

SmartNet Work Package1

TSO-DSO coordination for accommodating ancillary services from distribution networks

Daan Six – WP1 Leader



Agenda



- Objectives WP1
- Overview tasks and deliverables
- Budget and timing
- Practicalities and points of attention



To get a view on the needs for ancillary services in the future European power system

To analyze the availability and possible contribution to ancillary service provision by flexible resources connected to the distribution grid



To analyze possible ways of TSO-DSO interaction for the provision of ancillary services by flexible resources connected to the distribution grid

To determine common assumptions, common modelling language and to gather necessary information for the simulations in the project



Objectives WP1 - DOW

- To establish the **role of DRES and DSM sources** at distribution grid level **for the provision of ancillary services**
 - *Note: investigate advanced power technology as “pure” grid asset (T1.5) and its possible interaction with other flexibility sources*
- To create a **taxonomy of flexibility assets** connected to the distribution grid that can partake in ancillary services **and** corresponding **information models**
- To elaborate **basic schemes for TSO-DSO coordination and ancillary services** provision by means of DRES and DSM sources connected at distribution grid level
- To develop **static grid models**, i.e. description typology and characteristics, of distribution networks
- **Additional notes:**
 - Specification and preparation for the simulation environment (WP2 – WP4): data (<-> T4.2) and information gathering + common understanding/language
 - Take into account Distributed Generation, Demand Side Management, storage and effects of vertical and horizontal coupling

Agenda



- Objectives WP1
- Overview tasks and deliverables
- Budget and timing
- Practicalities and points of attention

- T1.1 Ancillary services within the future European power system
(TL Tecalia) – M1-M9
- T1.2 Availability and role of RES and DSM connected at distribution level
for the provision of ancillary services (TL N-SIDE) – M1-M15
- T1.3 Basic schemes for TSO-DSO coordination and ancillary services
provision (TL VITO) – M1-M9
- T1.4 Specifications for the simulation environment
(TL AIT) – M1-M15
- T1.5 Role of advanced power technology (TL RSE) – M1-M9

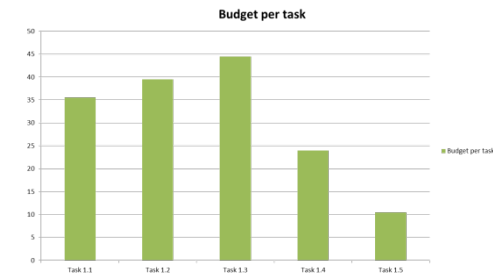
Task 1.1

Ancillary services within the future European power system

(TL Tecnalia) – M1-M9

- **Main idea: getting a view on the need for ancillary services within the future European power system**
- **Task Leader: Julia Merino Fernández (Tecnalia)**

Partners PM/efforts by task participant



RSE	AIT	DTU	ENDESA	N-SIDE	SINTEF	TECNALIA	Terna	UStrath	SELNET	VITO	VTT
6	1	1	1	1	3	7	2	6	0,5	4	3

Task 1.1

Ancillary services within the future European Power system

(TL Tecnalia) – M01-M09

D1.1 Ancillary service provision by RES and DSM connected at distribution level in the future power system (M09)

- 4 main subtasks to be accomplished

Ancillary services:



T1.1 is the main input to T1.2 and lays the groundwork for the project

Task 1.1

Ancillary services within the future European Power system

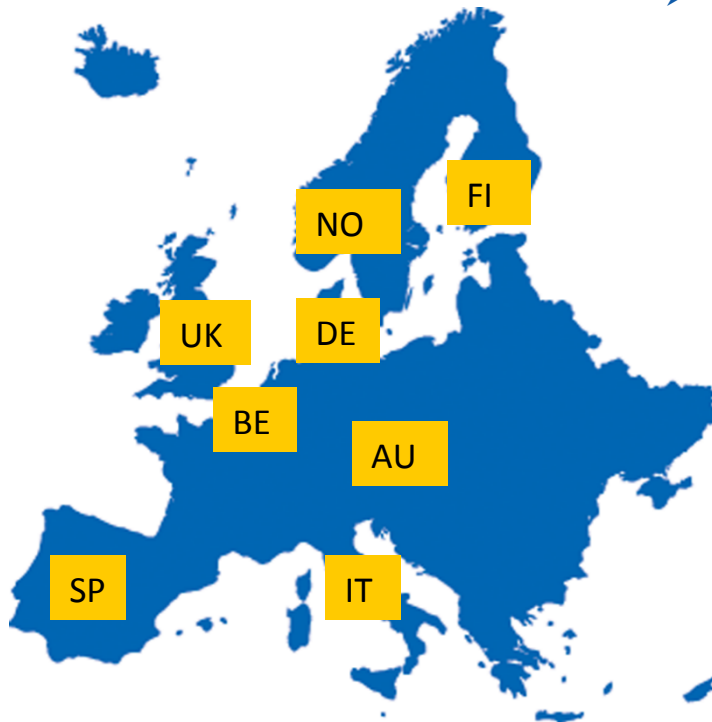
(TL Tecnalia) – M01-M09

T1.1.1. Current status

Technical/Economic/Regulatory approach

Partners from **8 different countries** involved in the task

➤ **Template design** for data collection harmonization among partners, dealing with several aspects, such as... (TBD/TBC)



- Type of ancillary service (Primary/Secondary/Tertiary & Voltage/Frequency, Balancing)
- Compulsory/Optional
- Remuneration scheme
- Service providers
- Market type (Day-ahead, Intraday...)
- Service provision characteristics (droop, reserves sizing...)

Task 1.1

Ancillary services within the future European Power system

(TL Tecnalia) – M01-M09

T1.1.2. Future scenarios

Energy Mix – Requirements of system performance

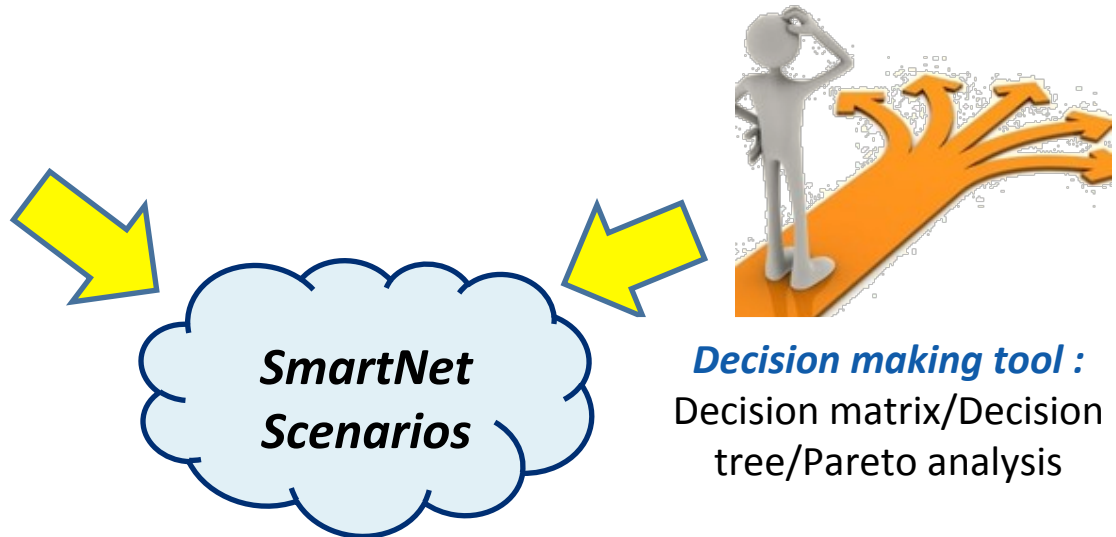
Background from other projects/
sources (eHighway 2050, ELECTRA
IRP, ENTSOe, SG-CG...)



Definition of the time horizon



Energy Mix alternatives



Future scenarios define

T1.1.3. Future needs

- Novel ancillary services
- New providers/participants
- New resources characteristics
- New regulatory requirements

Task 1.1

Ancillary services within the future European Power system

(TL Tecnalia) – M01-M09

T1.1.4. Sizing reserves

Development/Use of a **Reserve Dimensioning Tool** that will take into consideration:

- Country-specific characteristics
- Scenarios
- Factors affecting the reserves needs
- Sensitivity
- Voltage level (Transmission & Distribution)

The focus will be in the countries of WP4 national cases/WP5 physical pilots
Italy (Pilot A), Denmark (Pilot B) and Spain (Pilot C)



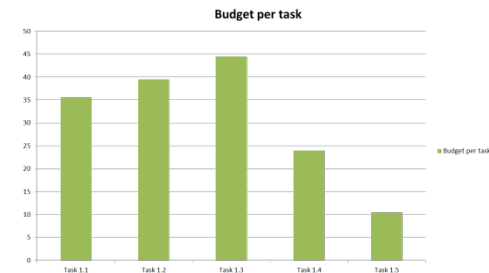
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Task 1.2

Availability & role of RES and DSM connected at distr. level for ancillary services provision
(TL N-SIDE) – M1-M15

- Main idea: which ancillary services can be provided by which distributed sources?
- Task Leader: Olivier Devolder (N-SIDE)

Partners PM/efforts by task participant



RSE	AIT	DTU	N-SIDE	SINTEF	TECNALIA	Terna	UStrath	SELNET	VITO	VTT
3	4	4	10	3	4	1	1	0,5	6	3


Task 1.2

Availability & role of RES and DSM connected at distr. level for ancillary services provision
(TL N-SIDE) – M1-M15

- Task Objectives:
 - Deliver a **taxonomy** of flexibility assets connected to the distribution level that can partake in (future) ancillary service markets. The classification will take into account
 - the different physical characteristics and dynamic behaviour
 - in line with the different ancillary services defined in task 1.1.
 - Linked to this taxonomy, define a hierarchical information model where depending on the level in the hierarchy and the service to be provided, different information models are described
 - Project this taxonomy on the future power system to quantify the need and availability of flexibility sources with a focus on countries which are part of WP4 (national cases) and WP5 (physical pilots)

Task 1.2

Availability & role of RES and DSM connected at distr. level for ancillary services provision
(TL N-SIDE) – M1-M15

- Characterization of “physical” flexibility sources
 - Listing of flexible RES
 - Definition of meaningful parameters (dynamic characteristics, typical size, typical share in the load/generation, etc.)
 - Assessment of level of controllability / uncertainty (notion of “risk” associated to flexibility usage)
 - Quantity availability in existing & future Power System in particular for pilot countries
 - Mapping with needed ancillary services at local and global level (coordination with T 1.1.)
 - Clustering in categories and interface with market products (coordination with T2.3) which must be tractable for system operators thus “simplified”
 - Keeping in mind market participants must be able to efficiently convert and aggregate “physical” flexibility into market products (coordination with T2.2)
- 
- A blue bracket on the right side of the slide groups the last three bullet points (Mapping, Clustering, and Keeping in mind) and points to a list of design considerations for an information model.
- Design of adequate Information model(s) depending on:
- Ancillary service / Level in Hierarchy
 - Market Clearing Models
 - Aggregation Models

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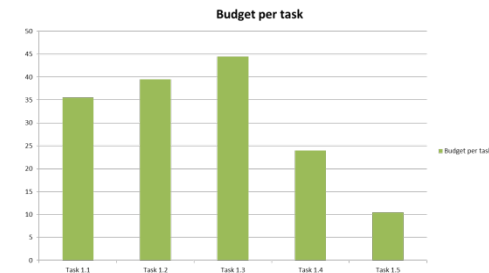
Task 1.3

Basic schemes for TSO-DSO coordination and ancillary services provision

(TL VITO) – M1-M9

- **Main idea: provide schemes for TSO-DSO coordination for AS provision from distr. connected DG and DSM**
- **Task Leader: Daan Six (VITO / EnergyVille)**

Partners PM/efforts by task participant



RSE	AIT	DTU	ENDESA	N-SIDE	DC	SINTEF	TECNALIA	Terna	UStrath	SIEMENS	SELNET	VITO	VTT
3	3	3	2	3	5	3	3	1	3	0,5	1	10	3

Task 1.3

Basic schemes for TSO-DSO coordination and ancillary services provision

(TL VITO) – M1-M9

Analysis TSO-DSO coordination needs in terms of high-level electricity market architectures : focus DG, DRES, DSM

Define roles, responsibilities, modalities and required information exchanges (TSO-DSO-aggregator-BRP-market) – link to WP2 clearing algorithms and WP4 national cases

Comparison models: advantages, disadvantages, possible implications in terms of network planning, market design and functioning, ICT requirements, alternatives possible (?)

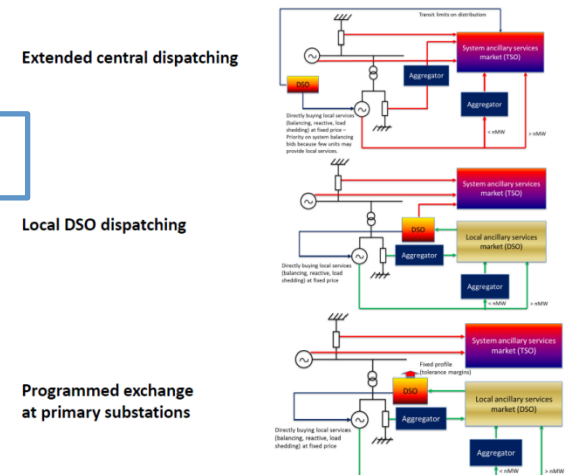
Task 1.3

Basic schemes for TSO-DSO coordination and ancillary services provision

(TL VITO) – M1-M9

D1.2 Basic schemes for TSO-DSO coordination (M09)

- 4 subtasks to be accomplished



T1.3.1.

Starting point –
European context

T1.3.2.

Develop
methodology for
analysis of schemes

T1.3.3.

Apply methodology
on basic schemes
and alternatives

T1.3.4.

Compare results
and assemble
deliverable

T1.3 should deliver one of the key outcomes of the project, related to the priority elements of LCE-06-2015 and the European market design initiative

Task 1.3

Basic schemes for TSO-DSO coordination and ancillary services provision

(TL VITO) – M1-M9

Timeline

T1.3.1.
Starting
point – Eur.
context

T1.3.2.
Develop
methodology
for analysis of
schemes

T1.3.3. Apply
methodology
basic
schemes

T1.3.4.
Compare
results &
assemble
D1.2

28/2

Literature review TSO-DSO interaction schemes
(NCs, Eurelectric, Balancing Stakeholder Group,
DSO-TSO cooperation platform)

Agreed first core scheme to be analysed

31/3

Agreed methodology for assessment of schemes
(indicators + & -, dimensions, comparability) + first
application on core scheme=> lessons learned +
brainstorm alternative schemes

27/5

Revised methodology, application on all schemes,
initiate solutions for identified issues

30/6

Agreed table of content D1.2

31/8

Interpretation and analysis results, iteration for
potential solutions for identified issues, detailed
description TSO-DSO coordination schemes

30/9

Finalization D1.2

D1.2

Project links

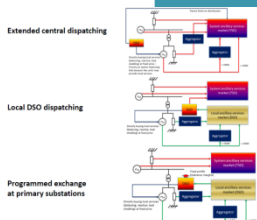
T1.1 context AS
Europe + T2.3 –
T2.4 for core
scheme

T2.2 - T2.3 - T2.4
Market setup

WP2/4/5
Market, labs,
tests

WP2/4/5
Market, labs,
tests

WP6/7
Recomm., Diss.



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Task 1.4

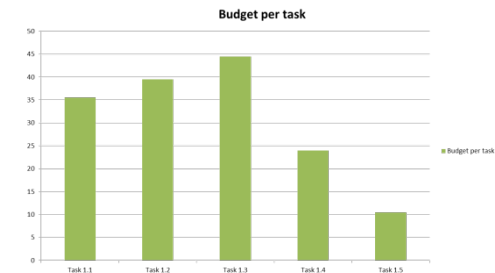
Specifications for the simulation environment

(TL AIT) – M1-M15

- **Main idea: specify inputs for WP4 simulations**
- **Task Leader: Stefan Übermasser (AIT)**

Partners PM/efforts by task participant

AIT	DTU	ENDESA	TECNALIA	Terna	SIEMENS	SELNET	VITO	VTT
8	5	1	1	1	0,5	1	6	1



T1.4 – Main goals

- Main goal: **specify inputs for WP4 – Lab testing** *Input for*
- Specify topology and characteristics of distribution networks *WP2, WP4*
- Define parameter ranges for flexible resources (e.g., available flexibility, location, ramp rates,...) *WP2*
- Agree on modelling formats to allow modelling and lab testing *WP2, WP4*

T1.4 – Timeline and first activities

- Immediate action needed for modelling format *deadline*
- Subtask 1.4.1: 03/2016
 - Clarification of available models from involved partners (e.g. tools, modelling language, required inputs, outputs)
 - Communication of abilities of RSE Software platform and AIT lab infrastructure (e.g. in terms of models which can be handled, boundary conditions)
- Subtask 1.4.2: 04/2016
 - Collection of partners' experience and relevant projects concerning representative networks
- Subtask 1.4.3: 12/2016
 - Definition of networks to be used for simulation
 - Definition Parameter ranges for flexible resources
- Subtask 1.4.4: 12/2016
 - D1.3 Characterization of flexibility resources and distribution networks - Draft
 - D1.3 Characterization of flexibility resources and distribution networks - Final 03/2017

Questionnaire

T1.4: Aim and goals

	2016												2017											
Time	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
T1.4																								
Activities			ST1	ST2								ST3 ST4 D1.3 Draft			D1.3 final									

↓

Input for															WP2 WP4									
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Task 1.5

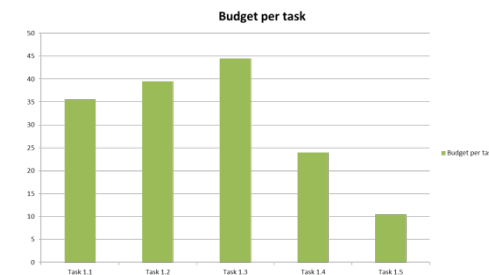
Role of advanced power technology

(TL RSE) – M1-M9

- **Main idea: investigate role of new power technologies for higher flex and/or higher efficiency for ancillary service provision at TSO-DSO network interface**
- **Task Leader: Giacomo Vigano (RSE)**

Partners PM/efforts by task participant

RSE	SINTEF	Selta	Ustrath	SELNET
4	2	2	2	0,5



Task 1.5

Role of advanced power technology

(TL RSE) – M1-M9

- Goals

Identification of new power technologies that can improve the interface between the networks managed by TSO and DSO:

- Subtask 1.5.1: Smart grid devices and solutions for the direct provision of ancillary services (TSO-DSO interface related)
- Subtask 1.5.2: Smart grid devices and solutions that increase the reliability/availability of flexibility resources
- Subtask 1.5.3: D1.3 Characterization of flexibility resources and distribution networks

- Results

- Connection between ancillary services and new power technologies
- Detailed description of investigated technologies for their successive modeling

Task 1.5

Role of advanced power technology

(TL RSE) – M1-M9

	Main role	Role in TSO-DSO interfacing
Distribution Power Electronic Transformer	Improved regulation of the voltage profiles along the distribution feeders	<ul style="list-style-type: none"> • Flexible exchange of reactive power (primary and secondary voltage regulation) • Power quality support (?) • Increase the availability of DERs
Direct Current (DC) links	System decoupling for better management of connected DER power flows	
STATCOM and FACTS for distribution	Local improvement of power quality at distribution level	

Task 1.5

Role of advanced power technology

(TL RSE) – M1-M9

	Main role	Role in TSO-DSO interfacing
Storage devices	Improvement of power quality and leveling at distribution level	<ul style="list-style-type: none"> • Flexible exchange of active and reactive power (primary and secondary regulation of frequency and voltage / system inertia support) • Power quality support (?) • Increase the availability of DERs
Static Transfer Switch	Transfer of DG/load/ feeder from a preferred distribution network to an alternative one	<ul style="list-style-type: none"> • Congestion management at transmission level
Measurement devices	Contribute to network state estimation for the distribution system management	<ul style="list-style-type: none"> • Detailed knowledge of the state and availability of flexible resources • Reduced uncertainty in optimization processes aimed at the provision of ancillary services

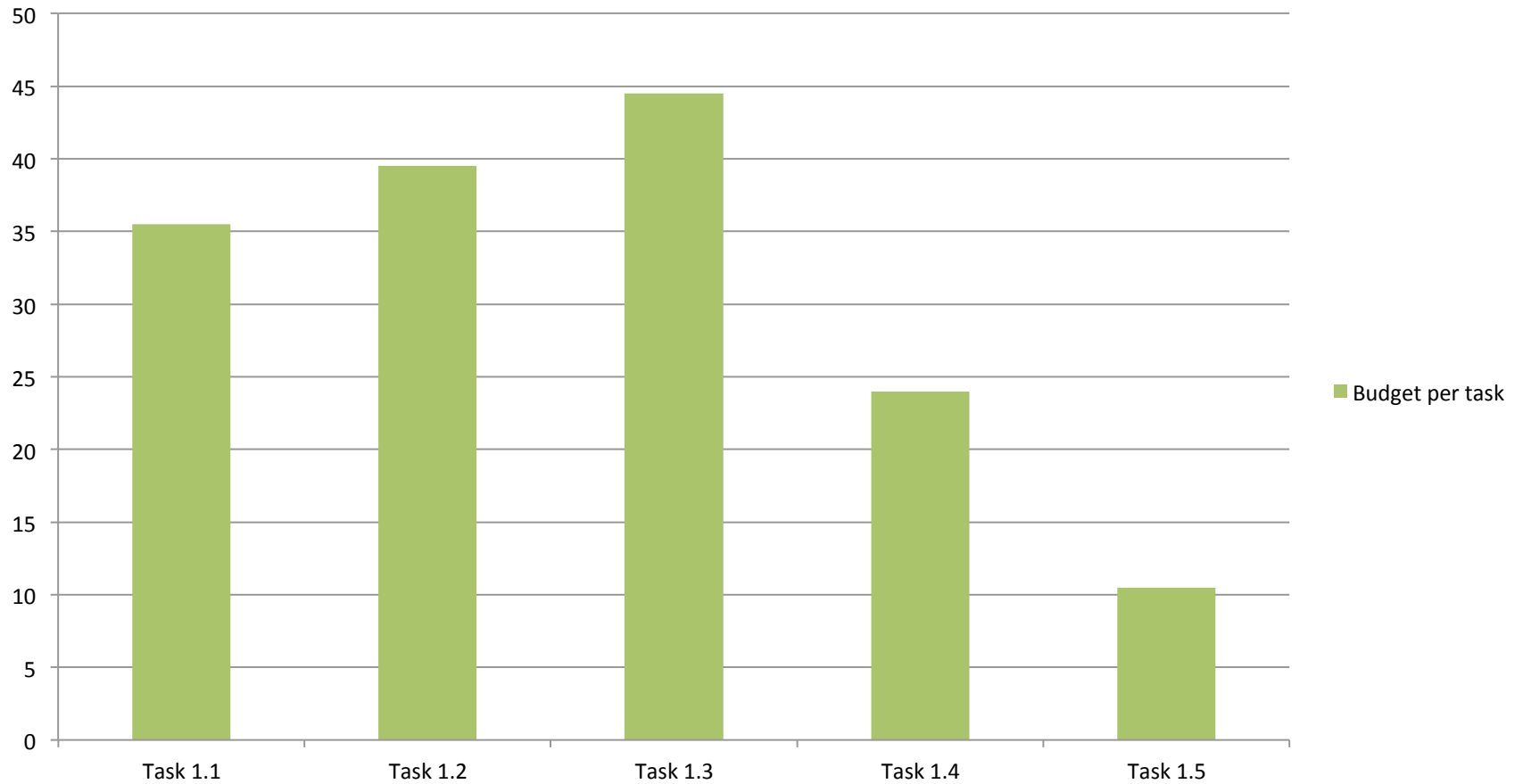
- D1.1 Ancillary service provision by RES and DSO connected at distribution grid level in the future power system (M9) – **Tecnalia**
=> T1.1
- D1.2 Basic schemes for TSO-DSO coordination (M9) – **VITO / EnergyVille**
=> T1.3
- D1.3 Characterization of flexibility resources and distribution networks (M9 - M15) - **N-SIDE** (with substantial support AIT + RSE)
=> T1.2 + T1.4 + T1.5

Agenda

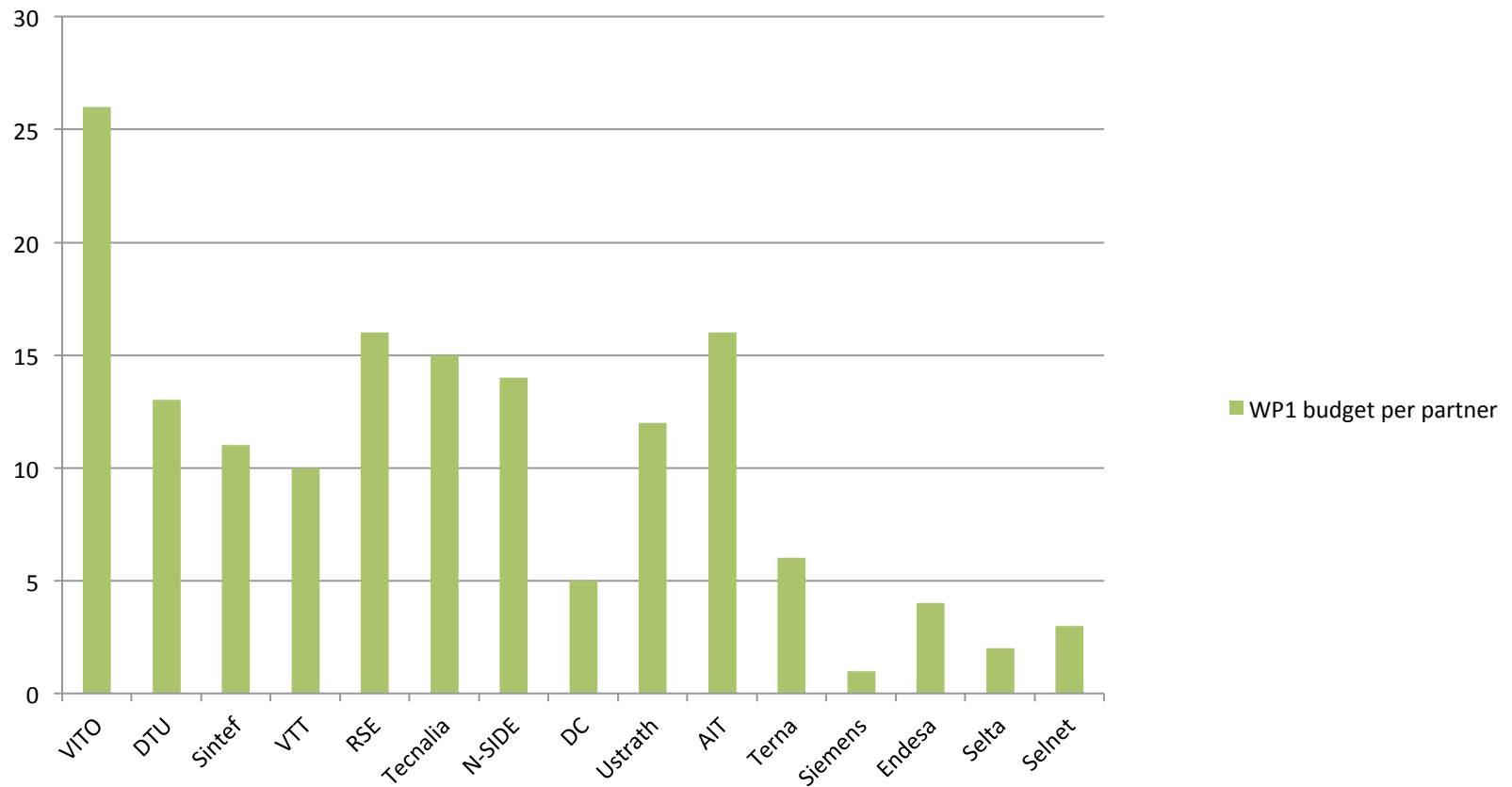


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Budget per task



WP1 budget per partner



Planning and coordination of subtasks for the short term

Important note: M6 ~ M9

		Year 1						
		M1	M2	M3	M4	M5	M6	
Task 1.1	1.1.1 Current status AS							M2
	1.1.2 Future scenarios AS							M3
	1.1.3 Future needs AS							M5
	1.1.4 Sizing reserves / AS							M9
Task 1.2	1.2.1 Taxonomy of flexibility assets							M9 - 15
	1.2.2 Define information model							M9 - 15
	1.2.3 Scenario projection to map and derive quantified availability and needs							M9 - 15
Task 1.3	1.3.1 Starting point – European context							
	1.3.2 Develop methodology for analysis of TSO-DSO schemes							
	1.3.3 Apply methodology on basic TSO-DSO schemes and alternatives							M9
	1.3.4 Comparison results analysis and propose solutions							M9

Timing – interdependencies other tasks

Planning and coordination of subtasks for the short term

Important note: M6 ~ M9

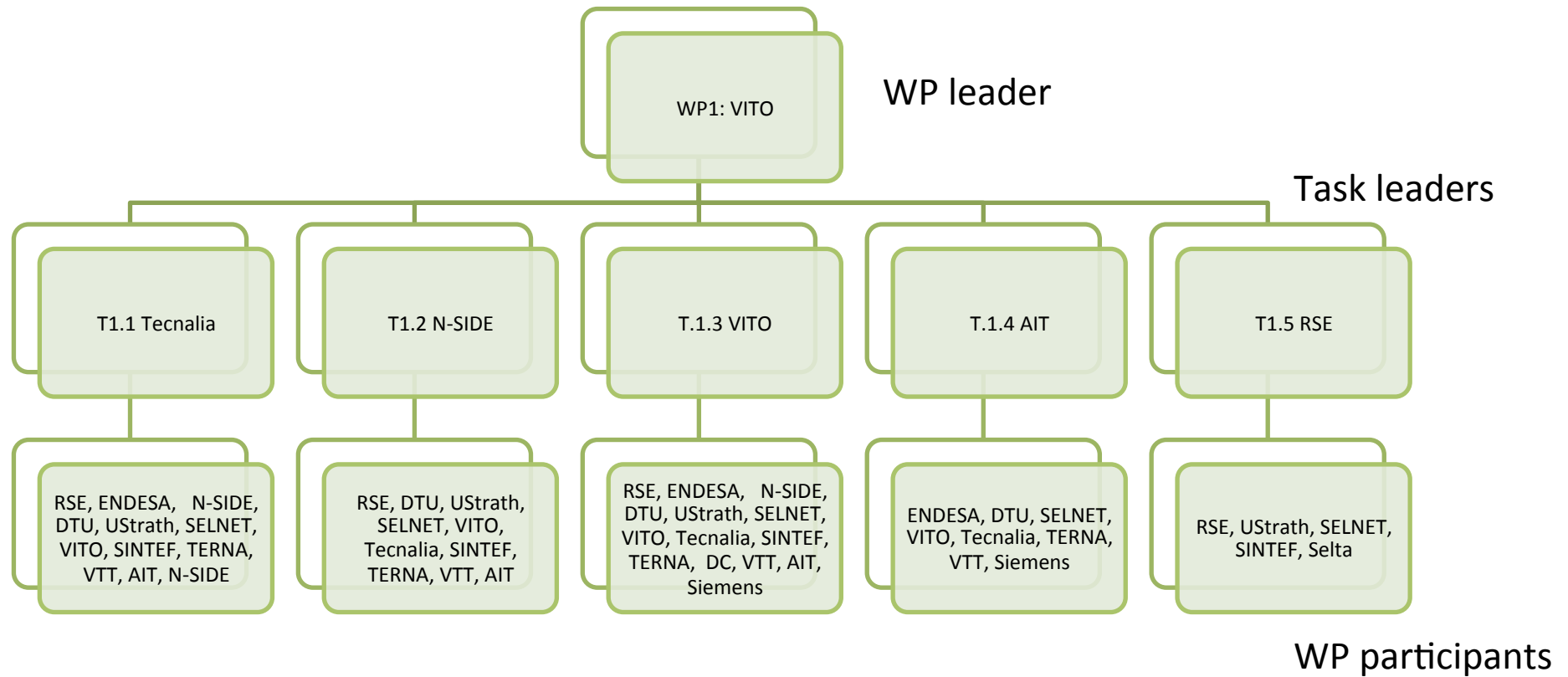
		Year 1						
		M1	M2	M3	M4	M5	M6	
Task 1.4	1.4.1 Clarification available models and RSE SW and AIT lab abilities							M3
	1.4.2 Collection partners' knowledge representative networks							M4
	1.4.3 Definition networks for simulation and parameter ranges flex sources							M12 - 15
	1.4.4 Writing D1.3 together with T1.2 and T1.5							M9 - 15
Task 1.5	1.5.1 Advanced power technology for the direct provision of AS (TSO-DSO interface related)							M9
	1.5.2 Advanced power technology that increase the reliability/availability of flexibility resources							M9
	1.5.3 Writing D1.3 together with T1.2 and T1.5							M9 - 15

Agenda



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Points of attention: communication



- Task leaders: write out task description in 2-3 pages: focus content and practicalities (timing and contributions)
- Contacts to be gathered:
 - Excel will be provided by WP leader to all contributing partners of work package 1
 - First name, family name, phone number, (mobile phone nr), mail
 - Each partner: send your companies task contributors to WP-leader
 - Consolidated overview will be sent around afterwards**=> Deadline end of week**
- Coming weeks/months:
 - Core team = WPLs + TLs: regular telcos/webconf + decision physical meetings
 - Task actions/telco's: organized by TLs (include WPL)
 - Bilateral contact at all times
- Telco WP1: WP-leader and TL mandatory, WP participants voluntary -
Wednesday 3/2 10:00-12:00

- Expected contributions of partners:
 - based on indications during proposal phase and allocated budget
 - Forgotten / deviations based on kick off => contact WP-leader
- First actions: collection of available information / experience from different partners, for different tasks
- Discussion items:
 - Overall framework => discussion (see next slide)
 - T1.1: reserve dimensioning tool – experiences?
 - T1.5: storage \Leftrightarrow T1.2
 - Agreed timeframe for the envisioned project solutions?
 - Specific interaction issues (inter-task, inter-WP)?
 - ...

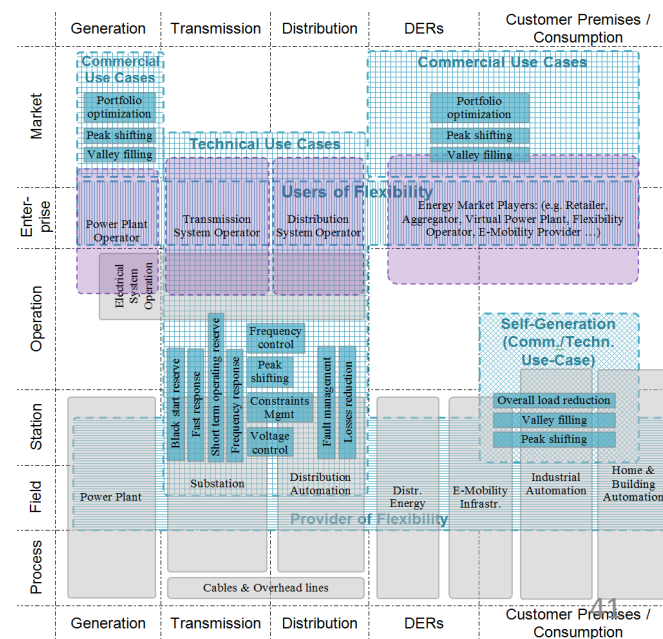
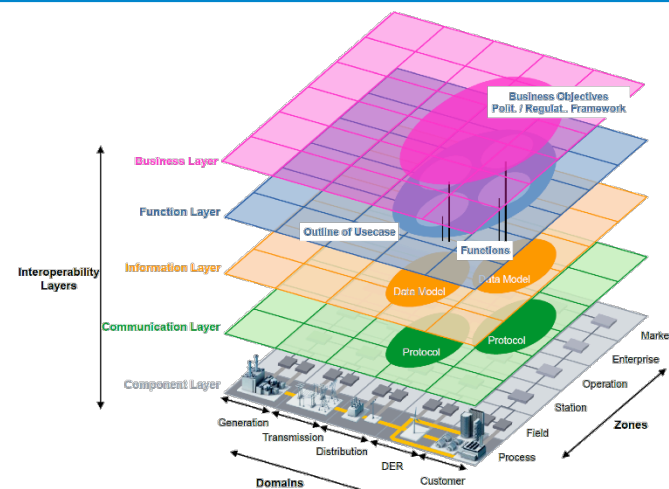
WP1: overall framework?

Smart Grid Architecture Model

(M/490 program and CEN-CENELEC-ETSI Smart Grid Coordination Group)

- Overall generic high-level framework for...

- Description of Clusters, Entities & ICT
- Definition and display of flexibilities
- Generic description of networks and use cases
- Display of market models
- ...



What ancillary services will we need in the future?

- Inventory SoA and novel approaches ancillary services (incl. DRES and DSM)
- Technical, economic, regulatory
- Future power system scenarios

Data gathering and specifications for simulation

How should this be coordinated, by which TSO-DSO interactions?

- Economically effective
- Grid-secure
- Roles, responsibilities, information exchange
- Network planning, market architecture, ICT

What ancillary services can be provided by resources connected to the distribution grid?

- Inventory distr. grid connected resources
- Create categories based on physical characteristics and behaviour
- Link the availability and characteristics to the needs



Set of requirements for ancillary services for different scenarios in the context of an evolving European energy system



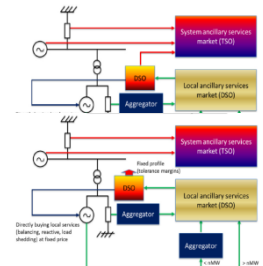
Product/service definition of possible ancillary services that can be provided by distributed flexibility resources (DRES, DSM)



A generic classification of distributed flexibility resources based on their characteristics and suitability for ancillary services



Detailed description of the characteristics and implications of possible TSO-DSO interaction schemes for ancillary services provided by flexible distributed resources



Thank you for your attention...

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AS – collaboration TSO-DSO

- As part of the energy transition, the relation between TSOs and DSOs will intensify
- Balancing stakeholder group
 - Balancing stakeholder group = platform where ACER, ENTSO-E and stakeholders are gathered (in force since 2015)
 - Deliverables envisioned:
 - Deliverable 1: EU Roadmap for Early Implementation of Electricity Balancing Regulation:
 - Set the high level plan how current national markets shall, through the stepping stone of regional balancing markets, develop towards a European Balancing Market
 - Deliverable 2: Cost Benefit Analysis on Imbalance Settlement Period (in accordance with article 21 NC EB) – deadline Q1 2016
 - Deliverable 3&4: proposal for standard mFRR & aFRR products (in accordance with article 29 NC EB) - mFRR & RR (Q1 2016); aFRR (Q2 2016)
 - Deliverables 5-7: Proposals for pricing methodology Balancing Energy; List of Activation Purposes of Balancing Energy bids; High level principles for Balancing algorithms

AS – collaboration TSO-DSO

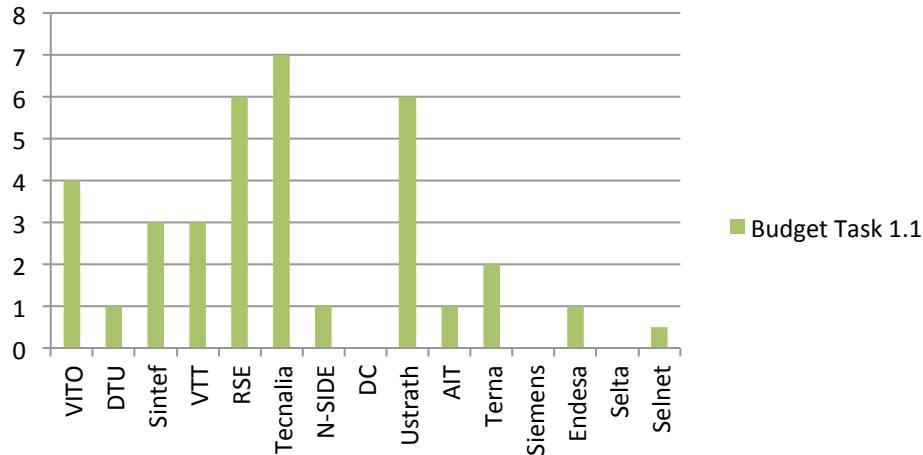
- DSO-TSO Cooperation platform
 - Members: ENTSO-E, EDSO, CEDEC, Eurelectric, GEODE
 - Areas highlighted that need improvement:
 - Roles and responsibilities – TSO and DSO have own and shared responsibilities
 - Flexibility in the market: flexibility used for different purposes and by different market participants (issues: baseline calculation, coordination of activation of flex, priority of flexibility, decisions by one network operator should take into account impact on other network operator...)
 - Technical cooperation (network planning, system operation, sharing and provision of data)
- Need for structured meeting platform where DSOs and TSOs discuss jointly challenges together and identify together new technologies that improve interactions (communication tools, protocols)
- Collaboration DSO-TSO needs to take into account national situations:
 - level of automation
 - existing communication systems
 - voltage levels that are operated
 - Is the DSO actively managing the grid
 - Are forecasts provided by the DSO towards the TSO?

AS – collaboration TSO-DSO

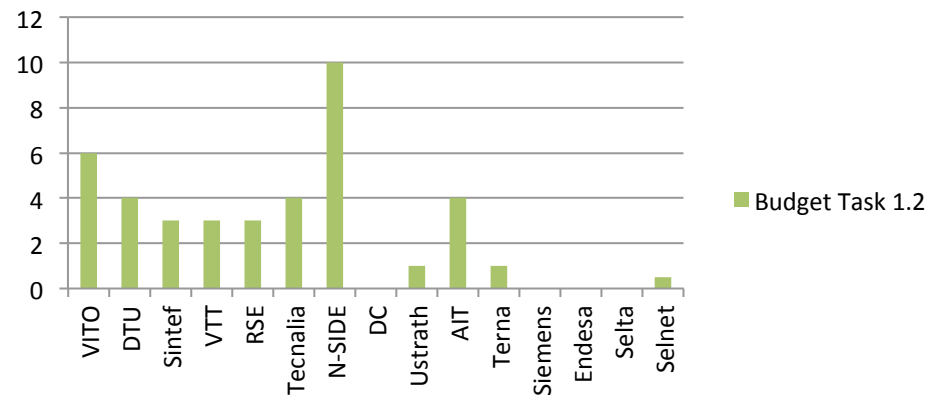
- Data management
 - Cfr. CEER: need for clear rules concerning collection, processing, storage and transmission of data, combined with privacy and security settings
 - Need for standardisation of data formats and data exchange
 - Important role for a neutral data coordinator or data hub (could be DSO or third party)

- http://www.eurelectric.org/media/237587/1109_entso-e_pp_tso-dso_web-2015-030-0569-01-e.pdf

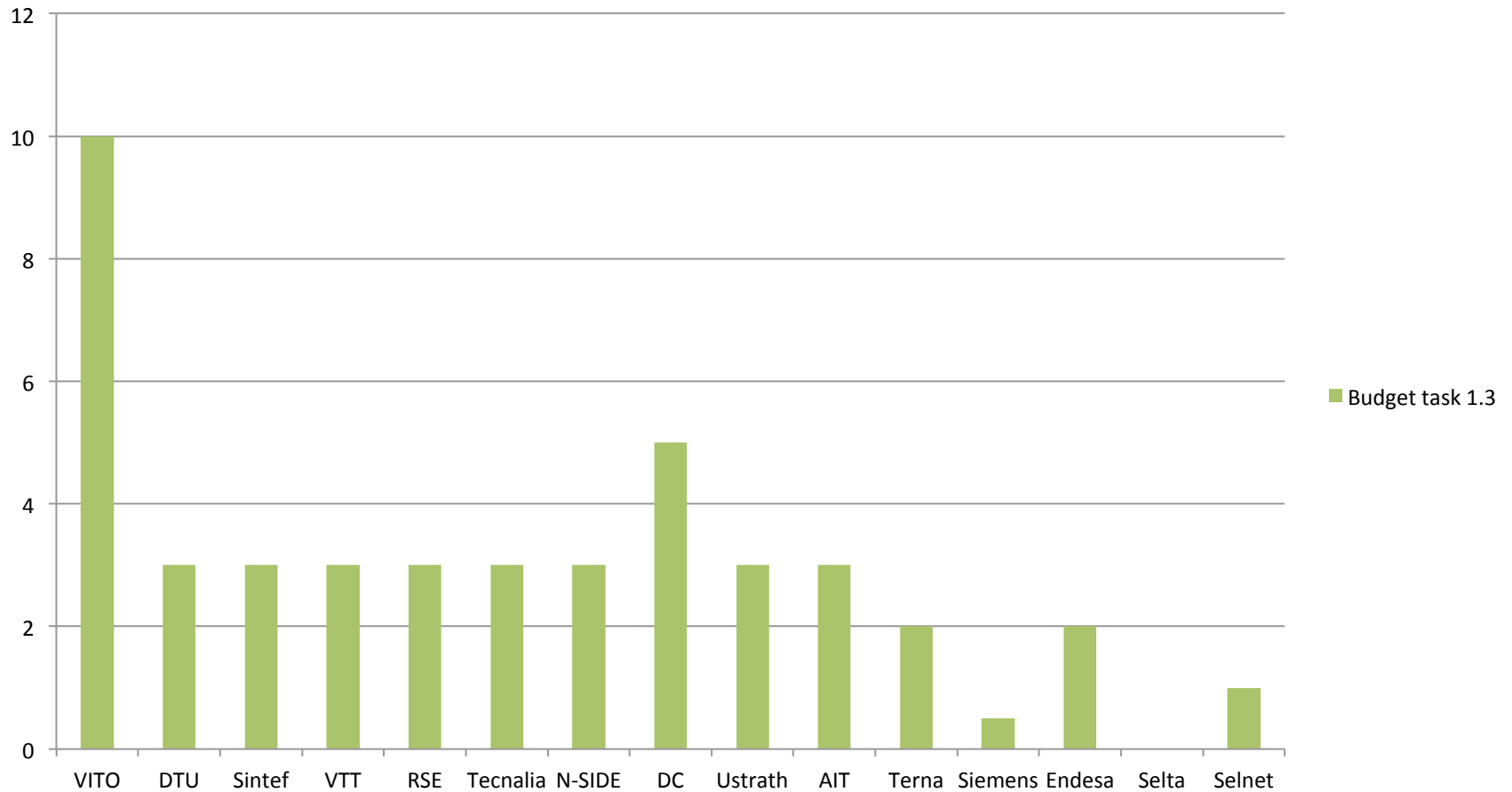
Budget Task 1.1 - AS future Eur. power system



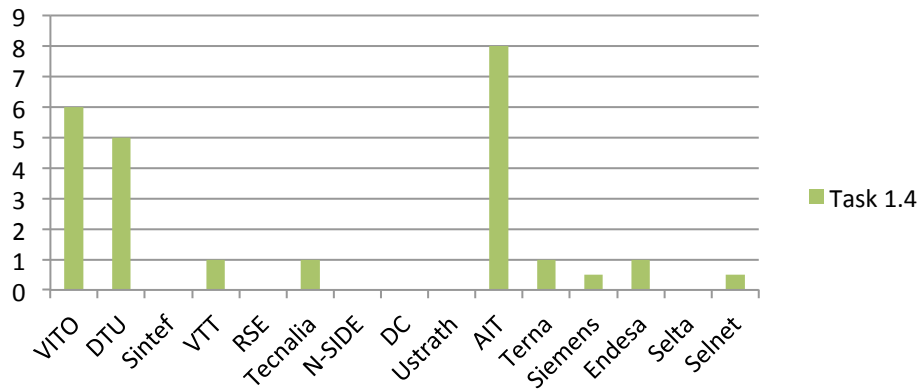
Budget Task 1.2 - availability and role of distr. connected RES & DSM for AS



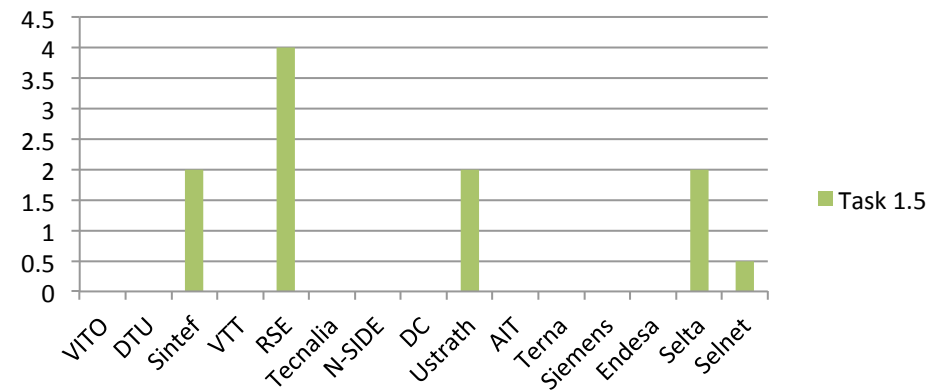
Budget Task 1.3 - TSO-DSO coordination schemes

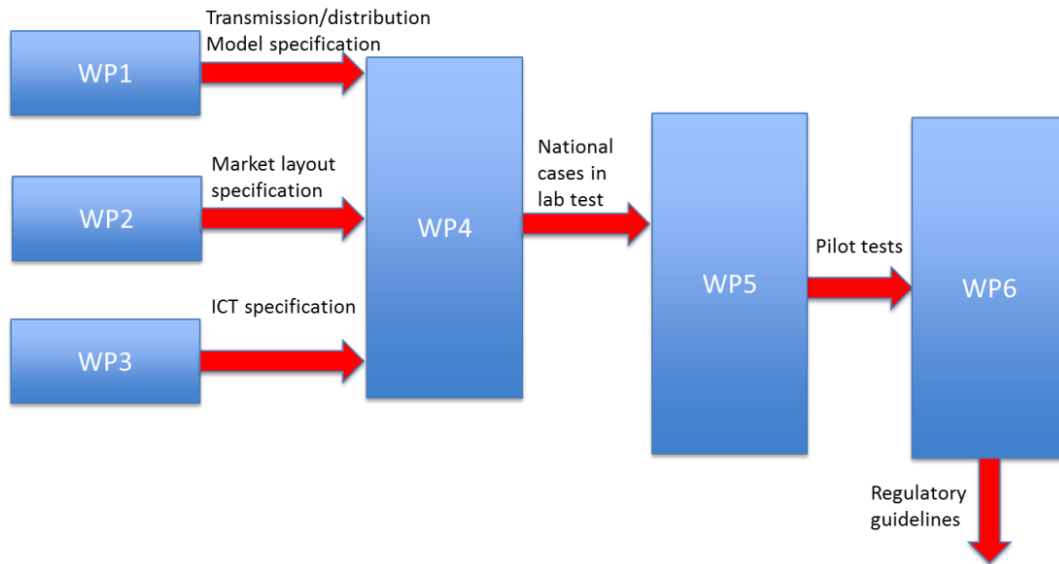


Task 1.4 - Specs simulation environment



Task 1.5 - Role advanced power technology





Underline with a red circle the domain of your WP and use this space for possible notes on the chronogram.

	Year 1				Year 2				Year 3			
	1	4	7	10	1	4	7	10	1	4	7	10
WP1												
WP2												
WP3												
WP4												
WP5												
WP6												
WP7												
WP8												

Task 1.2

Availability & role of RES and DSM connected at distr. level for ancillary services provision
(TL N-SIDE) – M1-M15

- In house expertise of N-SIDE:
 - **Enertop**: Optimisation Software modeling flexibilities of industrial plants and leveraging them on flexibility markets
 - **Industore Research project** aiming to quantify and optimize the potential of industrial demand response in Wallonia
 - Through collaboration with DSOs and universities N-SIDE also has contacts with researchers active in distribution systems (e.g. www.gredor.be or E-cloud project)
- The expertise from other partners:
 - RSE, AIT, DTU, SINTEF-E, Tecnalia, Terna, UStrath, SELNET, VITO, VTT

