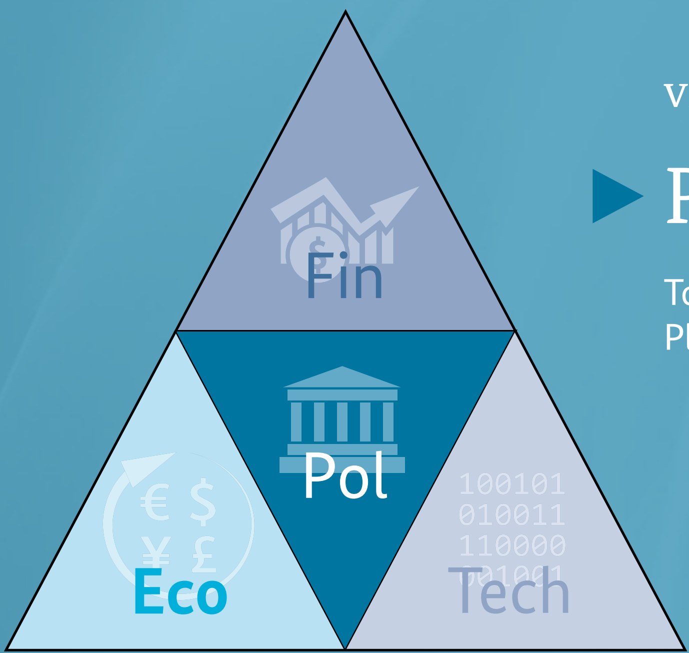
Federal Ministry
for Economic Cooperation
and Development

vRE Discussion Series – Paper # 01

# POLICY

## Towards Adequate National Renewable Energy Planning for dynamic energy sectors

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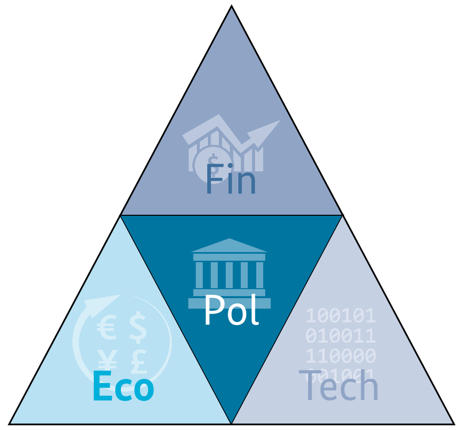


### The GIZ TechCoop vRE Programme

Over the past decade, a "1st wave" of National Subsidy Programmes for variable/ fluctuating Renewable Energies (vRE) has (i) led to impressive growth in global cumulative installed capacity of wind and PV power and (ii) dramatic RE cost reductions. However, due to their typical "technology push" focus, most of these **1st wave national vRE programmes have not aimed at achieving an economically optimal pathway for national wind and PV development over time**. Naturally, this has led to suboptimal national RE deployment, resulting in (i) unnecessary losses of Government budget and credibility (subsidy schemes were too expensive or too slow, RE technologies were scaled up too early or applied at the wrong network nodes, lack of planning resulted in avoidable transmission losses or dispatch problems), and/or (ii) excessive private sector profits and/or massive insolvency waves after subsidy-driven vRE bubbles. None of this is intrinsic to vRE technologies or economics: it was simply ill-advised planning.

**Increasingly, OECD and non-OECD Governments want to move beyond simple vRE technology-push policies, and shift to a new, 2nd wave of optimized national vRE pathways**, by applying the same fundamental economic, financial and political goal functions that are used successfully for standard power system planning. To this end, vRE need to be analyzed as an INTEGRAL part of the national energy system and its growth in time and space, by applying methods which readily fit the toolkit already used by dispatchers, regulators and utilities.

**Integrated vRE National Masterplans do not exist yet**, though it is pretty clear what they would have to accomplish (IEA 2014, SMUD 2013). This has several causes, such as: (i) the inherent fluctuating character of vRE (wind and PV feed-in depends strongly on sunshine and wind availability at any given moment) poses a set of specific power planning and dispatch problems to established sector agents (dispatch, regulator, utilities) which may seem daunting initially (yet, a closer look reveals that they can be handled easily by these players with their existing processes, with a modest amount of training); (ii) existing studies have often focused on OECD countries and their results are not readily transferrable to GIZ partner countries (where grids can be weaker and demand grows faster and hydro can play a more positive role in vRE development); and (iii) few studies focus on pragmatic incremental steps based on the real-life generation mix, transmission system and fixed short-term capacity planning of specific countries (most look at long term vRE targets including smart storage >2030 instead, thus providing little guidance to pragmatic policy makers).

### The GIZ vRE Discussion Series

Under the "vRE Discussion Series" we will continuously put forth emerging results and issues of special interest to GIZ partners, along the 4 main fields of our work: vRE policy, economics, finance and technology issues. As the series' title indicates, these are often based on work in progress, and we strongly encourage suggestions and ideas by mail to the contact below.

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# Towards Adequate National Renewable Energy Planning for dynamic energy sectors

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# Towards Adequate National Renewable Energy Planning for dynamic energy sectors

*Klas Heising, Kilian Reiche and Bernhard Zymla (based on World Energy Council, 2014)*

Over the last 3-5 years, media coverage of the immense potential of renewable energy in Sunbelt countries has mushroomed, and so have intransparent business-to-business deals in these countries - which are rarely based on sound national analysis of costs, benefits and maximizing public welfare. The latter is because past renewable energy policies and expansion plans (where they exist) have all but neglected the necessary diligence regarding optimal deployment for each technology over time (**"To maximize national net benefits, which amount $X_{ij}(t)$ MWp capacity of technology i should we invest in year t at site $S_j$"**). Instead, the integration of variable and fluctuating renewable energy (especially wind energy and solar photovoltaics = "vRE") in national energy systems is often based on unduly simplified, populist and outright wrong arguments: Supporters tend to downplay the need for more detail and resolution in dispatch adjustment and regulatory planning, as well as the actual (risk-adjusted) financing costs; while opponents tend to exaggerate the cost of grid operation, grid strengthening and system security. Both tendencies hinder governments to pursue pragmatic power plant and grid expansion strategies, as would be needed for a well-balanced ratio of variable renewable and readily dispatch-able power plants.

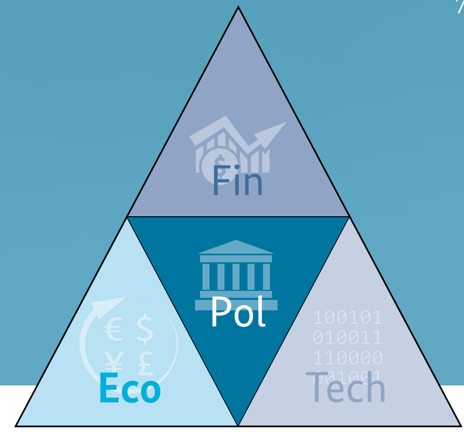
In addition, energy planners and **policy makers tend to transfer methods and models beyond their boundary conditions**, without further reflecting on countries whose framework conditions do not fit at all in the effective range of these models (for example, consider the copy-paste-like energy sector reforms in the nineties, or the lack of adaptation when transferring EU feed-in laws to non-European destinations). For an accurate and goal oriented analysis of the possible role of the international development cooperation in energy and climate policy regarding the deployment of vRE in partner countries, it is necessary to explicitly identify and accurately address the specific differences in the energy sectors between these countries and the "vRE pioneer countries" of Europe!

Most non-OECD countries are characterized by, inter alia, very **dynamic growth of energy demand** year after year, shortcomings in security of supply, and sector efficiency (see Figures 1 and 2). Thus, there is also a significantly higher investment demand compared to GNP than in OECD countries. In the electricity sector, annual growth rates of demand well above 5% are not unusual.

Energy Ministers from non-OECD countries focus their attention therefore on readily dispatchable capacity expansion and the cost-effectiveness of power generation. Thus, it initially seems surprising that some of these countries have formulated their own and very sizeable goals for vRE expansion. This is all the more unexpected if viewed from the European perspective - in the context of ongoing disputes over the amount and nature of the additional costs of massive vRE shares in the electricity sector (shadow power plants; EEG apportionment; Network expansion). On the other hand, the medium-term vRE expansion plans of the non-OECD countries seem modest when compared with the challenges, and above all, remain in some countries significantly behind an economically sensible deployment.

**An in-depth look shows that vRE in most emerging and developing countries would be both a cost effective and a significant contribution to the key challenges of the energy-sector. For this, it is a prerequisite to analyze which vRE options fit best into the necessary and rapid development of real-life national networks and power plants.**






The key national vRE questions in need clear criteria and answers are: **Where, when and how much vRE should be implemented in a given country, to optimize the overall national benefit?**
Such solid vRE expansion planning must be country specific, pragmatic, and objective (that is, without predefined vRE goals). Thus, in some cases, may even lead to a reduction of vRE deployment goals (where the latter have been defined purely on populist grounds or murky analysis) – while in other cases it can easily lead to the inclusion of 20% energy generated by vRE in the short-term, even when purely energy-economic costs and benefits are taken into account!

The substantial potential of vRE to address pressing power sector problems fast (for instance, PV can be implemented in less than a year from plan to operation (say, to reduce load shedding or emergency diesel generation), and wind and good sites boasts LCOE (Levelized Cost of Electricity) well under thermal alternatives) can only be utilized if readily usable methods and tools for national vRE analysis are available, tested and understood.

Therefore, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), under its "Technology Cooperation Sector Programme (TechCoop)" and various other donors and international specialist institutions are actively working on **identifying and demonstrating appropriate vRE planning and implementation instruments** to guide their partner countries in their efforts for a cost-effective implementation of renewables. However, this is neither an easy nor straightforward task:

Firstly, the required methods – even for OECD countries – are still in statu nascendi (hence, are finding themselves in the stage of being developed).

Secondly, as mentioned earlier, differences between non-OECD countries and countries with high shares of renewables (vRE pioneering nations), as well as differences within the currently applied methods, demonstrate a substantial bottleneck.

Neglecting these vital aspects and applying allegedly 'OECD-tested' vRE planning methods may lead to delusive/misleading results. For example:

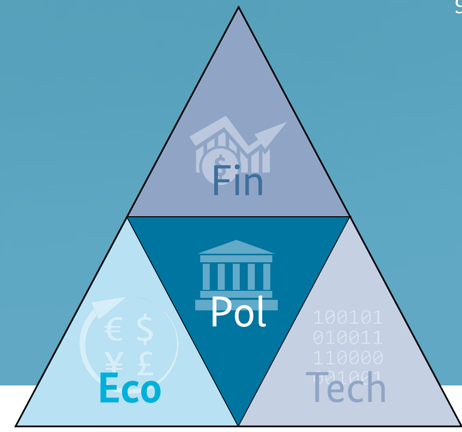
- In many non-OECD countries, abundant generation capacities from large-scale hydro power are available, with considerable day and week storage (usually varying by season). If optimally dispatched, **hydro generation can effectively be utilized in much the same way as a large-scale battery or pumped-storage hydroelectric power plant**, which increases vRE benefits – and could eventually encourage the successful adoption of 'smart grids/energy solutions'. Already today, a significant economic benefit can be derived from an optimal hydro dispatch, which translates into a decrease of operational expenditures. Furthermore, compelling effects regarding energy security can be observed due to complementary seasonality.

- Most vRE capacity expansion has taken place in countries with very moderate climatic zones. Therefore, most common vRE forecasting tools are consequently based upon parameters and algorithms adjusted to those. Hence, **planning instruments do not reflect the characteristics of non-OECD countries** and therefore require amendments in order to be appropriate for local climatic conditions.

- **Most publications on LCOE do not properly assess technology-specific risks.** Assumptions for capital costs are thereby often set too low and hence suggest that specific technologies may bear substantial competitiveness.

- Local low-, medium- and high voltage transmission lines are coined by low stability and large variations. So far there is no common ground on how the usual industry standards – such as grid codes – shall be adopted to the conditions in countries with no reasonable/low shares of vRE.

However, the most important, but not most prominently mentioned difference in energy policy occurs from the diverging **dynamic growth patterns** of the respective markets. In OECD-countries the expansion of vRE capacities typically follow quite a different pathway, due to the stagnation of local power markets.

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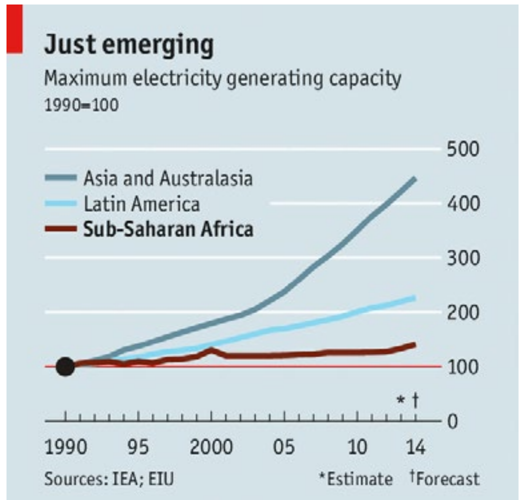
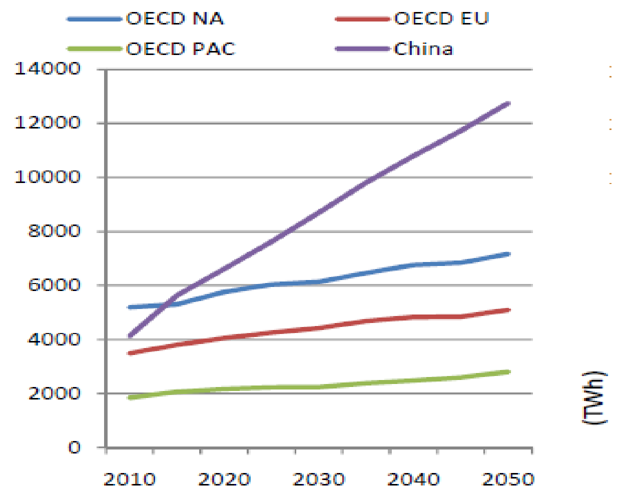
To a substantial degree, this can be characterized as a zero-sum-game or crowding-out competition. In extreme cases, however, entire industries face tremendous financial losses or even bankruptcies. Non-OECD countries thus have an additional comparative advantage regarding vRE optimization via policy planning: Markets with dynamic and strong growth rates/patterns will face less opposition from the established/existing energy industry. However, this also requires that implications from the future thermal power assets, as well as grid expansion and electricity market design, are thoroughly considered in vRE national analysis.

To successfully harness vRE potential will require vRE support mechanisms which adequately control the costs of deployment, target and attract appropriate investor types, and vary the pace and regional distribution of vRE assets in a smart way.

The "Technology Cooperation Sector Programme (TechCoop)" has started to collect a growing set of case studies and tools which can serve as inputs to the much needed international move towards proper vRE planning. We will diffuse emerging findings along the way, in a new "VRE Discussion Series", of which the present paper is the first issue. The Series will cover the 4 main fields of VRE methods and planning: VRE Policy, Technology, Finance and Economics. The figures below illustrate the issues discussed in this paper.




*Figures 1-2: Growing electricity demand - IEA, 2011 and The Economist, 2014.*

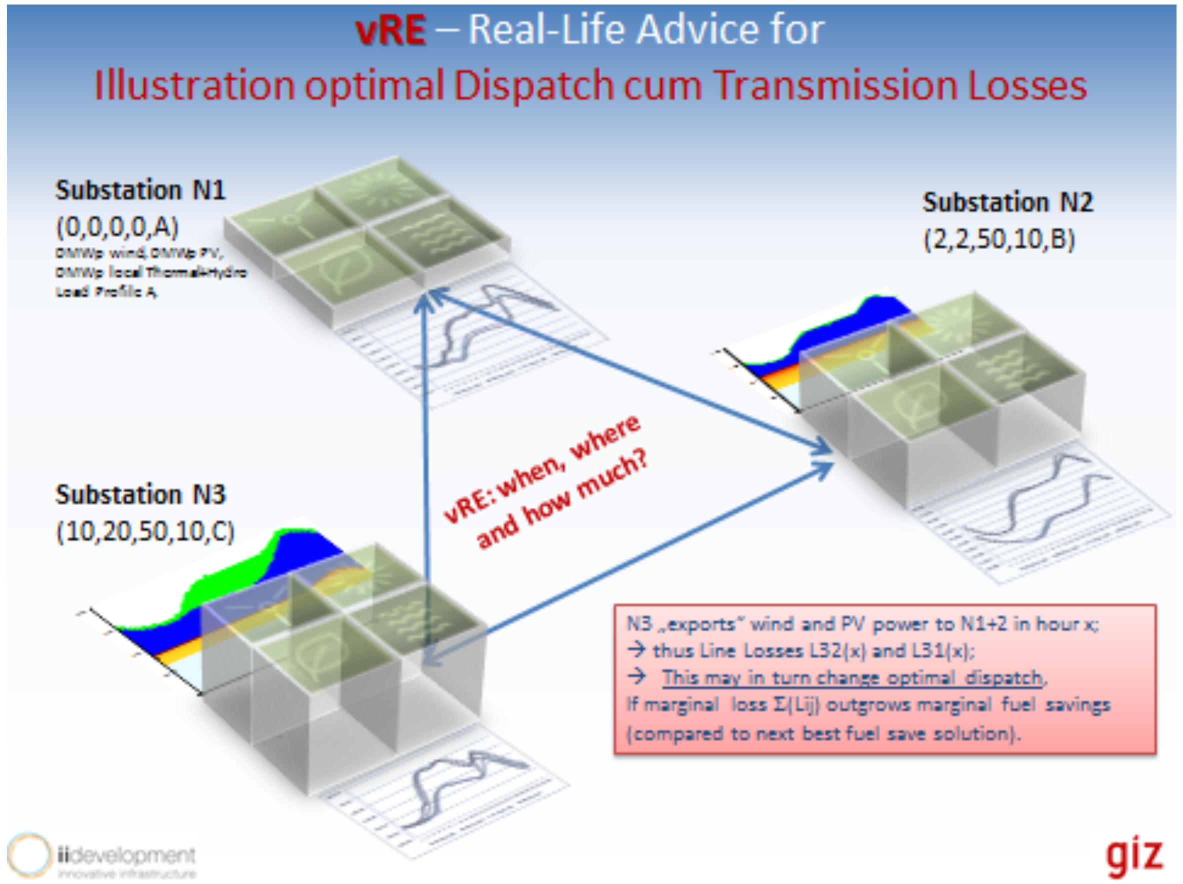



*Figure 3: Illustration of optimal vRE planning: Where, When, How Much?*

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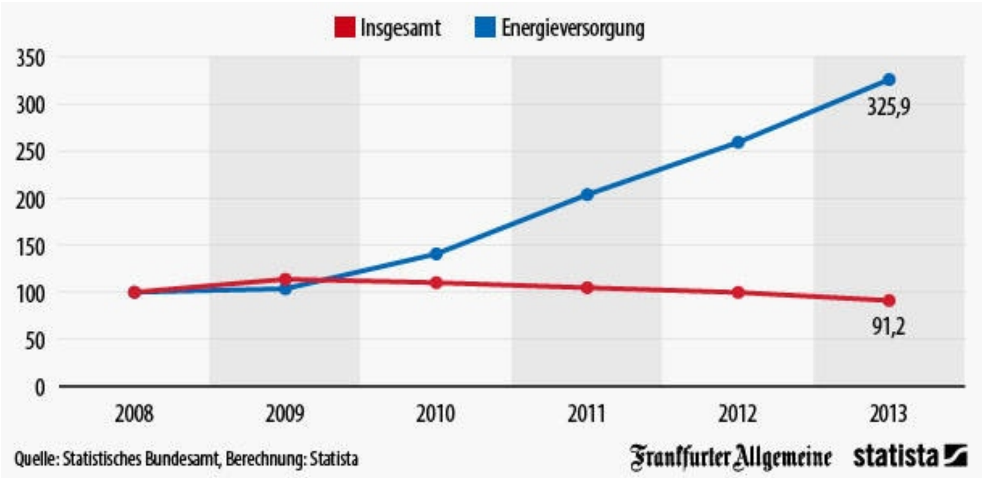


*Figure 4: A good share of the recent peak in insolvencies by German Energy Firms (FAZ 2014) could have been avoided with a smarter planning and a „soft landing" for the national vRE subsidy scheme.*

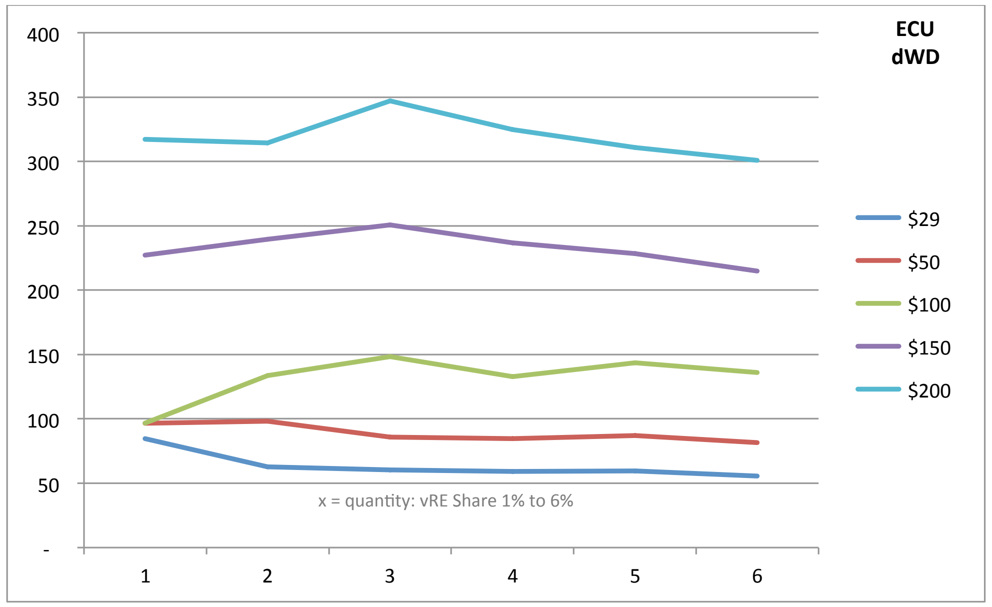


*Figure 5:.In a parallel publication, we show the significant net benefits of vRE [USD/MWh] (x-axis) in a real-life power grid (here in LAC) for different fuel prices (for the replaced thermal generation under optimal dispatch; y-axis). As we can see, vRE benefits shrink much slower than commonly expected with growing vRE share.*

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