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Improving energetic sustainability and resilience of APEC cities through results-oriented monitoring

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ABSTRACT

Cities account for more than half the world population and are therefore of growing interest for sustainability. They offer a far greater variability and much smaller size than most countries, yet they evidence most of the unsustainable development trends addressed in the Sustainable Development Goals (SDG). The recent "APEC Sustainable Urban Development Report - From Models to Results" identifies five sustainability deficits of APEC cities. APEC started developing Low Carbon Model Towns (LCMT) in 2010 and created the APEC Sustainable Energy Center (APSEC) in 2014, endowing it with the responsibility of developing an APEC-wide Cooperative Network of Sustainable Cities (CNSC). APEC would greatly benefit if this process was scaled up to include a greater number of cities and achieve deeper cooperation and a measurable contribution to SDGs and to the corresponding APEC aspirational goals. This article shows how results-oriented monitoring could be beneficial to improve sustainability and resilience among APEC cities. Results-oriented monitoring can consist of simple tracking of basic indicators, it can be upgraded to monitoring a few selected key metrics related to energy and industry, or it can be fully developed to monitoring a complex multi-dimensional urban system in a context of integrated urban planning as part of the urban policy cycle. In this latter case cities are real life laboratories for national and global sustainability.

Introduction

This article has five parts and a conclusion.

1. Sustainable Urbanization Deficits in APEC.
2. Policy Responses by UN and APEC Leaders.
3. Results-Oriented Monitoring at Basic Commitment Level.
4. Results-Oriented Monitoring of Local 2050 Vision with 2030 Targets and Action Plan.
5. Results-Oriented Monitoring in the Context of Integrated Urban Planning.
6. Conclusions.

1. Sustainable Urbanization Deficits in APEC

Quoting the APEC Policy Support Unit (PSU), APEC is one of the largest regional organizations of the world comprising 21 economies accounting for almost 60% of world Gross Domestic Product (GDP), more than 50% of the world's mega and large cities with over 5 million inhabitants each, and almost 40% of the world's total population (APEC PSU 2017). The growth rate of APEC population since 1990 has been lower than world average, meaning that the APEC share of global population has been decreasing between 1990 and 2015. APEC GDP growth rate since 1990 has been higher than the global GDP growth rate, implying that the APEC share of global GDP has been steadily increasing since 1990. APEC total primary energy supply (TPES) has been growing faster than global total primary energy supply. Hence, according to the APEC Expert Group on Energy Data Analysis (EGEDA), the APEC share of global TPES has increased from 53% to 58% between 1990 and 2015 (APEC EGEDA 2018).

Against this background, the APEC Sustainable Energy Center APSEC has elaborated the APEC Sustainable Urban Development Report – From Models to Results which was endorsed by the APEC Energy Working Group and released as APEC publication in 2019 (APSEC 2019).

The report identifies five sustainability deficits of APEC cities:

- General lack of circularity. This is a global problem, not limited to APEC. At global level, even the first step of the circular economy, namely the collection rate of solid municipal waste, lies still under 75%. Southeast Asia is one of the regions where especially dumping of plastic waste into the oceans is still high.

- Insufficient disaster resilience of APEC: Due to its location in the "Ring of Fire", the APEC region is characterized by high exposure to seismic-volcanic activity. The Pacific Ocean is, furthermore, at the origin of the increasing number and strength of hydrometeorological events. Between 1998 and 2017, both, seismic-volcanic as well as hydrometeorological disasters affected in average 220 million APEC inhabitants per year, of which 65'000 per year were killed in annual average. Economic losses due to disasters have been estimated by the World Bank to cost APEC at least 10 billion USD per year in average.

- Lack of decoupling between GDP and carbon dioxide (CO2): APEC CO2 emissions continue to grow in absolute terms, albeit slower than APEC GDP, but faster than global emissions. The picture is a little more positive for per capita CO2 emissions compared with per capita GDP. For both, APEC and global level, some first signs of peaking appear, indicating that a weak decoupling may happen soon. APEC CO2 intensity has been decreasing by 1% per year between 1990 and 2014, too little for a region whose GDP has been growing at over 3% per year during that period. Recall that in order to attain the goals of the Paris Climate Convention, there should be strong decoupling between CO2 emissions and GDP so that CO2 can be phased out by the middle of the century (2050) despite sustainable GDP growth.

- Danger of slum formation: At global level, the proportion of urban population living in slums has decreased between 1990 and 2014, but the absolute number of slum dwellers has increased. APEC is better off than world average. However, several APEC cities show danger of slum formation. Slums appear when the municipalities fail to set up elementary infrastructures such as roads, water and electricity distribution grids and waste collection schemes for newly arriving dwellers. Slums paralyze economic activity of their cities.

- Lack of SDG relevant data. This lack is perceptible at national level. The United Nations Economic and Social Commission for Asia-Pacific Asia and Pacific SDG Progress Report 2017 (UNESCAP 2017) shows, e.g., that at national level, only 27% of SDG-relevant data are available. Urban data are even more scarce, making it more difficult to monitor progress in urban development. APEC PSU discussed the creation an APEC depository for urban data (APEC PSU 2017).

2. Policy Responses by UN and APEC Leaders

Sustainable development is a highly interdisciplinary subject combining the complexity of all its component disciplines. In order not to lose focus in lengthy discussions, it has been an important step for global policy makers, especially the UN General Assembly, to have paved the way by setting a comprehensive "2030 Agenda for Sustainable Development" for the period 2015 – 2030 (UN 2015). The agenda contains seventeen SDGs which can be broken down to 169 more specific targets. These goals and targets have the advantage to set priorities in this highly complex area.

Each SDG contains substantive targets (numbered .1, .2, etc., e.g. target 7.1) and instrumental targets (numbered .a, .b, etc., e.g. target 7.a), except SDG 17 which is itself the overall instrumental goal to attain all the other SDGs and therefore contains only substantive targets. Some of the targets are quantitative, others semi-quantitative allowing specific groups of the global constituency to concretize them to become fully quantitative.

Following the adoption of the SDGs in 2015, the UN General Assembly has further refined the targets and adopted a fully-fledged SDG indicator framework comprising altogether 244 SDG indicators. Of these, nine appear in two or three SDG targets, so that the total number of indicators on which general agreement has been reached is 232 (UN 2019). Each indicator can be referenced either through the three digits indicating goal, target and indicator (e.g. "1.1.1 Proportion of population below the international poverty line"), or through a specific UN Statistics Division (UNSD) indicator code (e.g. C010101).

Looking more precisely at the set of 232 SDG indicators, many of them have only one code, but their definition

requires sub-specification by population categories, e.g. 8.5.2 “Unemployment rate, by sex, age and persons with disabilities”. This is an example a three-dimensional sub-specification as sex, age and disability are three totally independent dimensions, each of which may have two or more groups such as, e.g. age groups or disability groups.

One of the strengths of SDGs is their relative conciseness. Conciseness without loss of substance is achieved through referencing altogether 14 other global documents of similar political value adopted by the UN or specialized UN bodies (see APSEC 2019 for an analysis). Two of these specialized documents are particularly important for energetic-environmental issues. These are:

- Paris Agreement under the UNFCCC (UNFCCC 2015) to which SDG 13 refers indirectly by “Acknowledging that the UNFCCC is the primary international, intergovernmental forum for negotiating the global response to climate change”. The Paris Agreement is hitherto the most comprehensive and deep global agreement addressing the aspect of climate mitigation (i.e. reduction of CO2-emissions) and climate adaptation (i.e. measures adapting to climate change). It is in substance, together with the countries’ pledges (or Intended Nationally Determined Contributions INDC), the concretization of SDG 13. Note that also target SDG 9.4 “By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities” includes the CO2-related indicator 9.4.1 “CO2 emissions per value added”.

- The Sendai Framework for Disaster Risk Reduction (DRR) 2015 – 2030 (UNWCDRR 2015), referenced in the Paris Agreement as well as in three SDG indicators (1.5.3, 11.b.1, 13.1.2), sets quantitative targets for measuring disaster risk reduction. As hydrometeorological disasters are increasing in frequency and intensity because of climate change, the Sendai Framework is also the quantitative framework for measuring reduction to adverse effects of climate change. It is substantively included in SDG 11.5.1 and 11.5.2 on reducing effects of disasters, in SDG 11.b on integrated urban planning and in SDG 13.1 on resilience and adaptive capacity to climate-related hazards.

The relationship between the three frameworks, the SDGs, the Paris Agreement, and the Sendai Framework, all referring to the same period 2015 – 2030, can be illustrated in the following figure. Key goals of the Sendai Framework are included in three SDGs, while the Paris Climate Agreement is a concretization of SDG 13.

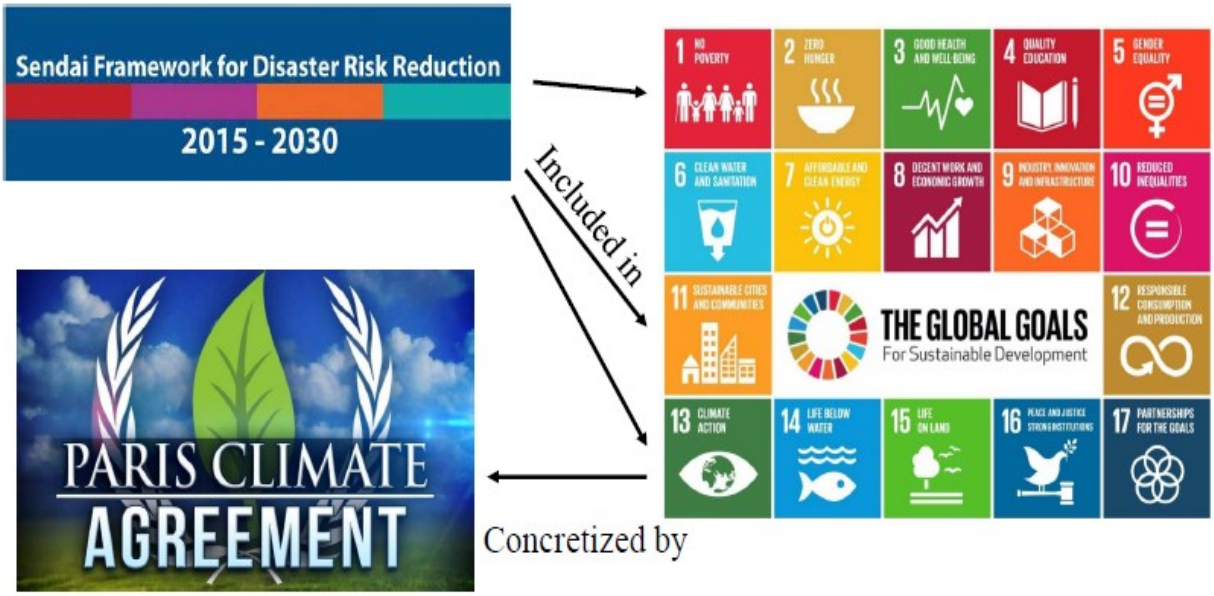

Figure 1. Relationship between the key UN frameworks. *Source*: APSEC

APEC Leaders have up to now adopted five major energy-related initiatives or goals:

- In 2000, APEC Leaders meeting in Indonesia declared: “We welcome the new energy security initiative” (APEC Leaders 2000). There is no corresponding language on energy security in the SDGs.

- In 2009, APEC Leaders meeting in Singapore declared: “We also commit to rationalize and phase out over the medium-term fossil fuel subsidies that encourage wasteful consumption, while recognizing the importance of providing those in need with essential energy services” (APEC Leaders 2009). This goal mirrors SDG indicator 12.c.1 on inefficient fuel subsidies, which in the SDGs is part of the overarching theme of sustainable consumption and production patterns.

- In 2010, APEC Leaders meeting in Yokohama declared “We will create low-carbon communities in the region” (APEC Leaders 2010). This initiative created the concept of Low Carbon Model Town LCMT and the corresponding indicator system LCT-I as well as an LCMT-Task Force for monitoring progress. Up to now, seven LCMTs have been created. This goal has several indirect mirrors in the SDGs. SDG 11 sets the general goal to make cities and human settlements inclusive, safe, resilient and sustainable. SDG 9 on resilient infrastructure, inclusive and sustainable industrialization and innovation includes as target “CO2 emissions per unit of value added”. SDG 13 formulates the general intention to mitigate carbon emissions, with indicators 13.1.1, 13.1.2 and 13.1.3 addressing disaster risk reduction issues.

- In 2011, APEC Leaders meeting in Hawai’i declared “We aspire to reduce APEC’s aggregate energy intensity by 45 percent by 2035” (APEC Leaders 2011). This goal mirrors SDG 7.3. on doubling the global rate of improvement in energy efficiency, and SDG indicator 7.3.1 “Energy intensity measured in terms of primary energy and GDP”.

- The 2014 the APEC Energy Ministerial meeting in Beijing declared: “We aspire to the goal of doubling the share of renewables in the APEC energy mix, including in power generation, from 2010 levels by 2030” (APEC Energy Ministers 2014). This goal mirrors SDG 7.2. on the increase of renewables’ share.

Specifically, on sustainable urbanization,

- the APEC Foreign Ministers, meeting in Beijing in 2014, declared: “We endorse the APEC Cooperation Initiative for jointly establishing an Asia-Pacific Urbanization Partnership” (APEC Foreign Ministers 2014). They also agreed “to establish a cooperative network of sustainable cities in the APEC economies”. The Cooperative Network of Sustainable Cities CNSC has rapidly developed to include not only the proper APEC Network of Low-carbon and Energy efficient Cities comprising by now 11 members, but also the APEC Sustainable City Services Network comprising 15 enterprises or organizations that can provide sustainability services to the cities, and, furthermore, it includes the APEC Sustainable Cities Workshop held annually in conjunction with the APEC Energy Working Group meeting . In the SDGs, the goal of horizontal cooperation is indirectly mirrored by all those SDGs which include language on cooperation and partnerships of all kinds.

In sum, APEC has created two distinctive approaches to sustainable urbanization: the LCMT process started in 2010, and the CNSC process started in 2014. The already quoted APEC Sustainable Development Report – from Models to Results finds that the needs of improving urban sustainability in APEC is so large that scaling up the process is a first order priority. The report sets out elements of a results-oriented cooperative strategy for scaling up APEC sustainable urbanization by targeted focus on energy technologies that synergize resilience with better economic performance, social inclusiveness and less environmental impact. This article spells out the elements proposed in the report. The objective is to widen the CNSC network, i.e. increase the number of member cities, and deepen the cooperation, i.e. have the possibility for cities to engage in different levels of cooperation, from an initial basic level of commitment consisting of a commitment to improve sustainability and showcase the results, to a stronger commitment towards a local 2050 vision with 2030 targets and action plan, and beyond that, to a commitment to the highest level of cooperation, consisting of implementing integrated urban policies and planning towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and development

and implementation of holistic disaster risk management.

3. Results-Oriented Monitoring at Basic Commitment Level

Results-oriented monitoring of cities is the cornerstone of the proposed cooperation with cities. Monitoring means regularly observing and recording some type of activity. For observing long-term phenomena, annual observations suffice. The observations should, if possible, stretch back to the beginning of APEC in 1990.

"Results-oriented" implies linking the monitored activity to some type of result achieved by the cities during the observed period. Since such frameworks as the SDGs or APEC goals and targets described above have been adopted at the highest political level, the most natural choice is to link the monitored activity to the targets set in these frameworks.

Despite having reduced the complexity of sustainable development, the SDGs still contain a considerable number of altogether 232 indicators. While in future it may be conceivable to monitor all these indicators, in the beginning the number of indicators is very limited and focused on a type that is clearly applicable to cities.

The basic commitment level is defined as commitment of the city to improve sustainability and to publicly showcase the result.

Showcasing the result is essential for the SDG indicators, as the whole SDG system is an entirely voluntary endeavour. It is, therefore, widely accepted that progress towards SDGs should be monitored by showcasing the results in public information systems, including public websites.

At the basic commitment level, monitoring requires compiling data on four fundamental local metrics that reflect the basic characteristics of the city:

Figure 2. Local population, local GDP, local energy consumption, local CO2 emissions

Note that local GDP is given in local currency. The CNSC platform operator transforms it to purchase power parity corrected USD with base year 2011 (USD PPP 2011) using the International Comparison Program 2011 Data Bank (World Bank ICP 2018). These metrics, if collected at local level, allow monitoring the following local SDG indicators:

Table 1. SDG indicator and local equivalent indicator used at basic commitment level

SDG indicator	Local equivalent indicator	Primary formula	Composite formula
7.3.1	Local energy intensity measured in terms of local energy consumption and local GDP	Local energy consumption / local GDP	Annual % decrease
8.1.1	Annual growth rate of local real GDP per capita	Local real GDP / capita	Annual % increase
9.4.1 or UNFCCC INDC	Local CO2 emission per unit of value added locally, or local CO2 emissions	Local CO2 emissions / Local GDP, or local CO2 emissions	Annual % decrease of local emissions / GDP, or of local emissions

When national indicators are being adapted to local indicators, this raises the question of the boundary of local

communities. This problem has been resolved in the "Global Protocol for Community-Scale Greenhouse Gas Emission Inventories – Reporting Standard for Cities" (WRI GPC 2014). It provides basically for three scopes of GHG emissions:

- GHG emissions from sources located from within the city boundary.
- GHG emissions occurring as a consequence of grid-supplied electricity, heat, steam or cooling.
- GHG emissions that occur outside the city boundaries as a result of activity taking place within the city.

The GPC definitions and methodology provide for the possibility to aggregate city-data to national data avoiding omissions or double counting.

At basic commitment level, the only thing that matters is observing and publicizing the respective trends of the three indicators mentioned in table 1. The basic commitment level serves only to see whether the city develops in the right direction. For each city, the departing points in the base year, the annual rates of change and the end points for the year 2030 are all different. The observation expressed in the basic commitment level should be achievable by local communities of any size, no matter whether urban or rural.

An example of results-oriented monitoring at the basic commitment level can be found e.g. in SDG trackers as they appear now more and more frequently on internet. The official SDG 7 tracker (World Bank 2019) implements the tracking of the four targets of SDG goal 7 at country level. Among the monitored targets is the energy efficiency goal, defined as average annual rate of improvement in primary energy intensity (%), where primary energy intensity is the ratio of total primary energy supply (TPES) over GDP, measured in megajoule (MJ) per USD 2011 PPP. The website (http://trackingsdg7.esmap.org/) allows visualizing an interactive map and an interactive timeline for each of the four targets at global level as well as for each economy. The timeline for energy efficiency at global level, e.g., is shown below. It shows that global energy intensity has steadily decreased from 7.7 MJ/USD PPP 2011 in 1990 to 5.1 MJ/USD PPP 2011 in 2016.

As mentioned above, at the basic commitment level, each member city of the network makes available the four annual data series mentioned in Figure 2 to the tracker operator. For this purpose, each city engages to designate a local CNSC expert to handle communication with the tracker operator. The tracker operator makes the quality control of the data mentioned in Figure 2 received from cities, computes the three indicators listed in table 1, and shows each of them in an interactive map and a timeline, respectively (see Fig. 3).

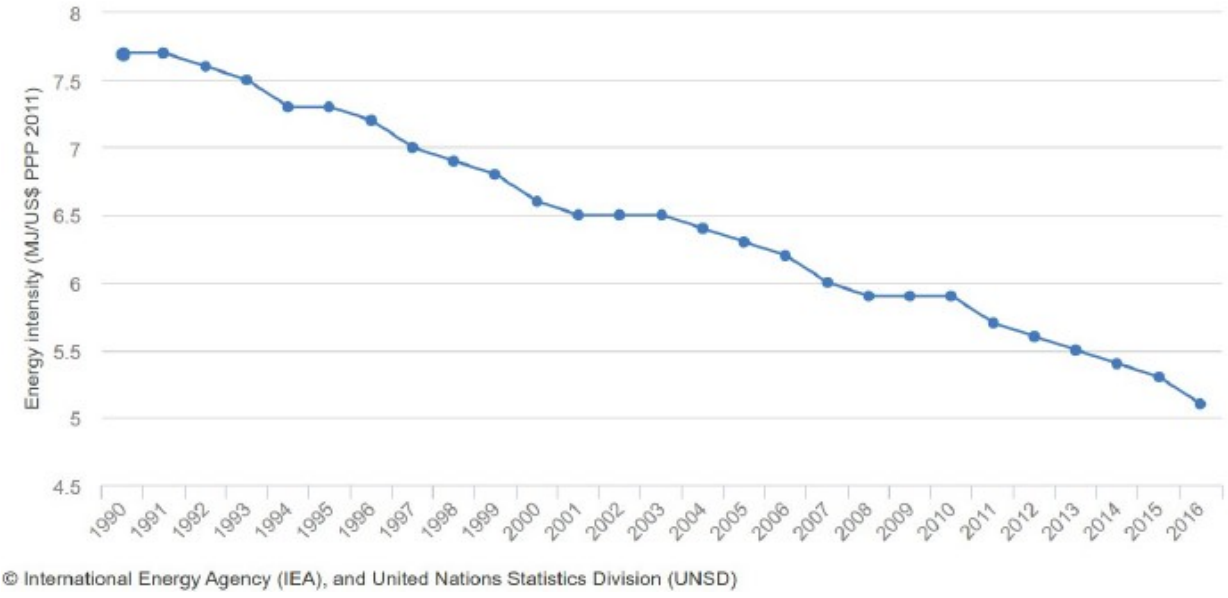

Figure 3. Energy intensity trend at global level, taken as example. *Source*: World Bank 2019

4. Results-Oriented Monitoring of a Local 2050 Vision with 2030 Targets and Action Plan
Some cities might wish to deepen cooperation up to commitment level two.

Commitment level two consists of the commitment to elaborate and implement a local 2050 vision with 2030 targets and action plan, incorporating commitments of level 1 as well as commitments of all indicators of SDG 7 (sustainable energy), key indicators of SDG 9 on innovation and of SDG 17 on IT. Local targets are based upon SDG indicators and take account of pre-existing local (BAU) scenarios wherever they exist.

The rationale for commitment level two is obvious: Many SDGs or targets are either not moving fast enough or moving in the wrong direction. As an example of a variable needing complementary action, take the share of renewable energy in global total final energy consumption. Looking at the past 25 years, rather than steadily moving upward, the global renewables share has been stationary within a narrow corridor between 16% and 17.5%. Since the creation of the International Renewable Energy Agency (IRENA) in 2009, the trend has been upward, albeit still rather slowly and with severe setbacks in 2010 and 2011. This is the sign that specific policies are needed. In 2014, IRENA published its Renewable Energy Roadmap REMAP 2030, showing that doubling the share of renewables from 18% to around 30% to 36% by 2030 was not only possible, but also cheaper than providing energy supply from fossil sources (IRENA 2014).

IRENA also states that "*Total electricity storage capacity appears set to triple in energy terms by 2030, if countries proceed to double the share of renewables in the world's energy system*" (IRENA 2017). Pumped hydro storage, which currently still accounts for 96% of global electricity storage, will increase only marginally; the bulk increase comes likewise from utility-scale batteries and from rooftop-related battery storage. The IRENA report states that stationary battery energy storage increases 17 to 38-fold (i.e. with additional 170 GWh to 410 GWh) between 2015 and 2030 to meet the additional storage demand related to doubling the renewables' share. The big uncertainty stems from the uncertainty over the quantity of EVs in 2030. The higher the quantity of EVs, the less stationary battery storage is needed. Most of this storage will be located near consumer centres, i.e. cities.

In 2014, also APEC leaders adopted the aspirational goal to double the share of renewables by 2030. At BAU, APEC is not likely to attain this goal (APERC 2016). Given the relative size of APEC compared to the world, about half the incremental stationary battery energy storage (i.e. 85 GWh to 205 GWh) will have to take place in APEC cities.

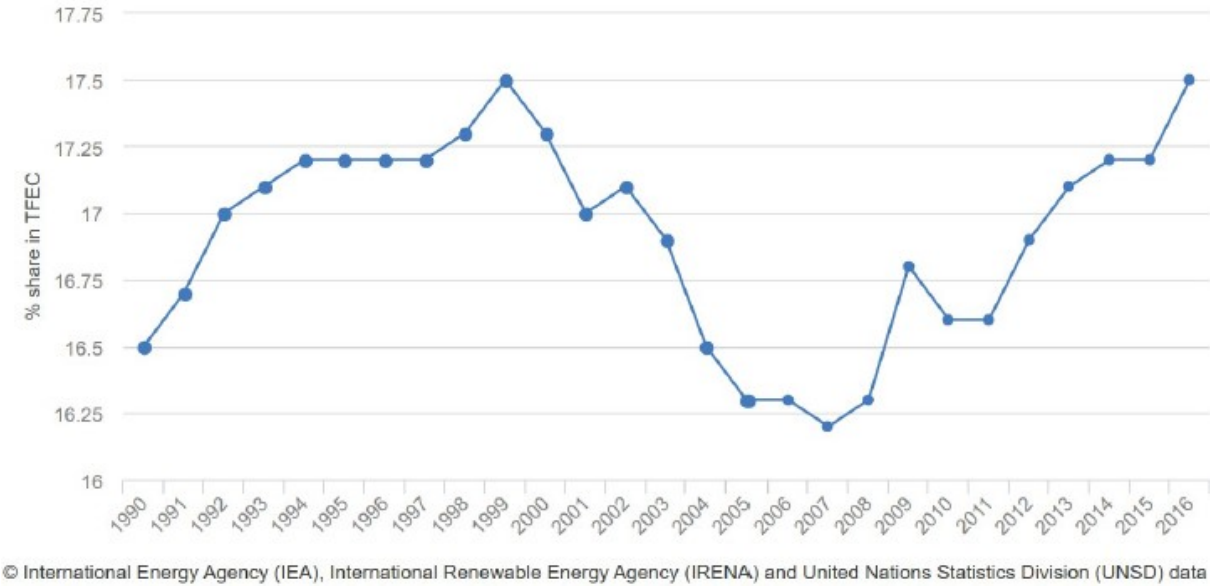

Figure 4. Share of renewable energy in total final energy consumption, taken as example. *Source*: World Bank 2019

Addressing the renewables' share, therefore, clearly requires supplementary action by the cities. Such action should be structured around a coherent 2050 vision. The 2050 date is chosen as this date is more and more often seen as a key milestone for phasing out CO2 emissions in order to limit the global temperature rise to 1.5 degrees (e.g. CCC 2019). The 2050 vision should embody at least three interlinked elements:

- What will the energy system of the city look like in 2050?
- What innovative industrial elements are there / should there be in the city to support this energy transformation?
- How does the city's IT infrastructure favor this energy transformation?

Any other elements chosen by the city may be added. The corresponding 2030 action plan should be inspired from the 2050 vision. For guiding the development of local 2050 visions with 2030 targets and action plan, the scope of relevant indicators to be monitored is broadened as compared to level one. In order to minimize data collection costs for cities, no new indicator is defined, only such indicators already defined in the SDG list of 232 indicators are taken into consideration. Sub-specifications of indicators by social categories are only used if the corresponding data are readily available. It is expected that in the coming decade most SDG indicators will be generally monitored at national levels. As national statistics often use aggregate local statistics as building blocks, it is expected that those local statistics which have relevance for local sustainable development will be collected and monitored at local level.

At commitment level two, a strong focus remains on energy, therefore, the remaining three indicators of SDG 7 (clean energy) are included in level two. These require the following local data, adapted from the corresponding national data:

- SDG 7.1.1 Proportion of local population having access to electricity.
- SDG 7.1.2 Proportion of local population with primary reliance on clean fuels and technology.
- SDG 7.3.1 Local renewable energy share in local total final energy consumption.

A central success factor for implementing sustainable energy is to show that it goes hand in hand with improved economic performance. It would, in fact, be impossible to motivate cities to implement energy policies that diminish economic performance. Annual growth rate of local real GDP per capita is already included in commitment level one. Commitment level two, therefore, focuses on indicators related to industrial innovation as found in SDG 9, "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation":

- SDG 9.2.1 Local manufacturing value added as a proportion of local GDP and per capita.
- SDG 9.2.2 Local manufacturing employment as a proportion of total local employment.
- SDG 9.3.1 Proportion of local small-scale industries in total local industry value added.
- SDG 9.5.2 Local researchers (in full-time equivalent) per million inhabitants. If the city has less than a million inhabitants, the denominator is adjusted to take account of the size of the city.
- SDG 9.b.1 Proportion of medium and high-tech industry value added locally in total local value added.

Given the important role of IT, commitment level two also includes indicators on IT as mentioned in SDG17, "Strengthen the means of implementation":

- SDG 17.6.2, Fixed local Internet broadband subscriptions per 100 inhabitants, by speed; is in fact a percentage.
- SDG 17.8.1, Proportion of local individuals using the Internet.

These indicators are destined to on the one hand to prevent cities from aspiring to become service-only communities free of industrial activity, which would be a detrimental loss of local technical skills and economic diversity for them. These indicators also take into consideration that tomorrow's big players are today's SMEs, therefore a certain proportion of local SMEs is necessary to keep the local economy dynamic and future oriented.

It is important to note that all the indicators of levels one and two are mutually supportive in the sense that there is

no fundamental conflict between these indicators. This does not exclude, however, the presence of trade-offs between them, meaning that attaining a little more of one target might imply attaining a little less of another target.

Beyond the 2050 vision and the 2030 action plan, commitment level two requires from the cities three more things.

- Firstly, developing a results-oriented leadership and internal stakeholder consultation and dialogue mechanism so that stakeholder's suggestions can easily be collected and reflected in the vision and targets.

- Secondly, the cities learn to identify for each indicator at least one policy instrument that positively influences the development of the indicator. This is an indirect consequence of the cybernetic law of requisite variety (Ashby 1956).

- Thirdly, the cities realize pilot projects that positively influence attaining the local targets. The most useful pilot projects are so-called plus-energy districts. These are housing districts that in annual average produce more energy than they consume. Today's best practice typically allows plus-energy districts to produce not only all the energy needed for in-house activities, but also to power the energy needed by the car fleet of the dwellers. The energy surplus of such districts could possibly be further increased in future by integrating waste-to-energy and/or wastewater-to-energy processes into the design of the district. Plus-energy districts will also contribute to decentralized energy storage.

The role of monitoring is also enhanced and becomes more important than just controlling data quality and showcasing the results in a tracker. At level two, monitoring comprises some research activity consisting of elaborating realistic 2050 visions with 2030 targets and action plans for the cities. These visions and action plans improve any pre-existing BAU scenarios of the cities and can be compared to the respective APEC goals or SDGs and targets. Furthermore, level two needs monitoring the city's speed of progress towards attaining these targets by assisting cities to identify the required policy instruments and providing specific capacity-building where necessary. Finally, concerning pilot projects, monitoring may require convening investor or donor roundtables that facilitate raising the required funds.

Besides the above example of the renewable energy share, another example of a goal that is likely to develop in the right direction but not fast enough can be identified. This is the energy efficiency goal 7.3.1, doubling the rate of improvement of energy intensity measured in terms of primary energy and GDP. During the reference period 1990 – 2010, the annual decrease has been -1.3%, hence the goal for the period 2015 – 2030 is -2.6% (World Bank 2019). The SDG 7.3.1, therefore, goes well beyond the APEC energy intensity goal (-1.5%). APEC economies and APEC cities will have to take additional action to fulfil SDG 7.3.1.

5. Results-Oriented Monitoring in the context of Integrated Urban Planning

Commitment level two does not suffice to be called "holistic sustainable and resilient local development". It limits itself to the areas of energy, industrial innovation and IT. This falls still short of considering the genuine problems of urban development, neither does it include adaptation to climate change such as disaster risk reduction, nor inclusiveness of vulnerable groups.

Commitment level three consists of the commitment to elaborate and implement local integrated urban policies and planning, incorporating commitment level two as well as all indicators of SDG 11 (cities), all other SDG indicators addressing specifically local communities, and all indicators relating to local infrastructures.

The core of indicators can be found in SDG 11 (inclusive, safe, resilient and sustainable cities and communities). Monitoring SDG 11 requires the following local data adapted from national data:

- SDG 11.1.1 Proportion of local urban population living in slums, informal settlements or inadequate housing.
- SDG 11.2.1 Proportion of local population that has convenient access to public transport, by sex, age and persons with disabilities.
- SDG 11.3.1 Ratio of local land consumption rate to local population growth rate.

- SDG 11.5.1 Number of local deaths, missing persons and directly affected persons attributed to disasters per 100,000 population. This is identical to SDG 1.5.1 and SDG 13.1.1. It is also the combination of the first and second target of the Sendai Disaster Risk Reduction Framework (UNWCDRR 2015) which suggests using the 10-year moving average for this indicator. If the city has less than 100'000 inhabitants, the denominator is adjusted to take account of the size of the city.
- SDG 11.5.2 Direct local economic loss in relation to local GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters. This is very similar to SDG 1.5.2 and the third and fourth target of the Sendai Disaster Risk Reduction Framework. Possibly use a 10-year moving average for this indicator.
- SDG 11.6.1 Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities.
- SDG 11.6.2 Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted).
- SDG 11.7.1 Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities.
- SDG 11.a.1 Whether the city implements urban development plans integrating population projections and resource needs.
- SDG 11.b.2 Whether the local government adopts and implements local disaster risk reduction strategies in line with national disaster risk reduction strategies. This is identical with SDG 1.5.4 and SDG 13.1.3 and is also the fifth target of the Sendai DRR Framework.

The above still do not include information on those SDG indicators that are specifically addressing local communities or cities. These are SDG 11.b.2 mentioned just above as well as the identical SDG 1.5.4 and 13.1.3. Besides these:

- SDG 2.5.2 Proportion of local breeds classified as being at risk, not at risk or at unknown level of risk of extinction (for rural communities)
- SDG 5.5.1 Proportion of seats held by women in … (b) local governments
- SDG 6.b.1 Whether the local administrative unit has established operational policies and procedures for participation of local communities in water and sanitation management
- SDG 16.7.1 Proportions of positions in … local institutions, including (a) the legislatures; (b) the public service; and (c) the judiciary, compared to national distributions, by sex, age, persons with disabilities and population groups

Besides the above-mentioned, the indicators of level three include those on which local authorities can have an influence as they depend on local infrastructures that are normally in the competence of local authorities:

- SDG 1.4.1 Proportion of local population living in households with access to basic services.
- SDG 3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services)
- SDG 3.9.3 Mortality rate attributed to unintentional poisoning
- SDG 4.1.1 Proportion of children and young people (a) in grades 2/3; (b) at the end of primary; and (c) at the end of lower secondary achieving at least a minimum proficiency level in (i) reading and (ii) mathematics, by sex
- SDG 4.4.1 Proportion of local youth and adults with information and communications technology (ICT) skills, by type of skill
- SDG 6.1.1 Proportion of local population using safely managed drinking water services.
- SDG 6.3.1 Proportion of local wastewater safely treated.
- SDG 6.5.1 Degree of local integrated water resources management implementation (0–100).
- SDG 8.5.2 Local unemployment rate, by sex, age and persons with disabilities.
- SDG 9.1.1 Proportion of the local rural population who live within 2 km of an all-season road (for rural communities)
- SDG 10.4.1 Labour share of local GDP, comprising wages and social protection transfers

- SDG 12.4.2 Local hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment.
- SDG 12.5.1 Local recycling rate, tons of material recycled.
- SDG 14.1.1 Index of local coastal eutrophication and floating plastic debris density (for coastal cities)
- SDG 15.1.1 Local forest area as a proportion of local land area.
- SDG 16.1.1 Number of local victims of intentional homicide per 100,000 population, by sex and age.

In sum, the indicators of level three comprise the three indicators of level one, the ten indicators of level two, and the ten indicators of SDG 11, the four supplementary indicators specifically addressing local communities, and the 16 indicators linked in one or the other manner to urban infrastructures, in total 43 indicators. At level three, two SDGs, namely SDGs (energy) and SDG 11 (cities) are included with all their relevant indicators. This list is still a relatively small subset of approximately 19% the 232 SDG indicators.

The objective of commitment level three is to allow APEC communities to progress towards holistic sustainable development. For this purpose, the full list of commitment level three indicators comprises at least one indicator of each SDG. This ensures that all elements of sustainable development (e.g. social inclusion, resource efficiency and progression towards circularity, including climate mitigation, disaster resilience and adaptation to climate change) are being monitored with a minimum of indicators.

At commitment level three, cities are real life laboratories for national and global sustainability. With the growing number of indicators, however, the possible conflict between targets becomes more likely. The above collection of indicators contains at least one indicator (15.1.1.) that regularly shows a conflict with all the others. The conflict can only be resolved if a business model for the forest is developed. Such business model should be inspired by the various ideas put forward for administering the commons (Hardin 1968) or for internalizing externalities (Ostrom 1990). Without such business model, increasing the local forest area might possibly diminish some other economically productive activity.

The cities engaged at commitment level three engage, beyond the activities already undertaken at level two, in integrated urban planning in view of fixing targets for each of the indicators and implementing policies to attain them all. Besides developing plus-energy districts, the projects involved in level three include TOD type mass transport infrastructures as well as any measures to diminish transport needs (e.g. mixed residential-commercial districts) and congestions. Projects in specific infrastructures (water, wastewater, electricity, IT) might be included.

The specific situation of each city or local community is, however, dependent on national legal and administrative frameworks governing local communities. Depending on such frameworks, local communities might either have the capacity to do any of the following:

- Integrated urban planning and policies
- Develop and implement a budget
- Possibility to collect data and set up early warning systems
- Capacity to set up and control infrastructures.

If local communities lack some or all of these powers, they will be dependent on corresponding instructions and allocations of funds coming from central government. The specific situation of each city in this regard determines which indicators can be included and which ones must be omitted as the city lacks any instrument to influence it. In extreme cases, the lack of local managerial autonomy could conflict with the requirement to dispose of a sufficient number of instruments to implement holistic and integrated urban sustainability policies. In that case, some of the above indicators will have to be omitted or exchanged for other indicators over which the city might have power, but which are not included in the above list. Furthermore, at level three, cooperation between cities is more intense than at lower levels because cities want to exchange more specific information.

For the monitoring agency, an additional research task of level three is to show the role of integrated urban design (including buildings and transportation of persons and goods) for attaining urban SDGs. Within this task, the

monitoring agency assists the city in guiding it towards improved fulfilment of local SDG targets. This includes the use of analytical models and tools analyzing causes and effects between targets.

6. Conclusions

This article paves the way for building a framework of results-oriented monitoring of APEC cities allowing them to monitor fulfilment of local sustainable development goals. The analysis builds upon the "APEC Sustainable Urban Development Report – From Models to Results", that has been endorsed by the APEC Energy Working Group and published by the APEC Secretariat. The elaborated framework provides for enlarging and deepening the Cooperative Network of Sustainable Cities created by APEC Leaders in 2014. Enlargement of the network basically takes place for any volunteering APEC city whose leadership takes the commitment to improve sustainability and to showcase the result (commitment level one). Beyond this basic commitment level, deepening the network takes place at commitment level two by allowing cities to progress rapidly towards more sustainable development by targeted focus on the three elements energy, industrial innovation and ICT. For that purpose, commitment level two requires elaborating a local 2050 vision on the energy system of 2050, the local industrial activities that will support it and the local IT infrastructure that will favour this energy transformation. This vision will inspire the 2030 targets, action plans and pilot projects elaborated by the city. Cooperation level three broadens the cooperation to full-scale holistic sustainable development, taking specifically account of cities' individual situations, while limiting itself to less than one fifth of all SDG indicators. At level commitment level three, two SDGs, namely SDG7 (energy) and SDG 11 (cities), are included in full. At all three commitment levels, monitoring is taking place using the SDG trackers to visualize and disseminate the cities' results for each monitored indicator.

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