Connecting Renewable Energy to the Grid

Regulatory Issues and Connection Charges

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Abbreviations and Terminology

CMU	Cabinet of Ministers of Ukraine
DNO	Distribution Network Operator
DUoS	Distribution-Use-of-System Charge
LoI	Letter of Intent
LRMC	Long-Run Marginal Cost
MFE	Ministry of Fuel and Energy
MoU	Memorandum of Understanding
NERC	National Electricity Regulatory Commission of Ukraine
NPV	Net present Value
SHP	Small hydropower plant
SRMC	Short-Run Marginal Costs
RE	Renewable Energy
RES-E	Renewable Energy System for Electricity Generation
SHP	Small Hydropower Plant
SRMC	Short-Run Marginal Cost
TOOR	Transfer of Operating Rights
TSO	Transmission System Operator
TUoS	Transmission-Use-of-System Charge
WEM	Wholesale Electricity Market

Technical terms

distributed generation	same as embedded
embedded generation	generators, e.g. RES-E, connected to a distribution grid.

Ukrainian institutions

Derzhenergonaglad	State Energy Inspection
Energomarket	State enterprise, wholesale buyer/seller
Oblenergo:	Regional Electricity Distribution Company
Oblispolkom	Regional administration body
NEC Ukrenergo	National Transmission Company and System Operator

1. CONNECTION CHARGES: PRINCIPLES AND PRACTICE

1.1 TYPOLOGY OF CONNECTION CHARGES

The main difference in international practice for the financing of connection costs is between "shallow" and "deep" connection charges. Each modality has its variants as shown in the table below.

Table 1: Investments Costs included in the Connection Charge

	RES-E	TSO/DSO
Shallow connection charge	**1**. The direct costs of connecting to the nearest or most practical point on the existing network + the costs of the measuring devices necessary to record the electricity transmitted and received + installation and maintenance of the control system and communication lines to the grid operator, if plant is connected to grid operator´s control system	Costs associated with grid reinforcement and system strengthening
Ultra-shallow charge	Hook-up at plant site to the line connecting the plant with the distribution grid	All line extension and grid strengthening costs
Deep connection charge	1 +**2**: capital investments for strengthening of distribution network	Marginal increase in operating costs not included in connection charge
Very deep charge	1 +2 + **3**: required strengthening of transmission grid	
Hybrid, "shallowish" charges		
"Proportional use" deep charge	1 + 2a: estimated usage share of deep connection cost within the distribution system	
Mixed charges	1 + 2b: annual use-of-system charge during operation	

A shallow connection charge charges the RES-E only for those assets which, at the time of construction, are to be used exclusively by the connectee ('single user assets'). That means the cost of connecting a RES to the closest point on the existing network: the hook-up to and the connection line to the nearest sub-station on the distribution grid. RES-E larger than 10 MW are connected to the control system; typically, their direct costs include also the communication line and controls. The control system provides real-time system information and ensures that the plant operator's instructions are implemented in such a way as to guarantee the reliability of the electric system.

The *deep connection charge* asks the RES-E operator to pay for the shallow costs plus the costs of grid reinforcement. The charge can be very deep in the event, that a modification is required to the transmission system as a consequence of the connection of the RES-E to the distribution system, then all reinforcement costs to the transmission system will be borne also by the RES-E: 11KV/LV transformer + 11 kV circuit + 33 kV transformer + 132 kV switchgear as result of excessive fault level. But more common practice is that deep connection charging stops with the costs occurred at one voltage level above the voltage level at the point of connection.

Shallowish or mixed connection charges seek a compromise between the two: the RES-E operator and the DSO share the costs of grid reinforcement. The connection charge includes the RES-E's direct connection costs and a share of the DSO's costs for reinforcements based on an assessment of its proportional use of the new infrastructure.

The *ultra-shallow connection charge* policy, where the DSO finances also the connection line up to the plant site, meaning that the RES-E operator pays only for the hook-up of the system to the connecting line, seems to be practiced only by the Ukraine.

1.2 PRINCIPLES FOR CONNECTION CHARGES

1.2.1 ECONOMIC PRINCIPLE: PROMOTE RE-POWER SUPPLY AND MINIMIZE ITS COST

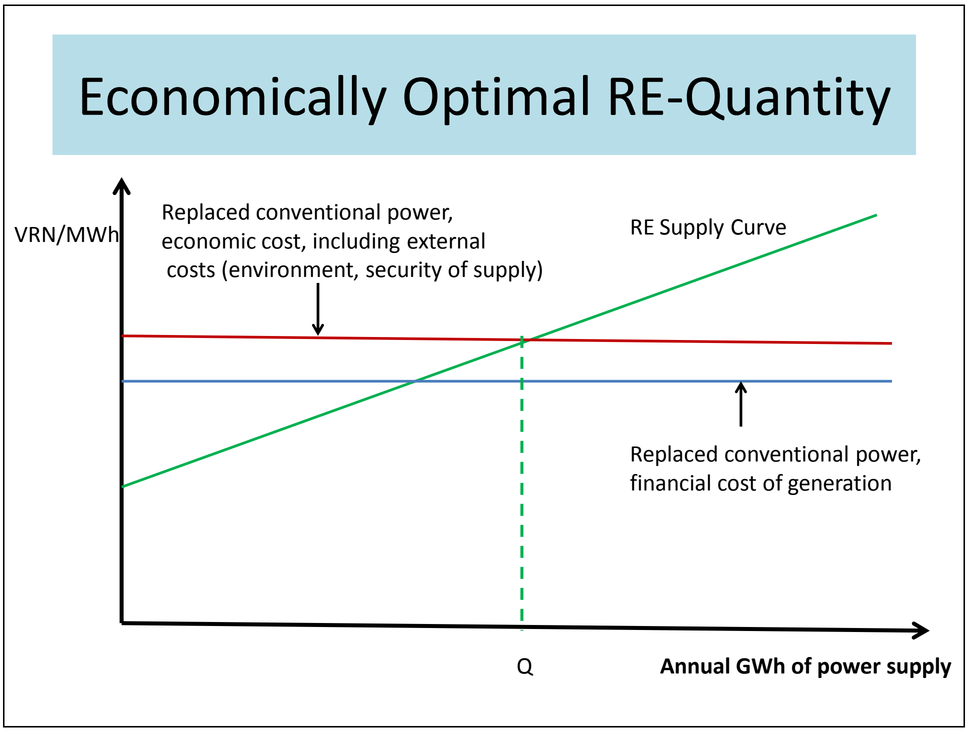
For connection charge policy, two basic economic principles apply:

(i) The connection charges must promote the *micro-economic objective of investment efficiency*; i.e., give generators and DNOs the correct pricing signals for a rational allocation of resources. Efficient charges incentivize prospective generators to make the right locational decisions.

(ii) Pricing policy should promote the *achievement of wider public policy goals*, like the quantitative goals for the penetration of RES-E in national power supply.

In the ideal world of energy-economic policy and planning, policy makers would fix RE penetration targets with reference to the economically optimal quantity of RE-power supply. The theoretical concept is simple: the optimal quantity of RE on the power market is reached at the point of penetration where the cost of additional RE-power supply equals the economic value of replaced conventional power supply including externalities.

The methodology is illustrated in the chart below. The *RE-supply curve* shows how increasing quantities of annual GWh require the phasing in of increasingly more expensive sources of supply. RE-supply replaces the conventional power that has the highest costs in the merit order. The value of replaced power is shown in two curves: one shows the *financial value,* the other the *economic value* of replaced conventional power. The point of intersection of the RE-supply curve with the economic value curve indicates the optimal supply of RE-power. The economic calculations to determine the economic optimum are relatively straightforward. Yet, RE policy goals are not in any country determined in this rational way. Instead a penetration target for a future year is fixed relatively arbitrarily to reach a compromise between opposing political views.



Nevertheless, the notion of an economical optimum remains: the incremental costs of RE-power supply on consumers and on the public budget must be kept within a politically acceptable limit. The cost limit is expressed in various ways. It can be *expressed explicitly from the start* by (i) fixing the annual subsidy amount that is allocated to RE-support, or (ii) the maximum percentage cost increase on utility bills[1], or (iii) by organising tenders for RE-power supply with an upper limit on accepted price levels for contracted RE-power. It can *be expressed implicitly during the implementation of a RE-support program* as a political reaction to the rising bill on consumers caused by high costs of RE-support in the form of (i) abrupt reductions in feed-in-tariffs for new projects or (ii) by putting a lid on the amount of new RE-capacity per year that is eligible for support.

The point is that the notion in regulatory theory of "justified and reasonable costs" applies also to the promotion of the penetration of RES-E on the power market.

Application of these economic principles to the present situation in the Ukraine leads to two observations.

1. The absence of a connection charge provides RES-E developers with no locational incentives; this makes the attainment of a specific RE-penetration target economically inefficient.
2. It is obvious from the problems developers face in getting connection applications processed by the oblenergos, that the goal of promoting investments in RES-E is not achieved either. The idea, that the reduction in the upfront investment finance will help investments in RES-E, is too simplified: it complicates the financing of investments!

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[1] In 2004, the voters of Colorado passed the renewable energy standard ballot initiative setting the requirement that Colorado's investor-owned utilities generate 10 percent of their retail sales from renewable resources by 2015. The vote mandated the entire program to be halted if it increased utility bills by more than 2 percent. The Colorado General Assembly increased the standard twice to the now-existing 30 percent by 2020; yet, still subject to the 2 percent incremental cost limit.

1.2.2 Burden-sharing principles

Fairness in burden-sharing is a key normative principle in the regulation of economic activities. The two most relevant burden-sharing principles are:

(i) The principle that beneficiary pays: The beneficiaries of investments in transmission and in distribution should bear the costs; consumers should not be saddled with costs for benefits they don't receive.

(ii) That network charges should be equitable: connection charges should not create cross-subsidies between customer groups; levies on demand connections and on embedded generators should follow the same charging policy.

1.3 CONNECTION CHARGE POLICY IN UKRAINE

1.3.1 Connection to distribution grids

Before 2008, Ukraine experimented with two different connection charges for larger load customers: a deep connection charge and an "average cost" charge. The first charge led to protests from consumers whose connection triggered the need for grid expansion and reinforcement: they failed to understand why they should pay the full cost of capacity expansion, which benefitted later consumers as well. Next, a power institute was entrusted with the task to develop a new cost calculation methodology, which estimated the "average cost" of a connection. This led to protests from the oblenergos that the calculated charge did not allow them to recuperate their costs. In 2008, the connection charge was abolished.

The no connection charge policy in the Ukraine is not in accordance with the principle of 'beneficiary pays'. Although the policy is applied both to demand customers and to generators, it leads to a cross subsidy from demand customers to RES-E, and from RES-E that optimises the location to those who do not. Because the oblenergos do not charge RES-E a distribution-use-of-system charge (DUoS), the cost of the connections must be recuperated from the general consumer tariff revenue.

If the Ukraine fixed its feed-in-tariffs on the basis of technology specific cost of generation estimates, one could claim that it was irrelevant whether the cross-subsidisation happened via the feed-in-tariff or via subsidized connection charges. But the pricing formulas used in the Ukraine are too imprecise to establish a link between the level of the feed-in-tariff and the level of the connection charge.

1.3.2 Connection to transmission grids

RES-E connecting to a transmission grid pay a deep connection charge.

Due to transmission constraints, only a limited part of the RES-E potential in the Ukraine can be implemented without significant investments in the network. The highest wind potential is concentrated in Crimea and Southern Ukraine (Odessa, Kherson and Mikolaev regions), the highest solar potential in the Crimea. Those regions are transmission constrained. In the Crimea, the constraints are caused by limited evacuation capacity. In the Southern regions, the constraints are due to the location of the existing substations.[2] In this context, the deep charge makes sense as a "second best" rationing instrument. Tenders for new RE-capacity with the winners being decided on the basis of the lowest requested feed-in-tariff would be more efficient. But to promote future investment efficiency, the deep charge must be supplemented by the identification of priority transmission investments that can lead to investments in new RE-supply at the lowest cost to the overall economy.

1.4 CONNECTION CHARGE POLICIES IN EU COUNTRIES

1.4.1 TRENDS IN CHARGING POLICIES FOR TRANSMISSION AND DISTRIBUTION GRIDS

There is no evolving international consensus practice concerning the optimal allocation of finance responsibility for the costs of connection. The *differences in national policies for connection charges* are substantial. They reflect the fact that different principles and policy considerations, each reasonable and valid, lead to different conclusions. The charging philosophy depends on the weight policy makers attach to these. Yet, a few observations can be made.

First, apart from the preferential right to a connection, RES-E generation is not given a different treatment than other generators: the same charging policy applies. The connection policies of the relevant transmission companies do not in most countries include special provisions for RES-E.

Secondly, the overall trend is for countries to apply a *shallow charge for connections to the transmission grid* and a *deep connection charge for embedded/distributed generation*:

- For distribution connections, deep connection charging is the most widely used charging mechanism. 8 out of the 'original EU-15' countries, use deep connection charging. 4 use shallow charging. The remaining 3 either use a hybrid of the deep and shallow systems or have no consistent approach to connection charging.
- For transmission connections, of the 31 countries listed in Annex, 19 use shallow charges, 9 deep charges and 3 shallowish charges.

Related to the above is a third majority trend: whereas generators connected to the *transmission system pay transmission-use-of-system (TUoS) charges* in most countries (enabling costs of deeper reinforcement to be met from general TUoS revenues), embedded generators do not pay *distribution use of system (DUoS*) charges. Transmission networks are designed and developed to accept generation connections; distribution networks are designed for demand load. Whereas the purpose of transmission is to accommodate generation and the tariff system is designed for that, generators are aliens in the distribution grids and treated accordingly in DNO tariff and charging policy. But, also in this case, there is no uniformity:

- TUoS and DUoS tariffs include either one or more of the following: fixed (€/month); capacity (€/kW) and utilization (€/kWh) charges.

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[2] Taking into account existent transmission limitations and provided assumptions, the Mercados report ..... estimates the total attainable wind potential of Ukraine at 11,000 MW, the solar energy potential at 2,500 MW, while the forecast value of small hydro power (SHP) development till 2030 is 1,140 MW of capacity with annual electricity yield of 3,750 GWh/year.

- In some countries, such as France, Germany and Italy, the transmission charge is levied, not on the generators, but on the demand customers (purchasers of the generation). In other countries, e.g. Australia, England and the Netherlands, both generation and demand pay transmission charges, with generation paying the greater portion.
- Inter alia the UK has been experimenting with DUoS charges for distributed generation.

The exclusive consumer-supply focus of DNOs is changing. Increased embedded generation will force DNOs to allocate existing network capacity between competing generation connections; future "smart grids" will be actively managed.

1.4.2 SHALLOW CONNECTION CHARGE FOR EMBEDDED GENERATION: KEY ISSUES

For *RES-E developers*, one advantage of the shallow connection charge is the reduction in their cost of investment, the other is cost transparency. To the extent that this enables more RES-E projects to be implemented, the policy goal for the penetration of RES-E on the power market is facilitated.

Under an incentive scheme of regulation, a shallow connection policy promotes *investment efficiency on the part of the DNO*. Since the cost of deep reinforcement is internalised by the DNO, DNOs have an incentive to find the most cost-effective ways of making capacity available for each generation project.

The shallow connection charge provides RES-E developers with a *location signal*. But compared with the deep connection charge, the signal is weaker. There is, therefore, a need for other signals to discourage generators siting in locations that would adversely affect system efficiency.

A shallow connection charge regime must have *fair and transparent mechanisms for the recovery of the deep costs incurred by the DNO*. In most countries, the DNOs recuperate these costs through the DUoS charge levied on their demand customer base. In countries, not practicing a national consumer tariff policy, this would raise the retail tariffs of DNOs accommodating the highest penetrations of embedded generation. To avoid the distributional consequences of local consumers paying extra-charges for the implementation of a national policy, these costs are typically covered by a system-benefit-charge levied on all consumed kWh nationwide.

In addition, after the investment phase, the connection of the RES-E increases the *DNO's costs of operation* for administration and for the maintenance of the facilities directly related to the connection. In the absence of a DUoS-charge on generators, the regulator must decide how increased operational costs are to be allocated: through the shallow charge (the NPV of calculated future costs is added to the upfront cost of investment) or through the DUoS charge on the general demand customer base.

The fact, that grid reinforcements financed by the DNO may be needed before the investment in the connection financed by the generator can take place, can lead to project delays.

1.4.3 DEEP CONNECTION CHARGE FOR EMBEDDED GENERATION: KEY ISSUES

In most countries, the deep connection charge only includes costs incurred in the system up to one voltage level above the point of connection. Some countries practice a very deep charge, including costs also further up in the transmission system that are triggered by the connection of an embedded generator.

The *economic efficiency* signals of deep connection charging are mixed:

- On the one hand, it provides a strong economic incentive to RES-E developers to produce green electricity at locations where grid connection costs will be lowest, thus lowering the economic cost for the electricity system as a whole.
- On the other hand, it provides no incentives to DNOs to plan and operate their networks in order to make capacity available to embedded generators. Invested assets paid for by the generator do not become part of the regulatory asset base of the DNO. If there is not enough capacity available to accommodate a proposed generation plant, the cost of the reinforcement works is charged to the prospective generator at no cost to the DNO. If unused capacity is available, the generator gets to use it at no charge, leaving the DNO with less capacity available to serve other network users.

The problem is that DNOs under most regulatory frameworks gain no profit from connecting embedded generation:

1. They receive no DUoS revenue from embedded generators.
2. The price control rewards efficient operation of the networks as presently configured and managed.
3. There is an incentive to build network, which will form part of the regulatory asset base, rather than to connect generation, which does not.

For energy policy, the deep connection charge poses two disadvantages. For *RE-policy* it is an issue that high connection costs hamper the rapid deployment of RES-E. For *competition policy*, the fact that high connection charges may constitute a barrier to entry into the generation market goes against the regulatory objective of facilitating competition in the generation and supply of electricity.

Furthermore, the deep connection charge is difficult to implement in a manner that satisfies the normative principle of fairness in burden-sharing.

- One reason is lack of transparency: network reinforcement costs are often uncertain. This puts the DNO in a strong bargaining position when the price is set.
- The other is that network charges should reflect the long-run cost of making network capacity available for use by generators; yet, deep connection charges tend to reflect short-run network costs. When there is sufficient network capacity available to absorb a RES-E, no deep connection charge is levied: the capacity used was paid for by other network users. Making this capacity available to the generator means that new capacity must be provided – at a cost – as and when other parties wish to connect to the same part of the network. Thus, the generator does impose costs on the network, even if they are not incurred immediately, but is not charged. If capacity is insufficient, the DNO imposes the full deep connection charge on the "first comer" who causes an immediate need for a grid reinforcement. Later-coming RES-E can piggy-bag on the investment financed by the first comer. The first-comer has the legal right to be reimbursed by a later-comer for a proportional share of the deep connection cost. Often the DNO has the regulatory obligation to charge a newcomer for his pro-rated share of the former investment, passing on the payment to the first-comer. But, this only reduces the economic disadvantage of being a first-comer, and the reimbursement regulation is difficult to apply in practice.

An alternative solution for the DNO is not to charge for the reinforcement costs upfront – but only charge a shallow connection charge upfront - and to recuperate the deep costs on an annuitized cost basis through the introduction of an *annual* *generator DUoS charge.* In this way, the DNO can recuperate its costs, while investments in RES-E are not slowed down due to problems in finding upfront finance for grid reinforcement.

Deep connection charging gives embedded generators firm access to network capacity. Under a shallow charging policy, there may be a need for DNOs to negotiate interruptible connections in locations where network constraints are an issue.

1.4.4 SHALLOWISH CONNECTION CHARGES: KEY ISSUES

The shallowish connection charge addresses the first-comer problem by *charging the deep charge on a proportional basis according to the estimated use share of the total cost* of reinforcement. The first-comer is charged for his estimated usage share of the deep assets in the long run and subsequent generators are charged their proportional share. The methodology for how to arrive at god approximations of proportional use is described in chapter 2.

Also in this case, the shallowish connection charge can be levied as a combination of a *shallow upfront connection charge* and a *DUoS charge covering the shallowish deep connection costs*.

Ideally, shallowish connection charges are set to provide both DNOs and developers of RES-E with the right pricing signals and economic incentives for optimizing their investments and operational procedures. For RES-E developers, the pricing formula strikes a compromise between the two objectives of giving locational incentives and reducing the burden on the RES-E to pay grid reinforcement costs. The formula enables the DNO to recover costs of 'deep' network reinforcements that are required; yet also give DSOs an incentive to plan and operate their networks in a way that makes capacity available to embedded generators.

1.5 REGULATION OF CONNECTION CHARGE REVENUE

Connection charge revenue for embedded generation is not regulated at present in any countries. The connection contract is considered a purely commercial transaction between two parties.

The DNO's costs of investment; which are not covered by the connection charge, become part of the regulatory asset base.

In the future, when embedded generation has become more widespread, and smart grid technology has been introduced, the notion that embedded generation is a somewhat alien part of the distribution grid customers can no longer be upheld. The logical charging policy then would be the combination of an upfront shallow connection charge and a generator DUoS charge to pay for deep connection costs on a proportional use basis. This would be accompanied by the transfer of all deep investments to the regulatory asset base. The transactions would then become subject to regulatory oversight.

2. METHODOLOGY FOR CALCULATING COST OF CONNECTION

2.1 INTRODUCTION

2.1.1 PRINCIPLES FOR COST CALCULATION

A proper *methodology for calculating the cost of a connection* is important for two political-regulatory tasks: (i) It is essential for a rational planning by an Oblenergo of its grid expansion and reinforcement and for NERC's appraisal and approval of such plans. (ii) It provides the basis for the political choice of the *charging methodology* for the cost of a connection.

The methodology for calculating the costs of a grid connection are the same for all generation technology, whether fossil-fuel based or RES-E. And whereas the former includes some generation specific cost items, the principles for calculating the cost of connection for a larger demand customer are the same.

2.1.2 FOCUS ON CONNECTING RES-E TO DISTRIBUTION GRIDS

A *transmission system* connects generators with loads. It is designed to accommodate connected generation and transport their outputs to the distribution networks and to major load customers connected at transmission level.[3]. The system is actively managed.

A distribution network, on the other hand, is designed to accommodate *load* and not *embedded generation* (generation connected directly to a distribution grid). Embedded generation poses a new challenge for a Distribution Network Operator (DNO) with regard to grid design, planning and operation. The challenge will in the medium term be accentuated by the switch to 'smart grids', which will introduce active grid management also at distribution level.

The focus of this report is, therefore, on cost drivers and benefits linked to the connection of RES-E to distribution networks. They comprise:

- Cost drivers.
  - Extension of the network to connect the generating installation with the distribution network
  - Necessary reinforcement of the existing network
  - Administrative and other costs to prepare and implement connection
  - The net present value of future increments in DNO operating costs
  - Necessary reinforcement of the transmission network (not relevant for small scale RE-generation)
- Cost saving benefits.
  - reduced network losses
  - stabilization of voltage levels particularly in rural areas
  - 'negative load' from embedded generation with an output smaller than existing load may allow the postponement of otherwise required grid reinforcement
  - electrical characteristics such as fault contribution

[3] Technical literature distinguishes between *transmission*: voltages from 230 kW and upwards; *sub-transmission*: voltages in the 66 to 132 kV range for distributing energy within a district and *distribution*: voltages from 34 kV and below for carrying energy from local sub-stations to individual consumers.

2.2 RELEVANT EU DIRECTIVES

2.2.1 LEVEL OF HARMONIZATION

The methodologies of cost calculations in member countries are not harmonized. No EU primary or secondary legislation offers comprehensive guidelines on calculation of costs. However, "Directive 2009/28/EC on the promotion and use of energy from renewable sources and subsequently repealing Directives 2001/77/EC and 2003/30/EC", Art. 16 offers indications on how to charge for connection costs:

- *Transmission System Operators (TSOs) and Distribution Network Operators (DNOs) must set up and publish rules on costs of connection of RES generation* "…to set up and make public their standard rules relating to the bearing of the costs of technical adoptions, such as grid connections and grid reinforcements, improved operation of the grid and rules on the non-discriminatory implementation of the grid codes, which are necessary in order to integrate new producers feeding electricity produced from renewable energy sources into the interconnected grid."
- *These rules must take into account both costs and benefits to the system of connection, including benefits for previously and subsequently connected generation.* "Those rules shall be based on objective, transparent and non-discriminatory criteria taking particular account of all the costs and benefits associated with those producers to the grid……."
  "…..taking into account the benefits which initially and subsequently connected producers as well as transmission system operators and distribution system operators derive from the connections"
- *Rules must be reviewed every second year by the public authorities*
  "Member states every second year – starting in 2011 – review the rules on "bearing and sharing of costs".

2.2.2 REGULATION OF DISTRIBUTION NETWORK REINFORCEMENT AND EXPANSION

Distribution network reinforcement and expansion are rarely subject to regulatory approval (as opposed to transmission). In several countries, there is, therefore, no uniformity in how different DNOs calculate costs of connection to the network. Each DNO might employ its own methodology. Some countries have requirements for notification to the regulatory authority of the methodology for charging and of the actual charges being employed, but this does not necessarily imply any coherent methodology of cost calculation.

2.2.3 TECHNICAL CODES

For any planned generating installation, the requirements of *technical codes* of connecting embedded generation to the network must be complied with. The technical codes are to an increasing degree becoming harmonized among the EU countries. The technical codes and requirements for connection to the network are addressed in ACER (Agency for the Cooperation of Energy Regulators) draft "Framework Guidelines on Electricity Grid Connections". After finalization, these guidelines are implemented in the form of "network codes" by the TSO-cooperation ENTSO-E. Each DNO must then publish their implementation of the network connection rules.

2.3 RECOMMENDED COST CALCULATION METHODOLOGY

2.3.1 TRANSPARENCY FAVORS APPLICATION OF 'SIMPLE' COST CALCULATION MODEL

Use of advanced mathematical models to calculate the cost of a connection 'up to the second decimal point' is not the way to go.[4] All EU-countries (and the vast majority of countries in the world) practice a charging policy under which generators pay for all or part of the costs imposed by their connection to a distribution grid. To ease the conclusion of the connection contract between a DNO and a RE-E, emphasis in the cost calculation methodology is on transparency.

Some EU countries require the DNOs and TNOs to publish their methodology for calculating the costs of connections, others do'nt, despite the fact that consultant reports drawing comparisons between international practices are unanimous in recommending such publication for reasons of increased transparency.

2.3.2 COST CALCULATION – A TWO-STEP METHODOLOGY

For the cost calculation of a connection, a two-step methodology is used.

First, one calculates in a systematic way all the costs for a DNO that are triggered by the connection of RES-E.

Next, by objective procedure, one determines which of the total costs can be reasonably attributed to the specific RES-E investment, taking into account the benefits that load consumers and future new embedded generation get from the total investment.

2.3.3 STEP 1: CALCULATE TOTAL COSTS TRIGGERED BY A CONNECTION

The connection to the public electricity network of any installation generating electricity has various impacts and thus costs to the network and the system. Cost impacts can be grouped in the following categories:

1. *Extension* of the network to connect the generating installation with the distribution network.
    - The connection line/equipment from the generating installation to the point of connection to the distribution network
    - RES-E larger than 10 MW are normally connected to the control system; their direct costs include also the communication line and controls
    - The costs of acquiring of land rights necessary for the connection
    - The costs of securing wayleaves/easements for plant, cables or lines including any consents
2. Necessary *reinforcement* of the existing network:
    - Installation of switchgear at a substation some distance from the new generation installation, needed due to increase in fault level caused by the connection. The possible need for replacement of switchgear is

[4] About two years ago NERC dropped the application of a complicated methodology prescribing an algorithm for calculating the average cost of connecting major consumers; which calculated all the costs for reinforcement. The methodology turned out to be blackbox – it was too difficult to understand by the DSOs and the connected parties. It also did not generate sufficient revenue to cover the DSOs' costs for reinforcement.

due to increase in fault level, which depends on the capacity of the new generating installation.

  - Installation of reactors or static VAR compensators, needed due to possible voltage increase if the generator runs during times of low load.
  - Capital costs of building a new substation, if the maximum of how much generation can be connected to a substation is reached. If the maximum is exceeded it will give rise to potential voltage level problems.
  - The costs of securing suitable substation sites including any necessary land rights.
  - Increasing the network capacity of existing connection lines and of the distribution network.[5] If the generation's output off-sets capacity demands coming from expected load increases, these costs are negative, that is cost savings are incurred.
  - Necessary costs of reconfiguring the distribution system.

3. Various *administrative and other costs*, such as
   - Connection application
   - Assessment and design
   - Design approval
   - The costs of public enquiries and environmental impact studies
   - Costs associated with the work on Sites of Special Scientific Interest (historical investigations), railway lines etc; and
   - Determining or providing information on point of connection
     - System / feasibility / fault level studies
     - Provision of wayleaves (rights of use of land)
     - Additional meetings with the DNO or site visits
     - Administration
     - Substation locks and notices
4. The *future incremental operating costs* imposed by the connection on the DNO such as:
   - Balancing costs – especially in the case intermittent generation
   - Costs of other system services to accommodate the capacity/energy of the RES-E generation
   - Cost savings, in some technical literature referred to as negative costs, from embedded generation benefits to the grid system in the form of reduced network losses.
   - Cost savings from embedded generation benefits to the grid system in the form of stabilization of voltage levels.

[5] The impact on networks one or two voltage levels above are normally taken into account; whereas it is a widely held view that networks at voltage levels below that of the connection are not influenced.

- In addition to "necessary costs", the owner of the generation installation may ask for additional services giving rise to additional operational costs.
- Cost of maintenance of distribution assets exclusively used by the specific RES-E and of administration.

5. Necessary *reinforcement* of the *transmission network*:
   - Connection of larger generating installations, which might have impact on transmission level investments might be analysed by the TSO. Cost of such planning work.
   - Necessary investments by TSO.

The cost items under points 1 & 3 & 4 (last two items only) are the socalled "shallow costs" of connection: the direct costs of connecting a RES-E to the nearest, technically convenient point on the grid. The calculation of these is straightforward. Cost items 2, 4 (first four items) & 5 make up the "deep costs" of connection: the costs of grid reinforcement and operation. The estimate of these is a more tricky issue because the calculation must take into account also the *generation related benefits to the network* (cost savings) and not just the *generation-related costs*. In addition, the first-comer problem must be solved: that the marginal connection causes the immediate need for reinforcements which provide capacity to accommodate aloes later-comers.

2.3.4 STEP 2: IDENTIFY THE SPECIFIC COSTS ATTRIBUTABLE TO A NEW CONNECTION

The first step for cost allocation is to distinguish between three cost drivers:

1. The *DNO's "minimum scheme*": the capital cost elements of connecting the specific (generating) installation using the technically feasible solution with lowest overall costs.
2. The *DNO's "enhanced scheme*": technical solutions with higher capital costs than the least cost solution in the short run are chosen, due to their benefits in the long run for the overall network- operation and system planning for future connections.
3. *Changes/additions to the minimum scheme required by the applicant*, that impose investments on top of the minimum or least cost scheme; for example another point of connection and specific services.

The *incremental cost of the enhanced scheme* compared to the *minimum scheme* is excluded from the calculation of the connection costs.

The second step is to distinguish between the short terms marginal costs and the long-term marginal costs imposed by the connection. All countries apply a pragmatic approach to *the 'first mover disadvantage'*: that the capacity expansion required by a connection will benefit later embedded generators also. The *short run marginal costs (SRMC)* imposed by the first connection are larger than the *long-run marginal costs (LRMC)* imposed by the generator. The *LRMC* are equal to the *average capacity use* of the generator.

A proper conversion of the SRMC of a new RES-E connection into LRMC requires as reference a medium-term grid expansion plan. As a minimum that plan must estimate the development of connected load and generation in the various "cells" of the network of that DNO, including subsequent connections to the feeding circuit of expected future RES-E. Such estimations will never prove "true", but provide a realistic "second best" estimate.

2.3.5 FUTURE COSTS OF OPERATION AND MAINTENANCE IMPOSED BY A NEW CONNECTION

Part of the connection costs (and benefits) are upfront investment costs (including the upfront administrative costs); the others are costs (and benefits) during operation. In most countries, DNOs do not invoice embedded generation an annual/monthly use-of-system charge as they do for load consumers. Instead, they invoice the total cost of the connection upfront, by adding the *present value of the operational costs* to the upfront investment costs.

2.3.6 'NEGATIVE LOAD' FROM GENERATION CAPACITY LOWER THAN EXISTING LOAD

Generation capacity connected at distribution level makes use of network capacity; which is the major component of the total cost of connecting a generator. But it also *relieves the requirements for network capacity to cover demand load* as long as the generation capacity is lower than the load. The 'negative load' from embedded generation with an output smaller than existing load may allow the postponement of otherwise required grid reinforcement due to operation at lower operational temperatures in the network and postponing the time when load once again will determine new dimensioning.

The Danish charging methodology takes this into account in a pragmatic rule-of-thumb way in the form of a "cost reduction element" to the network capacity charge. The size of the cost reduction is a linear function of the size of generation capacity relative to load. The methodology starts with the assumption that 'X' MW of generation capacity connected to the grid calls for the reservation of 'X' MW of grid capacity for the distribution/transmission of generated energy. The cost of this is calculated as the price for a new investment in this capacity. Next one takes into account that generation may or may not offset load demand for network capacity. If the capacity of the generator is equal or larger than the load, the offset is zero. If it is lower, a reduction factor is applied to the calculated cost of network capacity.

2.3.7 EXPORT OF GENERATION OUTPUT HIGHER THAN EXISTING LOAD

Frequently, the grid network lacks the capacity to export significant amounts of connected embedded generation. The cost of this, including of required adjustment in the transmission system, is attributed to the connection.

2.3.8 NON-APPLICABILITY OF THE N-1 PROTECTION PRINCIPLE

The *N-1 protection principle* for protecting consumers against loss of supply in a radial system, ensures that when one line falls out, the other reserve line can continue to cover the demand for load (sending power the other way around). The extra line is not needed for generation; generation, therefore, has a lower requirement for gross capacity than load. In the cost calculation methodology, this can be taken into account by multiplying the calculated cost for the investment in new "X" MW of new grid capacity by a cost reduction factor. The reduction corrects for the fact that some of the investment from the point of view of generation represents over-investment, exclusively for the benefit of load customers.

3. REGULATORY REGIME FOR CONNECTIONS IN UKRAINE

3.1 LEGAL FRAMEWORK FOR CONNECTIONS OF RES-E

3.1.1 PRIMARY LEGISLATION

The Cabinet of Ministers of Ukraine (CMU) provided by its Resolution No. 126 "On Characteristics of Connection to the Electricity Networks of Energy Subject that Produce Electricity from the Alternative Energy Sources" dated 19 February 2009 (the "*RES-E Connection Resolution*") for the basic terms for connection of the RES-E producers. The Resolution obliges the distribution and transmission companies to take all the measures to connect such RES producers to their electricity networks and recommends NERC to take two measures: (i) all costs of the licensee incurred by connecting the RES producers to their networks and all losses incurred in connection with purchase of the electricity produced by RES at the "green" tariff should be included in the transmission tariffs; (ii) to exempt the RES producers from obtaining generation licenses. The CMU authorized the NERC to approve the agreements on connection of the RES producers to the electricity networks and agreements on sale and purchase of the electricity produced from RES.

The resolution was incorporated into primary legislation through the Law of Ukraine on Amendments to Electricity Law No.1220-VI of 1 April 2009 *(Green Tariff Law).* It states that transmission and distribution network companies: (i) may not refuse renewable energy systems generating electricity (RES-E) access to such networks[6] and (ii) should provide for the costs incurred by connecting a RES-E to their networks and (iii) the National Electricity Regulatory Commission (NERC) should include such costs in full when approving the submitted investment programmes; (iv) the wholesale electricity tariffs may include costs of financing the RES development.

3.1.2 SECONDARY LEGISLATION

Rules for connecting demand customers to the network had been in place from 2005. But the rules for connecting demand customers were revoked in 2008. Since then no connection charges have been levied neither on load consumers, nor on embedded generation.

NERC resolution "On Connection of Generators" No. 47 of 21 Jan 2006 provides a detailed procedure for how to obtain a connection to a distribution grid.

A *Sample Connection Contract* was approved by NERC Resolution No. 838 of 16.07.2009 "On the Approval of Template Contracts for Entities Producing Energy from Alternative Sources". It takes into account the legal provisions that RES plants should be connected free of charge. In the absence of the other required rules and procedures, the template contract has been of little consequence.

The *Ministry of Fuel and Energy of Ukraine* issued the Order of 28 October 2009 No. 570 "*On Approval of Rules for Connection of Wind Farms to Electric Networks".* The rules determine a mechanism for connecting and transmitting to electric networks electricity generated by wind farms with an installed capacity of 100 MW

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[6] This is in accordance with the Act "On Natural Monopolies" No.1682-III of 20 April 2000, which states that natural monopolies are obliged to provide non-discriminatory selling terms of goods produced by them to the consumers and to not impede agreements concluded between producers who carry out activity in the adjoining markets and consumers.

or more. The rules aimed particularly at windfarms planned to be constructed in the Autonomous Republic of Crimea and Mykolayiv oblast.

The NERC Resolution No. 1422 "*On Approval of Rules for Issuing and Agreeing the Technical Specifications for Connection to Networks of Power generating Facilities*" of December 2009, regulates the relationships between the customers and owners of electric networks with regard to provision of equal (non-discriminatory) access to electric networks and establishment of rights, obligations and authorities of all parties during connection to electric networks.

The procedures for connecting to a transmission grid are defined by the "*Rules for Relationship between NEC Ukrenergo and Power Sector Entities* under Parallel Operation within the Interconnected Power System of Ukraine". Any generator directly connected to the high voltage (HV) system has to enter into an agreement covering the parallel operation of the networks with NEC Ukrenergo, the national transmission company and system operator. The rules provide a template agreement form, the "Coordination Provisions for Interconnected System Operations", which the generator has to sign with the pertinent regional branch of Ukrenergo.

3.1.3 GAPS IN SECONDARY LEGISLATION

The secondary legislation for the connection of RES-E to the grid is neither complete nor coherent.

Ukraine does not yet have an approved *Grid Code or Distribution Code*. But a final draft exists.

No coherent secondary legislation exists regarding the *allocation of costs* for a connection.

Existing secondary legislation limits the *free-of-charge connection* of RES-E to plants up to 10 MW, the Electricity Law doesn't.

Statutory law does not provide any *deadlines for connection to the grid*. Deadlines may be specified in the connection contract, but the process for obtaining a contract can take a long time at the discretion of the oblenergo.

No regulations define how oblenergos are to take into account the expected connection of RES-E in their *annual grid expansion plans*.

3.2 PROCEDURE FOR APPROVING CONNECTIONS OF RES-E

The process for getting a network connection follows the procedure outlined in the NERC Resolution of 2006 "On Connection of Generators":

- The RES-E developer applies to the appropriate distribution company (oblenergo) with an outline investment proposal, specifying the intended capacity, type of plant and one or more proposals for a location.
- The Scientific and Technical Board of the oblenergo considers the outline proposal and decides on any limits or preferences, including for the location of the connection.
- The developer commissions the *technical and economic Feasibility Study* for the generation plant and its connection, which calculates the overall costs and benefits of the generation plant project and the S*ystem Study, which* models the oblenergo's network in order to assess the expected changes in power flows and hence the necessary network re-inforcement costs. The System Study can only be undertaken by certified design institutes or design entities, and the oblenergo and transmission system operator (TSO) must be

closely involved. Several Oblenergos have certified licensed design departments in-house. The System Study gives an estimate of the total connection costs and determines the optimal way of connecting to the network. The information is used for the connection cost component of the Feasibility Study.

- The project documentation then undergoes assessments from the environmental authorities, the local authorities, the construction supervision authorities.
- The developer must obtain the documentation proving that he has secured the land he needs for the project.
- The Oblenergo issues the *Technical Specifications*, the developer pays the Oblenergo for these and the two parties then sign *Connection Contract* drafted by Oblenergo, using the template from the NERC Regulation of 16 July 2009 № 838/.

3.3 CONSTRUCTION

RES-E developers wishing to construct connection assets themselves have, in principle, the right to do so. However they are expected to later transfer the assets to the network company under a procedure and financing rules which have yet to be developed.

3.4 PROCEDURE FOR APPROVING OBLENERGO INVESTMENT PLAN

The process for the approval of the investment programme of an oblenergo involves four Government institutions and comprises the following timeframes and steps[7]:

- Based on the results of its feasibility studies for the development prospective schemes, the *oblenergo* ranks its investment projects and includes the highest ranked in its proposed investment program for the coming year.
- By 1 July – submission of the proposed Investment Programme to the *regional administration body (Oblispolkom*), including full project documentation for the proposed measures. The Oblispolkom assesses the plans compliance with regional planning priorities, currently mainly geared towards consumption and supply quality.
- After approval by Oblispolkom and by 1 August, submission to *State Energy Inspection (Derzhenergonaglad)* whose main assessment criteria is the quality of supply.
- By 10 August - submission to *Ministry of Fuel and Energy (MFE)* where it undergoes technical and feasibility assessment in five separate departments. The grid operator is obligated to expand his grid in compliance with the general provisions of energy law. The main evaluation criteria are: (i) economy of resources, (ii) technical appropriateness and feasibility of the solutions proposed, (iii) the contribution of the programme to the aims of improving quality of supply, (iv) reducing of technical losses in networks, (v) modernisation and construction of new networks, introduction and development of metering and control systems.

[7] EBRD:"Investment in Electricity Production from Renewable Energy Sources in Ukraine. Developers Handbook." 2010

- By October - submission to *NERC* in the framework of tariff setting for the coming year. Criteria for assessment are the cost assumptions made. Hence full project documentation, including cost calculation, for all projects is needed.

3.5 FINANCING OF OBLENERGO INVESTMENT PLAN

3.5.1 INVESTMENT FINANCE IN A SYSTEM OF NATIONAL TARIFFS AND SINGLE BUYER

Power sector restructuring is still in a transitional stage in 2011.

State ownership in *generation* is to be limited to the four nuclear power plants owned by the state enterprise 'National Atomic Energy Generating Company', *Energoatom* and to the eight large hydroelectric power plants (ranging in size from 236 MW to 702 MW) owned by state enterprise *OJSC "Ukrgidroenergo*". Most of the 14 large thermal power plants in the Ukraine are privatized, the rest will be in 2012 as the latest. Most of the combined heat and power plants are in municipal ownership, but private ownership is not excluded. Investments in renewable energy plants are to be undertaken exclusively by private actors.[8]

The national transmission system of 220 kV and higher will continue to owned by State Company *"NPC Ukrenergo*", which is also transmission system operator. It consists of 8 regional transmission systems.

All *27 regional energy distribution companies, the oblenergos*, are privatized.

The *wholesale electricity market (WEM)* of Ukraine is currently, and at least until 2014, based on the Single Buyer Model. According to the Electricity Law, all generators in Ukraine exceeding an installed capacity of 20 MW must sell their output in the WEM, meaning to *Energomarket*, a state enterprise, which is the monopolist wholesale buyer/supplier.

Ukraine has *national electricity tariffs* applied by all 27 oblenergos. The tariffs depend on the type of consumer: voltage class, household or company etc.

Apart from a separate charge for reactive power flow, Ukraine practices a *pure kWh-pricing system*: there are no fixed monthly charges for covering fixed Oblenergo costs of administration and connection maintenance, nor are connection fees charged.

In the single buyer system with national tariffs, *Energomarket, acts as the central finance transfer agency*. Each month, an Oblenergo obtains tariff revenue from its consumers -for electricity supply to consumers and transmission of electricity to independent electricity suppliers – and pays Energomarket for received electricity according to the forecasted wholesale price approved by NERC in the beginning of month. In return, the oblenergo receives from Energomarket funds to finance investment projects included in its investment program approved by NERC; this is the "investment component" in the tariffs of an oblenergo.

3.5.2 PROJECTS FINANCED OUT OF PROFITS

Investment projects, which an oblenergo finances out of its profit, can be implemented without approval from NERC.

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[8] Ukraine has early 2011 an installed power capacity of 53.2 GW, of which thermal power plants provide 33.5 GW, nuclear power 13.8 GW and hydropower 4.6 GW. The contribution of non-conventional energy was insignificant: 86 MW of wind energy capacity and 8 MW of installed solar capacity.

3.5.3 *PROJECTS FINANCED OUT OF THE "INVESTMENT COMPONENT" OF THE TARIFF*

An oblenergo can use the investment finance received from Energomarket only for projects included in the investment program approved by NERC.

3.6 PROBLEMS ENCOUNTERED IN APPLYING THE REGIME

3.6.1 *PROBLEMS ARISING FROM LOW ELECTRICITY CONSUMER TARIFFS*

Developers experience problems in obtaining connection contracts from Oblenergos. This is mainly due to the low electricity tariffs that do not fully cover the total cost of the power system from generation to final delivery at the point of consumption. To protect the purchasing power of the population, the Government seeks to keep power prices as low as possible. The result is very low margins for distribution:

- NERC Regulation №1483 from 22.08.2011 fixed the *retail tariffs* for electric power at 63 kop/kWh (=5.7 eurocents) for 1 voltage class (27,5 kW and more) and at 84 kop/kWh (=7.6 eurocents) for 2 voltage class (less than 27,5 kW).
- The projected *wholesale market price* was 596 hrn/MWh (=5,4 eurocents/kWh) without VAT (NERC Regulation from 18.08.11, №1455).

The situation forces NERC to apply a restrictive network tariff policy, which does not allow, in practice, for the network companies to recoup the investments they would need to make for connecting a RES-E. When receiving requests for a connection, some oblenergos, therefore, apply a delaying tactic to postpone the inclusion of the requested RES-E connection in its investment plan. For a developer this means waiting a full year till the next investment approval cycle.[9]

Faced with this finance situation, SHP investors have, in some cases, financed the connecting line from the SHP to the distribution grid themselves, hoping for reimbursement of the cost at a later stage. Financing the connection of a RES-E to the grid is not a big problem for SHPs; their distances to the nearest transformer stations are usually short. For windfarms the cost is higher; those in the 50-100 MW size category are particularly uncertain about what the cost to them will be.

The "affordability issue" for the power system of how to finance the costs of connections is a subset of the general affordability problem arising from the application of feed-in-tariffs: how to control demand from new high-cost RE-supply for access to the power system and to the power market, when the incremental cost of supporting all RE-projects being commercially viable for investors is not affordable for consumers.

3.6.2 *NO NERC METHODOLOGY FOR INCLUDING CONNECTIONS IN INVESTMENT PROGRAM*

NERC has no fixed procedure/methodology for how to assess and approve the inclusion of a proposed connection in the investment program of an oblenergo.

3.6.3 *COORDINATION OF CONSTRUCTION OF SHP AND CONSTRUCTION OF CONNECTION*

There are no defined procedures for assuring a coordinated timing of the conclusion of the construction of the RE-plant and the construction of the grid

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[9] One developer appealed to the Interdepartmental Commission for Energy, Agency for Energy Savings. But in its formal reply to the appeal, the Commission could only confirm that the investment should be included in the investment plan. It had no means of enforcement.

connection. The procedure with NERC approval of investment programs and expansion plans complicates the coordination.

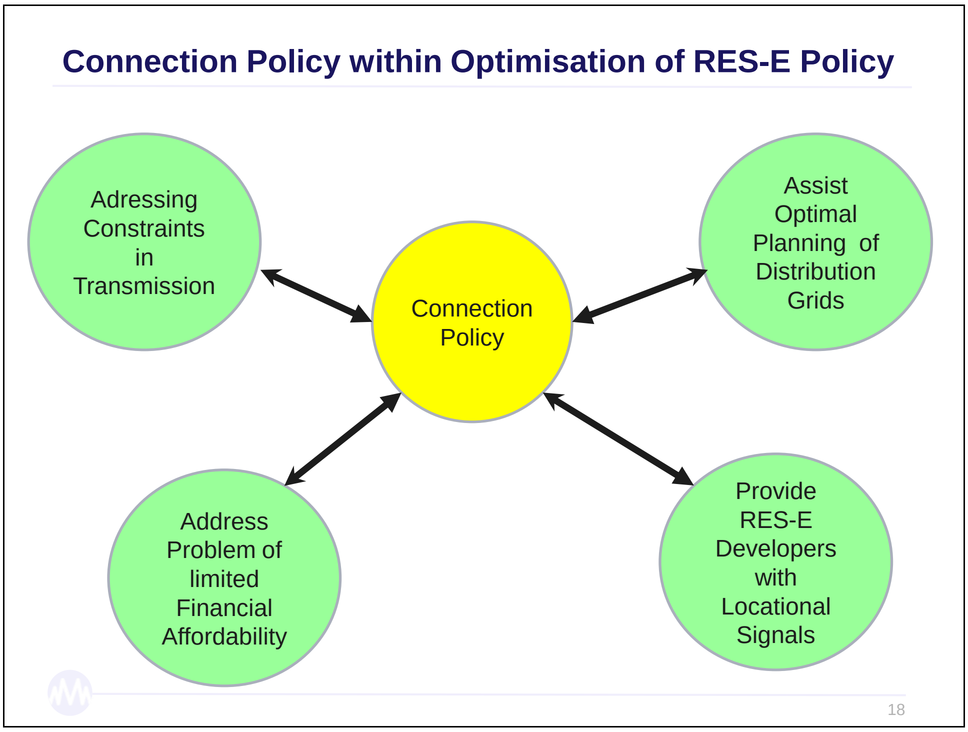
4. RECOMMENDATIONS FOR CONNECTION POLICY IN UKRAINE

4.1 THE CONNECTION CHALLENGE IN UKRAINE

The ongoing reform of the policy and regulatory framework in Ukraine for the connection of RES-E targets the optimization of investments in RES-E. The reform is a response to four challenges:

1. The ultra-shallow connection charge gives no locational signals to developers of RES-E projects. Requests for high-cost connections are submitted by projects that may not make commercial sense if a shallow connection charge were levied.
2. The oblenergos have negative commercial interest in connecting RES-E, as their investments are under-financed.
3. The planning of investments in grid expansion and strengthening by the Oblenergos does not pro-actively take into account expected future requests for the connection of RES-E. Planning is reactive – processed ad-hoc requests for connections are included in the annual investment plan, which is submitted to the policy and regulatory authorities for approval.
4. Transmission constraints call for a prioritization of transmission investments.

Development of the economically viable RE-resource potential along the least-cost path is an important RE-policy objective. In Ukraine least-cost development is particularly urgent in the light of the limited financial affordability on the part of the state and on the part of electricity consumers to pay for high-cost electricity.



NERC's work on developing rational rules and procedures for grid connections is hampered by basic flaws in the present policy and incentive framework for the promotion of investments in RES-E. The pricing formulas for the calculation of feed-in-tariffs are out of line with best international practice and turn investment in e.g. solar power plants into pure economic rent seeking. Ukraine's ultra-shallow connection charge is not practiced elsewhere for very good reasons. The ultra-shallow charge is for connections to the distribution grid, not for the transmission grid. Project developers, therefore, prefer to connect at a distribution network even if the transmission network is better. Since these flaws are established by primary legislation, they tie the hands of MFE and of NERC. The absence of charges other than the kWh-tariff in the tariff structure applied by Oblenergos may promote energy efficiency and social equity. But it is out of touch with requirements arising from the privatisation of the power sector and the need for transparent pricing. Further complications arise from the incompleteness of the policy and regulatory framework for RE. Basically, NERC is asked to develop a rational regulatory approach within an irrational RE-policy framework.

The flaws are well-recognised by NERC and by MFE. The economic cost of irrational laws and regulations will quickly become very apparent and force politicians to take corrective action in a near future.

4.2 METHODOLOGY FOR CALCULATING COST OF CONNECTION

The methodology must be transparent, simplicity is to be preferred over complexity.

The methodology must be future proof, capable of being able to be used also when changes are introduced in charging policy or in the regulation of DNO investments and operation.

The calculation of the costs attributable to generators must be net of cost saving benefits they provide in grid investment and in costs of operation. The calculation method must be able to establish (i) the shallow cost of connection according to the least cost technical solution, (ii) the share of triggered deep connection costs that can be clearly attributed to the needs of embedded RES-Es, and (iii) the share of triggered grid network improvements that are undertaken also with the view to benefit future load demand.

The breakdown is essential for charging policy (of RES-E for connection), for compensation policy (covering deep connection costs caused by generators, but not charged to them) and for NERC's regulatory assessment of the efficiency of distribution investments to satisfy load and the approval of the annual investment plan for grid expansion and modenization.

For the above reasons, it is strongly recommended to introduce the calculation methodology outlined in chapter 2. The methodology is to be used by all oblenergos. It is recommended that NERC develops the regulation for the methodology (providing the methodology document) in a collaborative effort with the oblenergos. The methodology document and the spreadsheet model applying the methodology are to be published on NERC's website. The cost assumptions for interconnection equipment used in the spreadsheet model, shall be published by the grid operator. NERC may consider to get a respected design institute to prepare cost estimates for key parameters on an annual basis.

4.3 REFORM OF OBLENERGO CONNECTION CHARGES AND ELECTRICITY TARIFF POLICY

4.3.1 RETAIL TARIFF STRUCTURE IS NOT SUSTAINABLE

The present heavy cross-subsidisation of domestic consumers by commercial consumers is not sustainable because it leads to the average tariff being lower than the average cost of supply: Whereas the wholesale market price is 0.5 Hryvna per kWh (4 eurocents), the domestic tariff is 0.25 Hryvna, the industrial tariffs are 0.95 Hryvna/kWh (below 27 kV) and 0.65 Hryvna/kWh for higher than 27 kV. There is not enough money for the oblenergos even to repair the grid!

4.3.2 SHALLOW CONNECTION COST CHARGE

It is recommended to introduce a *shallow connection cost charge* under which RES-Es are charged: (i) the total cost of the investments in connecting the plant to the distribution grid, (ii) incremental grid upgrading costs caused by the wish of a developer to get a solution, which is more costly than the least-cost technically satisfactory solution, (iii) all soft costs for developing the technical reports and all administrative costs for processing the request.

A *deep connection cost charge* for the proportional share of reinforcement costs (assuming other generators are connected later) gives the best location signal and the most effective rationing of RE-projects. In the present situation in Ukraine of severely restricted availability of power sector revenue to finance oblenergo investments in grid upgrading and expansion, it would also facilitate the implementation of RES-E projects: the oblenergos are more investment finance constraint than the average RES-E developer! Full developer finance for connections would enable an oblenergo to react to ad-hoc requests for connections without the need for having the investment approved a priori in the annual investment plan.

The consultant assumes that the switch from an ultra-shallow to a deep connection charge is, at present, not feasible politically. The proposal to introduce a 100 percent shallow connection charge is a compromise solution.

4.3.3 GENERATOR DISTRIBUTION USE OF SYSTEM (DUOS) CHARGE

As a complement to the upfront shallow connection cost charge, the consultant recommends the introduction of a generator DUoS charges covering, as a start, the estimated annual oblenergo costs for maintaining the shallow connection assets and the cost of administering the relationship with the RES-E during the year. One can call it a "*shallow DUoS charge*". The charge will be modest.

The existence of a generator DUoS will facilitate the switch at a later stage to a deep connection charge policy for new RES-E projects – or "shallowish" since a RES-E will be charged not the full cost of the deep connections, but only its proportional usage share of them. The upfront shallow connection cost charge would remain. But the shallow DUoS charge would be replaced by a "*shallowish DUoS charge"*. The deep investment component of the DUoS charge (the shallow charge elements will, obviously, still be included) would be equal to the deep connection cost on an annualized basis and discounted at the regulator's target rate-of-return on invested assets for oblenergos and multiplied by the generator's estimated usage share. The "surplus part" of the deep investments costs will be recovered from the shallowish DUoS charges levied on RES-E that connect later and from the general load consumer revenue. The primary objective is to find an additional finance mechanism for the oblenergo to recover its costs and, thereby, reduce the pressure on the limited finance from Energomarket. The oblenergo can finance the proportion of the reinforcements costs recovered by the charge directly through a mixture of own finance and a commercial loan. A secondary objective is to provide the oblenergos with a commercial incentive to connect generators. A third objective is to reinforce the location signal given to RES-E investors.

In the smart grid future, when serving load and embedded generation are both seen as equally natural customers served by a distribution company, the cost of investment not paid upfront by a shallow connection charge becomes part of the regulatory asset base, on which the oblenergo is allowed to earn a rate of return. The change will not affect the way the generator DUoS charge is calculated, since the formula above uses the regulator's target rate-of-return on invested assets for discounting.

4.3.4 *ANNUAL BUDGET FOR FINANCING DEEP CONNECTION COSTS*

As long as a shallow connection charge policy is applied, there is a need for a *finance mechanism to compensate the oblenergos for the deep connection costs of embedded generators*.

The compensation is a subsidy to RES-E, which is paid on top of the incremental cost subsidy provided by the feed-in-tariffs. The Electricity Law and the present Bill to modify the Electricity Bill ask for the incremental costs to be financed through the transmission tariffs. That is, it foresees the introduction of a "system benefit charge".

The annual cost of the connection subsidy must be made explicit to policy makers so that they can assess the financial consequences of their RE-policy targets. NERC/MEF should on their websites publish the annual budget, which is transferred from Energomarket to the oblenergos for RES-E connections, as well as the annual incremental cost of the feed-in-tariffs compared to the cost of replaced conventional power. If an explicit system benefit charge is introduced, this calculation will be performed in any case.

4.3.5 *EXCESSIVE DEEP COSTS TO BE PAID BY RES-E*

The principle, that only "reasonable costs"[10] can be recovered from regulated tariff revenue, calls for the introduction of a *cut-off rate for deep-connection costs that can be authorized by NERC and thus be* financed by the compensation budget. A generator seeking connection and giving rise to excess costs will be charged the full amount for costs beyond the defined cut-off rate. Section 4.5.2 discusses options for this.

The cut-off instrument is not alien for lawmakers in the Ukraine. The bill in Parliament to change the Electricity Law introduces the concept of a *standard connection* for RES-E up to 10 MW. Defined e.g. as a distance from the plant to the point of connection on the distribution grid of up to 2 km and low grid upgrading costs. Presumably, the cost of the defined standard connection would be calculated each year and published. The standard connection could be used in two ways. One is to have zero payment by the RES-E for a standard connection (apart from the ultra-shallow charge, which will be charged), but to charge fully for incremental costs larger than the costs of a standard connection. The other is to introduce a simple procedure for small scale generators to connect and to be approved 'automatically' by oblenergo/NERC.

4.5 PROACTIVE GRID PLANNING TO ACCOMMODATE CONNECTIONS OF RES-E

4.5.1 *NEED FOR PLANNING AND FOR PRIORITIZATION OF RE-INVESTMENTS*

The open-ended feed-in-tariff regime is the ideal RE-support instrument for countries that have high RE-penetration ambitions and deep financial pockets. Ukraine has neither. For the situation in Ukraine, the reverse auction regime as practiced in several Latin American countries would be the appropriate instrument: it limits the annual amount of supported MW to what is considered politically acceptable, while the reverse auction establishes the minimum market price for the

[10] The principle is stated in Germany's Renewable Energy Sources Act of 2004 article defining the right of connection to the grid: "The person obligated is the grid operator who is most closely located to the system site and whose grid is technically suitable to receive electricity. A grid is deemed to be technically suitable even if the grid operator has to expand his grid at an *economically reasonable expense* to import electricity."

level of the feed-in-tariffs for the tendered RE-supply. In the absence of a tender regime, *rationing must be introduced through project approval procedures*.

Transmission bottlenecks for the penetration of RE in resource-rich regions call for transmission expansion planning that take RE-policy objectives into account.

Reactive *grid planning for embedded generation* leads to sub-optimal investments in the distribution grid, which could be avoided by a forward looking grid planning approach that seeks to optimize investments for load and for embedded generation through an integrated approach.

The absence of pro-active planning of distribution investments for embedded generation poses *problems for the coordination of investments by project developers in new RE-capacity and investments by oblenergos in grid connection and grid reinforcement*. The administrative process involved from the time of application to the implementation of the connection will be eased and faster, if the appropriate planning framework for the distribution system is available in an updated version and the methodology for calculating the connection costs is formulated and published.

4.5.2 ECONOMIC INSTRUMENTS TO ENFORCE PRIORITIZATION

The planning recommendations, presented below, seek to promote *economic efficiency in resource allocation* and uphold the regulatory principle that only *reasonable costs* of investments can be included in the regulated tariff revenue, which the oblenergos can raise from consumers.

The concept of reasonable costs has an *economic dimension*: that the costs are justified by the economic benefits given to society – and a *financial dimension*: that the state budget or the consumers can afford to pay for the costs.

The feed-in-tariff rates are fixed by law. The level of the rates is, therefore, by policy makers deemed to be reasonable; at least on the basis of the information lawmakers received when the law was adopted. However, it remains to be seen whether the financial consequences for electricity consumers of feed-in-tariff support will be deemed reasonable, once they become clear to policy makers.

For the moment, the principle of reasonable costs is applied only to the grid connection costs that are paid for by the "investment component tariff", which is transfered from Energomarket to the oblenergos. NERC, in consultation with MEF, must define reasonable costs quantitatively and make certain that the interpretation is sanctioned or enabled by the Electricity Bill, which is under discussion in Parliament.

Because the present tariff policy leads to an average tariff that is lower than the average cost of supply, only a limited amount of finance can be made available for the financing of RES-E grid connections. This makes the economic dimension largely irrelevant and puts the financial dimension in the forefront of considerations. The limited financial volume forces NERC in its approval of investment programs to prioritize between received requests for connection.

For the prioritization approach, there exist two alternatives.

One is by CMU/MFE/NERC to adopt a *hard quantitative definition of reasonable cost of connection for the oblenergos to use when* assessing a request for a connection. The quantitative criterion can be expressed in terms of (i) Hryvna per MW RES-E capacity to be connected; or (ii) Hryvna per annual MWh generated electricity (forecast for average year of operation).[11] To a certain extent the procedure defines economically reasonable cost, but with reference to what is financially affordable. The problem with this approach is that the procedure does not put a lid on the annual amount of financial support that must be allocated to the connection of new RES-E projects. The financial volume will be defined by the number of projects that are put forward by developers, which can be estimated only with uncertainty. The uncertainty on the number of projects would increase if developers could get a high-cost connection project approved if they financed and paid the excess cost upfront.

The alternative is for CMU/MFE/NERC to fix a *hard quantitative limit on the annual budget, which is allocated to finance RES-E grid connections*. NERC would review the requests for connections in the investment programs submitted by the Oblenergos and approve connections according to the lowest required financial support per MW of connected RES-E capacity or per annual MWh of RES-E generated power until the budget is exhausted. However, the objective of triggering the largest feasible supply of RE-power with a given financial support budget is subject to the condition that a varied portfolio of RE-technologies is brought into the market. Otherwise, one could theoretically risk that only high-cost solar PV-supply would be connected, leading to a very modest percentage penetration of RE-power in national power supply.[12]

4.5.3 Proactive distribution grid planning

At present, optimal planning by DNOs of grid expansion and reinforcement is not feasible: the power sector is under-financed and planning proceeds through the approval of annual investment plans, not of pluri-annual plans.[13] Lack of finance for oblenergo investments is the main causal factor for the frustrations, developers experience when they apply for a connection.

The coordination of oblenergo expansion plans and RES-E development plans is also complicated by the lack of pro-active identification of sites suitable for RES-E in local and regional development and land use plans. International experience shows the high value of such efforts for the implementation of RE-projects. On this front Ukraine has the basic conditions in place for establishing a high-quality planning system capable of supporting the deployment of RES-E:

- The approval process of the investment plans of the oblenergos involves the most pertinent planning authorities: regional administration (Oblispolkom), MFE and NERC.
- The oblenergo investment plan must comply with the priorities fixed in the regional development plan.
- The preparation of water management plans includes the obligation of local authorities to identify sites for hydropower development and to allocate lands for these in their town and land use planning.
- Planning documentation is prepared by certified institutes.

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[11] The concept of a standard connection defined as distance from the grid does not take into account the size of the electricity generation. That is a weakness from the point of view of economic optimisation.

[12] The Ukrainian feed-in-tariff for solar PV is presently by far the highest in the world. For reference purposes: solar PV provides 2% of German power supply, the cost of support for this since 2002 amounts to 60 billion euro.

[13] The replacement of the feed-in-tariff regime by a Latin American style reverse auction regime would significantly improve the ability of developers and of oblenergos to plan their investments. Unfortunately, this is not yet under discussion in Ukraine.

A pro-active planning system can be implemented through actions in three areas.

First, Ukrainian legislation has few details concerning the obligations of grid operators to plan their expansion plans in accordance with the facilitation of Government energy policy objectives. Under present procedures it is a challenge to coordinate the timing of the oblenergo investments in connection with the commissioning of the RES-E. The development and implementation of plans for grid reinforcement can take up to five years. The preparation of the grid investment program takes about a year; its approval by NERC from half a year to one year. Next, the DSO obtains money for designing, then for procurement and finally for construction. It is, therefore, recommended that NERC issues a regulation obliging the oblenergos to update their planning and security criteria to include the connection of distributed generation as alternative to network expansion. Engineering criteria are to acknowledge the contribution of embedded generation to network security. Grid expansion plans, apart from the conventional load forecasts, are to include estimates of the likely penetration of new RE-based embedded generation. They include an analysis of the consequences of new RE-based embedded generation for the expansion plan and for the future operating costs of the oblenergo compared to the 'without new RE-scenario'.

Secondly, SHPs are paid the lowest feed-in-tariff of all technology-specific tariffs, provide the highest capacity value and pose the lowest problems for integration into the power system. Rational planning of the development of the country's unexploited economic *hydropower potential* can be achieved through the organisation of tenders for the right (concessions) to develop hydropower projects. The organization of the tender, under the leadership of MFE, would integrate the two dimensions of Ukrainian planning: the *sectorial plans* for the development of hydropower resources and for the development of the transmission and distribution grids and the *territorial action plans*: the Regional Social and Economic Development Plans for the regions along the river basin and the Local Authority plans for the use of local water resources, which include the identification of hydropower sites and their inclusion on the local land use plans. The Commission set up for the organisation of a tender would include representatives from all involved permit-issuing authorities. Each tender would include a multiple of projects, preferably by river basin. The connection of projects that attract winning bids would be included in the grid expansion plan by the oblenergo, and, if pertinent, by Ukrenergo in its expansion plans.

Thirdly, with reference to the Law on Local Town Development, a regulation can be issued to expand local land use planning to identify on public land *sites suitable for wind farms*, and, potentially, also *zones for development of solar PV*. The areas would be the most appropriate for development because they contain the highest energy potential and fewest environmental and resource conflicts. Ukrenergo and the local oblenergo would participate in the identification process pointing out where connections can be done at least cost to the power system. The identification of sites would come from two criteria. A financial: that the cost of connection should not be excessive). A technical: that the connection should not overload the grid.

4.5.4 PLANNING AND PRIORITIZATION OF TRANSMISSION GRID INVESTMENT

MEF/NERC/ Ukrenergo's policy for authorizing connections to the transmission grid faces three prioritization issues. One is the conventional one of absorption of intermittent power supply in the grid: at which percentage level of RE-load do the costs for back-up and balancing power become prohibitively high for the system operator? The other one is bottlenecks for export capacity of RE-generated power from high-RE-resource regions in Ukraine to low-RE-resource regions. The third one is costs of grid upgrading and expansion in response to requests for connection.

The first one can be handled by Ukrenergo fixing a cut-off limit for new connections to a regional grid once a certain percentage of power penetration is reached: international rules of thump point to a 15-20 percent RE-penetration rate. Beyond that level, costs of integration per additional MWh of supply start to face a steep increase. The cut-off rate would be fixed in consultation with MEF and NERC.

The prioritization of investments in the upgrading and expansion of the transmission grid can be based on the least cost of investment per connected MW of new RES-E capacity or per expected annual MWh of RE-generated power. This would comprise also assessments of investments in "enabler" facilities: transmission facilities intended to connect multi-proponent clusters of renewable generation resources. The objective of these is to promote the development of the more economic clusters of renewable resources and ensure that uneconomically small clusters are not developed at the expense of larger ones.

4.6 RECOMMENDATIONS FOR GRID CONNECTION APPROVAL PROCESS

On the one hand, the government carries out a tariff policy under which the power sector is constraint financially. On the other hand, the Government implements a feed-in-tariff policy with no pre-fixed limits on the amount of new high-cost RE-power supply that will be added per year. As long as this situation persists it will be impossible for NERC to implement rational rules for the connection approval process. The frustrations of developers in getting connections approved will continue: required rationing will be imposed either through foot-dragging processing of connection applications by the oblenergos, or by NERC through a prioritized selection of connection investments that are included in the annual oblenergo investment plans that are forwarded to NERC for approval.

The charging principles and technical requirements for grid connections must be transparent and published. It is recommended that the charging methodology outlined in chapter 2 will be developed by NERC into a NERG regulation in a collaborative effort together with the oblenergos.

If financial restrictions in the power sector force NERC to ration the approval of investment projects in grid connections through a cut-off limit on allowed investment per MW of RES-E capacity or per MWh of annual RES-E power generation, the limit will be communicated to the oblenergos.

NERC will issue a regulation describing the approval process for a connection which includes the obligation of the oblenergo to present a detailed technical offer to an applicant within a 75 days deadline. The offer must describe the technical requirements, the cost of the connection and its compliance with any quantitative cost cut-off criteria fixed by NERC, the connection charge and a time schedule for the implementation of the connection once NERC has approved the annual investment plan of the oblenergo. The regulation will fix a fine for non-compliance and for delays in response time and include an indicative methodology for how the financial losses of the developer caused by the delays can be calculated. It would serve as a reference guide for the Courts when developers request compensation from the oblenergo.[14]

Presently, it is the RES-E developer who commissions the system studies required to establish the conditions and required investments in the distribution grid for the connection to proceed. This procedure is rather unique, conventional international practice is that the DNO commissions the study and charges its cost study to the developer. The procedure in the Ukraine has the advantage of strengthening the bargaining position of the developer vis-à-vis the oblenergo. But, although the commissioned study is undertaken in close collaboration with the pertinent experts of an oblenergo, conceptually, the approach is not logical: investments in the grid and its operation are the exclusive responsibility of the DNO; which is why the DNO should commission the study. More important, the separation of the preparation of the technical documentation from the internal assessment and approval process of the oblenergo is difficult to reconcile with a deadline for the response by an oblenergo to a request for connection. The commissioning of the studies should be transferred to the oblenergo, which will charge the cost to the developer. NERC may consider to introduce a standard charge for the cost of preparing the documentation, depending on the RES-E technology and the connected capacity.

If the ultra-shallow connection charge is replaced by a shallow connection charge, the project developer may be allowed tender the construction of the connecting line himself if he believes that he can do the construction at a price cheaper than the one indicated in the break down for the cost of connection presented by the oblenergo.

4.7 INCENTIVE REGULATION USING THE BUILDING BLOCK APPROACH

The TOR (see Annex III) ask the consultant to provide recommendations to NERC for a future scenario where incentive regulation using the building block methodology has been introduced.

The building blocks approach combines elements of rate of return regulation (also called cost of service regulation) and price caps regulation, but belongs to the type of regulation known as incentive-based regulation.

In the building blocks method, the rate base (the approved revenue requirements for the regulated company) is calculated as the sum of two separate blocks: allowable capital expenditure (CAPEX) and allowable operating expenditure (OPEX). The CAPEX is the sum of two building blocks: the allowed return *on* capital (the company's weighted average cost of capital composed of equity and debt capital) which is applied to the regulatory asset base (sum of approved investment expenditures which have not yet been fully depreciated) and the return *of* capital, the depreciation allowance resulting from the regulated asset base. The OPEX comprises variable & fixed operation and maintenance, administration and overhead).

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[14] Several oblenergos have reacted with red-tape foot-dragging when responding to requests for a connection from developers of RES-E projects. The Law on NERC and the RE Law establish that in case of Obloenergos ignoring the laws, the state can charge fines on these companies and issue administrative orders. But these procedures take a time: the developer who has invested in the RES-E must first complain to NERC and to the Anti-Monopoly Committee. In the meantime, the RES-E cannot generate electricity and the developer company makes losses. According to developers, the fines are too low to serve as deterrent for delaying practices. And taking a foot-dragging Oblenergo to Court to get compensation for lost revenue is a long process with uncertain results

Inputs to the capital blocks methodology include an initial capital valuation and estimates of future levels of capital expenditure (where the investment projections of the regulated firms are taken as the base case for regulatory assessment), operating costs, sales volumes, costs and efficiency improvements.

The result is used to derive a future average tariff for each year of a five year tariff-projection. The annual tariff can then be expressed as percentage change over each of the precedent periods. Because the tariff is fixed for the five-year period (except for adjustments for inflation and exchange rate) the DNO has an incentive to do better than the projected performance levels that are built into the tariff path.

In the building block approach, projected investment costs of DNOs engaged in pro-active network expansion planning that can be specifically attributed to embedded generation will be accepted in the regulatory asset base, allowing the DNOs to earn a rate of return on these. Justifiable net-operating costs attributed to embedded generation will similarly be included in the OPEX.

The cost-calculation methodology outlined in chapter 3 shows how the net investment cost and net operating costs of embedded generation can be calculated. The recommendations in sections 4.3.2 and 4.3.3 introduce the combination of a shallow upfront connection charge and a "deep" generator DUoS charge, based on the cost-calculation methodology, are the key building stones for a future building block approach.

4.8 STEPS TO IMPLEMENT THE RECOMMENDATIONS

4.8.1 CHANGES TO THE ELECTRICITY LAW ARE REQUIRED

NERC/MEF are to take action, e.g. in the form of a joint position paper, to get the principle of reasonable and justifiable costs confirmed in the text of the present draft Electricity Law. Previsions in the present law that prevent the application of in practice of the reasonable cost principle must be removed. It is recommended that the law provides the following prescriptions:

(i) That feed-in-tariffs for RES-E are to be set at levels that are cost-reflective and avoid the accrual of economic rents to investors[15] and that it is the responsibility of Government to introduce the most effective and cost-efficient support approach, including potential use of competitive tenders to fix the level of feed-in-tariffs.

(ii) That it is the obligation of NERC, in consultation with MEF, to set pricing policies and procedures for connection charges that most effectively and cost-efficiently fulfill the attainment of Government RE-policy objectives.

(iii) That the cost of incremental cost support to RE will be covered by a system benefit charge raised on transmission tariffs.

(iv) That the cost of the system benefit charge, and thus the scale and scope of RES-E penetration, must not increase the average consumer tariff beyond a percentage fixed by Cabinet.

(v) That it is the obligation of NERC to monitor that laws, rules and regulations promote the reasonable and justifiable costs objective in

[15] Economic rent is defined as "excess returns, profits beyond the level needed to get investors to provide a given product or service".

practice and to take legislative initiative recommending desirable changes to policy makers.

4.8.2 Implementation of pro-active planning

The recommendations in section 4.5 require changes in secondary legislation and involve actors also outside the energy sector. The pertinent authority to push the collaborative efforts is the MEF.

4.8.3 NERC regulations

The recommendations in this chapter call for a number of NERC regulations to be issued. The most important are the issue of cost-calculation methodology and the procedures for the processing and approval of requests for connection.

ANNEXES

Annex I: Obtaining Technical Requirements for Connection to Power Grid

I.1. Creation of design-estimate documentation

1. Design of external connection to the grid;
2. Design of relay protection and automation;
3. Design of the internal connection of equipment and illumination;
4. Design of general construction and installation works;
5. Design of the automatic fire alarm;
6. Design of fish protecting facilities and devices;
7. Design of automation of equipment operation of the hydro power plant;
8. Design of automated system of electricity commercial accounting (ASECA);

Design of facility protection from the direct hits of lightning

I.2 Implementation of designs expertise

1. Complex;
2. Sanitary-ecological;
3. On labor protection issues;
4. On fire safety issues.

I.3 List of Documents to State Energy Supervision for Connection to the Grid

Documents that shall be submitted to the inspections of State Energy Supervision for registration of admittance on voltage supply to the electrical equipment of consumers of power energy

1. A letter from organization-customer on admitting of electrical equipment to exploitation.

2. Not overdue technical requirements on SS, which are issued by energy supplying organization.

3. Technical project of SS approved by corresponding energy supplying organization. Decision upon the project.

4. Act of the customer’s commission about acceptance of SS from installing organization.

5. Act of distribution of balance and operating belonging of SS and responsible parties.

6. List of the objects submitted for their acceptance to exploitation.

7. List of the deviations from a project, concerted with design, energy supplying organization and customer.

8. List of building and installation imperfections.

9. Certificate on electrical equipment, on materials or certificate about determination of foreign certificate, issued by the Committee of Ukraine on standardization and certification.

10. Financial documents for purchase of this electrical equipment and materials.

11. Copies of contractors licenses on a right of implementation of construction, testing and installation works and commissioning works.

12. List of the submitted technical documentation with marking of number and date of documents.

13. Protocol of measuring of resistance of the grounding contour of SS.

14. Protocol of measuring of resistance of grounding of electrical equipment of SS.

15. Act on the hidden works on construction of grounding facility.

16. Passport of SS grounding facility.

17. Act of verification of busses fastening.

18. Act of revision of disconnectors, switches of loading.

19. Act of revision of oily switches.

20. Protocol of tests for oily switches; switches of loading.

21. Act of revision of preventive voltages above 1000 V.

22. Act of revision of power transformers.

23. Protocol of tests of power transformers.

24. Act of revision of voltage transformers.

25. Protocol of test of voltage transformers.

26. Protocol of TS test with obligatory verification of the coefficient of transformation and its accordance with passport data.

27. Protocol of verification of relay protection with concordance of protection facilities by relay service of the corresponding power grid enterprise.

28. Protocol of tests by increased voltage of isolation of elements of the DD.

29. Protocol of brief analysis of transformer oil from transformers, oil-immersed vehicles taken before starting.

30. Protocol of test of insulating protective facilities.

31. Protocol of test of reactor.

32. Protocol of test of cable bridges by megaohmmeter after a gasket, by high voltage of direct-current (straightened) also.

33. Copy of an order about setting of the responsible person for exploitation of electrical equipment by the group from PS, Xerox copy of the certification.

34. An unilinear chart of SS (DD).

35. Passport on CTF.

36. Concordance of power facility installation with land owners.

I.4. Obtaining act of commissioning of ASECA

1. Concordance of detail designs
2. Receipt of protocols of check of transformers of current and voltage
3. Receipt of protocols of power failure
4. Receipt of metrology attestation of ASECA
5. Signing of Act of ASECA commissioning

I.5 Permission obtaining from organs of Derzhgirpromnaglyad Ukraine for start of implementation of works or exploitation of facilities

Territorial management of State Committee of Ukraine on Industrial Safety, Labour Protection and Mining Supervision of Ukraine or Derzhgirpromnaglyad of Emergencies Ministry of Ukraine

ANNEX II CHARGING POLICIES FOR CONNECTION TO A TRANSMISSION LINE

Country	First connection charges are "Shallow" or "Deep"?
Austria	**Deep**. Grid user builds own connection line. If grid reinforcements are necessary the user has to pay for this
Belgium	**Shallow**
Bosnia and Herzegovina	**Shallow**
Bulgaria	**Shallow**
Croatia	**Deep**
Czech Republic	**Shallow.** Customer pays connection lines up to connecting point of TSO. New generation pay a lump sum connection fee of 19.952€/installed MW, New consumption pay a lump sum connection fee of 7.981€/installed MW
Denmark	**Shallow** to partially **Shallow** (in some cases charges are calculated to a fictitious point that can be closer than the physical connection point)
Estonia	**Deep.** All the equipment, belonging to the connection + all reinforcements, needed prior to the connection are included in the connection fee.
Finland	**Shallow** in most cases, but a possibility to **Deep** in exceptional cases.
France	**Shallow**. The first connection is made to the nearest substation where the adapted voltage level is available and where this connection is technically possible.
Germany	**Deep** (customers) **shallow** (power plants)
Great Britain	**Shallow**
Greece	**Shallow**
Hungary	**Partially Deep** Maximum of 70% of investment costs for customers and 100% for generators; or generators build own connection line. If the generator used at least 50 % of renewable energy for its production per year, it pays only 70 % of the investment costs, and if this value is at least 90 %, it pays only 50 % of the investment costs.
Ireland	**Shallow to Partially Deep**. The connection charge is based on the Least Cost Chargeable shallow connection method. However the Least Cost Chargeable shallow connection method depends on the availability of appropriate transmission infrastructure in the area e.g. voltage level etc. Charges can also include station common costs or station extension costs (if higher). Demand customers pay only 50% of the charge, generators 100%.
Italy	**Shallow**. Grid user bears the cost of his own connection line. Enhancements of the grid are socialized in tariff.
Latvia	**Deep.** Grid users builds own connection line. All connection equipment and reinforcement are included in the connection fee.
Lithuania	**Deep** (100% of investment costs for customers and 100% for Generators. Exceptions are for connection of renewable generators)
Luxembourg	**Shallow** Grid user has to pay for his own connection line and substation. General reinforcements of the grid are socialized in tariff
FYROM	**Shallow** Grid user has to pay for the connection line other equipments belonging to the connection. General reinforcements of the grid are socialized in tariff.
Netherlands	**Shallow**
Northern Ireland	**Shallow**
Norway	**Shallow**
Poland	**Shallow.** The enterprise which is going to be connected finance all the expenditures to build the connection site which contains extension or rebuilding costs for the

	substation (if such necessary). The reinforcement and development of existing network is performed by TSO. Final customers pay 25%, RES and co-generation units of installed capacity <=5MW, generators and distribution companies 100% of investment expenditures for typical connection.
Portugal	**Shallow**
Romania	**Deep**
Serbia	**Shallow:** Generators and distributors pay for connection lines aimed at meeting security criteria (the most frequent case is the building of 'in-out' connection toward an existing line) and for substation. **Deep**: Industrial customers, in addition to payment for connection lines and substations, have to pay connection fees aimed at supporting further network development. Connection fees are 43 € per approved power in MW. **Note**: Generally, in 110 kV network, grid users keep ownership over 110/x kV substations
Slovak Republic	**Partially Deep**. Distribution companies pay 40% charge, TSO pay 60 % charge. Direct customers connected on the TSO pay 100% charge.
Slovenia	**Deep**
Spain	**Shallow**. The generator builds own connection line. Enhancements of the grid that affect the rest of system are socialized in the tariff.
Sweden	**Deep**
Switzerland	The cornerstones for the first connection charges for consumers and power plants have to be clarified by the NRA.

ANNEX III TOR FOR THE ACTIVITY

The TOR prepared by EBRD for the activity are as follows:

3.3.1 Mechanism for compensation of connection costs

Ukraine legislation has determined that E-RES generators should be connected to the network free of charge. While this is unusual in the European context, the free connection provides an additional support instrument to E-RES developers and may on these grounds be welcomed. However, the network companies still have to fund the connection costs, and unless a mechanism for compensation can be found they will continue to resist E-RES connections.

This sub-task will provide assistance to NERC and the network companies by providing a viable mechanism for recovering the costs of connection for E-RES within the framework of network tariff regulation in Ukraine. Given the state of network tariff regulation reform (i.e. the concepts and transition plans have been accepted, but the implementation of the new network tariff regulation has not started yet), two scenarios will be considered:

a) One scenario relates to the current situation, with the existing network pricing methodologies and investment program approval process. The Consultant should assist in devising a mechanism to improve the current process of approval of investment programs and subsequent inclusion of E-RES connection costs into the regulated tariffs of network companies, in order to make it faster and more predictable. This will involve all the entities involved in the process of investment program approval, namely the regional (oblast) administrations (regional development plans), the MFE (including the Energy Inspectorate *Derzhenergonaglyad*), the network companies, and NERC.

b) The second scenario relates to the implementation of the incentive regulation methodology in Ukraine, via a step by step transition process. This new methodology uses the building block approach, and the Consultant should focus on the capital costs and investment building block with the aim to provide appropriate incentives for network companies to connect E-RES producers to the network.

<u>Additional requests by NERC:</u>

At the start of the assignment, NERC requested that the formulation of a methodology for the calculation of the costs of a connection be given high priority.