Energy Technology and Governance Program
SOUTHEAST EUROPE DISTRIBUTION SYSTEM OPERATOR
SECURITY OF SUPPLY WORKING GROUP

Connection of Distributed Generation to Distribution Networks: Recommendations for Technical Requirements, Procedures and Agreements

DRAFT FINAL REPORT PRESENTATION
PART 1 & 2

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MEMBERS of WG – 9 DSO (6 countries)

- **Albania – OSHEE** *(OSHEE Operatori i Shpërndarjes së Energjisë Elektrike sh.a.)*
- **Bosnia and Herzegovina**
  - EDB
    *JP Komunalno Brcko*
  - EPBIH
    *JP Elektroprivreda BIH*
  - EPHZHB
    *JP Elektroprivreda Hrvatske Zajednice Herceg-Bosne*
  - ERS
    *JP Elektroprivreda Republike Srpske*
- **Croatia – HEP**
  *HEP – Operator distribucijskog sustava d.o.o.*
- **Macedonia – EVNM**
  *EVN Macedonia*
- **Serbia – EPS** *(up until July 2015 5 DSOs; now 1 DSO EPS Distribucija)*
  *Elektroprivreda Srbije*
- **Kosovo – KEDS**
  *Kosovo Electricity Distribution and Supply*
countries have adopted a variety of incentives to promote renewable energy (2020 RE targets)

activities are underway in the region for creation of a beneficial investment climate for RE producers → DSOs are under increasing pressure to respond to an often excessive demand for connection & access to the network

the project shall:

- assist the SEE DSOs develop set of rules and requirements related to connection procedure permitting, authorization and connection to the grids procedures shall be more streamlined and coordinated amongst the institutions in charge

- to help DSOs in preparing for operation with increased integration of distributed generation more electricity generated at distribution level, from RES, is requiring a system renovation in operation and regulation
PROJECT TASKS

Task 1
DG Connection Procedure Review

2 questionnaires

Task 2
Recognition of Inadequacies in the Current Procedure

Recommendations for improvements

Task 3
Select a U.S. DSO(s) and Provide an Overview of their Rules & Requirements for Integrating New DGs

Applicability in SEE

Task 4
Preparation of Final Report
### WORKPLAN

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<tr>
<th>Activity</th>
<th>Actor</th>
<th>Deadlines</th>
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<tr>
<td>Questionnaire preparation and distribution</td>
<td>EIHP</td>
<td>April 30, 2015</td>
</tr>
<tr>
<td>Collecting the answers</td>
<td>DSOs</td>
<td>May 20, 2015</td>
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<tr>
<td>Presentation of the first questionnaire responses (Athens meeting)</td>
<td>EIHP</td>
<td>June 1-2, 2015</td>
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<td>American Electric Power</td>
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<tr>
<td>Questionnaire responses clarification</td>
<td>EIHP</td>
<td>July 30, 2015</td>
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<tr>
<td><strong>Draft report – preliminary findings</strong></td>
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<tr>
<td>Collecting the answers</td>
<td>DSOs</td>
<td>August 31, 2015</td>
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<td>Presentation of the DSO updates – focus on DGs (Tirana meeting)</td>
<td>EIHP</td>
<td>October 16, 2015</td>
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<td>Vorarlberg Netz, NETZ OÖ, AIT</td>
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<tr>
<td><strong>High draft report</strong></td>
<td>EIHP</td>
<td>December 31, 2015</td>
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<td>One-day training workshop on DG interconnection practices (Skopje meeting)</td>
<td>EIHP</td>
<td>February 3-4, 2016</td>
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<td>American Electric Power</td>
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<tr>
<td>Review by WG members</td>
<td>EIHP</td>
<td><strong>end of February</strong></td>
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<td><strong>Final report</strong></td>
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<td><strong>end of March, 2016</strong></td>
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First meeting in Athens (June 1-2, 2015)

Topics covered

1. SEE DSOs overview already in operation, under construction or in some early phase of development
2. Rated (nominal) power of DGs interconnected to distribution networks
3. Formal steps and agreements in DG connection process - Croatian case
4. Analyses performed in the DG connection process (who performs them, software used, who is financing analyses)
5. Connection criteria (e.g. voltage drop/raise; losses)
   - definition of distributed generation, net metering
   - what is driving expansion of RES in U.S.
   - net metering (state caps, AEP experience, implications for tariffs)
   - process for integrating DG

Review and clarify data collected for new study
Second meeting in Tirana (October 16, 2015)

Topics covered

1. Impact of DG (RES) on DSO business
2. SEE support schemes and measures
3. Market model for DGs (RES and IPP)
4. Barriers for DG deployment (technical issues)
5. Practical challenges in SEE
6. Denial of connection in SEE
7. Connection charging (regulators participation)
8. DSO obligations with regard of access to and operation of grids (RES Directive)
9. Network capacity management – flexibility
10. Ancillary services in SEE
11. DSO overview
12. Recommendations and conclusions
Second meeting in Tirana  
(October 16, 2015)

Topics covered

2. EU experience with DG integration

- Smart grids Demonet in Biosphärenpark (Großes Walsertal, Austria)
  Approaches to a resource-conserving and smart integration of RES in rural areas:
  intelligent voltage control, pumped storage stations employed to integrate fluctuating levels of RES, V2G
  *(Vorarlberg Netz - Reinhard Nenning)*

- Hosting increasing number of decentralized PV installations (Austria)
  testing of control and monitoring solutions in a DN with high penetration of PV based on smart metering communication infrastructure – demo project (DG DemoNet Smart LV grid - Eberstalzell)
  voltage monitoring supports a more efficient use of the grid & increases hosting capacity → revision of planning methods
  *(Netz Oberösterreich GmbH - Andreas Abart)*

- Connection of Distributed Generation – Issues, status and lessons learnt
  support schemes for RES in EU, connection charging, impact of DG on DN, connection requirements and standards (Germany), ENTSO-E NC RfG, congestion management in DN (EEG - Germany)
  *(Austrian Institute of Technology GmbH - Benoît Bletterie)*
Third meeting in Skopje (February 3-4, 2016)

Topics covered

1. Presentation of draft final report
2. Recommendations for SEE DSOs
3. DSOs US experience

Mark Smith, Distribution System Planner for American Electric Power (AEP)

Distribution System Integration of Distributed Generation
Distributed Energy Resources - Modeling, Analysis and Planning
Distribution System Impact Study of Distributed Generation (input data, criteria, analyses)
State Administrative Codes and Standards
Interconnection process (flowchart)
Connection of Distributed Generation to Distribution Networks: Recommendations for Technical Requirements, Procedures and Agreements

High draft report:
185 pages
11 chapters
77 figures
54 tables
Chapters

- Introduction
  - definitions
  - key indicators of the SEE region
  - DSOs overview with regard of DGs
  - main barriers across EU for DG integration
  - technical issues limiting DG hosting capacity of the distribution network in SEE
DG connection procedure review & recognition of inadequacies in the current procedure

- questionnaires
- DG region overview (in operation, under construction, in some early phase of development)
- legal framework relevant for DG interconnection in SEE
- rated DG capacity & optimal connection point
- analyses performed in the DG connection process
- connection criteria and requirements
- provision of ancillary services
- connection steps & charging (SEE DSOs overview)
- priority and guaranteed access, priority dispatching, curtailment (SEE DSOs overview)
- denial of connection
Support schemes (incentives) and market models

- state of play with regard of NREAPs
- support schemes and measures in 6 SEE countries
- technology caps on installed capacity that is entitled to the support measures → quotas for incentivized RES
  
  in BiH (350 MW) and Croatia (400 MW) there are limits for WPP interconnection due to operational security of the system
  
  controversy → in both countries the applications for connection of WPPs exceed the limit by far

- market models for RES and IPP
  - in Albania, based on the questionnaire response for the study, from 2016 DSO might be obliged to purchase electricity produced by SPPs connected to distribution network
  - in Federation entity (BiH) system operators are required to prescribe methodology for prediction of production and delivery of data to operators for producer over 150 kW
  - in Republic of Srpska (BiH) DSO is obliged to buy electricity produced during test operation (i.e. initial parallel operation) of generation facility
Chapters (54 pages)

- U.S. & EU DSO overview of rules/requirements for integrating DGs and applicability in SEE
  - U.S. decentralized resources portfolio
  - U.S. utility interconnection practices (rules, guidelines, limits)
    history of small generator interconnection procedures; Federal USA; distribution-level interconnection policies
  - U.S. net-metering policies
  - U.S. review of selected states interconnection procedures
    (Texas, Ohio, California, Oregon, Massachusetts, Utah)
  - practical rules - simplified evaluation methodologies worldwide
  - timelines - District of Columbia small interconnection rules
  - transparency and publicity practices adopted by DSOs
  - EU approaches to mitigate virtual saturation and speculation in grid interconnection procedure
  - allocation of distributed generation grid connection cost
  - means to increase the hosting capacity
  - network capacity management - coordination of all relevant actors; deployment of “flexibility”
  - smart grid benefits for distributed generation in the future
Chapters (10 pages)

- Conclusions and recommendations for improvements in SEE and each DSO
- References (44)
- Appendix I – questionnaire
- Appendix II – requested clarification and additional questions to DSOs
Key indicators of the six focus countries

2014

share of RES in the net maximum electricity capacity of power plants

neither country exceeds 10% of RES share
Croatia dominates in the region with regard of installed capacity of RES (primarily due to the 339 MW installed capacity of wind PP)

850 MW of RES (i.e. 4,1%)
countries across SEE have long relied on hydropower
Albania is the world’s largest producer of hydropower as a percentage of total production; BiH generates a substantial share of its electricity from hydropower and has emerged as one of the region’s largest power exporters
less investment into wind and solar power except in Croatia
Key indicators of the 4 focus countries

535 MW DG installed capacity → 82% of the region installed capacity

- countries across SEE have long relied on hydropower
- leader in HPP is OSHEE followed by EVNM and EPS
- leader in SPP is HEP followed by EVNM
Key indicators of the six focus countries

1.814 DGs already integrated to DS; 1.238 in Croatia

distributed generation region overview

in each SEE DSO

by energy source

Total number of DGs in operation

1. Solar; 1,450
2. Hydro; 306
3. Other; 25
4. Biogas; 20
5. Biomass; 4
6. Wind; 9

80%
Key indicators of the six focus countries

1.814 - 656 MW DGs already integrated to DS

- the largest number of DGs interconnected to **LV** are **solar power plants** (most of them in Croatia)
- the largest number of DGs interconnected to **MV** are **hydro power plants** - most of them in Macedonian EVNM (91) and Albanian OSHEE (88)

- 46 MW (7%) of total installed capacity at LV
- 610 MW (93%) of total installed capacity at MV
- 1,431 (79%) of total number of DGs at LV
- 383 (21%) of total number of DGs at MV
- In KEDS & OSHEE no DGs at LV
Distributed generation under construction

**HPPs**
- Lead in total installed capacity of DGs **in operation**
- And also in total installed capacity of DGs **under construction**
- And also in total installed capacity of DGs **in early phase of development**

- **HEP & EVNM lead in total installed capacity of DGs under construction**
- **EPS & HEP lead in total installed capacity of DGs in early phase of development**

OSHHE did not provide data on planned DGs
SEE is experiencing a wave of HPP

- over 100 greenfield HPP under construction
- over 1,000 greenfield HPP either actively planned (~800) or potential (~200)

- **Albania** was the most active in this regard awarding concessions for no less than 435 HPP project from 2007-2013
- **Macedonia** is currently very active in awarding concessions – the government has announced to award up to 402 concessions for small HPPs
- **Serbia** there are more than 800 HPP on the national register (register currently being revised)

Distribution grids in the region already require significant investments to upgrade - power outages, voltage levels and losses are being regular problems in some areas

the uptake of DGs especially intermittent RES is treated with caution in most DSOs

Source: Financing for hydropower in protected areas in Southeast Europe, 2015, euroNATUR&RiverWatch
Currently effective legal framework dealing with DGs – relevant for interconnection procedure in SEE DSO

<table>
<thead>
<tr>
<th>Legal framework</th>
<th>EDB</th>
<th>EPBIH</th>
<th>EPHZHBI</th>
<th>EPS</th>
<th>ERS</th>
<th>EVNM</th>
<th>HEP</th>
<th>KEDS</th>
<th>OSHEE</th>
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<tbody>
<tr>
<td>General terms and condition for electricity supply and/or use of network</td>
<td>September 2014</td>
<td>October 2014</td>
<td>2013</td>
<td>August 2008</td>
<td>June 2011</td>
<td>2005 (sections dealing with connection procedure are still valid) July 2013</td>
<td>August 2011</td>
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Conflicts between DG developers and grid operators

DSOs are under increasing pressure to respond to sometimes excessive demand for connection & access to the network

- lack of experience on the side of the DG developer and/or grid operator
- lack of understanding of the situation and the processes of the counterpart also because of lacking communication
- disadvantages that grid operators have to suffer when DG plants are connected to the grid
- lack of trust between plant operators and grid operators due to conflicts in the past
- lack of resources (in terms of staff and technology) for the communication with DG developers on the side of grid operators as these costs are not sufficiently reimbursed
Work relationship between DSO & DG (investors)

- EU nation level research → communication problems between DSO and DG aggravated the grid connection process
- reduced flow of information and delayed the overall process ← legal regulation helped only to some extent
- measures which aim to improve the communication and ensure that experience of good cooperation will be disseminated on both sides; e.g. to establish a regular platform of communication between DGs and DSO

not all conflicts will be solved ← conflicts are originated by contradicting interests  cooperative actions will help parties to find solutions that serve their common interests

Germany: *Forum Netzintegration*
- stakeholders (energy sector) are meeting on a regular basis → identify main barriers for the development of the grid & formulate solutions
- exchange of ideas and perspectives
- *Forum* publishes *Plan N* which formulates the main findings of discussions

UK: *Electricity Network Strategy Group*
- two representatives (DSO, RES industry) collaborate on a continuous base
- close cooperation ↔ there is a direct link to discuss problems as soon as they come up
Challenges in SEE DSO networks

- Distribution grids in the region already require significant investments to upgrade → power outages, voltage levels and losses are being regular problems in some areas
- The uptake of DGs especially intermittent RES is treated with caution in most DSOs

- As observed by most of SEE DSOs, small HPP, and recently also photovoltaic PP, are usually built in rural areas with a small number of customers and low level of load, where the distribution network is not that well developed (weak) and power plants are far away from primary substations
- Due to the low loading in SEE rural areas, when the required DG connection power is many times higher than the local load (i.e. DGs transfer most of the generated energy to the transmission system via the distribution system, thus violating the basic principle of DG), this brings additional complexity and costs to DG and DSO
- Obviously the best effects of DGs on the distribution network have been observed in areas where minimum local load levels are approximatively equal to maximum connection power (i.e. DGs located close to the center of local consumption)

**CHALLENGE**
How to accomplish, through development of regulatory framework, that DGs have incentive to become beneficial for the system?

- Obligations of DGs in terms of support system operation in responsive way
- Legislative solutions to promote location of DGs where the existing grid can accommodate the additional generation capacity with no or minimal additional investments and increase of losses
Insufficiently regulated issues in SEE DSOs in the connection phase

- unclear regulations concerning the distribution of costs
- information policy regarding costs
- connection can be (temporarily) denied due to insufficient capacities
- no explicit obligation to immediately reinforce grid to allow for connection either to allow provision of ancillary services (flexibility) to DSO by DGs
- capacity limits for RES
- connection moratorium due to lack of grid capacity
- lengthy grid connection procedure (primarily due to DSO activities conditioned by other parties)
- complex procedures for small DGs
Insufficiently regulated issues in SEE DSOs in the **operation phase**

- countries in the region have a low share of DG operating on their grid → grid operation simply not yet be problematic due to this low DG share
- possible that with an increasing DG share the situation will dramatically change in the future → early steps would be required to minimize future impacts

- major barriers that might be expected in SEE DSOs in the grid operation phase:
  - voltage control
  - dispatching priority for RES
  - proper regulation for congestion management (curtailment)
  - ancillary services provided by DGs to DSO
Insufficiently regulated issues in SEE DSOs in the grid development phase

- DSOs in the region are obligated to prepare a distribution system development plan for the period of minimum 10 years → plans are rarely publicly available
- not so reliable source of data regarding the available hosting capacity of the networks for connection of new DG
- DGs are not adequately included in distribution network development plans → different pace of grid and DG development
- lack of proper incentives for DSO and DGs

Traditional approach - operator performs an individual analysis and provides an individual solution to each connection

- coordinated grid connection request process
  - TSO or DSO do not receive individual requests → requests are collected by the regional administration and after a validation process submitted for an aggregated analysis by the DSO & TSO
  - in addition to the cost sharing mechanism (proportionally to the capacity assigned to each RES project), the agreement for the development of such infrastructures contain the necessary guarantees, payment and execution terms
- benefits:
  - overall minimized network development and project cost
  - reduction of project risks thanks to the possibility to correctly analyze both the costs and timetables needed for the different RES scenarios
  - reduced time for acquiring all necessary administrative permits

Example - Spanish “Evacuation Boards”
Virtual saturation & speculation issues

**Virtual saturation** → refers to a situation in which *portion of the grid could theoretically allow connection of DG but cannot practically proceed* because its whole capacity is reserved by DGs that are not yet connected.

- Some projects in development take up all the available capacity thus making it impossible for other investor to request connection.
- What is maybe even more severe in the long-run → *virtual saturation may prevent DSOs from developing the grid appropriately*.
  - As it is unclear what projects will be realized DSO is unable to assess what grid developments will be necessary.
  - DSO is hindered in setting up a master plans that takes DG growth accurately into account.

**Speculation** → it refers to the *practice of reserving all available capacity on the grid in order to subsequently sell* the reserved capacity to other producers who may need it.
EU approaches to mitigate virtual saturation and speculation in grid interconnection procedure

- EU countries are currently following two different approaches to mitigate virtual saturation:
  - introduce for the grid connection process a set of intermediate steps (France, Germany, Estonia)
    each of them ending with a realistic and appropriate milestone that the project developer has to reach within a certain period of time (e.g. first step - submission of building permissions, …)
    - if a project developer fails to reach the next milestone in the given time the reservation expires and the developer has to restart with the first step
    - prevent projects from being idle and would thus support a quick implementation of projects
    - process provides DSO with a clearer understanding of which projects will be commissioned and when → help them to assess how much capacity will be connected in a conceivable period of time and to accommodate the own planning
    - consequence → the process would be less stressful for DSO and DG
    - requires more communication and coordination between all actors
    - more sophisticated connection process could become a challenge for less experienced DG installers

EU countries are currently following two different approaches to mitigate virtual saturation:

- introduce a reservation fee (Bulgaria, Poland, Czech Republic) to be made by the plant developer when applying for the connection
  - developers have to pay in advance to the connection process and thus the stranded asset risk is moved from DSO to DG
  - major advantages:
    1. speculative behaviour will become more risky (less attractive) → the costs will entail a financial risk considering that the investment will be useless if the reserved capacity cannot be sold in due time
    2. the recipient (DSO) could use the fee as an additional resource for grid development

Technical issues limiting DG hosting capacity

- **Thermal ratings**
  - DG has the effect of changing current flows
  - overloading of network components (lines / transformers)

- **Voltage regulation**
  - DGs may have a positive effect (compensating voltage drops); high DG penetrations complicate VC & may lead to overvoltage situations
  - excessive tapping of OLTC (wear of the equipment & increased maintenance)

- **Fault level**
  - DG contribute to the fault current → may lead to exceeding the short circuit capacity of network

- **Power quality**
  - DG installations may induce power quality disturbances → fast voltage variations due to switching operations, harmonic, flickers,…

- **Other technical constraints**
  - reversal of power flows in network
  - effect on mains signaling systems
With higher integration requirements on DGs become more demanding

- the large amounts of RES in networks increased the concerns of TSOs and DSOs who need to guarantee a continuous and reliable power supply in the grid

**CONTINUITY**
- uncertainty related to the unpredictable capability of RES may have an impact on the grid stability and therefore on the CoS

**QUALITY OF SUPPLY**
- introducing new technology and connecting to lower short circuit networks may result in higher harmonic emissions, voltage fluctuations & resonances
- reactive power capability is also critical in order to guarantee acceptable voltage levels

**RELIABLE & SECURE SUPPLY**
- disconnection of large amounts of RES may impact the overall stability of the grid
- available spinning reserve is needed to ensure a secure operation

- grid codes in some EU countries have changed dramatically → now require not only that PV and WPP stay connected during grid disturbances, but also that they be able to support system operation in a responsive way
- new requirements were introduced progressively, first for installations connected at the HV level, then at the MV level
- some of these requirements are now being extended to the LV grid
With higher integration requirements on DGs become more demanding

1. Active power reduction in case of over-frequency (LV & MV)

- In the past, PV systems were required to disconnect from the grid when frequency exceeded a defined range.
- The sudden disconnection of a large PV power generation would have had a negative impact on the system stability.
- In Germany, Italy, Spain, and Belgium, grid codes have been recently revised to require PV systems of all sizes to progressively reduce their power output as frequency increases.
- Other countries must urgently integrate this requirement in their grid code to avoid costly retrofitting.
- Retrofitting decided in Deutschland (“Stability-act”, July 2012) → until December 2014: 400,000 PV installations / 1Mio. inverters / several GW (costs: ~100 M€)
  - ½ from network tariffs
  - ½ from the renewable fee (EEG)
  - No cost for PV owners

Evolution of the German grid code and regulations as PV deployment has increased (GW)
With higher integration requirements on DGs become more demanding

2. Fault ride-through capability - dynamic grid support for the MV grid

- fault on the system causes brief voltage drops
- if only a short voltage drop appears and generators immediately disconnect → system balance might severely be affected
- short voltage changes should be subject to “ride-through” ↔ national grid codes require PV systems (at MV level) to stay connected during the voltage disturbances and to inject reactive power during grid faults
- as a result they contribute to the resolution of the incident and help to trigger grid protection devices
- this capability has to be assessed at the LV level

Evolution of the German grid code and regulations as PV deployment has increased (GW)
With higher integration requirements on DGs become more demanding

3. Provision of reactive power and voltage support - static grid support at MV and LV level

- keeping the voltage between defined limits is becoming a primary concern of DSOs due to the increasing number of generators connected to the distribution network
- this makes the connection of additional DGs difficult or impossible without grid reinforcement
- since 2012 in Germany, PV systems bigger than 3.68 kVA have been providing static grid support by reactive power control
- control strategy depends on the size of the PV system, the voltage level and the local characteristics of the grid

Evolution of the German grid code and regulations as PV deployment has increased (GW)
Currently effective Grid Code requirements in Germany

Extensive requirements to grid supporting and stabilizing control functions:
- Reactive power (from 3.68 kW)
- Remote control, remote switching (>100 kW)
- Dynamic grid support (MV)
- Active power control - system stability
- Generation management

Grid supporting functions for LV
- Active power control
  - Active power reduction at over frequency
  - Active power injection at under frequency
- Reactive power control
  - Fixed set point or characteristic curve
  - \( \cos \varphi = f(P) \)
  - \( Q = f(U) \) (optional)
- Generation management
  - Temporary limitation of the active power at grid supply shortfalls (congestions)
  - On request of the network operator DNO

Grid supporting functions for MV
- Active power control
  - Active power reduction at over frequency
  - Active power injection at under frequency
- Reactive power control
  - Fixed set point or characteristic curve
  - \( \cos \varphi = f(P) \)
  - \( Q = f(U) \) (optional)
- Generation management
  - Temporary limitation of the active power at grid supply shortfalls (congestions)
  - On request of the network operator DNO
- Dynamic grid support
  - "Stay on characteristic curve at voltage dips"
  - Contribution to short-circuit current
### Means to increase hosting capacity of distribution system

**Network reinforcement**
- reinforcement, rearrangement or construction of new network (feeders, transformers)
- construction of new HV/MV substations for interconnection of DG only ("DG collectors")

**Short-circuit**
- usage of DG with lower fault current contribution, transformers with a higher impedance, fault current limiting reactor
- upgrade of network equipment to meet the increased fault level
- sequential switching (reduce the fault current contribution of DG)

**Voltage regulation**
- replacement of HV/MV transformers with increased tap range
- readjustment of control settings of OLTC and of MV/LV transformer fixed taps (e.g. installation of MV/LV distribution transformers equipped with OLTC)
- replacement of the feeder capacitor banks with switchable ones
- installation of reactive power sinks (i.e. reactors) on the network

**DG control**
- reactive power or power factor control (variety of ways that this may be implemented)
- active power curtailment (resolve voltage regulation and local congestion issues → economic implications)
- more effective anti-islanding protection schemes

**Other**
- modifications to allow bidirectional power flow (replacement: protection, reclosers)

**Future concepts**
- usage of SCADA software or other (smart grids infrastr.→ near real time information)
- decentralized storage and demand response (e.g. peak shaving)
- coordinated voltage control on the distribution network (HV/MV and MV/LV substations and voltage regulators on the feeder)
Connection costs

- in most countries of SEE, DGs can obtain permits to connect to the grid, but only if they meet technical requirements for grid connection and their integration does not adversely affect the system.
- to meet these criteria, an upgrade of the network is often needed, raising the question of How to finance the connection costs?:
  - cost bearing rules define which part of the costs is covered by the DG and which part by the TSO/DSO
  - cost sharing rules define how the necessary cost should be distributed between subsequently connected producers that all benefit from the same reinforcements or new lines

- payment for reinforcement of existing infrastructure seems the most controversial – there is not a straightforward methodology to determine the additional capacity needs and reinforcements costs.

- if connection is paid on the basis of actually incurred (or estimated) costs, network user might be discriminated depending on the existing infrastructure:
  - it may lead to that first connected customer pays more than those that come later using the existing whole structure of his connection → in principle customer who payed actual cost should be reimbursed if the installed structure is used to connect new customers (cost sharing – ERS example in SEE region)

- advocates of contribution based on real costs believe that it will prevent cross subsidization, provide locational signals (siting of new generators in locations that would not adversely affect overall system efficiency).
Connection costs

- no harmonized situation in the EU
  - deep connection charging is the most commonly used
  - MS with shallow charging tend to have higher DG & RES installation levels
  - transparency is low → too much emphasis on the “negotiation” between developer and DNO (critical for DGs)

- seems to be no clear answer
  - How to allocate DG grid connection cost between the parties involved in such a way that the allocation is considered as reasonable or just by all stakeholders?
  - there is no allocation mechanism that outperforms the other in every respect

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<th>Charging Method</th>
<th>Summary</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>“Shallow”</td>
<td>Generator pays only for the cost of equipment needed to make the physical connection to the grid. Costs of reinforcement are borne by DNOs.</td>
<td>• Lowest cost for DG &amp; RES • Transparency &amp; consistency • Reinforcement costs can be recovered via tariff system</td>
<td>• Poor locational signals • DNO reinforcements can add project delays</td>
</tr>
<tr>
<td>“Deep”</td>
<td>Generator pays all costs associated with its connection. Includes the cost of physical connection to the grid and any upstream grid reinforcement costs.</td>
<td>• DG &amp; RES generally don’t pay UoS charges • Provides a degree of locational signal</td>
<td>• Cost uncertainty, often prohibitively high for DG/RES • Significant DNO power • One generator can pay for reinforcements caused by others</td>
</tr>
<tr>
<td>“Mixed”</td>
<td>Generator pays for the physical connection to the grid, plus a proportion of any upstream grid reinforcement costs based on its proportional use of new grid assets</td>
<td>• Reinforcement costs paid by generator relate to his use of the new connection assets • Provides some locational signals to generators</td>
<td>• Clear rules needed to determine proportional costs • Reliant on DNO to perform upstream reinforcements • Costs can still be high for DG</td>
</tr>
<tr>
<td>“True”</td>
<td>Generator pays a cost equivalent to the cost of connecting to the nearest point on the grid with sufficient capacity to accommodate the generator without reinforcement</td>
<td>• Provides some locational signals to generators</td>
<td>• Connection costs potentially very high (especially for remote wind farms, etc)</td>
</tr>
</tbody>
</table>

Connection costs

strong leadership is needed from policy makers to develop the right frameworks to create a truly non-discriminatory, objective and transparent terms, conditions and tariffs for connecting new producers of electricity

RES Directive

DSOs shall set up and make public standard rules relating to bearing and sharing of costs of technical adaptations (such as grid connections and grid reinforcements) which are necessary to integrate RES producers into grid.

DSOs are required to provide RES producers wishing to be connected with information on:
- grid connection cost estimates
- timetables for processing requests
- an indicative timetable for grid connection

Policy requirements

increased consistency and transparency in relation to DG & RES connection charging (using best practice templates)

reduce reliance on bilateral “negotiation” between developers and DSO to determine connection charges

clear and published connection cost calculation procedures and charges based on a fair evaluation methods & with defined timescales

DG & RES developers should be given the right to access the technical parameters of DSOs' networks in order to facilitate the optimal placement of new generation plant

the DG or RES should make a (percentage) financial contribution to reinforcement costs (e.g. Apportionment Rules in the UK) limited to those costs at the voltage level at which the generator is connected proportion of reinforcement costs not paid for by the generator should be the responsibility of the DSO – cost sharing methodology

very small generators - shallow charging shall always apply
in the observed SEE region “deep” approach prevails causing investors doubts that the connection charges are high

“deep” approach cannot be characterized as the worst possible choice, however → in the absence of transparency, a “deep” charging method may provide more incentives and scope for discrimination than a shallow charging approach

### Costs for connection

<table>
<thead>
<tr>
<th>DSO</th>
<th>Who pays</th>
<th>Classification</th>
<th>Unit costs</th>
<th>Contracts</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDB</td>
<td>Investor</td>
<td>Deep</td>
<td>No (Investor pays specifically for the costs incurred for the particular connection)</td>
<td>2</td>
</tr>
<tr>
<td>EPB</td>
<td>H</td>
<td>Investor/DSO (network usage fee) micro-RES 2-230kW pay only for equipping metering point with metering equipment</td>
<td>Other (deep)</td>
<td>Yes (HV 71,6 €/kW; LV 99,7 €/kW), but if actual connection costs exceed double the value of connection fee (i.e. unit costs multiplied by rated power capacity), then investor pays actual connection costs.</td>
</tr>
<tr>
<td>EPHZH</td>
<td>B</td>
<td>Investor/DSO (network usage fee) micro-RES 2-230kW pay only for equipping metering point with metering equipment</td>
<td>Other (deep)</td>
<td>Yes (HV 70 €/kW; LV 100 €/kW), but if actual connection costs exceed double the value of connection fee (i.e. unit costs multiplied by rated power capacity), then investor pays actual connection costs.</td>
</tr>
<tr>
<td>EPS</td>
<td>Investor</td>
<td>Other (according to the methodology “shallow”)</td>
<td>No (case-by-case)</td>
<td>2</td>
</tr>
<tr>
<td>ERS</td>
<td>Investor</td>
<td>Deep</td>
<td>No (Investor pays specifically for the costs incurred for the particular connection)</td>
<td>2</td>
</tr>
</tbody>
</table>

Pursuant to the Methodology - „shallow” scheme. Based on the EPS response to the study questionnaire, costs are determined on a case-by-case basis and can differ considerably.
Connection Charging Methodology is in the drafting process
System operators shall develop connection charging methodologies: Distribution Charging Principles, issued by ERO in 2012 stipulate: Distribution applicants for the connection of new generation, or increases in the connection capacity for existing generation, should pay shallow connection charges set so as to recover the direct costs of the provision of the connection to the nearest suitable point on the distribution system, including any metering and step-up transformers necessary to enable the connection but should not include the cost of any reinforcement of the system that may result from the connection upstream of the point of connection.

<table>
<thead>
<tr>
<th>DSO</th>
<th>Who pays</th>
<th>Classification</th>
<th>Unit costs</th>
<th>Contracts</th>
</tr>
</thead>
</table>
| EVNM       | Investor/DSO (network usage fee)  
Connection fee does not take into account needed reinforcements, but if there is a need to reinforce network then it pays for capacity | Shallow Deep | No (case-by-case) | 1         |
| HEP        | Investor                      | Deep           | No (investor pays specifically for the costs incurred for the particular connection) | LV 2  
MV 5         |
| KEDS       | Investor                      | Shallow**      | No ** (DSO shall develop connection charging methodology) | 1         |
| OSHEE      | Investor                      | Deep (according to 2012 ERE nr. 22 regulation of new connections) | No (case-by-case; individually calculated) | 1         |

Network Code → deep
Energy Law allows the regulator to oblige the competent operator to cover the connection costs of preferential generators and recover the costs incurred as part of the regulated services price when needed to provide incentives to promote RES or when necessary to attain the targets set out in the Government's Renewable Energy Strategy. → shallow
Connection costs

Consider “shallow” approach for the charging regime related to connection to the grids

- the cost for connection to the grids is an important part of the overall investment decision an investor in renewable energy has to take into consideration
- transparency towards applicants has to be ensured and the rules for connecting to the power grid have to be based on objective and non-discriminatory criteria
- in order to make sure producers can generate electricity where renewable resources are available, producers should be charge with the cost of connection to the nearest point in the public electricity network only (“shallow” connection cost) and not with the costs for reinforcement or expansion of the networks (“deep” connection costs)
- the T/DSO are the appropriate undertakings to create an optimal infrastructure by investing in grids reinforcement or expansion of the grids and socialize the cost for the ownership and maintenance of the network assets with all network users through regulated network tariffs

If SHALLOW charging philosophy is applied two issues that must be considered

- the method of recovery of reinforcement costs
- the need for locational signals to discourage the siting of new generators in locations that would adversely affect overall system efficiency
Connection costs – cost sharing principle in SEE

Rulebook defining the method, terms and conditions and procedure for connection to the distribution network of generation facilities which use RES and efficient co-generation (2014)

Annex 3 - criteria for allocation of costs of technical reinforcement and improvement in the network between producers

- cost sharing model among producers for:
  - connection line
  - feeder bay
  - increase of existing distribution network hosting capacity

- apportionment of costs to develop a new connection line shared among multiple producers is based on:
  - installed capacity \( S_i \)
  - length of the connection section (segments) which is used by each producer \( l_j \)
new producer that interconnects to the existing distribution line bears part of the total costs of the connection line $l_v$.

- section of connection line used by the new producer is divided into segments whose number ($s$) is determined based on the number of producers ($p$) connected ahead of point of connection of the new producer: $s = p + 1$

section of connection line used by the new producer is divided into two segments: $l_1$ and $l_2$ since there is one producer already connected ahead point of connection of the new producer.
Connection costs – cost sharing principle in SEE

- new producer that connects to the existing distribution line bears part of the total costs of the connection line
- costs of the connection line:
  - $C_1$ costs component related to overall building setup of connection line not dependent on the rated capacity of the line
  - $C_2$ costs component dependent on rated capacity of the line

\[
T_n = \sum_{j=1}^{s} T_j = \sum_{j=1}^{s} [T_{gj} + T_{ej}] = \sum_{j=1}^{s} \left[ \frac{C_1}{(N + 1) - j} \cdot \frac{l_j}{l_v} + C_2 \cdot \frac{l_j}{l_v} \cdot \frac{S_n}{\sum_{i=j}^{N} S_i} \right]
\]

- new producer participates only in costs of 1st and 2nd line segment
- costs component related to building setup of 1st line is divided equally among all producers → new producer bears 1/3 of these costs
- costs component of 1st line segment which is dependent on rated capacity is divided among all producers based on their share in sum apparent power of all producers
Connection costs – cost sharing principle in SEE

monetary compensation to other (previous) producers:
costs of the connection line that are be borne by new producer
are used to offset costs borne by existing producers – 1\textsuperscript{st} and 3\textsuperscript{rd}

\[ T_2 = O_1 + O_3 \]

\[ O_1 = \frac{T_{g1}}{2} + T_{e1} \times \frac{S_1}{S_1 + S_3} \]
reimbursement to 1\textsuperscript{st} producer – just for 1\textsuperscript{st} line segment

\[ O_3 = \frac{T_{g1}}{2} + T_{e1} \times \frac{S_3}{S_1 + S_3} + T_{g2} + T_{e2} \]
reimbursement to 3\textsuperscript{rd} producer – for 1\textsuperscript{st} & 2\textsuperscript{nd} line segment

\[ O_i = \sum_{j=1}^{i} O_{ij} = \sum_{j=1}^{i} \left[ \frac{T_{xj}}{N-j} + T_{ej} \frac{S_j}{\sum_{k=j}^{N} S_k} \right] ; \quad i = 1,...,N ; \quad i \neq n \]

- \( T_{g1} \) component of 1\textsuperscript{st} line segment (borne by new producer) is equally reimbursed to 1\textsuperscript{st} and 3\textsuperscript{rd} producer
- \( T_{e1} \) component of 1\textsuperscript{st} line segment (borne by new producer) is reimbursed to 1\textsuperscript{st} and 3\textsuperscript{rd} producer based on their share in sum apparent power of these producers
- 2\textsuperscript{nd} line segments costs (borne by new producer) are reimbursed only to 3\textsuperscript{rd} producer
Connection costs – cost sharing principle in SEE

Costs of feeder bay shared among several producers is linearly distributed on producers:

\[ C_n = \frac{C_u}{N} \]

- \( C_u \) are total feeder bay costs
- \( C_n \) is the part of feeder bay costs covered by \( n^{th} \) producer

Monetary compensation from new \((n^{th})\) to each other producer:

\[ C_{ob} = \frac{C_n}{N-1} \]

- \( N=3 \)
- \( n=2 \)

\( C_2 = \frac{C_u}{3} \) contribution of new producer to feeder bay costs (each producer participates on a equal basis)

\[ C_{ob1} = C_{ob2} = \frac{C_2}{2} \] reimbursement to 1\(^{st}\) producer reimbursement to 3\(^{rd}\) producer

- component of feeder bay costs which is borne by new producer \((C_2)\) is equally divided on other 2 other producers
Connection costs – cost sharing principle in SEE

Cost for increasing existing distribution network hosting capacity
distributed among producers based on producer share in total installed capacity of all producers

- $M_n$ is new producer share in total costs
- $M_u$ is total cost related to increasing existing distribution network hosting capacity

Monetary compensation from a new ("n") to other producers ("i"): 

$$M_n = M_u \cdot \frac{S_N}{\sum_{i=1}^{N} S_i}$$

$$M_{ob1} = M_2 \cdot \frac{S_1}{S_1 + S_3}$$

reimbursement to 1st producer

$$M_{ob2} = M_2 \cdot \frac{S_3}{S_1 + S_3}$$

reimbursement to 3rd producer

- part of total cost for increasing existing distribution network hosting capacity which is borne by new producer ($M_2$) is divided among all other producers based on their share in sum apparent power of other producers
Connection costs – cost sharing principle in SEE

ERS - DSO is obliged by the Rulebook (2014) to assure proper implementation of previously described cost sharing model

EVNM - Cost sharing rules governing how costs should be distributed between subsequently connected producers that benefit from the same reinforcements and new connection facilities are defined in the Distribution Network Code

KEDS – according to NREAP 2011-2020 (2013)
New Connection Charging Methodology (being drafted) shall establish that the subsequently connected generators will share the cost of connection with the initially connected generators, proportional to the installed capacity
Clear and transparent connection procedure is a must
Flowchart with standards, deadlines...

- the Energy Networks Association, in conjunction with DSOs, has produced a series of Connection Guides to assist with connection of generation to the network.
- there are three separate Distributed Generation Connection Guides
- the flowchart guides investors to the most relevant Connection Guide for the Distributed Generation investor is planning to install

http://www.spenergynetworks.co.uk/pages/understanding_the_connection_process.asp
encourages discussion & undertakes regular engagement with stakeholders by holding forums

http://www.spenergynetworks.co.uk/userfiles/file/ICEDG.pdf

- **DG Work Programme** shows the actions DSO is already taking, or intend to take, to improve:
  - **Application Process**
    application process is as simple as possible whilst still providing DSO with all necessary information
  - **Information Provision**
    clear and concise information and data that allows customers to undertake their own assessment of their connection needs before seeking a formal connection offer
  - **Communication**
    communicate with customers in the manner in which they seek, within acceptable timeframes and with the quality
  - **Choice**
    DSO wants to ensure that investor makes the right choice when making a new connection (contestable works)
  - **Enablers to Connection**
    DSO wants to remove, where possible, all perceived barriers to connection and does so by listening to customers feedback and seeking resolution
  - **Distribution / Transmission Interface**
    DSO wants to work with customers to ensure they understand the transmission constraints DSO operates under
  - **Communities**
    DSO recognizes community projects and provides assistance for communities who want to get a connection

WG 3. deliverable DG Study
DG Work Programme shows the actions DSO is already taking, or intend to take, to improve the connections process for DGs:

- **Application Process**
  
  - DSO will meet with DG investor within 5 working days of a request to discuss pre-application or application
  - DG will be assigned with a named local contact within 1 working day of application being received
  - review the minimum information DSO requests for the initial connection application
  - DSO will publish clear guidelines on our requirements for the size of generation connection being sought
  - provide a facility that allows DG to submit connection application online (on-screen ‘hint’ text to support DG through the process; able to upload supporting documents to assist DSO in processing application i.e. photos, drawings, site development plans etc.)
  - automatic email acknowledging submitted application
  - provide additional support to ‘first-time’ customers (‘buddy’ system)
Streamlining and simplification of procedures & Transparency
installation and commissioning of small DGs

- inform publically all potential investors on the available hosting capacity of the networks enable applicants to self-screen projects, e.g.:
  - France (erdf) - [http://capareseau.fr/](http://capareseau.fr/)
  - Canada (Hydro One) - [http://www.hydroone.com/Generators/Pages/StationCapacityCalculator.aspx](http://www.hydroone.com/Generators/Pages/StationCapacityCalculator.aspx)
  - UK (Electricity Northwest) - [http://www.enwl.co.uk/](http://www.enwl.co.uk/)

- introduction of fast track technical screens to accommodate small generators interconnections certain work in SEE DSO already can be observed, e.g.:
  - 30kW limit in HEP
  - 23kW limit in EPHZHB and EPBiH
  - 50kW limit in EPS and ERS

SEE DSO shall benefit from best practices and lessons learned through this project from the U.S. → simplified screening criteria used in U.S. DSOs consider [IEEE 1547.7-2013](https://ieeexplore.ieee.org/document/6737638) → provides good practices for engineering studies of the potential impacts of a DR interconnected to the distribution system (criteria, scope, and extent for those engineering studies are given as functions of identifiable characteristics of the DR, the EPS, and the interconnection)

- increased efficiency in the application process for very small, certified inverter-based systems that pose a low likelihood of adverse system impacts of the sort that require extensive study
Conclusions and recommendations for improvements

**OSHEE (Albania)**

- Distribution network old (average 38 yrs.); high losses in the grid (43.5% in 2012)
- Insufficient metering, unpaid bills and illegal connections have dramatically increased electricity consumption and peak demand → weakening the system and leading to underinvestment in much-needed network capacities
- Load shedding, black-outs and curtailments (loads, RES) are common across the country → grid investments are needed
- Albanian Government is developing an off-take contract for small HPPs based on “take-or-pay” principle → guarantee the small PP that in case of their curtailment by the network operator without a technical reason they will be compensated for the reduced output
- REL (2013) obliges DSO to connect with priority all RES to the closest point in the grid satisfying technical requirements ← methodology for grid connection & standard connection agreement has not yet been adopted by ERE (due to the postponement of the entry into force of REL)
- TSO/DSO have to increase transparency regarding connection and access to the grids
- NEAP has not been adopted; REL (2013) application put on hold; secondary legislation is still missing
- Introduce feed-in tariffs for other technologies besides hydro
- Feed-in tariff changes every year; the formula of the selling price not a long term decision
- Shall define entity for managing RES imbalances
Conclusions and recommendations for improvements

EPHZHB, EPBiH (Federation entity, BiH)

- limited information and no guidelines (brochures) on the web site → DSO have to increase transparency regarding interconnection and access to the grids
- there is a lack of information for investors when it comes to the legal framework that regulates the field of renewable energy
- Distribution Code is old (2008) → contains only limited number of provisions related to producers; no special provisions regarding RES
- the “renewable energy operator” did not adopt standard PPA for privileged and qualified producers (as proposed in REL) (at least it is not publically available on the web site)
- renewable energy operator shall establish a methodology for allocating costs of balancing to the privileged and qualified producers and the also share of costs of balancing that will be covered by incentive fees collected from final customers
- REL (2013) envisages all RES to enjoy priority in processing request for connection to the distribution network in the Federation of BiH; however, the Rulebook on methodology for setting the cost, terms and conditions of connection to the distribution network (2014) did not develop the "priority in processing" principle for RES
Conclusions and recommendations for improvements

ERS (Republic of Srpska, BiH)

- the first in the observed region that introduced net-metering (REL, 2013)
  i.e. netting of electrical energy fed to and consumed from the distribution network (in 2015 introduced in Croatia)
  responsible Ministry informed about administrative barriers that prevent implementation - Indirect Taxation Authority provided obligatory opinion by which netting is prohibited → invoices should be issued both for consumption and delivered generation
  although first customers are registered by regulator there are issues (i.e. taxation, standards contracts) which must be resolved before the system becomes fully applicable

- in comparison to the rest of DSOs in the region ERS web site contains rather comprehensive publically available practical guidelines on the connection procedure and standard contracts

- by adoption in 2014 of Rulebook defining the method, terms and conditions and procedure for connection to the distribution network of generation facilities, it could be considered that ERS advanced the most with regard of legal framework related to technical criteria and connection requirements for DG → it could serve as exemplar

- only RES & efficient co-generation producers under feed-in tariff are entitled to priority access; all other RES and efficient co-generation producers, even those entitled to premium for electricity sold at the electricity market, are not entitled to priority access ← not in line with RES Directive

- separate legal company shall be established acting as a renewable energy operator

- simplified procedure for small DGs shall be developed (i.e. below 50 kW)

- cost sharing model for producers is used
Conclusions and recommendations for improvements

**HEP (Croatia)**

- shall improve market functioning (model) and the calculation of balancing costs caused by eligible producers and accordingly imbalance charges for eligible producers in the incentives system
- after the expiration of the incentive period all privileged producers shall sell on the wholesale market i.e. become market participant or conclude contract with some supplier/trader on the market producers below 1 MW - no licence for electricity production is required for them which is prerequisite for obtaining market participant status
- they shall find market participant willing to conclude a PPA with them otherwise they shall be disconnected from the network by system operator
- it might be more convenient to appoint some supplier which shall have obligation to conclude (under certain conditions) PPA with small privileged producers whose production is not incentivized and which are not obliged to issue licence for electricity production (i.e. producers below 1 MW) → otherwise, DSO might be exposed to inconveniences related to the disconnecting such producers (including RES) from the network until they sign PPA,
- new Distribution Code is being drafted – current Distribution Code (2006) is deficient in addressing DGs and RES and efficient cogeneration
- in Distribution Code (2006) and General Conditions for grid Usage and Electricity Supply (2015) there are no explicit provisions providing for RES priority dispatching
- simplified procedure for small DGs shall be developed (i.e. under 30 kW) (i.e. fast tracking & screening criteria in the connection procedure)
Conclusions and recommendations for improvements

KEDS (Kosovo)

- DSO may refuse to connect an applicant temporarily or permanently; this study suggests to introduce variable network access contracts (flexibility optional/obligation) i.e. optimization of network capacity via improved consideration of DGs such as applied in Germany or UK
- Sample PPA shall be drafted by the Public Supplier (approved from ERO) in order to increase security for RES investors according to the current scheme, PPAs are signed only after the construction of RES plants, at the time of their commissioning, which makes project funding difficult
- No simplified procedures are applied (either planned) for small scale DGs (e.g. solar panels in buildings) → simplified procedure for smaller units (fast tracking & screening criteria - USA)
Conclusions and recommendations for improvements

EVNM (Macedonia)

- NEAP has not been adopted; the 3rd energy package partial adopted
- recent amendments to the Law on Urban and Spatial Planning and to the Law on Construction improved administrative procedures:
  - (for small HPP) shortened and facilitated the procedure for adoption of the urban plans (one of the most complicated and time consuming procedure)
  - possibility for applying for construction permit before the land titles issues are resolved
  - application for connection to the grid can be initiated prior to obtaining the construction permit (shortening the procedure)
- considerable efforts have recently been made for introduction of more efficient and transparent grid connection procedure primarily through amendments in Distribution Code (3x in 2014) → further work on making more transparent connection procedure and charging has to continue
- cost sharing model for producers (Distribution Code)
- simplified connection procedure for small DGs shall be developed
Conclusions and recommendations for improvements

EPS (Serbia)

- distribution network old (average 33 yrs.)
- in the forthcoming period the regulatory framework shall be defined with an aim to achieve maximum simplification of administrative and technical procedures for installation and commissioning of small RES-based plants having installed power below 50 kW
- in comparison to the rest of DSOs in the region EPS web site (e.g. [http://www.elektrovojvodina.rs/sl/korisnicki_servis/Uputstvo-za-priklucenje-elektrane-na-distributivni-sistem-elektricne-energije](http://www.elektrovojvodina.rs/sl/korisnicki_servis/Uputstvo-za-priklucenje-elektrane-na-distributivni-sistem-elektricne-energije)) there are comprehensive guidelines, request forms and information related to the interconnection of DG to distribution network
- new model of PPA for RES shall be adopted allowing investors greater certainty for investment in RES
THANK YOU FOR YOUR ATTENTION

ANY QUESTIONS, COMMENTS, REMARKS?