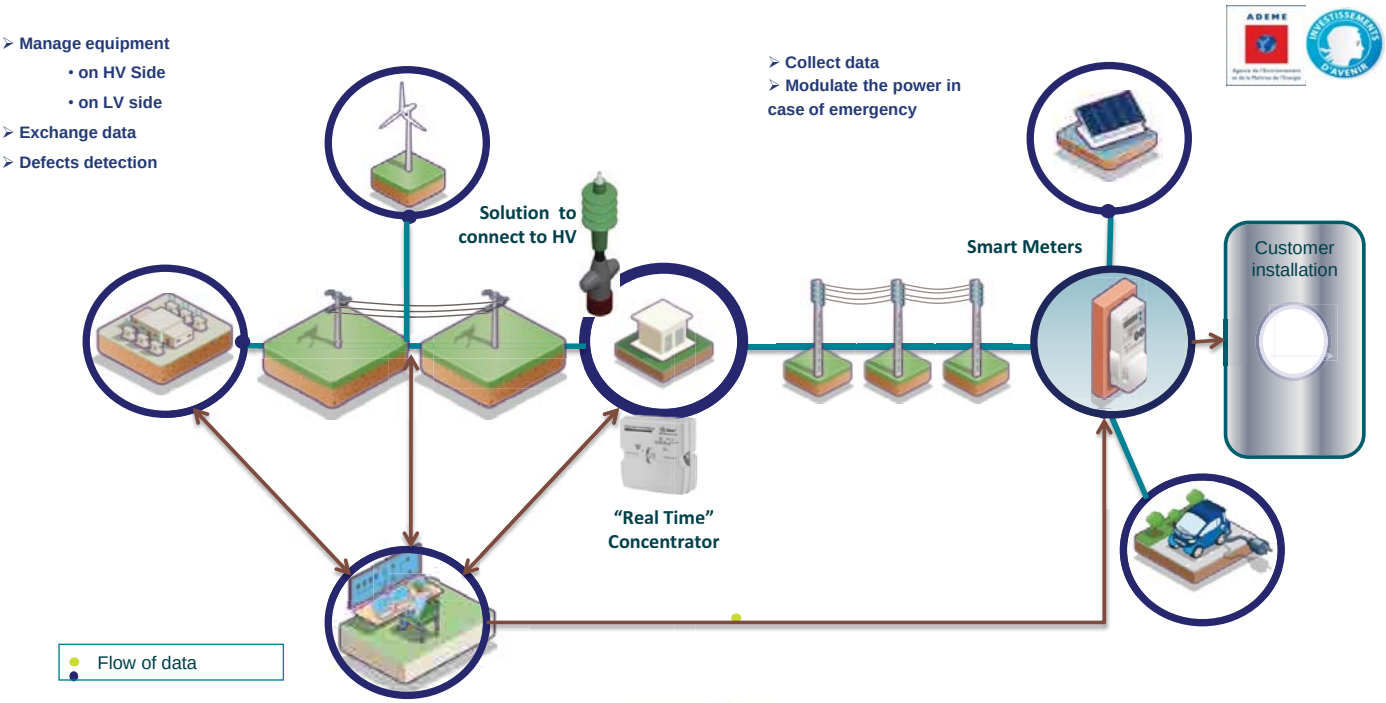


The third G3 pilot SOGRID Project

Programme Linky

- Manage equipment
  - on HV Side
  - on LV side
- Exchange data
- Defects detection

- Collect data
- Modulate the power in case of emergency



G3 - PLC Alliance : objectives and organization

Programme Linky

G3-PLC Alliance 3 main objectives :

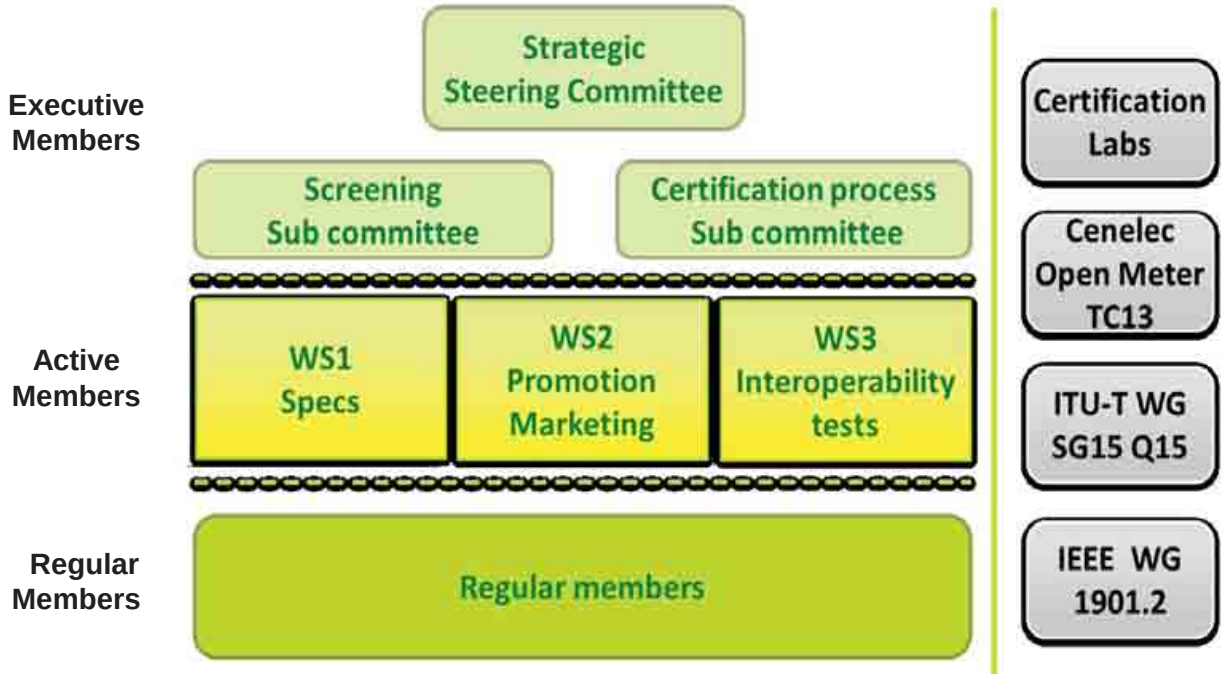
1) Maintain and ensure the evolution and backward compatibility of the G3-PLC specifications

2) Operate interoperability & conformance tests and programs of certification

3) Promote :
   - G3-PLC follow-up in ITU-T Smart Grid Working Group
   - G3-PLC technical features and overall value to utilities and DSOs worldwide
   - G3-PLC in any Smart Grid applications

G3 - PLC Alliance : objectives and organization

Programme Linky



An international standard for smart grids applications

Specifications and Standardization	
07/2010	ERDF joined ITU-T
05/2011	ERDF founded G3-PLC Alliance
12/2011	G3-PLC is an international standard (G.9955/G.9956)
12/2012	5 major silicon vendors (Maxim, TI, ST, Freescale, Renesas) performed Interoperability tests (IOT) on PHY layer. An event organized by G3-PLC Alliance
08/2013	Decision to freeze the specifications after a last batch of enhancements
12/2013	Revised G.9903 has been consented by ITU-T
04/2014	First Certification Approval delivered by G3-PLC Alliance

- 193 countries have voted for G3-PLC in Geneva at Dec. 2013.

- The G3-PLC standard has been negociated among more than 40 international members at the **International Telecommunication Union**.
- ITU G.9903 is a **free open standard** published since April 2014.
- **193 countries have voted for G3-PLC in Geneva at Dec. 2013.**

G3-PLC :
a long but successfull process to achieve **commun** and **robust specifications**

Quartum, Eco CO2 & TBH Project

presentation to Taiwanese delegation

Paul Rossinès, Jacques ALLARD, the 22nd of July 2015

Quartum and its founders

Quartum is a start-up company founded in July 2014 by 2 energy experts

- **Jacques ALLARD co-founder and General Manager**
  - Chairman and majority shareholder of **Eco CO2**, B2B2C energy efficiency consulting firm, founded in 2009
  - 25 years of experience with EDF (Electricité de France)
    - CEO of Captelia, joint venture EDF/Imerys, solar tiles manufacturing
    - Founder & Chairman of Edelia, EDF subsidiary, residential smart grids
    - EDF R&D Head of department

- **Paul ROSSINES co-founder and Chairman**
  - Chairman and majority shareholder of **Miscantus**, B2B energy efficiency consulting firm, founded in 2010
  - Large experience in different energy sectors, France and International
    - EDF Vice-President Renewable Energies, CEO of EDF distributed renewables
    - Large energetic projects General Manager (Oil & Gas, Urban Waste, Independent Power Plants), in France, Europe, Africa, North & South America, Asia
    - Professor at INSTN (CEA Saclay) Energy Project Development &economics

Our vision in energy efficiency

We are convinced that:

- The energy Consumer is a key actor of energy efficiency, but has no energy culture
- The best results are based on the good understanding of the relationship between comfort and energy needs.
- The energy Consumer needs a pertinent information, an help in the interpretation of the phenomenon, a coaching in the behavioral change and a support in the adaptation of the assets
- Information Technologies are a tool helping the Consumer to understand, choose and decide.

Let the Consumer grow in his energy knowledge and become actor of his energy efficiency to avoid rebound phenomenon

Our multidisciplinary team develops solutions in accordance with this vision. This team includes technicians, engineers, coaches, a designer and a social psychologist specialist in energy.

Smart metering

Linky by ErdF , the french distribution network operator:

"Linky, the communicating meter

Linky is not just an electricity meter. As well as providing accurate meter readings, it can perform remote operations, such as measuring the consumption and production of electricity, or resolving accidental outages. Linky also helps to control electricity consumption.

Today's electric meters are mostly electromechanical meters. They measure consumption and require a technician if a change in power or an outage occurs.

Linky is a communicating meter, which means that it can receive and send data without the need for the physical presence of a technician. Installed in end-consumer's properties and linked to a supervision centre, it is in constant interaction with the network. This is what makes it smart."

From the beginning, the Linky project faced criticism because the main benefits of this very high investment paid by the consumers are for the network operator and for the supplier, not for the Consumer.

TBH (home dashboard) project

Among the thematic included in the RFP launched in 2011 by ADEME, the French energy efficiency Agency, was the question of the Consumers' acceptability of smart grids new services and equipment and how these smart grids can bring benefit to Consumers to blow the socio economic lock.

We answered by TBH proposal, aiming to demonstrate how a good information associated with adapted coaching allows energy savings for the end use Consumer with positive consequences for the country and the planet in terms of greenhouse gas emissions and resources savings.

A few studies did exist in other countries (USA, Italy, etc.), but not in France. The Goal of the project approved by ADEME and supported by the French Government is:

Conducting a large study on a representative panel
of 3,200 French consumers,
to assess the potential for energy savings
of various display systems
and indicators relating to their electricity consumption.

TBH Alliance

TBH is developed by a consortium named TBH Alliance including :

eco CO2 Quartum Fludia Smart Energy Components

CGI Business Consulting ARCHOS

Lutin Userlab Cité des sciences et de l'industrie SLPV analytics

ADEME

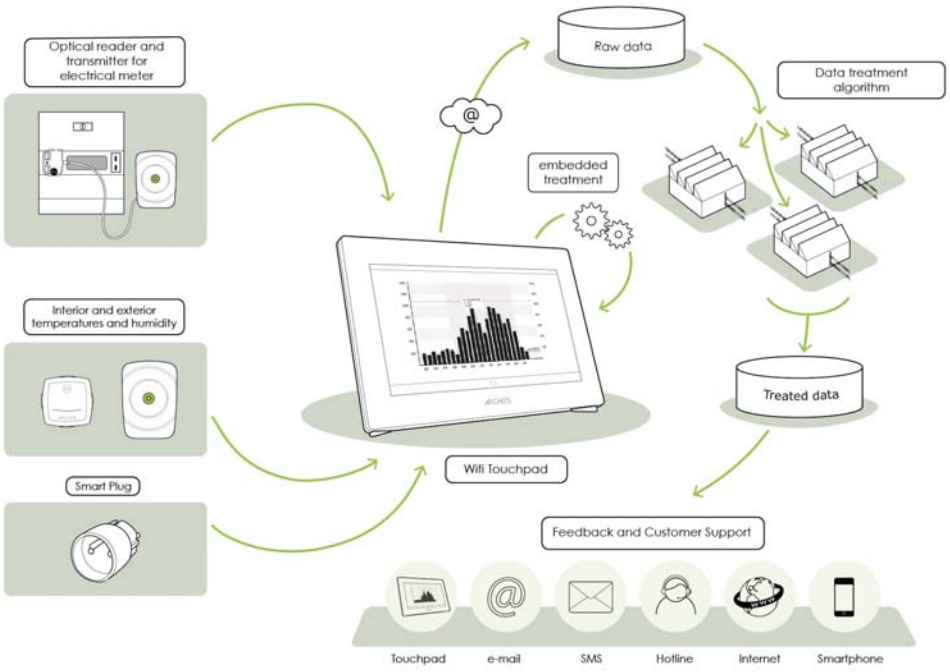
TBH Project is realized with the financial support of French Future State Investments managed by ADEME.

The beginning of the one year experimentation is planned in October.
This experimentation is also a commercial beta test of the services.

The objectives of **Quartum/EcoCO2** are to be a **HEMS services provider.**

TBH architecture schematic

More informations on http://projet-tbh.fr



French meters

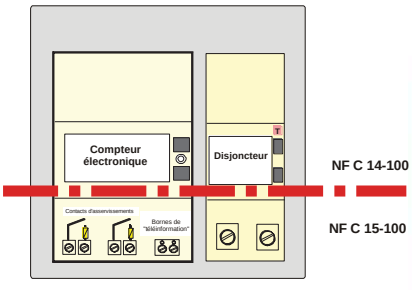
NF C14-100 & NF C15-100 standards define the limit between the Supplier domain and the Customer domain.

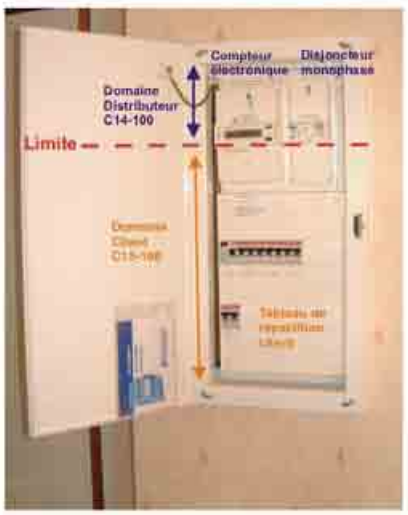
The « upstream » part of the meter is sealed and responsibility of ERDF

The « downstream » part of the meter is available to the customer.

UPSTREAM

DOWNSTREAM





Linky & electronic multi tariff meters send permanently data (index, instantaneous power, alerts…) via Euridis bus

Electromechanical & electronic single tariff have no downstream interface. It represents 60 to 70% of French meters.

A key element : the optic reader by Fludia

Fludia is a company founded in July 2002

- **Rémy MAROT Sales Director**
  - 5 years of experience in Energy
    - Fludia -Sales Director
    - Easy Solar – Development of innovative hybrid (PV + thermal) solar roof structure

  - 20 years in the Telecom industry in various positions of international sales & marketing and management of business areas within large companies :
    - ZTE China Corp - Sales Development of French Affiliate
    - Alcatel - Lucent- Global Account Manager
    - CS Telecom - Channel Manager Emea
    - Philips Com. Systems - Area Sales Manager

ADEME & the new French law on energy transition and green growth

French – Taïwan meeting on smart grids and metering

DOMINIQUE CAMPANA
DIRECTOR OF INTERNATIONAL AFFAIRS
ENVIRONMENT AND ENERGY MANAGEMENT AGENCY
(ADEME)

Paris, 22 July 2015

ADEME at a glance

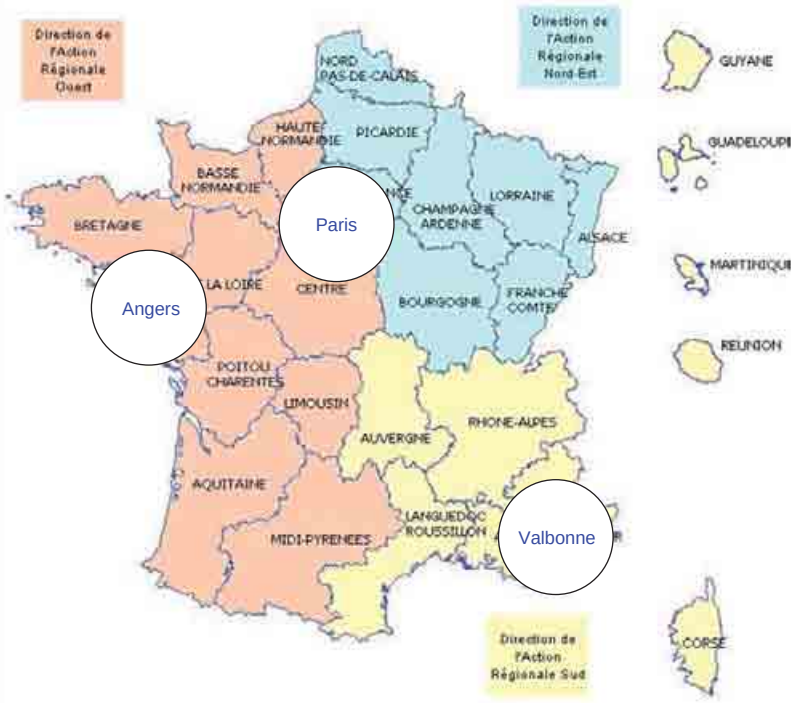
ADEME activity as operator of public policy
法国能源与环境控制署作为国家政策操作者采取的行动

ADEME is involved as Public Agency under the authority of Ministry of Energy, Environment, Sustainable Development and Research in the field of waste management & circular economy, polluted soils & wasteland, air pollution & noise, energy & climate:|
在能源效率和可再生能源领域，法国能源与环境控制署在能源环境可持续发展和研究部的授权下，充当公共机构。

ADEME actions in the field of Energy Efficiency & renewable energy:

- **Supporting research and innovation** for new technologies and services (R&D, Investments for the Future)
  支持新技术和服务（研发、对未来的投资）的**研究与创新**。
- **Funding demonstrators** (ZEB, buildings rehabilitation, smart grids, vehicles, industrial processes…)
  资助示范项目（零能耗建筑 （ ZEB ）、建筑物改造、智能电网、车辆、工业生产过程…… ）。
- **Technical advices** for regulations (buildings codes…) and labelling (buildings, equipment, cars), for energy efficiency obligation of energy suppliers and certificates, for financial and fiscal measures
  对条例（建筑条例**……** ）、标记（建筑物、设备、汽车）、能源供应商和证书的能源效率义务、以及金融和财政措施的**技术建议**。
- **Tools development** for GHG emissions inventory and reduction plans for communities, companies (tertiary, industrial, freight transport)
  社区和公司（第三产业、工业和货物运输）温室气体排放清单和减少项目的**工具研制**。
- **Funding local programs** with regional authorities (heat from renewable energy, waste management…)
  与地方当局共同**资助地方计划**（来自可再生能源的热能、废物管理…）。

Decentralized
to better act at local level

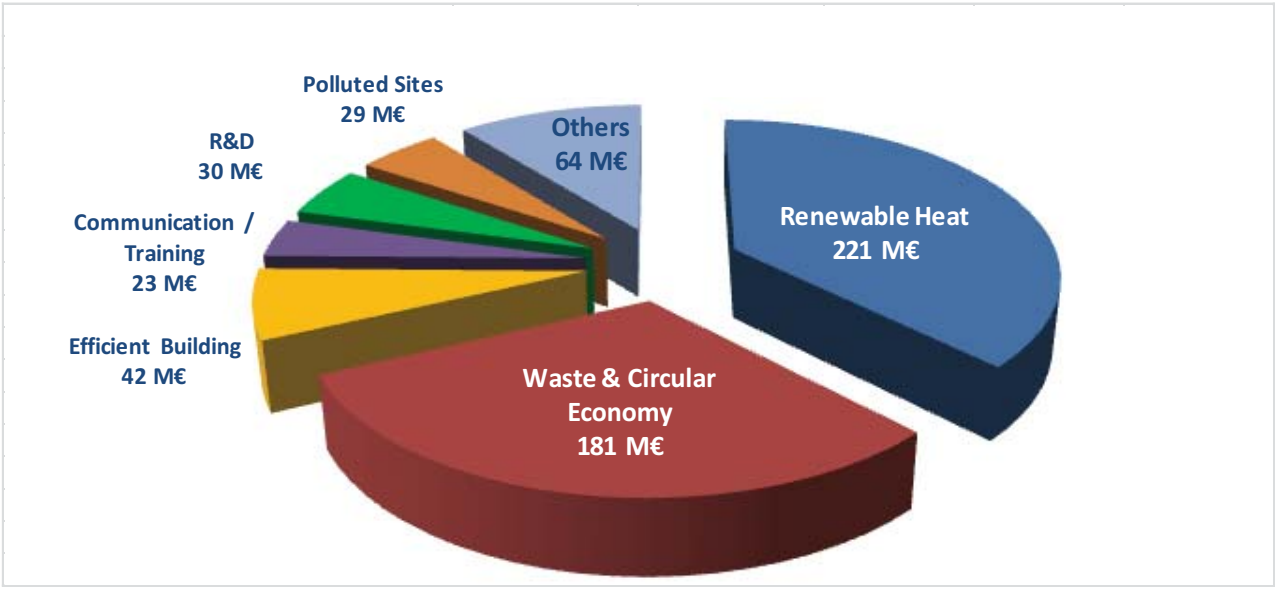


***A staff* ~ 1 000**
全体工作人员~ 1000

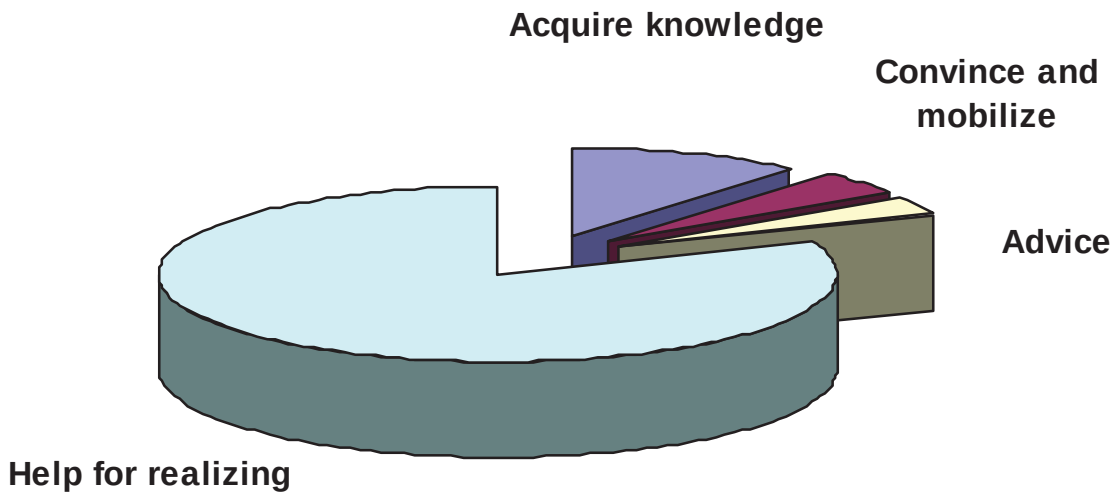
- **3** central sites (~50%)
  3个中心位置（ ~50%）
- **26** regional directions (**17** as from 2016)
  26种区域指导
- **3** representations in overseas territories
  海外领土的**3**个代表
- **1** office in Brussels
  位于布鲁塞尔的**1**个办事处

2015 Budget : 590 M€

Breakdown by topic



Breakdown by action



An additional budget from a national loan: the investments for the future

- Specific financial management by ADEME, separated from the general budget allocation
- Total amount: 3,55 billion € since 2010
  - 4 programmes
    - Vehicules for the future — 1,15 billion €
    - Renewable energies and green chemist
    - Circular economy
    - Smart grids

    — 2,4 billion €
- Means: subsidies, reimbursable aids, equity investments

The new law in France for energy transition and green growth

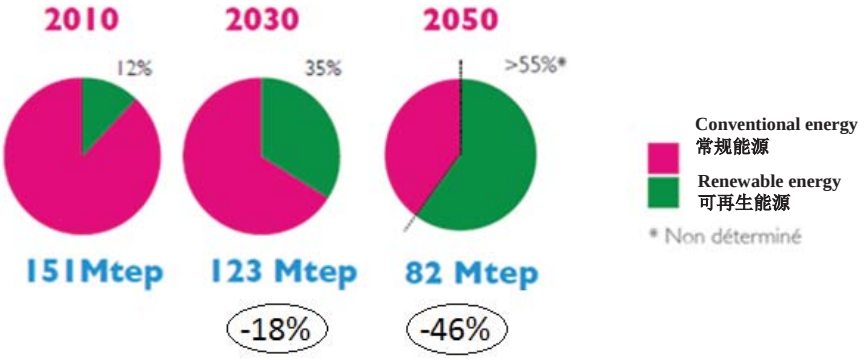
The new law in France for energy transition and green growth
法国能源转型和绿色增长新法

- **After a large debate among stake holders in 2013, a new law has been adopted by Government mid 2014 and under discussion by Parliament. It schould be adopted before the end of July 2015.**
  继利益相关者在2013年展开大讨论后，政府已于2014年中旬采纳一项新的法律，且国会也正在讨论该新法。

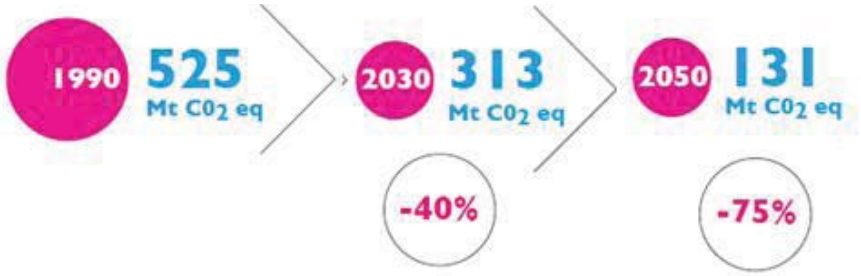
- **Main objectives to comply with factor 4 in 2050 :**
  在2050年符合因素4的主要目标：
  - ***Reducing GHG emissions by 40% in 2030***
    2030年，温室气体排放量下降40%。
  - ***Reducing energy demand by 50% to 2050***
    2050年前，能源需求下降50%。
  - ***Increasing the share of renewable energy from 13,4% (2012) to 32% in 2030***
    2030年，将可再生能源的份额从13,4% （2012年）提高到32%。
  - ***Reducing the share of nuclear in electricity mix from 75% to 50% in 2025***
    2025年，将核能在电力结构中的份额从75%减少至50%。
  - ***Reducing the share of fossil energy in energy mix by 30% in 2030***
    2030年，将化石能源在电力结构中的份额减少30%。

ADEME vision to 2030 and 2050
法国能源与环境控制署 2030年和2050年远景

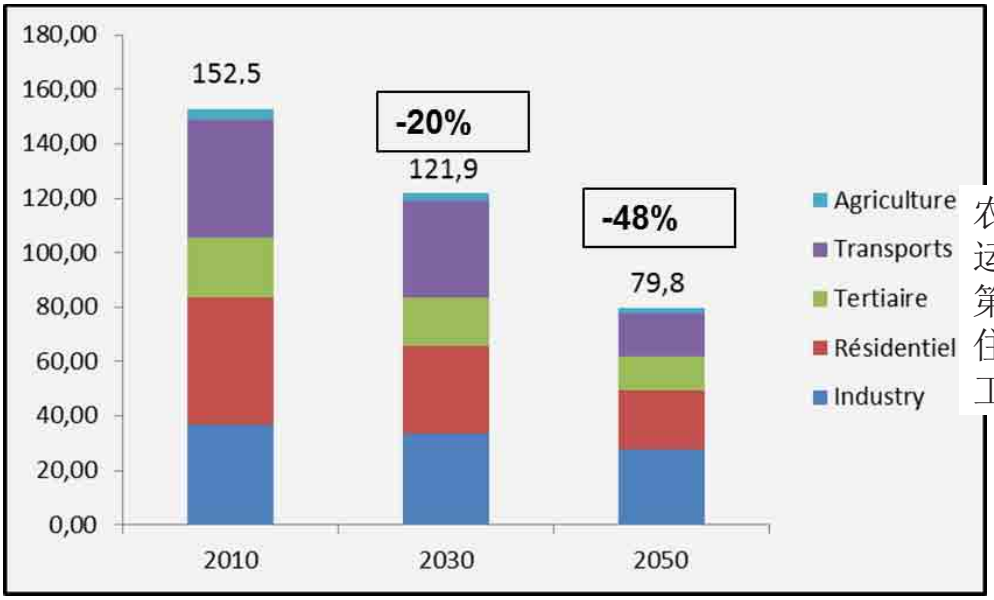
Energy balance
能量平衡



GHG balance
温室气体平衡

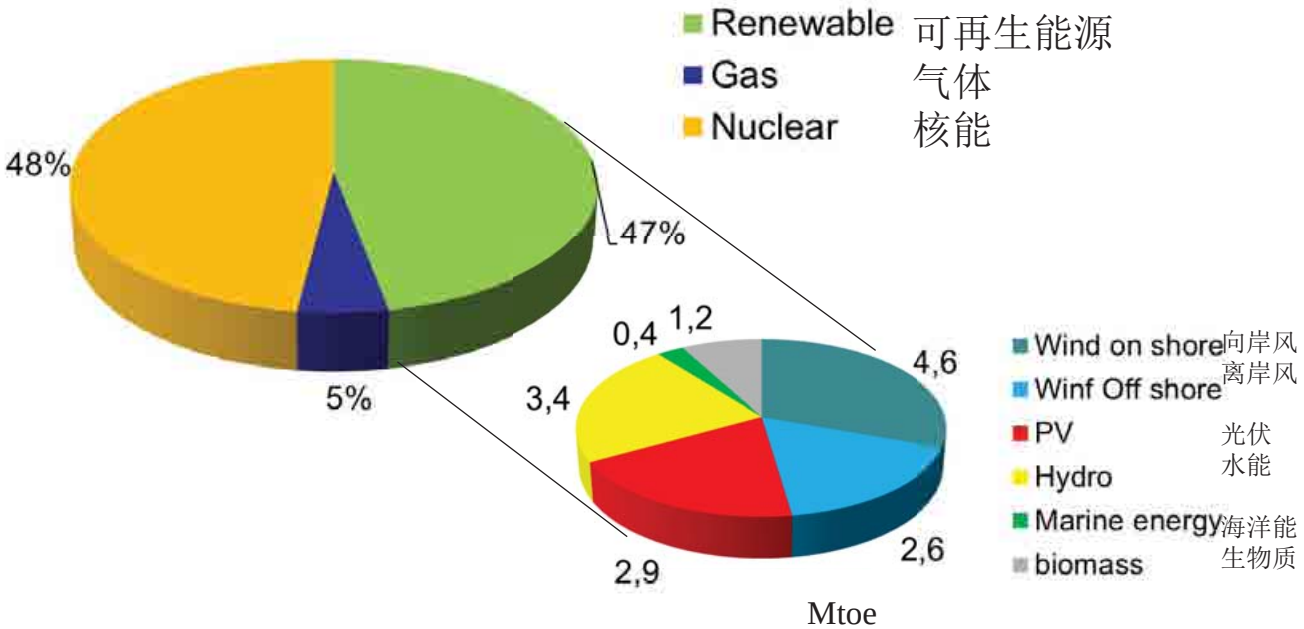


Energy transition scenarios to 2030-2050 elaborated by ADEME for National Debate (November 2012)
法国能源与环境控制署为全国辩论（2012年11月）详细阐释的2030年至2050年能源 转型情景

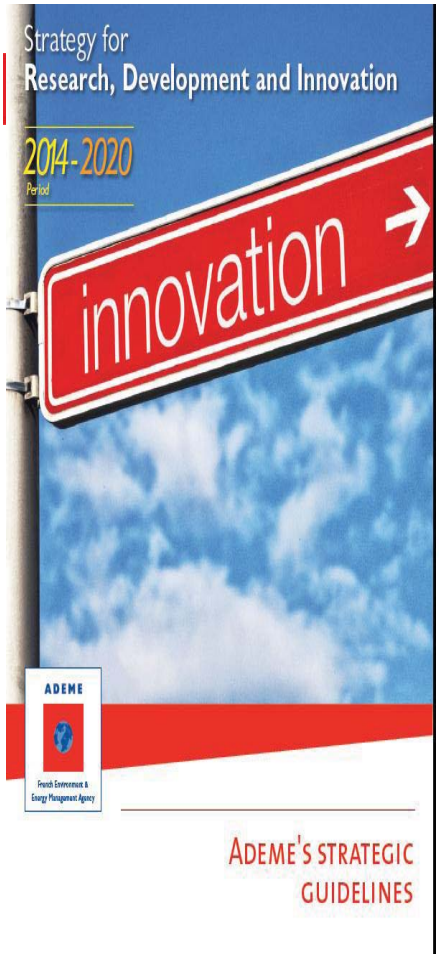


Final energy demand in 2030 and 2050
2030年和2050年最终能源需求

ADEME vision : Electricity mix in 2030
法国能源与环境控制署远景：2030年电力结构



Mtoe
百万吨油当量



Themes of roadmaps realized by ADEME by main programme

Sustainable production and renewable energy

- Renewable Marine energy
- Photovoltaic electricity
- Solar thermodynamic energy
- Hydrogen energy and fuel cells
- Energy storage systems
- Industrial Wind
- Geothermal energy
- Rail Systems
- Eco-designed products, processes and services
- Solar Thermal Energy
- Capture, transport, geological storage and re-use of CO_2
- Waste collection, sorting, recycling and recovery

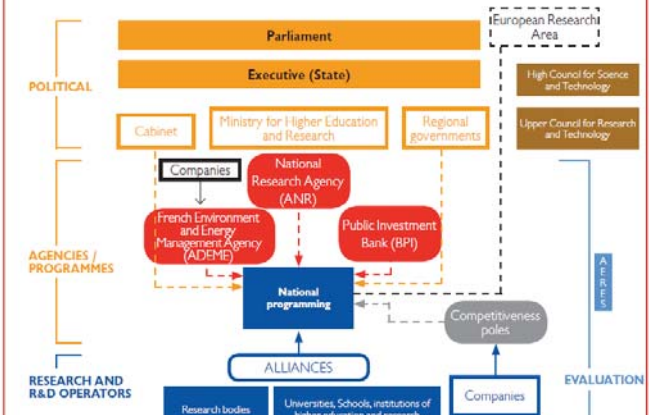
Sustainable cities, towns and territories

- Smart electricity systems
- Ships of the future
- Private vehicle – fuel combination
- Low GHG-emitting road vehicles
- Positive Energy and low carbon Buildings and building clusters
- Plug-in electric and hybrid vehicle charging infrastructure
- Mobility systems for passengers and freight
- Integrated approaches to logistics chains and personal mobility systems
- Challenges and prospects for efficient sustainable cities: climate, energy, environment

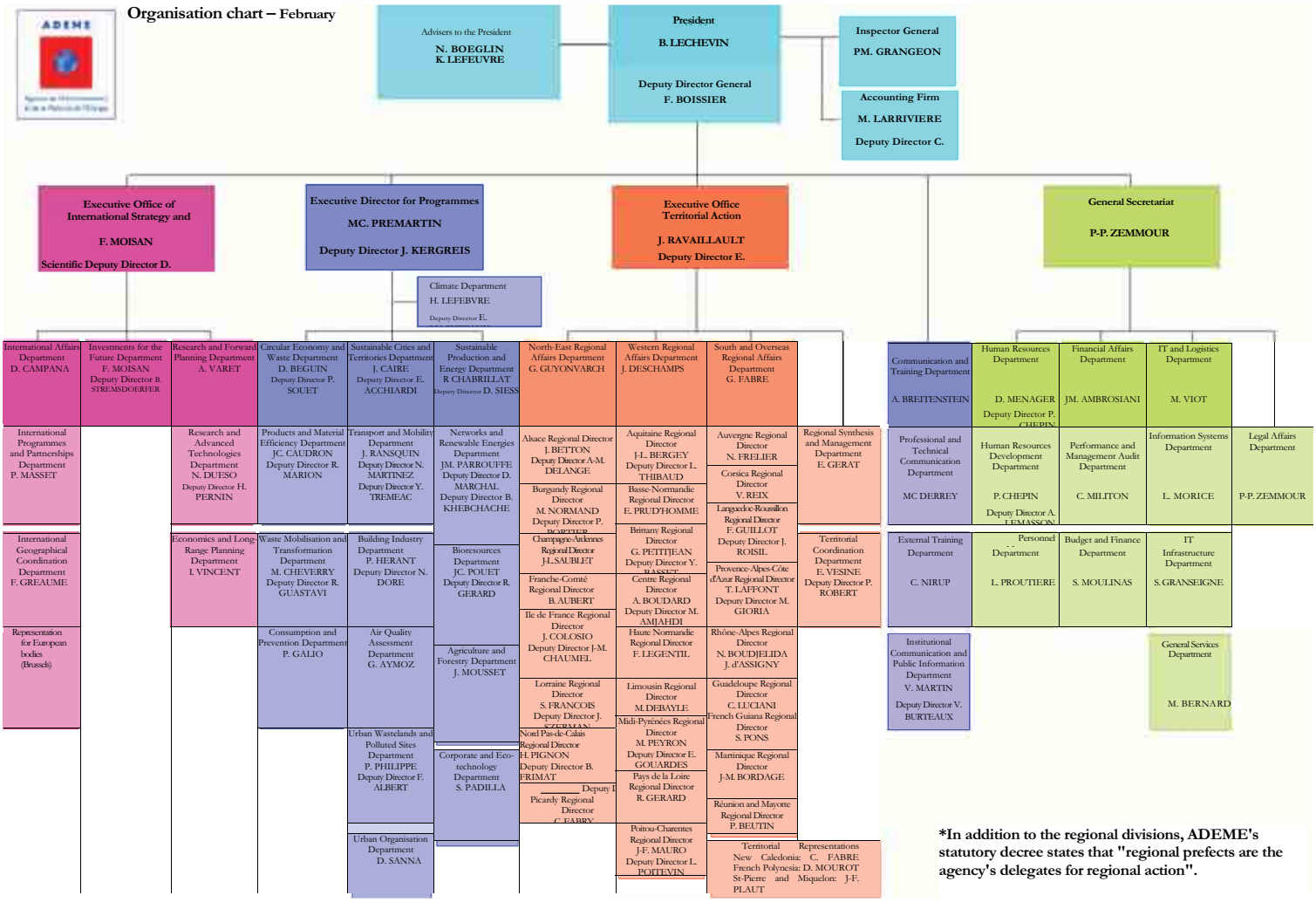
Agriculture, forests, soils and biomass

- Advanced biofuels
- R&D in plant chemistry
- Integrated management of soils, ground water and sediment

Organisation of research and innovation



Organisation chart – February



***In addition to the regional divisions, ADEME's statutory decree states that "regional prefects are the agency's delegates for regional action".**

Smart Grids
The French know-how

GSCN 2015 France – 15 April

Demand-Side Management Workstream

Cécile Gracy - ADEME

ADEME - The French environment & energy management agency

- A public Agency under the joint authority of the French Ministries for Ecology, Sustainable Development, Energy / Higher Education and Research
- **ADEME's Objective :** Be the point of reference and privileged partner for central and local authorities, professionals and the general public
- **Main fields of activity:** energy efficiency and renewable energy, waste management, soil conservation, air quality, noise abatement
- **Budget 2015**: 590 M€ for actions ; 2 300 M€ for the Investments for the future Programme (2010-2020)
- Around 1000 staff (3 headquarters and 26 regional branches in France)

4 main modes of action:

- ✓ **Acquiring knowledge and Developing innovations** (R&D and demonstration programs, roadmaps)
- ✓ **Providing expertise** (advising public authorities, Providing studies, tools & guides…, supporting decision making)
- ✓ **Convincing and mobilizing** (communication campaigns, advising citizens - notably through Energy information centers -, Informing and training professionals)
- ✓ **Financial support for project development** notably : renewable heat (221M€ in 2015), Waste and circular economy (188M€), polluted sites and brownfields (24M€)…

Context

Smart grids: the result of the convergence of electrical systems technologies with information and communications technologies

Smart Grids make it possible to address different challenges such as:

- Adapting electricity transmission and distribution grids to the energy transition, i.e. more renewable energy, more energy efficiency ;
- Implementing innovative grid management tools and ways to get more value from renewable electricity;
- Developing synergies between commercial offers for consumers and mechanisms to develop and exploit decentralized flexibility, thereby transforming the consumer into a "consum'actor";
- Resolving today's technological bottlenecks, for example energy storage or deployment of EV and the associated recharging infrastructure
- …

Main characteristics of the French Smart Grids industry

- **World leaders, SMEs and mid-cap companies specialized in all of Smart Grid technologies:** operators of electrical and telecommunications networks, equipment manufacturers, component producers, ICT companies…
- **Over 100 Smart Grids projects** are ongoing in France and many projects are led at the international level
- **R&D and innovation: over 20 demonstration projects** underway in the framework of the Investments for the Future program
- **France ranks first in Europe** for investments in Smart Grids projects
- Smart Grid is one of the strategic industrial priority of the “New industrial France” initiative

3 necessary skills for developing Smart Grids projects

MASTERING THE COMPLEXITY

Ability to control the deployment of complex systems, at every level of the electric grid.

LARGE SCALE DEPLOYMENT

Ability to manage the deployment at the scale of the French territory for Smart meters, for control systems…

HIGH LEVEL OF DEPENDABILITY

Development of reliable and maintainable electric systems, with high levels of security and high rate of availability.

References in terms of “System engineering”

A strong capacity to provide tailored and reliable answers to large scale and far-reaching energy choices. For example:

- ✓ The use of 12 million residential water heating boilers as decentralized storage facilities for more than 40 years
- ✓ The automation of the distribution grid
- ✓ The ongoing deployment of 35 million smart meters
- ✓ The distribution grid adaptation to integrate electric vehicles on a large scale (ongoing).
- ✓ …

The French electric system is already smart

- **An investment program aimed at making the electric grid smarter :**

Better monitoring and automation, large scale deployment of advanced metering…

- **A smart transmission grid, with a high level of Observability**
  - The largest electricity transmission system in Europe, managed by RTE
  - High quality grid monitoring: information from more than 40,000 data points collected every second to monitor the transmission grid

- **A smart Medium Voltage Distribution Grid**
  - Managed by ERDF, the first DSO in Europe, with 35 million customers
  - Strong monitoring and control capabilities at medium voltage level
    - ✓ *more than 100,000 measurement and remote control devices*
    - ✓ *30 regional dispatching centers acting like control towers*
    - ✓ *advanced software to analyze incidents, ensure fault detection, contribute to the development of self-healing networks…*

The result: a marked decline in average power failures and very fast restoration of the power supply for clients in case of severe meteorological disaster (storm, extreme cold…).

Innovation - The “Investments for the Future” program

- ✓ Smart Grids are one of the priority of that major program
- ✓ Objective: supporting pre-industrial experiments and demonstrators
- ✓ A program managed by the ADEME on behalf of the French State
- ✓ **18 projects launched so far in the field of Smart Grids, with a strong impact on the structuration of the French Smart Grid industry**
- ✓ Main characteristics of the projects:
  - A strong local presence, close the local authorities, companies and consumers…
  - …covering a very broad range of innovation across the smart grid value chain:
    - Experimentation of decentralized renewable integration in the grid (9 projects)
    - Technologies for grid management (9 projects)
    - DSM and Demand Response of consumer : 35 000 households involved in DSM projects (8 projects)
  - Projects that bring together TSO and DSO, equipment manufacturers, ICT companies, local authorities, research bodies, universities, final consumers

The IA program : Location of the demonstrators

Project with less local anchorage

- ENRPOOL
- MODELEC
- TBH ALLIANCE
- POST

Ecotechnologies fund

- *ACTILITY*
- *IJENKO*

Renewable energy integration

Final consumer actor of the system

Storage, demand response and grid management

Consumer/producer

SMART ZAE

Optimization of energy production (renewable) and consumption with storage (flywheel) and DC network in an industrial zone in Toulouse

SCLE, LEVYSIS, …

NICEGRID

A smart solar district in the city of Carros 1500 households and companies involved in grid local management

ERDF, EDF, ALSTOM, SAFT, RTE, …

GREENLYS

Large experimentation : Renewable energy, smart counters, 1000 households, 40 commercial sites in Lyon and Grenoble.

ERDF, ALSTOM, ATOS, CEA, Schneider Electric…

French organisations mobilized

PUBLIC INSTITUTIONS

Ministry for Ecology, Sustainable Development and Energy
www.developpement-durable.gouv.fr

Ministry for the Economy, Industry and Digital Affairs
www.economie.gouv.fr

Ministry of Foreign Affairs and International Development
www.diplomatie.gouv.fr

ADEME - French environment and energy management agency
www.ademe.fr

Club ADEME International
www.clubinternational.ademe.fr

UBIFRANCE
www.ubifrance.fr

AFD - French Agency for Development
www.afd.fr

ANCRE - French National Alliance for Energy Research Coordination
www.allianceenergie.fr

PUBLIC NETWORK OPERATORS FOR TRANSPORTATION AND DISTRIBUTION

RTE
www.rte-france.com

ERDF
www.erdf.fr

PRIVATE INSTITUTIONS

GIMELEC
www.gimelec.fr

IGNES
www.ignes.fr

Smart Grids France www.smartgridsfrance.fr

The Union of 10 French competitiveness clusters specialized in Smart Grids and IT:

Thank you for your attention!

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Laurent.caillierez@ademe.fr

Demand Response by Energy Pool

Lyon, France - July 23, 2015

Benoît DURETZ
Business Development Manager
Energy Pool

Martin DARONNAT
EnR-Pool Project Manager
Energy Pool

Contents

- Introduction to Demand Response and aggregation (25')
  by Mr. Benoît DURETZ, Business Development Manager
- EnR-Pool project : How to integrate better rewenable energies into the electric system ? (20')
  by Mr. Martin DARONNAT, EnR-Pool Project Manager
- Taiwanese government load management program for intelligent power systems, and relevant Demand Response projects in Taiwan
  by Taiwanese delegation
  Q&A (30')
- Wrap-up and next steps (15')

INTRODUCTION TO DEMAND RESPONSE AND AGGREGATION

Introduction to Energy Pool

The leading European Demand Response Operator

YOUNG, FAST DEVELOPING COMPANY

- 2009 — Company set up in France
- 2010 — Strategic partnership Schneider Electric
- 2013 — Operations in Belgium & UK
- 2014 — Operations in Cameroon, Japan & Norway
- 2015 — Operations in South Korea; Deployment in 4 countries; 1st DRMS sales

RECOGNIZED FIELDS OF EXPERTISE

- Regulatory & DR program design
- Customer Enrolment (MW)
- IT DR platform (DRMS)
- DR Operations

OPERATING CENTERS *1,500 MW managed 24/7*

- Chambéry *France*
- Douala *Cameroon*
- Tokyo *Japan*
- London *UK*

R&D PROGRAMS

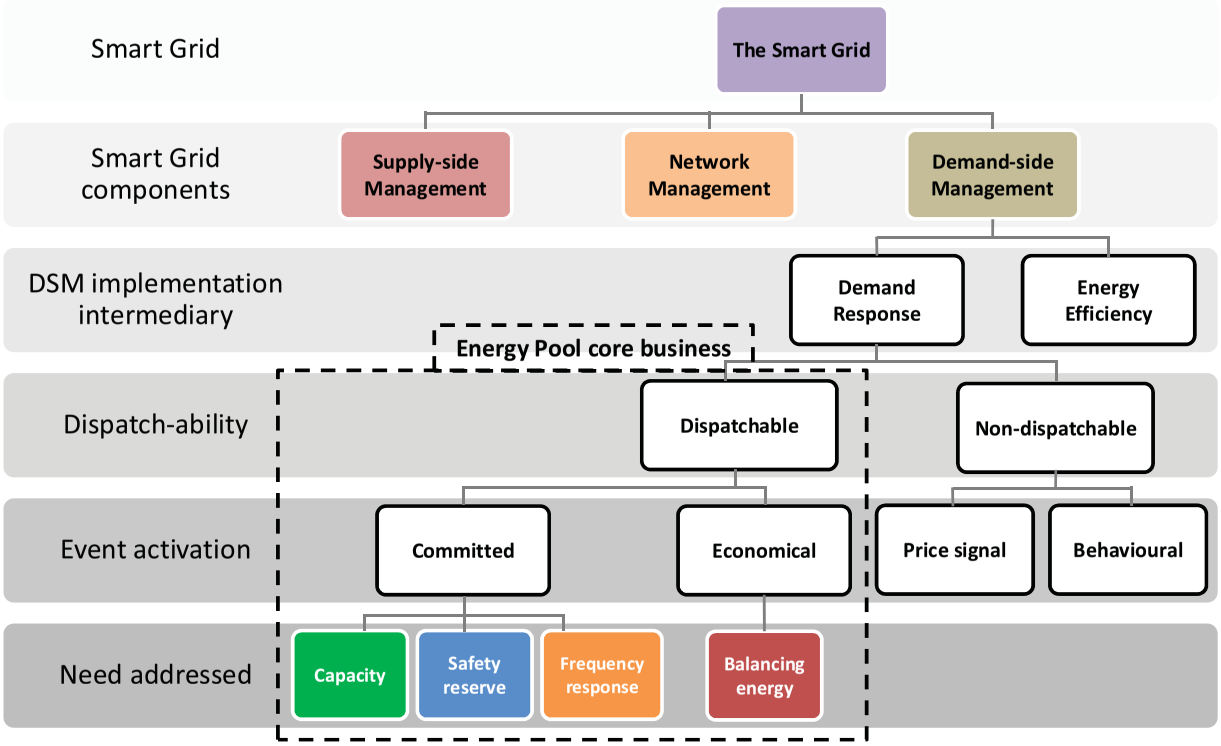
- Renewable integration through DR
- Electric vehicle and DR
- Electrical storage and DR
- Microgrid & complex sites

Introduction to Energy Pool

They have trusted Energy Pool for their DR services

Introduction to C&I Demand Response and aggregation

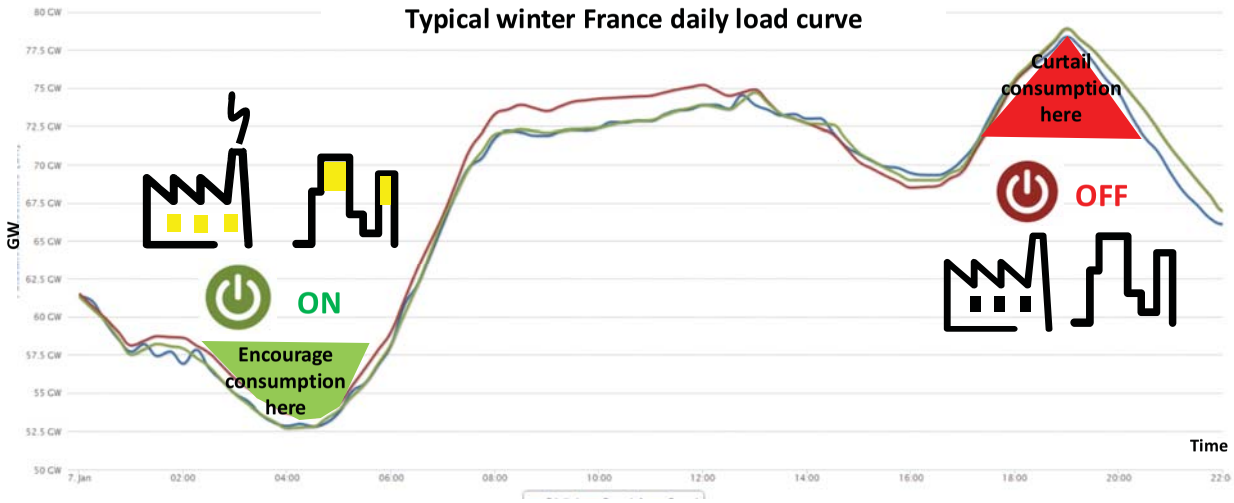
What is Demand Response ?



Introduction to C&I Demand Response and aggregation

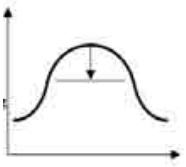
Demand Response : Curtailing loads or encouraging consumption

Typical winter France daily load curve

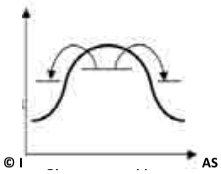


Three main types of Demand Response

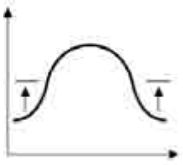
1 Peak shaving



2 Peak shifting

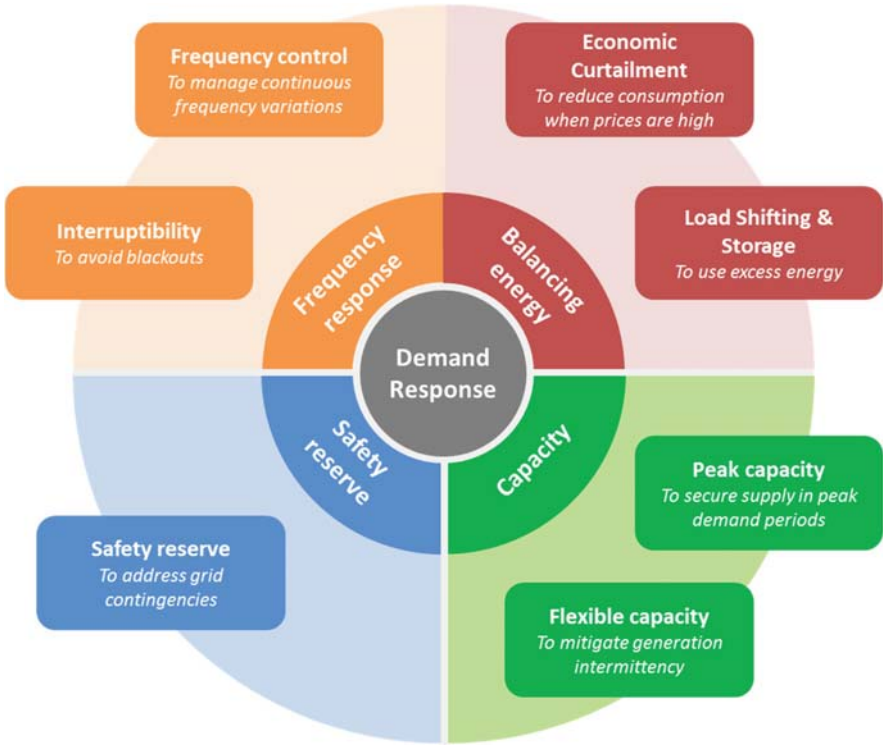


3 Valley filling



Introduction to C&I Demand Response and aggregation

Electric system needs addressed by Demand Response



Benefits of C&I Demand Response for the electric system

C&I Demand Response vs. Traditional peaking generation

A flexible, low carbon and cost-effective alternative to traditional and polluting peaking plants

C&I Demand Response

Cost-effective
- Low investment cost thanks to recourse existing assets
- Not sensitive to commodity price
- Reduces electricity imports and energy dependency
- Postpones investments in generation and T&D

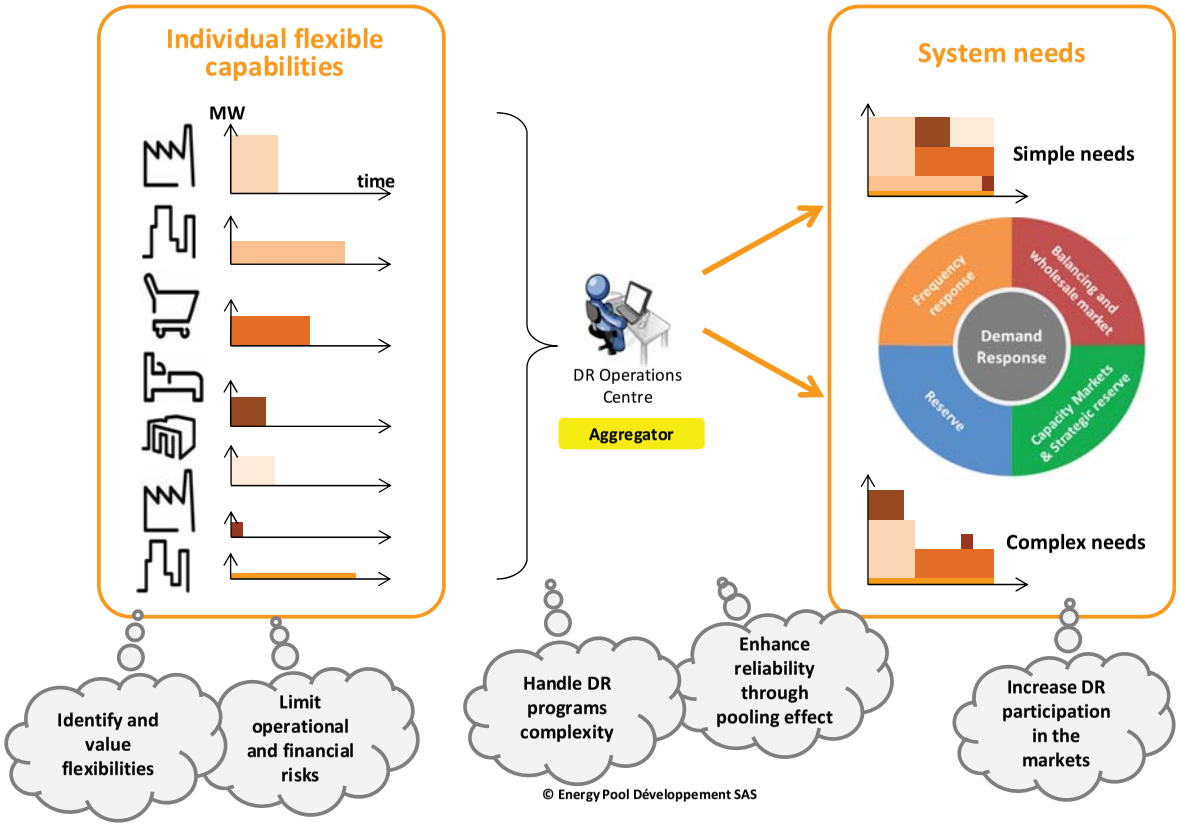
Favorable for environment
- Can avoid running highly polluting fossil fuel power plants
- Enables higher penetration of intermittent renewables
- Educates end-users to energy conservation

Effective and Reliable
- **Significant capacity (hundreds of MW)**
- **Quick implementation**
- **As reliable as generation**
- Adapted to each facility with accurate Measurement & Verification

Benefits for the industry
- New revenue stream with existing assets
- Optimisation of energy supply during power scarcity
- Competitive cost advantage for DR participant

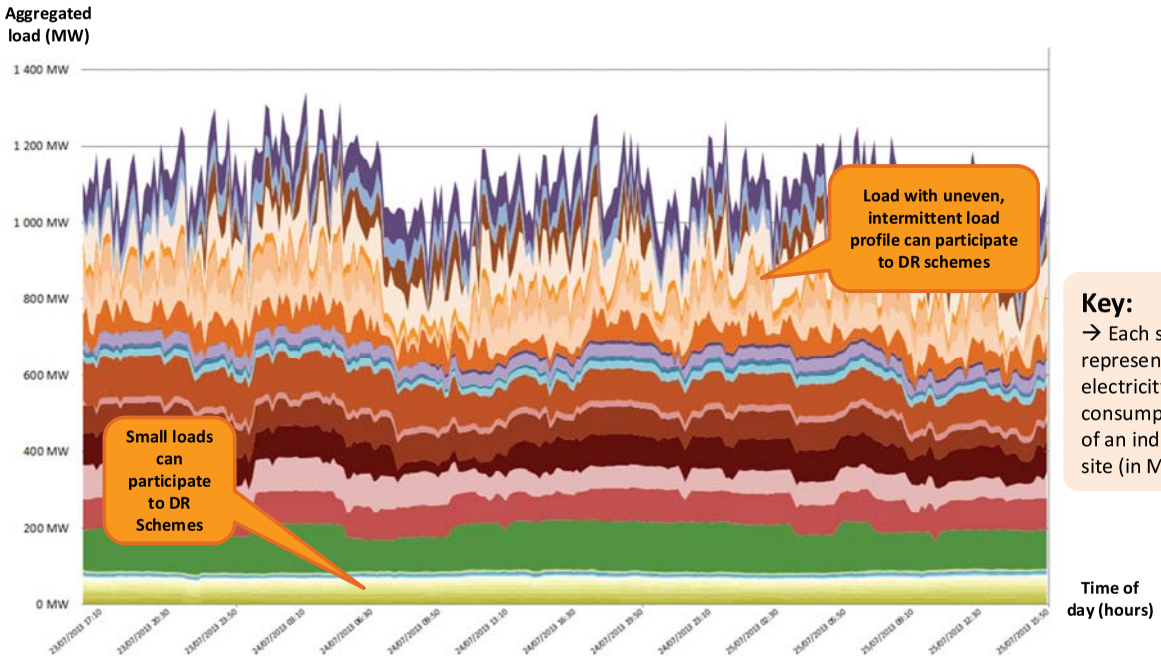
Introduction to C&I Demand Response and aggregation

Role of aggregation



Introduction to C&I Demand Response and aggregation

Benefits of aggregation



Key:
→ Each strip represents the electricity consumption of an industrial site (in MW)

- Aggregation increases DR volume and reliability of commitments
- Loads consumption are monitored on real time, **process by process**, **second by second**

Benefits of C&I Demand Response for the electric system

Comparison of Demand Response resources

	Industry	Commercial / Buildings	Residential
Individual curtailment capacities	Large	Small	Very small
Speed of implementation	Fast	Medium	Slow to medium (Private vs. Meter roll-out)
MW acquisition cost	Low	Medium	High
Annual availability	8000 h/ year	1000-8000 h/year	Less than 1000 h/ year
End-user priority	Production schedule, orders	Customer service	Comfort, health
Curtailable process complexity	High	Low	Low

Benefits of C&I Demand Response for the electric system

Examples of sites in Energy Pool portfolio




Electro-intensive industry

Steel, cement, aluminum, industrial gas, chemicals, metallurgical or chemical electrolysis, pulp & paper…

On-site generation

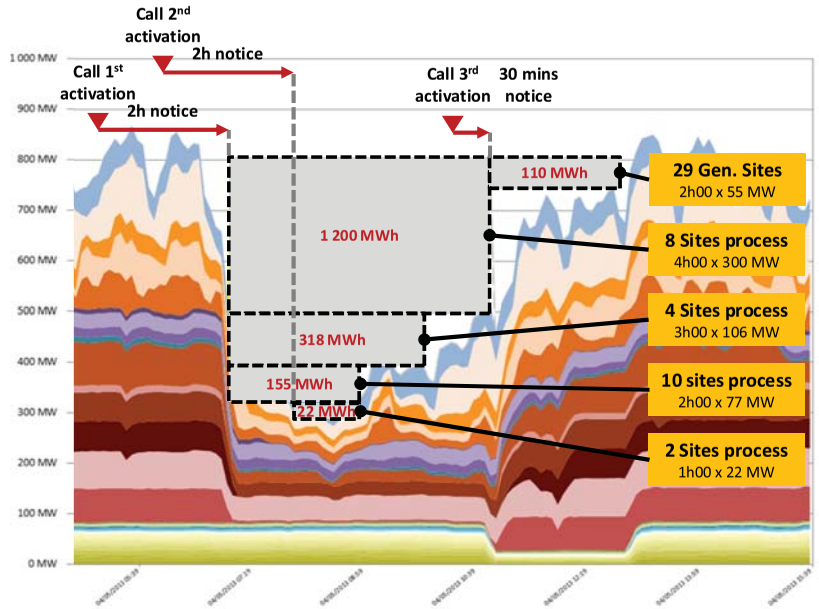
Water treatment & distribution

Cold storage

Benefits of C&I Demand Response for the electric system

Case study : Biggest European curtailment - April 5th 2013 [1/4]

On April 5th 2013, in a context of low temperatures vs. forecasts and some nuclear power plants in annual maintenance, Energy Pool performed the biggest European curtailment to date.



The record in figures

510 MW	Maximum load reduction
95 %	Share of national load reduction provided by Energy Pool
1,8 GWh	Total curtailed energy
100%	Reliability of the pool for RTE
53	Number of sites curtailed

Benefits of C&I Demand Response for the electric system

Case study : February 2012, peak demand record in France (101.7GW)

February 2012 : Energy Pool helps RTE to assume the peak demand record in France

Extract of TF1 national channel newscast (Feb.9, 2012)

Contacts

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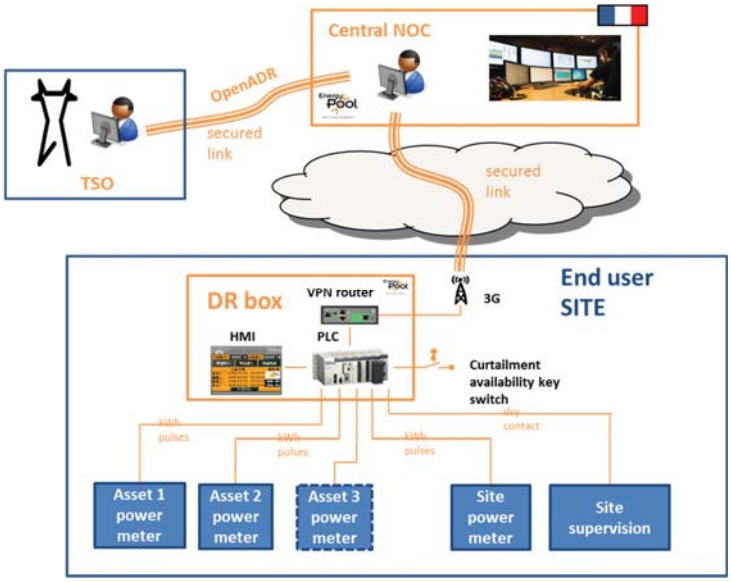
Location

Commercial, IT and International
19 Avenue Georges Pompidou – Immeuble Danica
69 003 Lyon
Tel . + 33 (0)4 88 13 16 60
Location

www.energy-pool.eu

Question from Taiwanese delegation

- 1. What is the metering systems requirement for the Demand Response execution in France ? Is the Demand Response load management system integrated within the Linky project?



Question from Taiwanese delegation

- 2. What are the incentives to encourage users (including industry, commercial and residential users) to join the Demand Response or Time of Use (TOU) projects ?

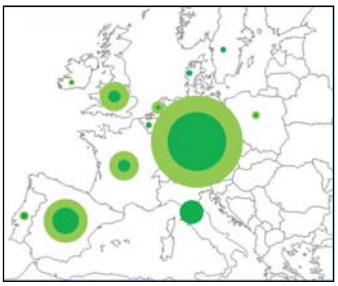
  - Economical : new incomes, equivalent of reduction of electricity bill
    → Up to 20% for an industrial end-user !
  - Participate actively in the quality and security of the electrical grid
  - Be innovative, image
  - Behavioral on a voluntary basis (residential)

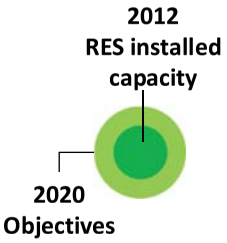
ENR-POOL PROJECT : HOW TO INTEGRATE BETTER REWENABLE ENERGIES (RES) INTO THE ELECTRIC SYSTEM ?

RES Integration

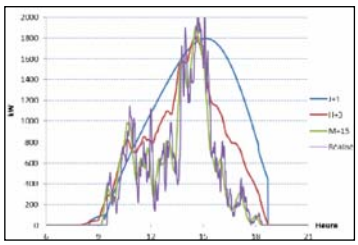
Context

EU objectives



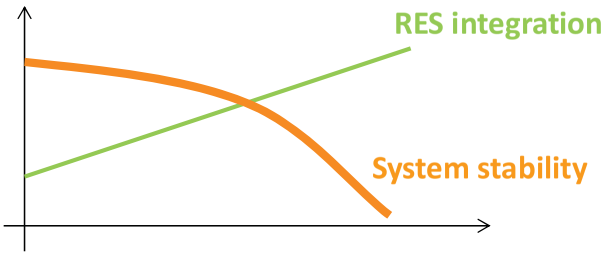


RES production



- Variability
- Forecast difficulty

Key problem



➢ Electric system has to be adapted to RES

Choices

× Do nothing

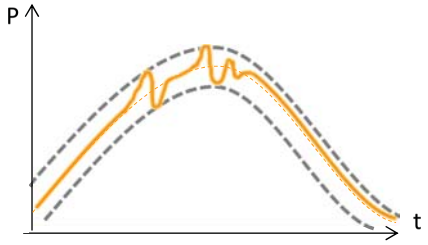
✓ Participate in the integration of RES

EnR-Pool

What are the biggest issues we need to address?

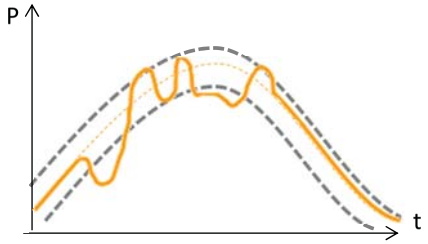
Production adjustment — Balancing

- Balance RES intra-day variability



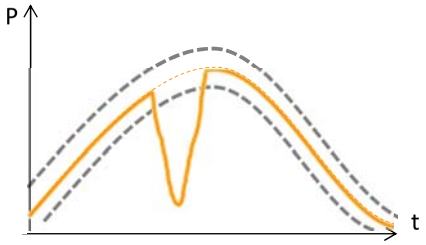
Long-term flexibility — Capacity

- Balance RES predictable variability



Short-term flexibility — Safety

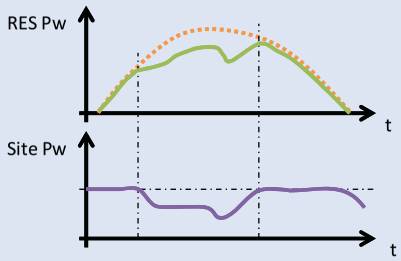
- Balance RES production hazard



What are the biggest issues we need to address?

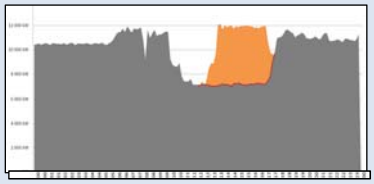
Production adjustment — Balancing

- ✓ Follow-up of the variations



Long-term flexibility — Capacity

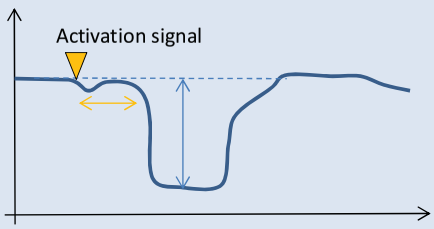
- ✓ Consumption curtailment
- ✓ Consumption stimulation



EnR Pool - Stimulation exemple

Short-term flexibility — Safety

- ✓ Short response time answer

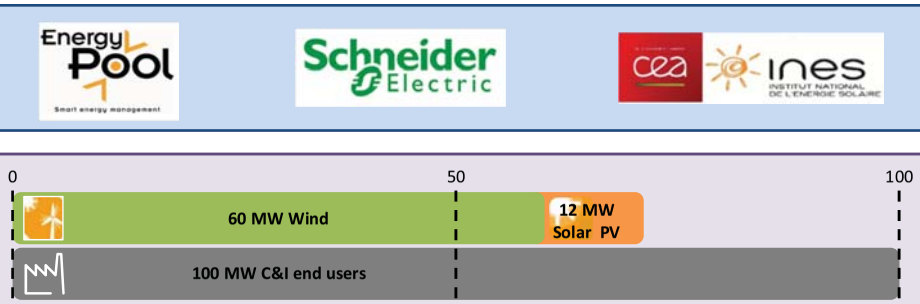


EnR-Pool Project

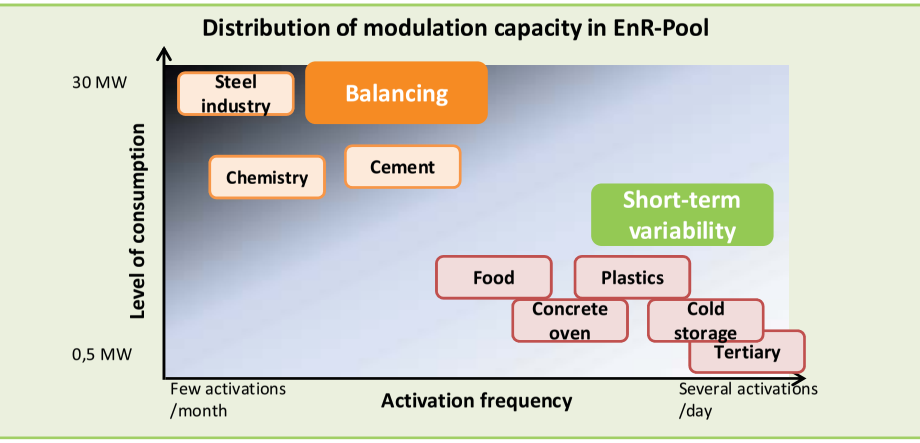
Stakeholders

Project partners

Renewable & Industrial resources



Industrial resources



Energy Pool solution: EnR-Pool Project

EnR-Pool demonstrator – forecast error indicator

Forecast error indicator

End user finder

Activation

Checking

"EnR-Pool forecast error indicator" calculates a sliding 72-hours forecast of possible problem periods caused by vRES assets

Wind generation forecast

PV generation forecast

EnR-Pool level

Demand forecast

Wind generation forecast

National level

Spot price

National level

Energy Pool solution: EnR-Pool Project

EnR-Pool demonstrator – End user finder

Forecast error indicator

End user finder

Activation

Checking

Each end user has its own technical characteristics

NEED

10 MWh

Modulation block

LIST OF FLEXIBILITIES

Confidential

Nom des consommateurs	Hausse ou Baisse	DMO	Domin	Domax	Puissance	Fréquence d'activation	Plage de dispo
	↑	45min	1h	4h	28 MW	2 act/jrs	6h - 20h
	↓	48h	30 min	240 min	1,2 MW	1 act/jrs	24h/7j
	↓	J-1 avant 20h	30 min	240 min	6 MW	1 act/jrs	jrs ouvrables
	↑ + ↓	J-1 avant 10h	30 min	120 min	0,7MW	jusqu'à 6 act/jrs	24h/7j
	↑	2h	20 min	8h	15 MW	2 act/jrs	6h - 14h
	↑	6 min	15 min	240 min	32 MW	4 act/jrs	0h - 23h59
	↑	2h	20 min	4h	15 MW	2 act/jrs	6h - 20h
	↑ + ↓	48h	30 min	120min	0,18 MW	1 act/jr	5 jrs/7
	↑ + ↓	48h	30 min	120 min	0,25 MW	2 act/jr	24h/7j
	↑ + ↓	J-1 avant 20h	30 min	120 min	0,2 MW	2 act/jr	24h/7j
	↑ + ↓	J-1 avant 20h	30 min	60min	0,1 MW	2 act/jr	5 jrs/7

OPTIMIZED CHOICE

Industry

✓ **Optimized choice of flexibility to address system need**

Energy Pool solution: EnR-Pool Project

EnR-Pool demonstrator – Activation

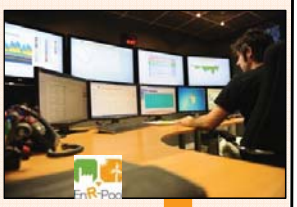
Forecast error indicator

End user finder

Activation

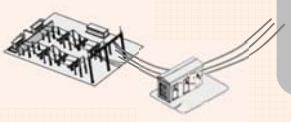
Checking

Pre Notification of Activation
- Hours of activation
- Assets to activate



Activation Order

Secured Internet



Industry

✓ **A specific activation protocol is used with each end user**

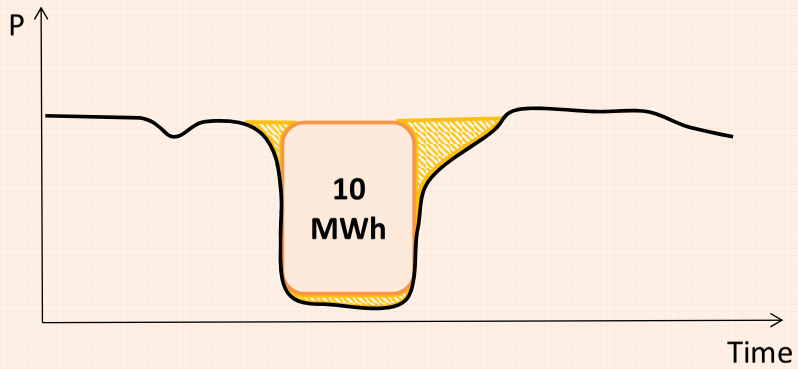
Forecast error indicator

End user finder

Activation

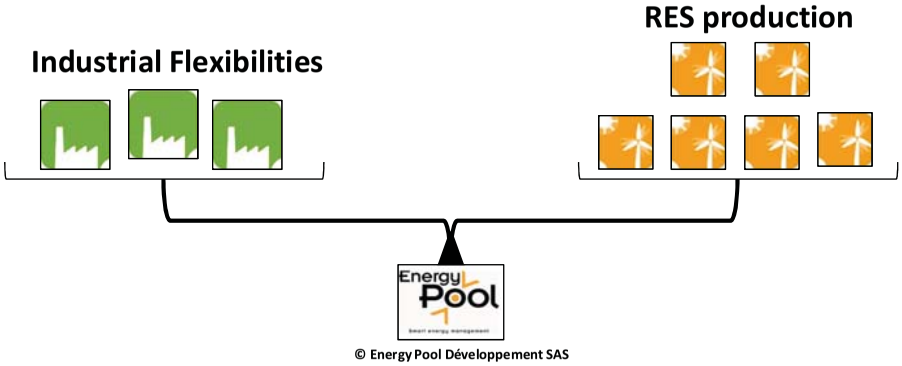
Checking

After each activation, we check the differences between what we asked for and what we got



✓ Feed back of each operation with end users
✓ Technical and operational improvements if needed

- The electric system would take great benefits if industrial consumers knew better how to use their flexibilities to address RES production issues.
- Aggregation enhances electric system performance and cost-effectiveness by coupling industrial flexibilities and RES production.
- Aggregation entities should be geo-located as RES production is decentralized.



TAIWANESE GOVERNMENT LOAD MANAGEMENT PROGRAM FOR INTELLIGENT POWER SYSTEMS, AND RELEVANT DEMAND RESPONSE PROJECTS IN TAIWAN

Questions from Energy Pool

Based on the study of « TPC AMI Introduction_201507_p » document

- Relation between Bureau of Energy and Taiwan Power Company
- Major energy issues in Taiwan
- RES integration in Taiwan
- Details on existing interruptible rate programs in Taiwan
  - Scheduled load reduction program
  - Forced load curtailment program
- Progress of DSM / DR in Taiwan
- Existing and forecast DR aggregation initiatives (pilot projects ?) in Taiwan
  - Financing ?
- Any DR aggregator involved in Taiwan ?
- Other stakeholder involved in DR in Taiwan (University, Research institute, etc.)?
- Advices to Energy Pool to enter Taiwan market ?

WRAP-UP & NEXT STEPS

THANK YOU FOR YOUR KIND ATTENTION

GreenLys: System View Pilot Project for Smartgrids

An urban full scale experiment in Lyon and Grenoble

« From DR management to grid interaction»

N. Hadjsaid on behalf of the consortium

2014 IEEE Power & Energy Society General Meeting Washington July 27-31 2014

GreenLys

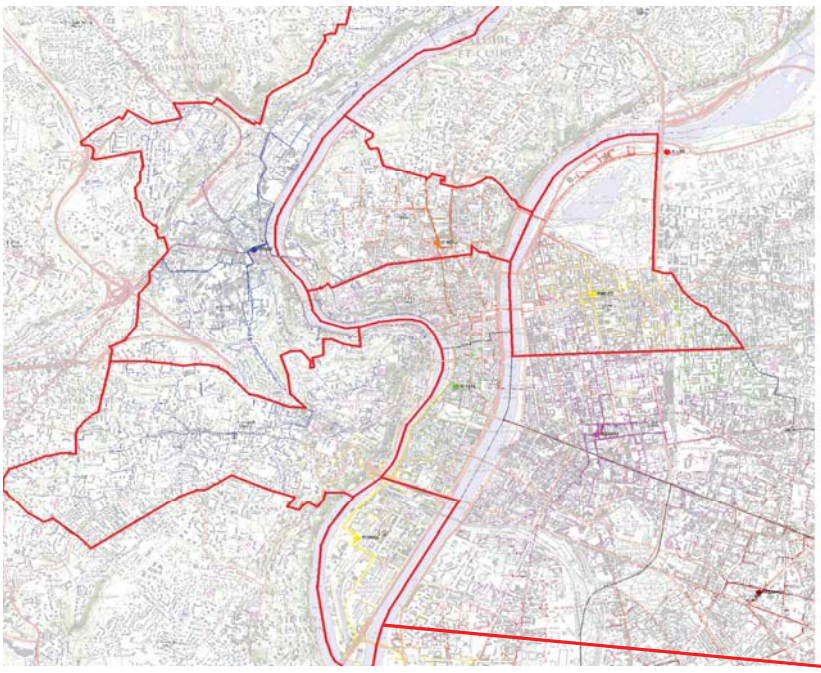
Introduction

An Urban SG demo project,
Involving the various value chain stakeholders

- ✓ 1er urban full scale demonstrator in Grenoble et Lyon
- ✓ Awarded in the first « Investissement d'Avenir » program from ADEME
- ✓ 43 million euros investment (Smartmeters not included, already funded)
- ✓ 4 year experimentation 2012-2016

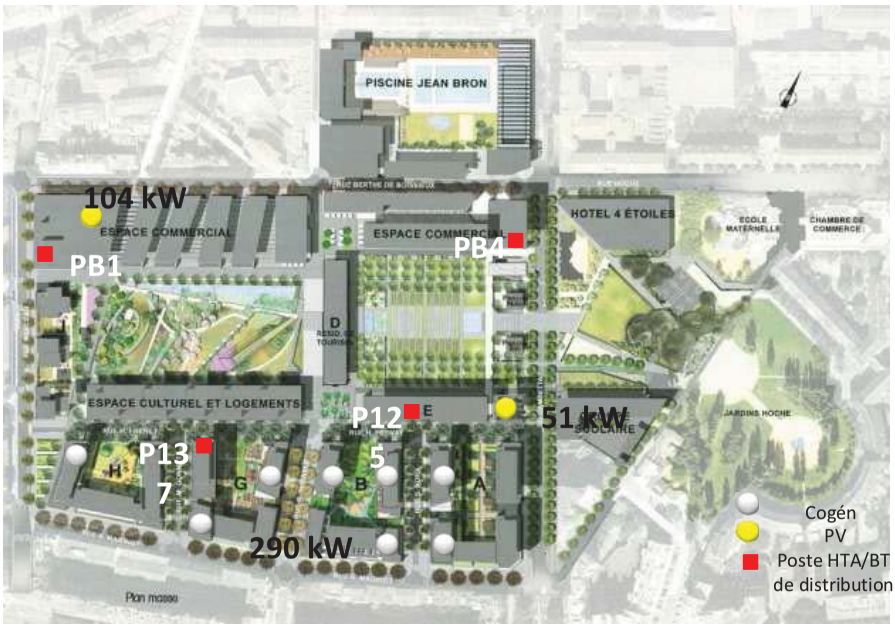
Complementary stakeholders representing the French energy chain

Lyon : Confluence District



Confluence district

Grenoble : 2 districts



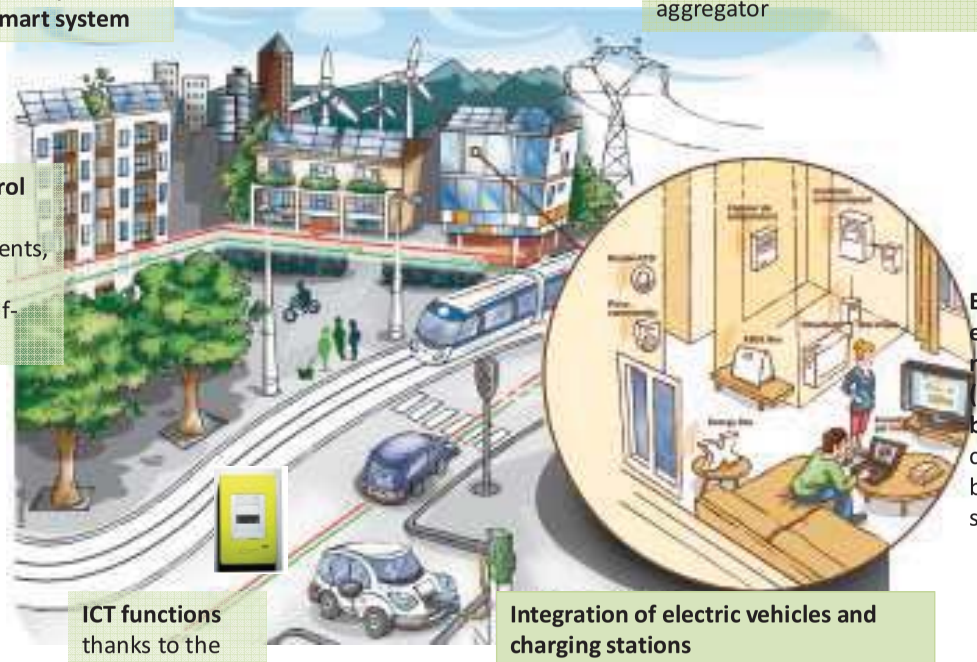
Caserne de Bonne and Bouchayer-Viallet

A project that covers the whole energy chain

Cost-benefit analysis **Specification of the transition steps to the future smart system**

Connection and control of DER (PV, cogeneration…)

Aggregation platform for load flexibility/business model for the aggregator



Smart control solutions (measurements, monitoring, analysis, self-healing…)

Experimentation of energy management tools (Linky & Energy box): Appliance curtailments + behavioral and sociological studies

ICT functions thanks to the Linky smart meter

Integration of electric vehicles and charging stations

GreenLys

Part 1 : Residential customer interaction: The consum'actor
Part 2 : Some advances on the aggregation function for DR
Part 3 : System considerations: constraints and opportunities for the power grid

ERDF · GDF SUEZ · ÊTRE UTILE AUX HOMMES · GEG · Grenoble INP · Schneider Electric · Investissements d'avenir · ADEME · ALSTOM · Atos Worldgrid · Rte · Ville de Lyon · tenerdis

GreenLys

Experimenting the new role of the end user within the electrical system

390 test end users as Consum'actors thanks to:

- ✓ Control equipment installed at the tested household (Wiser Solution)
- ✓ DR services (custom accompaniment, alerts, consumption monitoring, …)
- ✓ Tariff offers (Optim'Conso; Eco'Pointe)
- ✓ Participation incentives (Challenge Conso)

With specific search for results in terms of :

- ✓ What actions allow the evolution of consumer habits in practice?
- ✓ How to activate these actions to control peak demand?
- ✓ What are the actual load control capabilities?
- ✓ What is its effect on the comfort of the occupant?

Doubling the amount of participating customers compared to last year

Sociological study: Lessons learned

The involved customers expressed several requests on :

- ✓ **The equipment :** design & discrete, simple to use and functional ;
- ✓ **The services:** need to be understood by every one, accessible and detailed ;
- ✓ **Tariff offers:** clear, reassuring with a financial compensation
- ✓ **The curtailments:** being reassured on the comfort and the bills

4 profiles of involved customers emerge, with different motivations:

Innovative-tech: New technologies and innovation

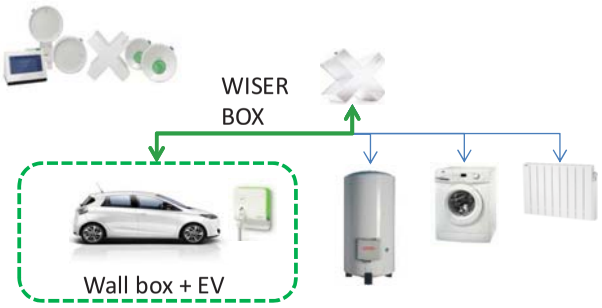
Environmental friendly (Ecophiles): Ecology

Saving: Savings and reducing bills

Energy sense : Energy in general (Stake of future generations)

Fulfilling these needs of different classes of involved customers is the key for success

The role of innovative devices and services



An installation that allows comfort control

- ✓ Connected and communicating
- ✓ Programming different modes (Eco, Holidays, Manuel, Program)
- ✓ Definition of a heating program & planning
- ✓ Sanitary hot water management
- ✓ Plug in EV management (2nd phase)

A panel of services with dedicated animation

- ✓ Visualization of consumptions per usage
- ✓ Alert service (up to 6 configurable)
- ✓ Visualization of historical curtailments
- ✓ Visualization of the load curve
- ✓ Advices for optimizing the subscribed power
- ✓ Sending curtailment orders

Main results: customers and DR

Capitalizing on recruitment process and installations
For a positive feedback experience (90% rate of satisfaction)

A good acceptance of load curtailment

- ✓ **20 000 load curtailment orders achieved during winter 2013/2014**
- ✓ **Low rates exemption (5%)**

Without any impact perceived on the comfort during the curtailment period

- ✓ **By contract the T° decrease cannot exceed 1°C**
- ✓ **Confirmed by the absence of complaints**

With subscription to tariff offers

- ✓ **235 experimental subscriptions on Optim Conso**
- ✓ **155 experimental subscriptions on EcoPointe**
- ✓ **25 % involved customers actively participate in Challenge Conso'**

Testimony of involved customers Grenoble & Lyon

« In GreenLys, I find reasons to situate my level of consumption relative to other testers clients. ***I make sure to never deviate from the orders of curtailment and my comfort has never been affected****! I prefer off-peak hours to start my high energy appliances »*
Martine Terrone

«I am sensitive to the principle of ***limiting my consumption during these peak periods. These incentive offers*** *allow me to be a responsible player in my energy consumption »*
Sébastien Thevenin

« With Eco'Pointe, simulated incentive tariff offer coupled with curtailments, I changed my consumption behavior. For example, today, I am careful to ***start my water heater only during off peak hours****. When I compare my actual bill, I realized that* ***I could really save money*** *if Eco'Pointe was a "real » offer.*
Basu Ananda.

«Thanks to the GreenLys tools for controlling energy demand, I can especially see my curves with a history of consumption over a long period. This service promotes ***choice and rational behavior over time*** **» - *Thierry Biaso***

Part 2

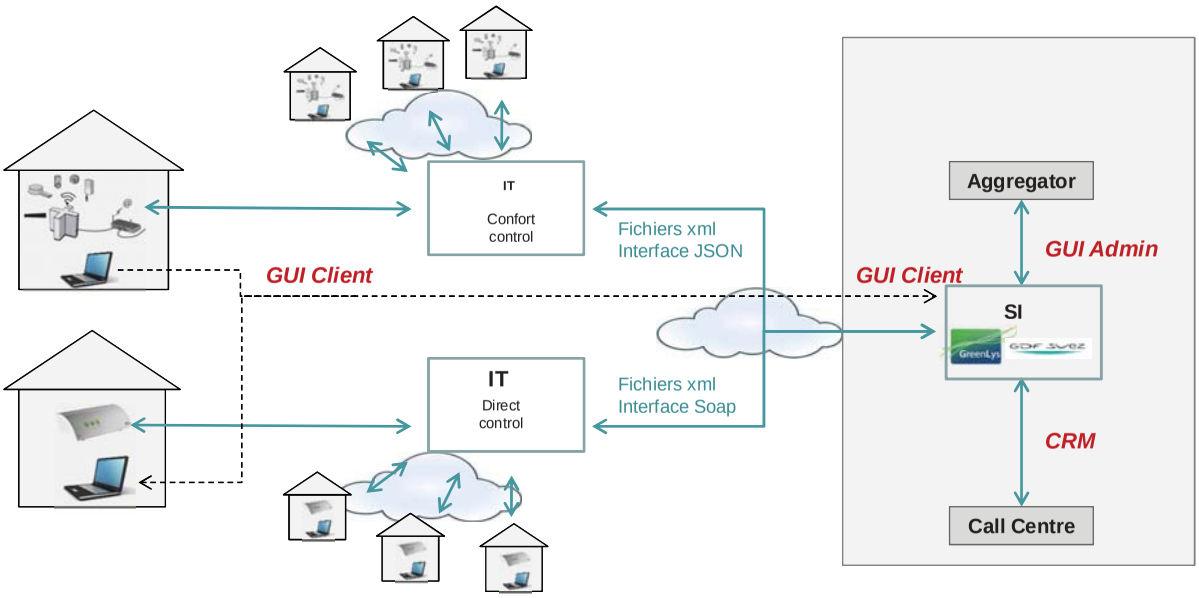
Some advances on the aggregation function for DR

Les effacements dans GreenLys : vidéo

http://www.greenlys.fr/reportages

An operational Load Control system for the residential customer

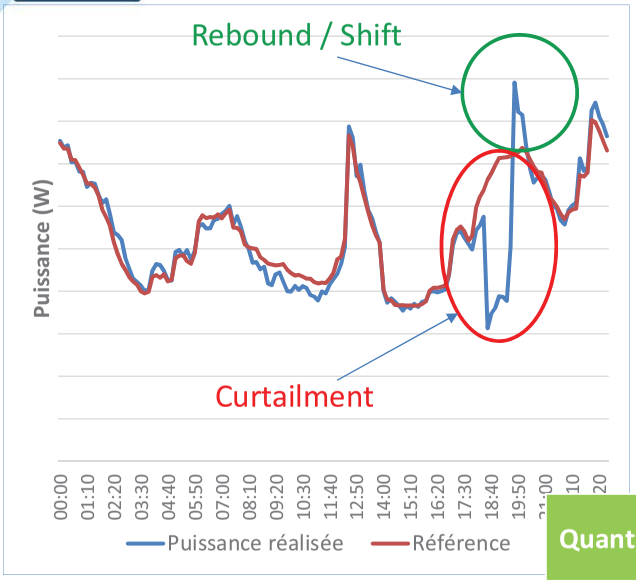
A global IT infrastructure from the client to the aggregator



2 possibilities of control

- **Direct control** on Healing, water heater
- **Comfort control, temperatures, water heater (+/- 1° C)**

Deformation of the load curve assessed



Multiple stakes :

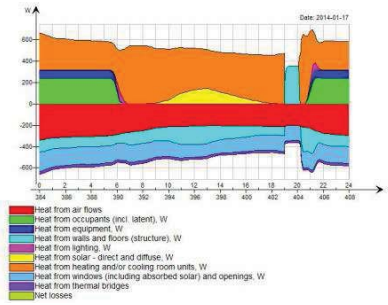
- The rebound in power must be mastered in order to limit T&D cost s
- The energy shift can represent a cost to customers and suppliers, which should be minimized

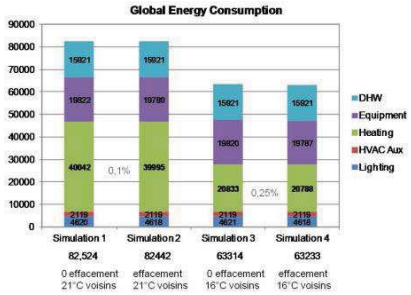
First results :

- Without control, the rebound in power can be significant and increases the peak at the substation
- The energy shift is observable an hour after the curtailment. Beyond that, it merges with the noise

Quantity	Values
Rebound	Between 25 % (local rebound control) and 45 % (without control)
Shift (1h later)	Between 20 % (local rebound control) et 60 % (without control)
Modeled shift	100% over 24h

In summary…





The temperature decreases slightly (comfort preserved)

High impact of wall inertia

The difference in heat loss is low

=> **The curtailment has little effect on energy savings** :

0,1% to 0,25% of heat consumption of the building

Between 0,4% and 0,72% on the tested apartments.

But easy to valorize economically due to the price spread

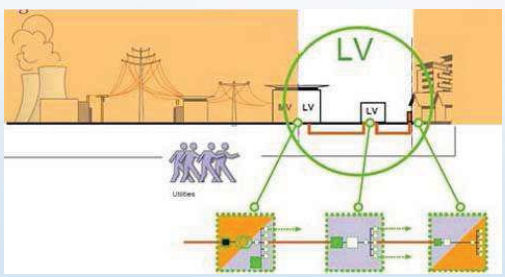
Nota : isocomfort curtailment, without waste

⇒ **The curtailment if effective at all levels of the building**

July 30th, 2014

Part 3

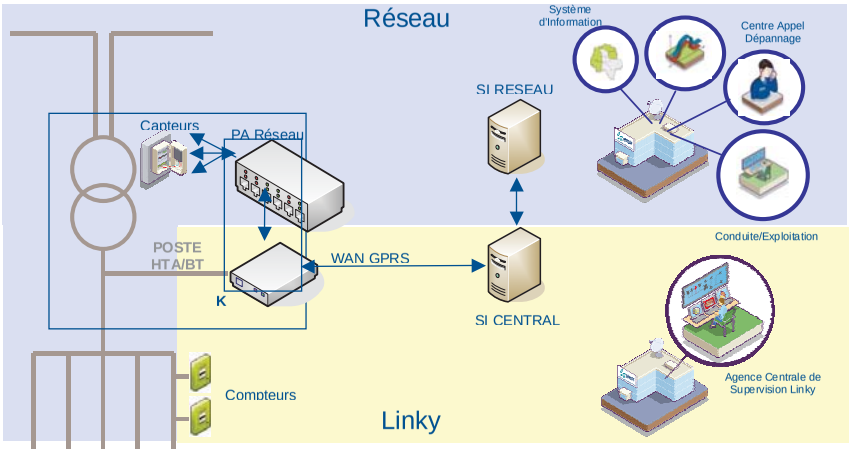
System considerations: constraints and opportunities for the power grid

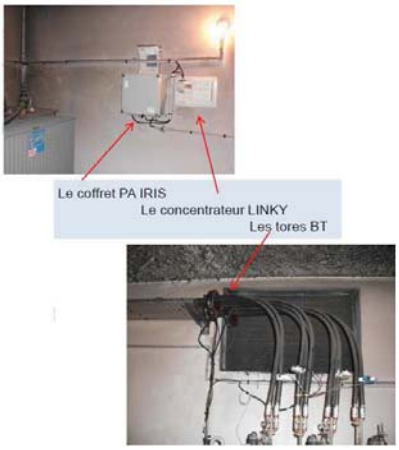


GreenLys: Observability for Flexibility

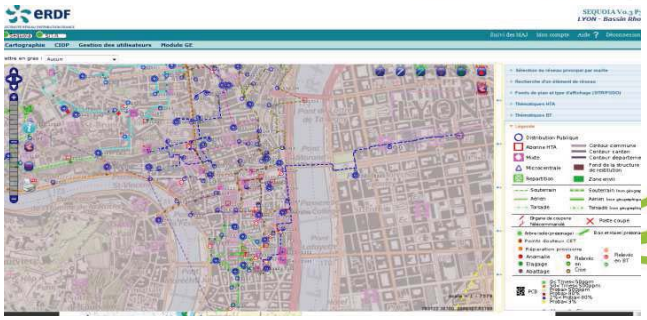
Testing new integrated technologies

Linky data for grid operation and upgrading



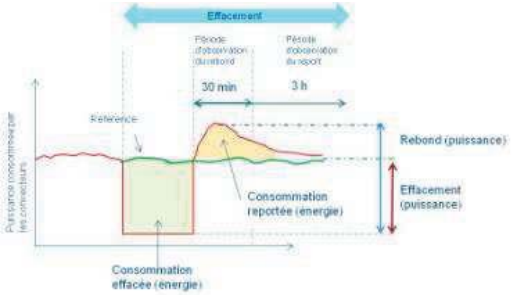


Implementing an IS for the supervision of MV/LV grid at « Séquoia » à Lyon



The distribution grid is totally observable, Linky is the basis of this observation

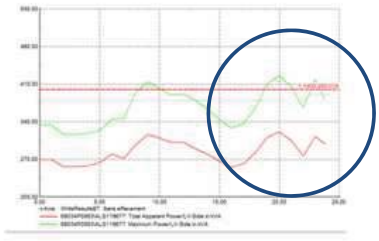
Constraints and opportunities of curtailments for grid management



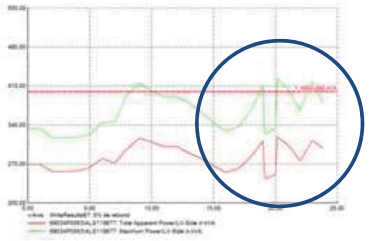
Implementing in grid modelling tools the achieved curtailments in GreenLys

The DSO « neutral market enabler »

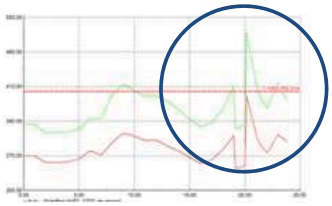
Sans Effacement (état initial)



0% de rebond



Cas 100% de rebond



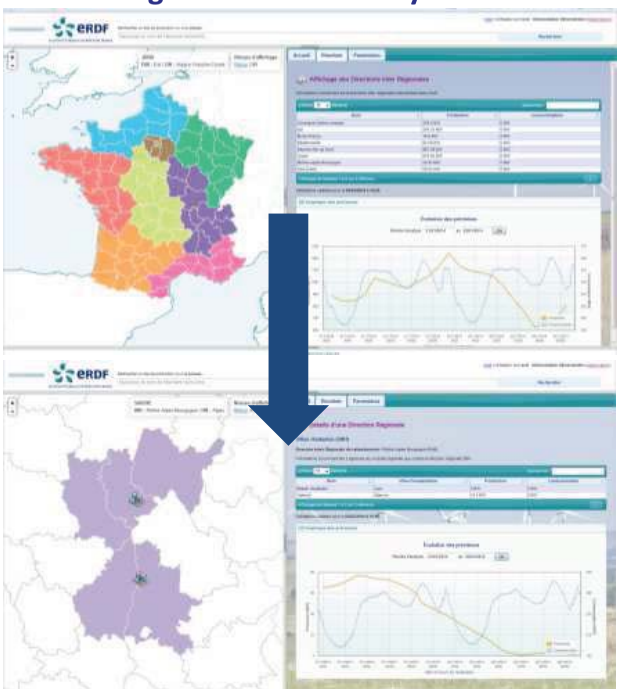
Transfo				
Transit	Oui	129,7%	20:10	
Surtension	Non	0%	ND	
Sous-tension	Non	3,5%	20:10	

Départs				
Transit	Oui	132,2%	20:10	6903420200
Surtension	Non	0%	ND	ND
Sous-tension	Oui	12,0	20:10	6903420200

A possible new positioning for DSOs in ex-ante management of perimeters & programs with respect to market participants

Innovative forecast solutions tested for better integration of REN and grid management

REN integration: a variability issue…



A solution tested in GreenLys : Prév'ERDF

- PV with CEA INES & HESPUL
- Wind with RTE (Préol)
- Consumption within ERDF

Solution prototyped in 2014

- Local vision « from D-3 to H-15mn »
- A vision for a substation perimeter
- A vision at the generation site connected to MV
- At MV/LV substation for sites connected at LV grids

Innovative control Volt/Var solutions tested for better integration of REN

A solution tested with GreenLys : the Accusine

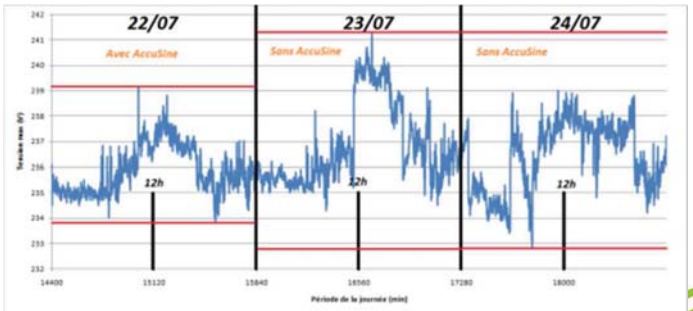
Accusine cabinet for V/Q management developed by Schneider Electric

Handling of the Accusine cabinet

Installing the Accusine at the connection box by ERDF agent

PV panels located in Lyon Confluence on which the "Accusine" solution was tested.

Résultats



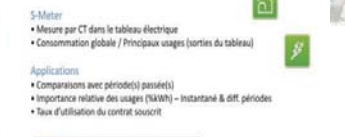
The voltages varies :
by +/-1% with the Accusine
And by +/-8% without the Accusine.

⇒ Encouraging results on the dynamics but not in the losses
⇒Future work on MV/LV tap changers!

Conclusions & perspectives

GreenLys, from experimental results to large scale implementation

- **An urban experimentation at a real scale illustrating the impact of consum'actors on the electrical system**
  - ✓ 390 involved customers (target 1000)
  - ✓ 20 000 curtailments achieved
- **Results that contribute to the « Energy Transition » debate and showing the value creation for the actors of the electrical system**
- **Highlighting solutions to solve the associated constraints :**
  - ✓ Demonstrating/implementing flexibility Technos
  - ✓ Local forecasting of DER outputs and consumptions
  - ✓ Tools for managing energy flows
- **A methodology for transition steps for massive deployment**



GreenLys

Thanks for you attention
Questions?

ERDF GDF SUEZ GEG Grenoble INP Schneider Electric

Investissements d'avenir ADEME

ALSTOM Atos Worldgrid

Rte

Ville de Lyon tenerdis

SMART ELECTRIC LYON

EDF projet Smart Electric Lyon et la convergence des mondes de l'énergie et de l'information

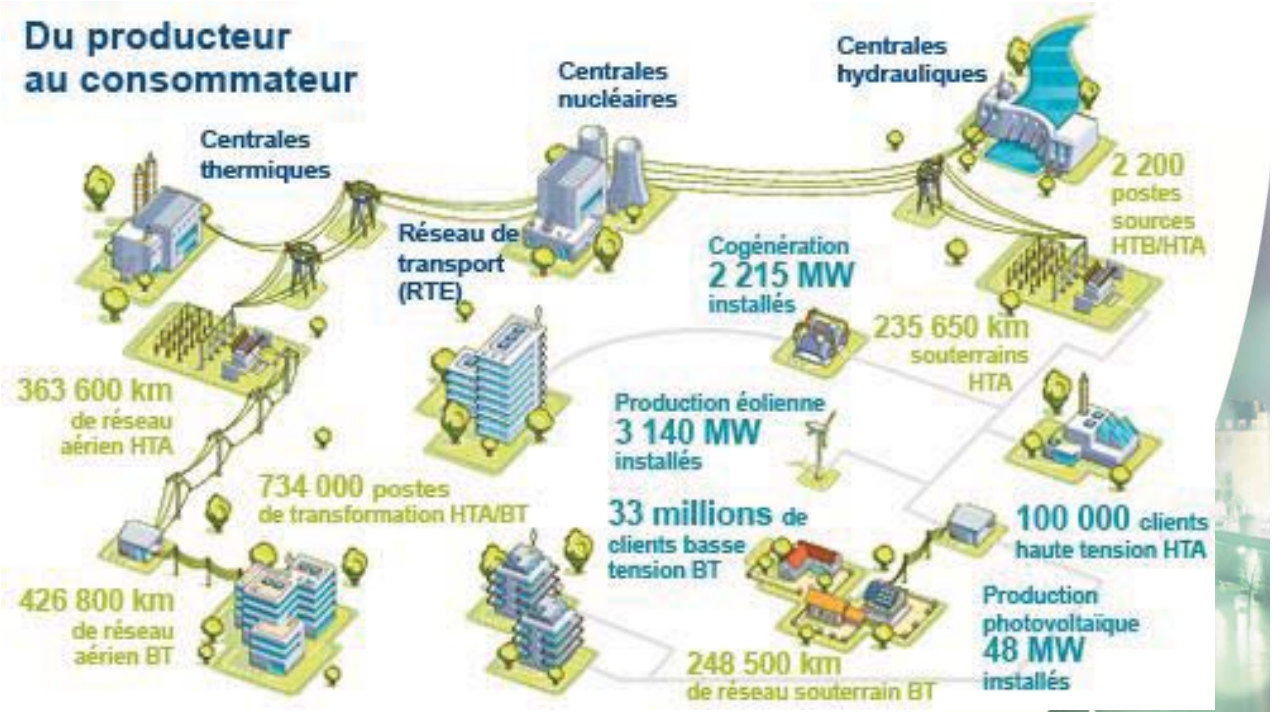
Le Groupe Professionnel Energie Arts & Métiers

28 avril 2014

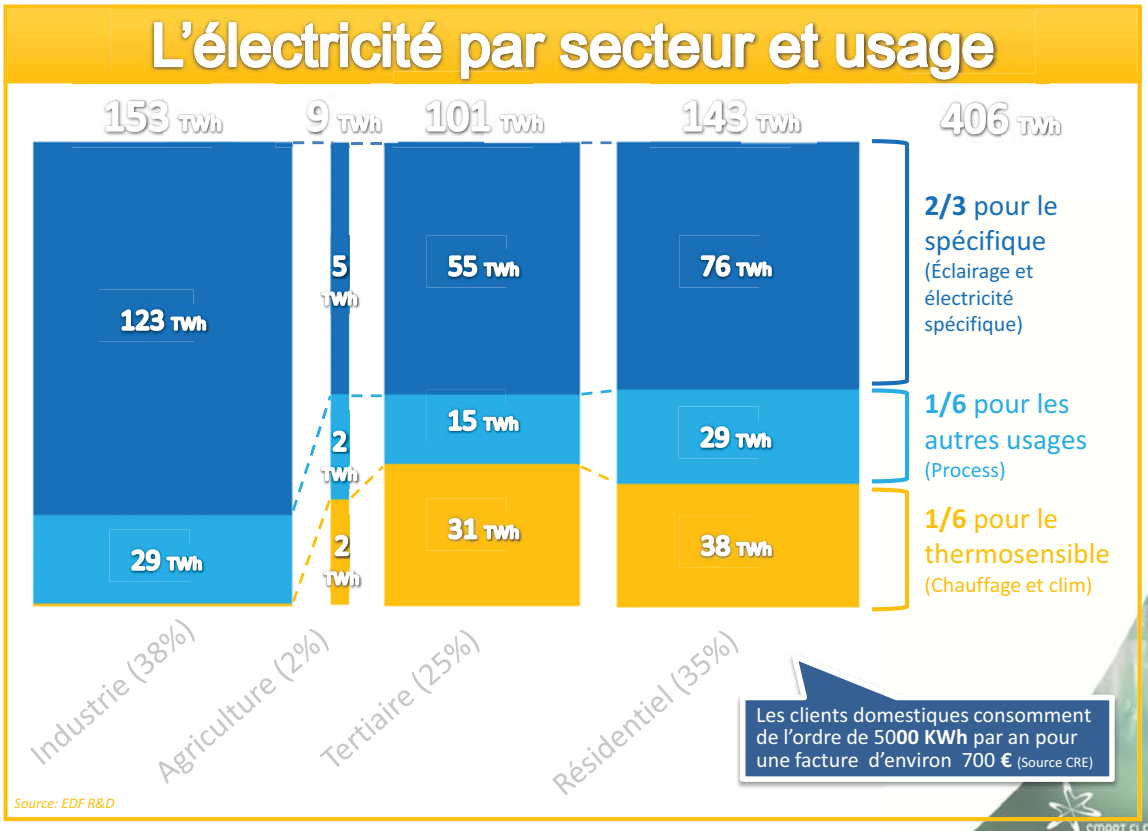
- Contexte
- Les Smart grids
- Smart Electric Lyon

Les composantes du système électrique

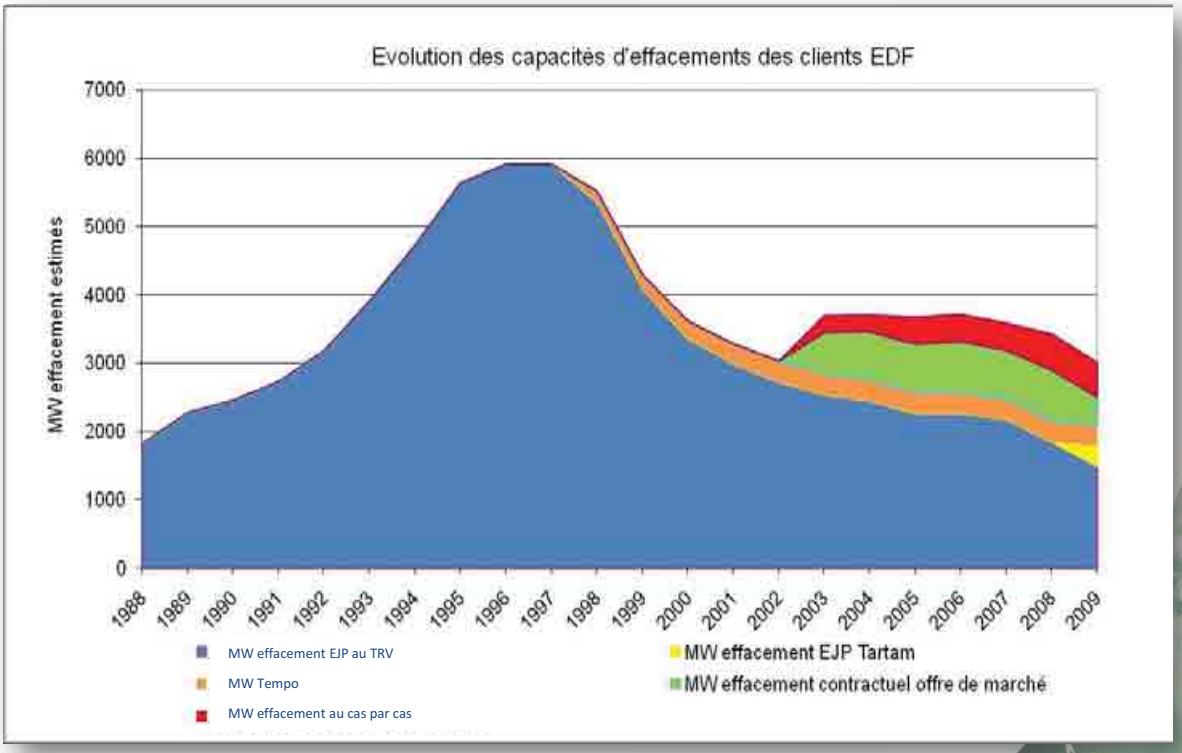
- Intensité - Gestion des flux
- Fréquence (grandeur globale)
- Niveaux de tension (grandeurs locales)



Consommation par marché et usages

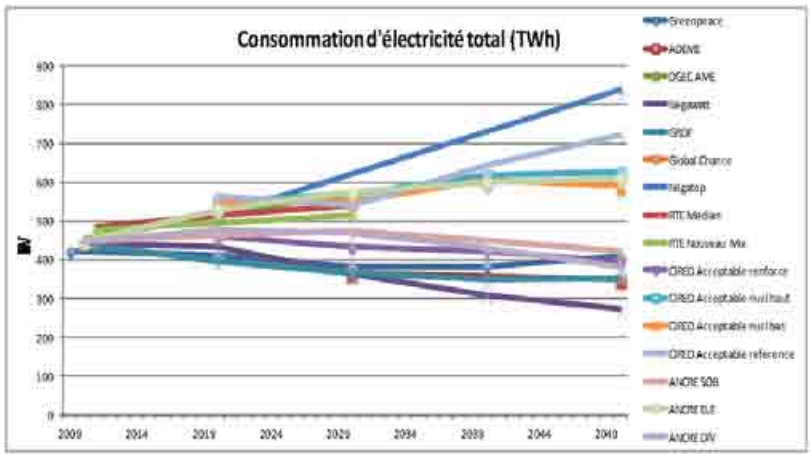


Consommation :
volume des effacements a diminué

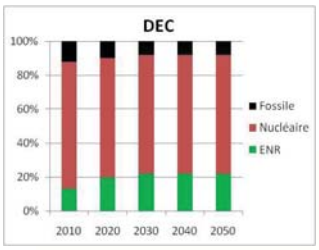


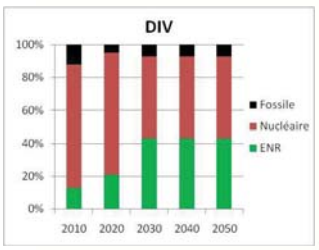
Quelques repères simples

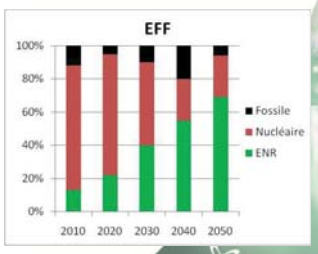
L'électricité, un vecteur d'avenir



Part croissante des EnR dans le mix







Objets connectés Compteurs

Google - Nest Lab

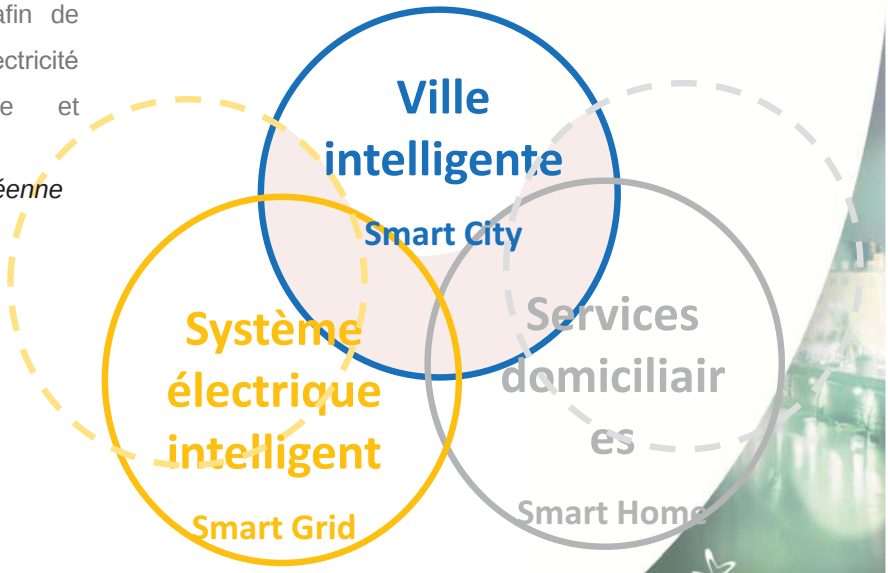
80 000 produits vendus par mois

- Système électrique, quels enjeux
- Les Smart grids
- Smart Electric Lyon

SMART GRID, LA CONVERGENCE ENERGIE / ECONOMIE NUMÉRIQUE AU SERVICE DE LA TRANSITION ÉNERGÉTIQUE

« Un Système électrique intelligent, ou « smart grid » est un système électrique capable d'intégrer de manière intelligente les actions des différents utilisateurs, consommateurs et producteurs afin de maintenir une fourniture d'électricité efficace, durable, économique et sécurisée. »

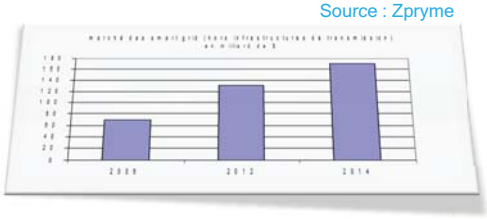
Définition de la Commission Européenne



DYNAMIQUE À L'ÉCHELLE MONDIALE….

Source : Zpryme

Boom du marché des équipements
(capteurs, compteurs intelligents, logiciels de transmission des données)



171 md$ en 2014

D'ici à 2015, marché mondial des compteurs communicants multiplié par 4 par rapport à 2008

En Europe, environ 53 Millions de compteurs intelligents sont aujourd'hui installés. Entre 133 et 145 nouveaux compteurs devraient être posés d'ici à 2020 soit 25 Milliards de dollars.

Compteurs 250 Millions en 2015

Source : Greenbang & Pike Research

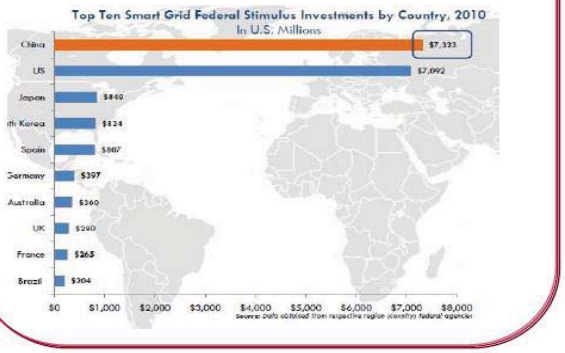
Des investissements importants dans le cadre des plans de relance en 2010

Chine : 7 323md$, États-Unis : 7 092md$, Japon : 849md$, Corée du sud : 824md$, Espagne : 807md$, Allemagne : 397md$. Australie : 360md$, Royaume-Uni : 290md$, France : 265md$, Brésil : 204md$

Une dynamique mondiale de démonstration avec une impulsion forte des états

Engagés depuis près d'une décennie, notamment en Amérique du Nord (U.S.A., Canada), les systèmes électriques intelligents connaissent, depuis 2 ou 3 ans, un intérêt accru, dans de nombreuses régions du monde : U.S.A., Europe, Asie (Japon, Chine, Corée,…).

Les incitations des pouvoirs publics encouragent l'innovation et les expérimentations en matière de Systèmes Energétiques Intelligents …



… en conséquence, les projets SEI se multiplient à travers le monde, en particulier les projets de Smart Metering, première étape vers un système de gestion intelligente de l'énergie.

Des drivers différents

Mais des projets systématiquement territorialisés

LE MARCHÉ DES SMART GRIDS

Optimisation du système électrique (Amont)

Territoires

Dynamique autour de 4 domaines

Secteur de l'habitat

Secteur tertiaire et industriel

- Contexte
- Les Smart grids
- Smart Electric Lyon

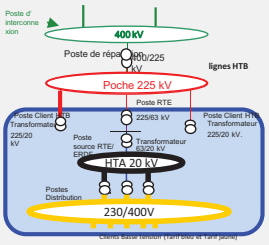
LES PROJETS PILOTES NÉCESSAIRES POUR LEVER LES QUESTIONS RELATIVES AU DÉVELOPPEMENT DE NOUVELLES SOLUTIONS ?

Quelles évolutions des modes de vie et des comportements de consommation (énergétique ?)	Quelle technologie de communication ?	Quel service et quel bénéfice Combien ça coute et ca rapporte ?	Quels acteurs et quelle filière industrielle ?

Les « Smart grids » au service du client

Système Electrique

Gérer le réseau, garantir la sureté et sécurité



Compteur

Compter, enregistrer, diffuser les données de façon descendante et ascendante

Client

Maîtriser et gérer la consommation et la production du logement et du bâtiment

OBJECTIFS : PROPOSER AUX CLIENTS …

- Des **informations** de **consommation** et de **production**
- Des **tarifs innovants** adaptés aux **besoins** des **clients**
- Des **équipements « intelligents »** et **connectés**

Charlotte BRET

Karine MARTINEZ

Un consortium réuni sur un territoire

DES PARTENAIRES INDUSTRIELS ET ACADEMIQUES UNIS AUTOUR DES MÊMES ENJEUX

coordination

EDF

partenaires

AGRO CAMPUS OUEST, ARMINES, MINES PARIS Tech, GROUPE ATLANTIC, CSTB, DELTA DORE, domobox, edelia GROUPE EDF, ERDF, UNIVERSITÉ FRANÇOIS-RABELAIS TOURS, hager, legrand, Noirot, orange, Panasonic, PHILIPS, Schneider Electric, SFR, somfy, UNIVERSITÉ DE LYON, utt

investissements d'avenir

ADEME, INVESTISSEMENTS D'AVENIR

soutiens

VILLE DE LYON, GRANDLYON, SIGERLy, ale Lyon, MINALOGIC, teneerdis

SMART ELECTRIC LYON

Un consortium réuni autour des mêmes enjeux

… POUR DÉVELOPPER

- **Une gamme de produits « compatibles avec le compteur »,** qui communiquent entre eux et avec le compteur,
- Une offre de **service adaptée.**

… POUR EXPÉRIMENTER

des solutions permettant de …

- **Mieux maîtriser son énergie** grâce à des services d'affichage de consommation, gestion et pilotage des usages, …
- **Agir sur sa consommation** pour modérer les « pics » pendant les périodes de fortes consommations hivernales.

… POUR ÉVALUER

- Le **potentiel de flexibilité** de la demande d'énergie de différents types de sites selon leurs usages,
- L'impact sur le système électrique,
- L'**acceptabilité** et la valeur-ajoutée perçue par les **consommateurs.**

SMART ELECTRIC LYON

La dimension industrielle est au cœur des enjeux du Projet

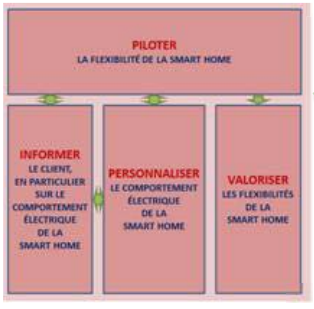
- Le Projet est construit avec les industriels de la filière électrique et des télécommunications et des ponts sont organisés avec les syndicats professionnels (IGNES, GIFAM,…)
- Les compteurs communicants offrent des possibilités de développer et valoriser de nouveaux services avec un vrai effet levier sur leur diffusion

L'émergence de **standards** favorisera la diffusion de solutions de gestion intelligente de l'énergie

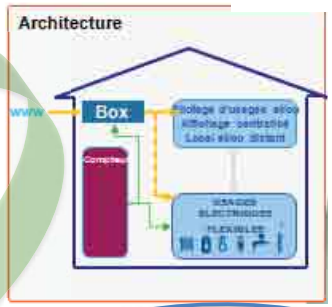
(Standard de communication, Labels Smart Grids)

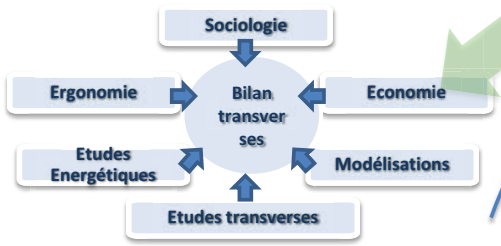
Un partage sur les besoins fonctionnels et les architectures techniques

Use Cases

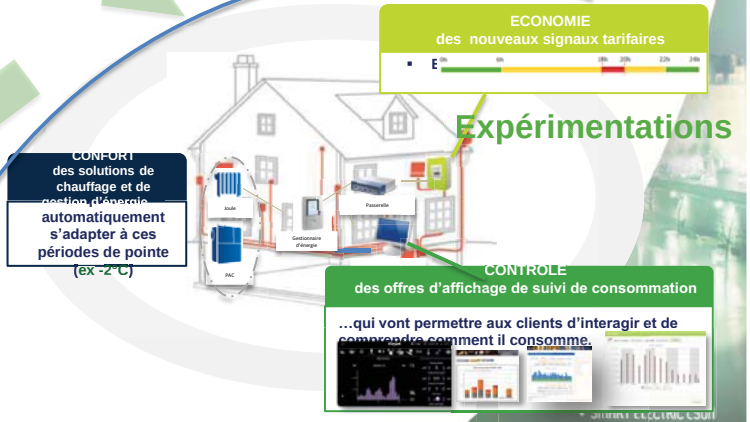


Architecture fonctionnelle

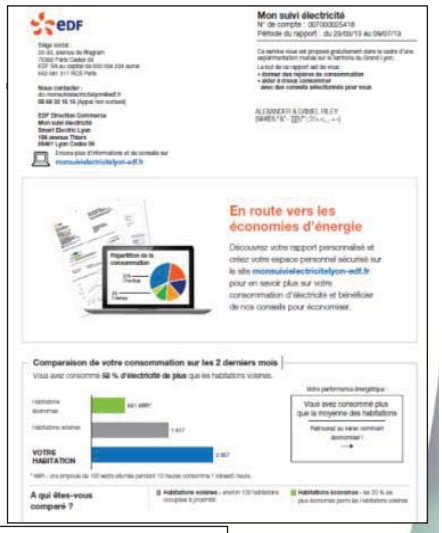




Expérimentations



Mon suivi électricité



25000 expérimentateurs

- Etre informés sur sa consommation et son budget

- Situer sa consommation par rapport :
  - ✓ A une centaine d'habitations semblables à moins d'1km
  - ✓Aux 20 habitations voisines les plus économes

- De bénéficier de conseils ciblés son profil et ses équipements

Les expérimentations résidentielles

Expérimentation d'équipements et services innovants combinant :

- ***CONFORT*** :

Equipements intelligents

- ***SIMPLICITE :***

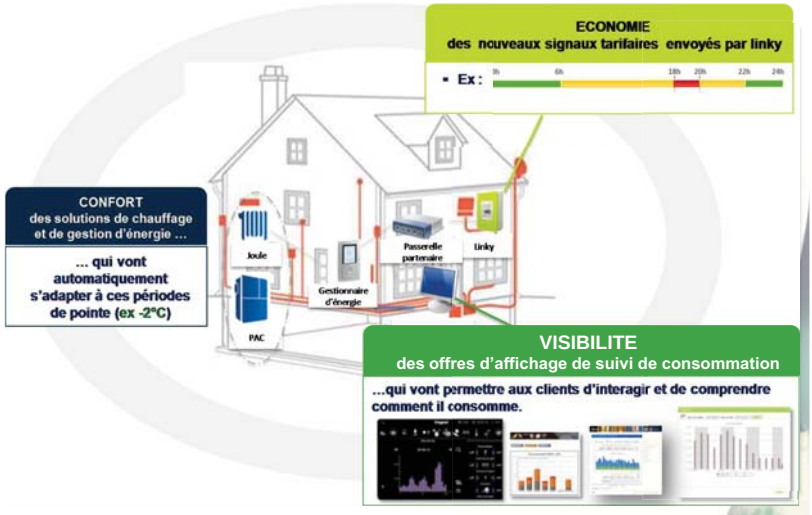
Interfaces personnalisées

- ***ECONOMIE :***

Incitations tarifaires

- ***VISIBILITE :***

Suivre sa consommation au quotidien

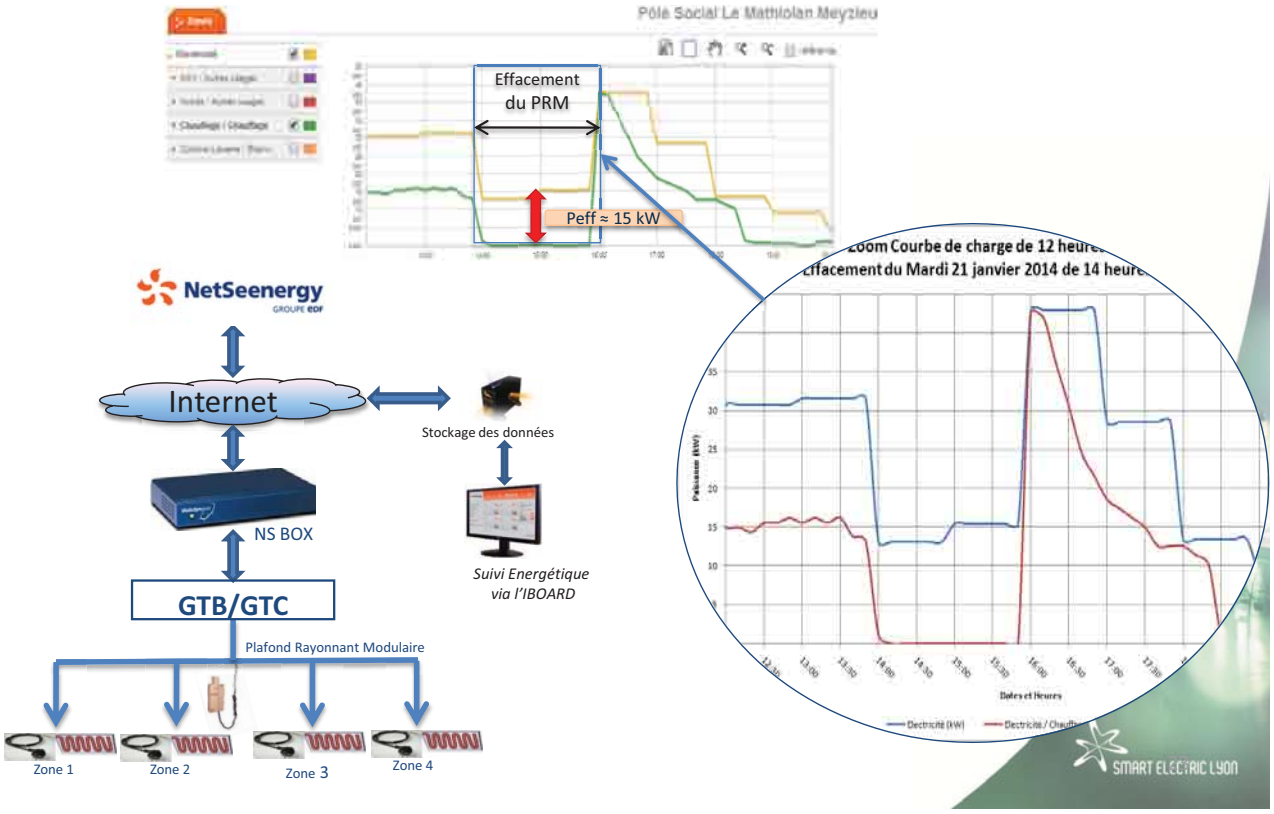


Offrir la possibilité aux clients de :

✓ **Mieux maîtriser son énergie** : Utiliser les services d'affichage des consommations, de programmation du chauffage …

✓**Agir sur sa consommation** : moduler sa consommation et en tirer les bénéfices grâce à de nouveaux tarifs d'EDF

Exemple d'effacement sur un site



Calendrier

2013	2014	2015	2016

Mon suivi électricité

Mon suivi électricité — 25 000 clients

Expérimentations résidentielles

Solutions …
- D'affichage
- D'équipements
- De tarifs adaptés

10 sites → 50 sites → 300 sites → 500 à 2000 sites

Expérimentations tertiaires

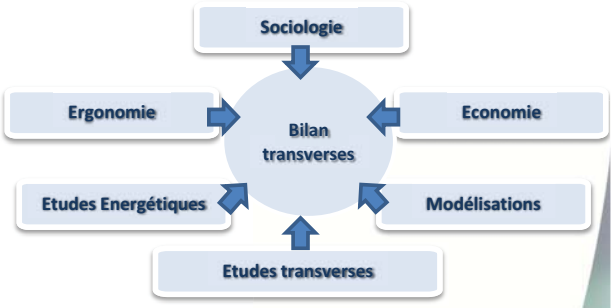
Solutions …
- D'affichage
- De suivi énergétique
- De pilotage

20 sites → 100 sites

RECHERCHE

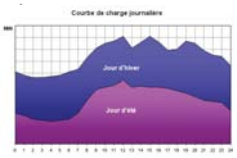
- Observer in situ (Ergo, Socio…)

  pour comprendre les comportements / besoins clients



- Etre statistiquement significatif/représentatif

  pour exploiter les données (de consommation) évaluer



- Simuler les comportements thermiques

  au travers d'un laboratoire semi virtuel pour extrapoler les résultats

L'espace Smart Electric Lyon

➢**Plateau : pilotage du projet et travail collaboratif**

➢**Show Room : découverte du projet et événements autour de Smart Electric Lyon**

➢**Laboratoire : développement et expérimentations de nouvelles solutions pour les partenaires du consortium**

Découvrir le projet

Comprendre le système électrique

Témoignages d'expérimentateurs

Pour plus d'informations, www.smart-electric-lyon.fr
Compte Twitter : #SmartElectLyon
Contact:
Gilles Cerardi – Responsable communication – gilles.cerardi@edf.fr

Smart Electric Lyon

@SmartElecLyon

Projet pilote de #SmartGrid le plus ambitieux d'Europe pour concevoir avec 100 000 lyonnais l'#électricité de demain. Consortium autour d'EDF et 21 partenaires industriels et universitaires.

Grand Lyon, France – smart-electric-lyon.fr

Innovative projects about smart meters & consumer engagement: example of SMART ELECTRIC LYON

5th plenary meeting – Joint session WG3.5-WG6.5

Riga, 24 March 2015

Outline

- Background and objectives of the project
- Main components of the project
- Questions raised

Background and objectives

- Preparation of the smart meters' roll-out in France + ADEME calls for projects about research & innovations related to smart meters & grids
- Two observations forming the rationale for Smart Electric Lyon

1) An emerging market with a lot of key issues still open

- technological paths & standardisation
- regulation framework & new rules for value sharing
- consumer behaviours

2) Business models still uncertain

- high access costs for an uncertain expected value
- complex ecosystem and sensitivity to behaviours
- few European references on proven real benefits of the solutions proposed

Background and objectives

- Focus on the aspects beyond the meter (consumer-side)
- Aim: creating a dynamic to address simultaneously

the technological issues

the regulatory issues

the support for the consumer

Background and objectives

SMART ELECTRIC LYON

- Focus on the industrial development

Electric grid

Managing the grid

Ensuring safety and security of electricity supply

…

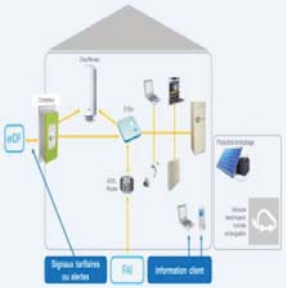
Meter

Metering, recording, sorting and communicating data

LINKY

Customer

Managing the energy consumption and possible generation of the dwelling/building



- Creating the basis for the development of new energy services
- Starting from the data provided by LINKY
- Taking into account industrial stakes

Main components of the project

SMART ELECTRIC LYON

The actors

Coordinator

EDF

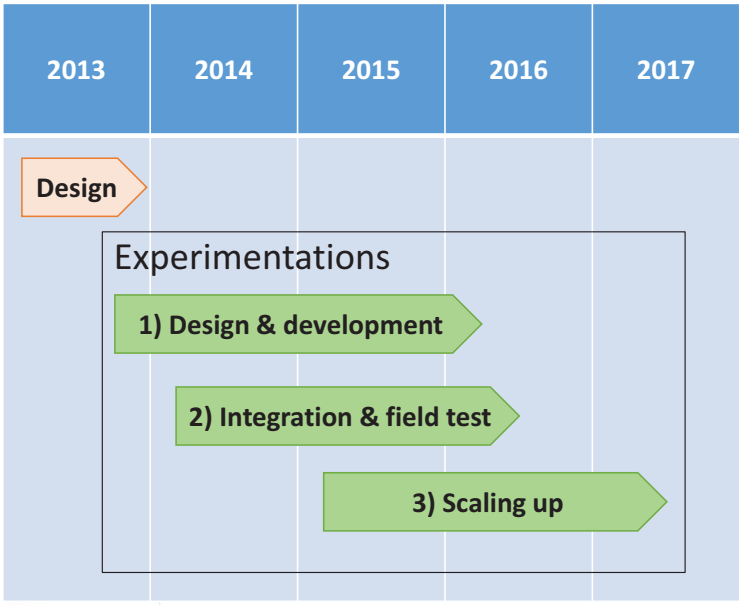
+ partners

AGRO CAMPUS OUEST, GROUPE ATLANTIC, ARMINES, MINES ParisTech, CSTB le futur en construction, DELTA DORE, domobox, edelia GROUPE EDF, ERDF ÉLECTRICITÉ RÉSEAU DISTRIBUTION FRANCE, UNIVERSITÉ FRANÇOIS-RABELAIS TOURS, etics, hager, legrand, Groupe Muller, orange, Schneider Electric, SFR, somfy, UNIVERSITÉ DE LYON, utt

Location

Main components of the project

Planning



Resources

- 60 full-time persons
- a real project platform
- 15 million € invested in R&D
- Specific IT platform for data collection

Main components of the project

1) Developing **compatible** services and product ranges

Solutions/services:
- Information service, display, HMI
- Energy management devices
- Energy systems
- MtM solutions

Standardisation:
- Feedback
- LINKY Radio transmitter
- Use cases (from proposition to real use)

2) **Raising awareness and interest** among industrials and consumers

- Contacts with 25,000 customers
- Service offers about energy consumption monitoring and display
- Communication and training for distribution and installation professionals (for devices, e.g. home automation)

3) **Evaluating the potential** for scaling up (Demand-Response / load management)

- Objective of 2,000 customers with servo equipment/devices
- Decrease rates in energy consumption and load shaving
- Adoption and use rates of the solutions and services
- Integrating the energy, sociological and ergonomic dimension

Questions raised

SMART ELECTRIC LYON

R&D objectives

Concrete issues

- **Testing** different levels and systems of information and technical "delegation"
- **Experimenting** new devices or solutions in real conditions
- **Technical problems**: few electric installations enabling the services intended → the meter is not enough
- **Roles of the actors (and regulations)**: DSO, electricity supplier, service providers, manufacturers, installers, consumers…

Thank you for your attention !

SMART ELECTRIC LYON

For more details about this project: **bruno.duplessis@mines-paristech.fr**

ADEME contact about smart meters R&D: **gaelle.rebec@ademe.fr**