COMMITTED TO IMPROVING THE STATE OF THE WORLD

Global Future Council on Energy 2016-2018

Policy Recommendations

January 2018

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REF 050318 - case 00043205

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Introduction

The world does not need yet another set of policy recommendations aimed at accelerating the energy transition towards low-carbon. Atmospheric carbon levels continue to increase, and rising temperatures coupled with intensifying severe weather and natural disasters clearly show that climate change is accelerating – the time for action is now. Innumerable industry groups, think tanks, researchers and other institutions have already outlined their perspective on policies that will support an energy transition. Instead, what is needed is a clear consensus on which policies to prioritize, and on steps to implement them.

To that end, this report provides a review of the current state of thinking across many policy agendas that already exist to identify areas of consensus. We expect that policy-makers may leverage this clarity to accelerate their efforts to implement these consensus policies.

Perspectives considered

We reviewed a number of recently published policy agendas related to accelerating the energy transition to identify the recommendations made in each. These reports include:

- World Economic Forum: *Global Energy Architecture Performance Index Report* (2017)
- B20: *a Climate for Change - Embracing the Transition towards Energy-Efficient, Climate and Resource-Friendly, Competitive Economies* (2017)
- IEA & IRENA: *Perspectives for the Energy Transition* (2017)
- Energy Transitions Commission (ETC): *Better Energy, Greater Prosperity* (2017)
- Climate Works (CW): *Faster and Cleaner 2 - Kick starting Global Decarbonization* (2017)
- We Mean Business (WMB): *The Business End of Climate Change* (2016)
- National Academy of Sciences (NAS): *The Power of Change - Innovation for Development and Deployment of Increasingly Clean Electric Power Technologies* (2016)
- IPCC: *Climate Change 2014 - Synthesis Report* (2014)

Consensus policies

From our review of these existing policy agendas, we identified clear overlap and consensus on six critical policies:

1. **Integrated policy frameworks**
   To provide clarity to businesses and investors, governments should create a stable long-term policy framework for clean energy. This will speed investment by sending clear signals about the direction of markets, and has broad support in most policy agendas reviewed.
2. **Carbon pricing**
   Governments around the world should enact stable and robust carbon pricing across all sectors of the economy. There are a variety of potential mechanisms that can be used, including carbon taxes and cap-and-trade. There is broad support for carbon pricing across all policy agendas.
3. **Smart subsidies**
   In tandem with pricing carbon, policy-makers should remove fossil-fuel subsidies, which are inefficient and primarily benefit middle- and high-income earners. Doing so would help to level the playing field, and would allow funds to be repurposed to support clean-energy policies. As with carbon pricing, there is broad support for this across policy agendas.
4. **Support innovation**
   Governments should support Innovation through targeted R&D subsidies on complementary and alternative decarbonization technologies, and should support technology transfer between developed and developing countries. This measure was also universally supported.
5. **Energy efficiency**
   Policy-makers should remove barriers to adoption of energy efficiency. This includes implementing standards and regulations, supporting financing tools and capital availability, as well as potentially financial incentives. It should be applied to buildings, end-use devices and industrial energy use. Building energy codes and appliance efficiency standards play a major role. The majority of policy agendas reviewed support energy-efficiency policies.
6. **Electricity market design**
   Policy-makers should reform power markets to recognize the changing needs of electricity systems

based on clean energy. This includes properly incentivizing flexible resources to enable integration of larger shares of variable renewables. This policy was supported by many policy agendas, with particularly strong support in those agendas with a power sector focus.

Other notable policies

The consensus policies listed above are a subset of the wide variety of policy approaches that have been proposed. Several specific policies that were called out separately by some policy agendas are included here as subcomponents within our recommended six policy areas:

- **Building energy codes** were identified by several policy agendas, specifically strengthening existing codes and improving enforcement. For the purpose of this report, this policy is included as a part of the Energy Efficiency policy recommendation.
- **Appliance efficiency standards** were identified as a potential policy measure in several agendas, but not separately identified by many other agendas. For the purpose of this report, this policy is similarly included in the Energy Efficiency policy recommendation.
- **Carbon capture and sequestration** appeared in some policy agendas, but was excluded from others. For the purpose of this report, it is included as a key technology within the Support Innovation recommendation.

Several oft-discussed policies did not appear to have the broad consensus across the policy agendas and are not included here. These policies may still have an important role in the energy transition, but there does not yet appear to be a global consensus on how to pursue them:

- **Steering investment** was discussed by a few policy agendas, specifically mobilizing investment and directing it towards the most impactful areas.
- **Energy access** was similarly noted within several policy agendas as an important policy to pursue, but these recommendations were at a very high level, without a clear set of actions.
- **Electrification** was surprisingly absent from most policy agendas, though several included expanded electrification of end uses as a priority policy. While this may well be a key policy to achieve the energy transition, there was insufficient explicit consensus on this area.

Recommended policies

Integrated policy frameworks

Policy-makers should prioritize the creation of integrated policy frameworks that create a long-term, cross-sectoral vision and stable policy, providing certainty to attract investment.

Definition

In the past, energy system policy has largely occurred in isolated silos – the power sector, mobility and other industries were each considered separately and with minimal regard for the others. However, this approach is no longer viable, as the energy transition is rapidly causing convergence between and across industries. Instead, what is now needed are integrated policy frameworks, which support and ensure robust planning across industries, support policy goals, and proactively address changing energy systems.

Rationale for importance

Integrated policy frameworks are critical to the energy transition in two ways. First, they enable effective and efficient planning between industries that might otherwise perform planning in isolation. For example, consider electric vehicles (EVs). On one hand, deploying significant numbers of EVs clearly presents a planning need for the mobility sector. But, at the same time, it requires significant planning from the power sector, information technology sector, and even the retail and construction sectors where charging equipment will be installed. Without an integrated policy framework creating a forum for collaboration, each sector would likely plan and operate in isolation, resulting in inefficient reactive responses.

Second, integrated policy frameworks are critical to provide clarity to business and investors through stable long-term policies. This is necessary to speed investment by sending clear signals about the direction of markets. Institutional investors are attracted to energy infrastructure, as it can provide diversification and long-term, stable cash flows in their portfolios. Individual investors are also increasingly interested in investing in clean-energy infrastructure as new pooled investment vehicles allow them to do. Integrated policy frameworks can enable such continued and expanded investment flows.[1]

[1] BlackRock. 2015. *Infrastructure Investment: Bridging the Gap between Public and Investor Needs*.

Mechanics

Building an integrated policy framework does not happen overnight, but as a result of a sustained effort through a fundamentally multistakeholder process. It requires bringing together not only government agencies and ministries, but also leaders from across industries. The exact process will differ depending on whether it is initiated top-down or bottom-up. It will also depend on the role of government in the energy sector, the degree of planning centralization and the technical capabilities of each stakeholder.

Regardless of how the process is shaped, an integrated policy framework should follow specific principles to be most effective:

- **Frame the long-term direction** for the energy sector as a whole, providing a vision that is both specific in goals and the expected end-state, while maintaining sufficient flexibility to incorporate new technologies and other unforeseen changes.
- **Engage key stakeholders** to ensure that perspectives are included from across all industries and groups involved, enabling long-term buy-in and support for implementation.
- **Provide certainty to investors** by minimizing political and regulatory risk, especially retroactive changes to policy, and increasing contractual and structural certainty through consistent legal enforceability.
- **Focus on transparency** by developing high-quality project data, including up-to-date long-term national development plans.
- **Acknowledge the needs of private capital** and build the appropriate environment to encourage investment, such as by determining funding structures that align the interests of investors with policy by targeting public financial support where it is needed to attract, not crowd out, private capital.

Implementation examples

The formation of integrated policy frameworks can be seen through both top-down and bottom-up examples.

A clear example of the top-down creation of an integrated policy framework is the Climate Change Act passed by the UK parliament in 2008. The act set forth a clear vision for characteristics of the country's future energy use, and provided government accountability and roles related to energy- and climate-related planning. In particular, it created the Committee on Climate Change to lead the ongoing development of strategy and reporting on climate change. By laying out a framework for the government's intentions on addressing climate change, the act has successfully paved the way for additional policy and regulation and created investment certainty in the country.

In China, a bottom-up approach was taken by the Alliance of Pioneer Peaking Cities (APPC), which was created by the Chinese government to help implement its commitment under the Paris agreement. Highlighted in the November 2016 *13th Five-Year Plan: Greenhouse Gas Emission Control Work Plan*, the APPC intends to assist the Chinese government in its 2030 peaking goals by helping cities establish, meet and exceed their own goals.

The APPC offers a platform for Chinese cities to share knowledge and resources; leverage existing tools, programmes and knowledge; and spur innovation of new policy- and market-based solutions for cost-effective development below required mandates.

At time of writing, the APPC is comprised of more than 80 cities and provinces representing approximately 35% of China's population, 51% of its GDP, and 43% of its CO_2 emissions. Successes and lessons learned by this cohort of leading cities will be incorporated into the central government's 14th Five-Year Plan, to be issued in 2021, to support broader adoption.

Questions for policy-makers

- Do your current policies provide sufficient investor certainty and long-term intersectoral vision?
- From your position, how can you best support the creation of an integrated policy framework?
- Which stakeholders are key to include and how can they be engaged in creating an integrated policy framework?

Carbon pricing

Carbon pricing should be implemented as quickly as possible across the globe. National and international bodies should lead this charge, while in their absence subnational bodies should impose their own programmes.

Definition

Carbon pricing imposes charges on those who emit CO_2 (or CO_2e) into the atmosphere. It includes two main strategies for imposing these charges: emissions trading systems, also known as "cap and trade", and carbon taxes.[2] Implicit carbon prices, such as end-use taxes on petrol or the removal of fossil-fuel subsidies, are other important tools but are not discussed here.

Rationale for importance

Carbon pricing is broadly accepted as the single most efficient and effective policy tool for reducing CO_2 emissions as it can influence decision-making on an economy-wide scale that overlays and supports other policies.[3]

[2] World Bank. http://www.worldbank.org/en/programs/pricing-carbon
[3] For example, carbon pricing supports the development of more efficient electricity market design, and further encourages investment in energy-efficiency projects.

At the same time, carbon pricing is not overly prescriptive – it provides price signals that incentivize changes in investment, operation and consumption patterns, but offers flexibility for companies and end users to optimize their behaviour. This, in turn, supports innovation in both technology and approaches, as new cost constraints induce technological progress and drive creation of least-cost solutions, while revenues from carbon pricing can be used to fund other low-carbon initiatives, such as R&D support.

In addition to the majority of studies reviewed for this report, carbon pricing has been endorsed by institutions from around the world and across the political spectrum, including business leaders, civil society organizations, multilateral development banks, and others.

Mechanics

Emissions trading systems place a cap on total allowed CO_2 emissions and then provide permits to companies for an allowance of CO_2 emissions under that cap. Penalties are charged for excess or unpermitted emissions, and companies are allowed to buy and sell emissions allowances to meet their needs.

Carbon taxes set a predefined price on either CO_2 emissions or the carbon content of a fuel. Depending on the structure of the programme, these taxes are then paid by the user or emitter.

Critical elements of successful carbon pricing strategies include consistency across sectors, stability in policy and strength of the policy. Consistent pricing across sectors is necessary to minimize loopholes and ensure a level playing field. Stable policy supports efficient investment decisions over the medium and long term, and creates market pull for clean-energy solutions. A strong price signal is important to ensure that the pricing is sufficiently meaningful to affect decisions; it is in this area where some of the current carbon pricing schemes, including the European ETS, have most significantly fallen short.

In addition to sectoral scope, the geographic scope of carbon policies is an important consideration. While regional, national and international examples all exist, each must address concerns about the risk of cross-border effects. These effects include emissions leakage that directly jeopardizes the intent of the policy by shifting carbon-intensive production outside the policy's jurisdiction.

Implementation examples

While carbon pricing has the potential for very significant impact, successful implementation of carbon pricing mechanisms has proven challenging. As with integrated policy frameworks, carbon pricing is best enacted nationally but, in some national legislative settings, its adoption has become politically controversial. This reality may encourage action at subnational levels – for example, the Regional Greenhouse Gas Initiative (RGGI) cap-and-trade system spanning 10 states in the north-eastern United States. In addition to finding policy-maker agreement, a carbon-pricing programme must be well designed to cost-effectively reduce emissions. However, examples of successful national implementation do exist. In particular, Sweden has shown how a carbon tax can reduce emissions without impeding economic growth.

Sweden has priced carbon emissions using a carbon tax since 1991. Since that time, Sweden has seen a 25% reduction in CO_2 emissions between 1991 and 2013, while GDP grew by 60% and the carbon tax increased from €30 per ton to €125 per ton, the highest level in the world. At the same time, Sweden's carbon tax triggered the rapid development of technology solutions, including energy-efficient district heating that is less carbon-intensive than traditional heating methods. Sweden has also structured their tax to reflect international considerations, including coordination with the EU Emissions Trading Scheme and by lowering the carbon tax on sectors in direct competition with untaxed foreign competitors.

Questions for policy-makers

- What is the political path to implementing a carbon pricing policy in your jurisdiction?
- Considering that political path, what geographic and sectoral scope can you pursue?

Smart subsidies

It is critical that policy-makers eliminate fossil-fuel subsidies and redirect funds towards effective, targeted programmes for clean technologies.

Definition

The OECD defines a subsidy as a financial contribution by a government that confers a benefit and either involves a direct transfer of funds (e.g. grants), potential direct transfers of funds or liabilities (e.g. loan guarantees); foregone government revenue (e.g. tax credits); government-provided goods or services other than general infrastructure; or income or price support.[4]

Subsidies can also include access to onshore and offshore resources through below-market leases and royalties, risk transfer in the form of subsidized loans or loan guarantees, cross-subsidies, import/export restrictions, price controls, purchase requirements and special regulatory exemptions. In addition to direct government contributions, the cost of negative externalities can be large and mask the real price of particular energy options.[5]

Rationale for importance

Subsidies to a particular industry or technological objective are established to accelerate or direct technical change; address problems with existing markets; or support struggling regions of a country. In some cases, this support has allowed specific industries to achieve proof of concept, or to get to scale and reduced deployment costs.

In many other cases, however, subsidies are driven by political power. They may flow to industries that would be fine without them, and are often difficult to end as the beneficiaries typically invest in protecting and expanding that government support. As subsidies are a form of non-market support, they should be also focused on solving known and specific problems or market failures they alone can address. The absence of private funding for early-stage technology research and development, for example, is not a problem that can be solved by market enabling policies like carbon pricing. Further, poorly designed and inefficient subsidies to any industry divert limited public resources away from social services or other more valuable uses.[6]

In particular, subsidies for the fossil fuel industry have been far higher in total, and have been in place far longer than support for clean energy. Subsidies to conventional energy tend to be permanent and often take forms that are difficult to quantify. Figure 1 shows how federal subsidies in the US have favoured fossil fuels over time.[7]

Even today, permanent subsidies for fossil fuels in the US exceed those for renewable energy by seven to one (Figure 2).[8] More than half of global fossil-fuel subsidies occur at the subnational level. Government commitments to reduce fossil-fuel subsidies, e.g. in the context of the G20, have not yet been consistently implemented.

Mechanics

Smart subsidies should follow design principles that guide towards efficient mechanisms supporting energy transition objectives – complementing, but not replacing, market mechanisms:

1. **Mandatory transparency and access to data** to ensure policies are not undermining commitments and are yielding expected outcomes. Costs and benefits should be clearly delineated and externalities accounted for to ensure subsidies are effective and efficient.[9]
2. **Align fiscal spending with climate and environmental objectives** while improving economic efficiency. This could include incentivizing competition between various subsidy options to achieve the lowest subsidy cost for any benefits attained.
3. **Encourage market-based competition** to allow all resources to compete on a level playing field. Market mechanisms should be designed to reward resources that provide certain attributes, such as lower carbon emissions, flexibility, resilience, etc.

[4] OECD. 2017. *OECD Activities To Improve Transparency On Fossil-Fuel And Other Subsidies*.
[5] Doug Koplow. March 29, 2017. *Testimony to U.S. Congress Hearing on Federal Energy-Related Tax Policy and its Effects on Markets, Prices, and Consumers*.
[6] Doug Koplow. 2014. *Energy Poverty: Global Challenges and Solutions*.
[7] DBL Investors. 2011. *What would Jefferson Do?*.
[8] Oil Change International. 2017. *Dirty Energy Dominance: Dependent On Denial*.
[9] The Governmental Accounting Standards Board might provide guidance for such accounting: http://www.gasb.org/home

Figure 1: Cumulative historical federal subsidies

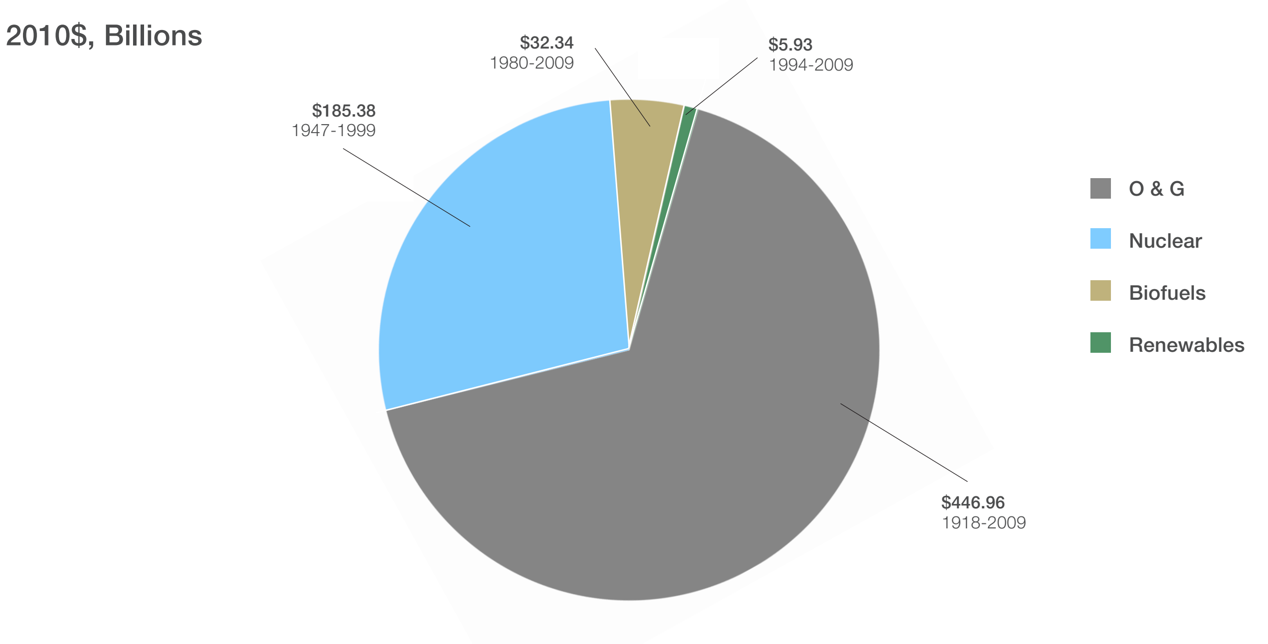
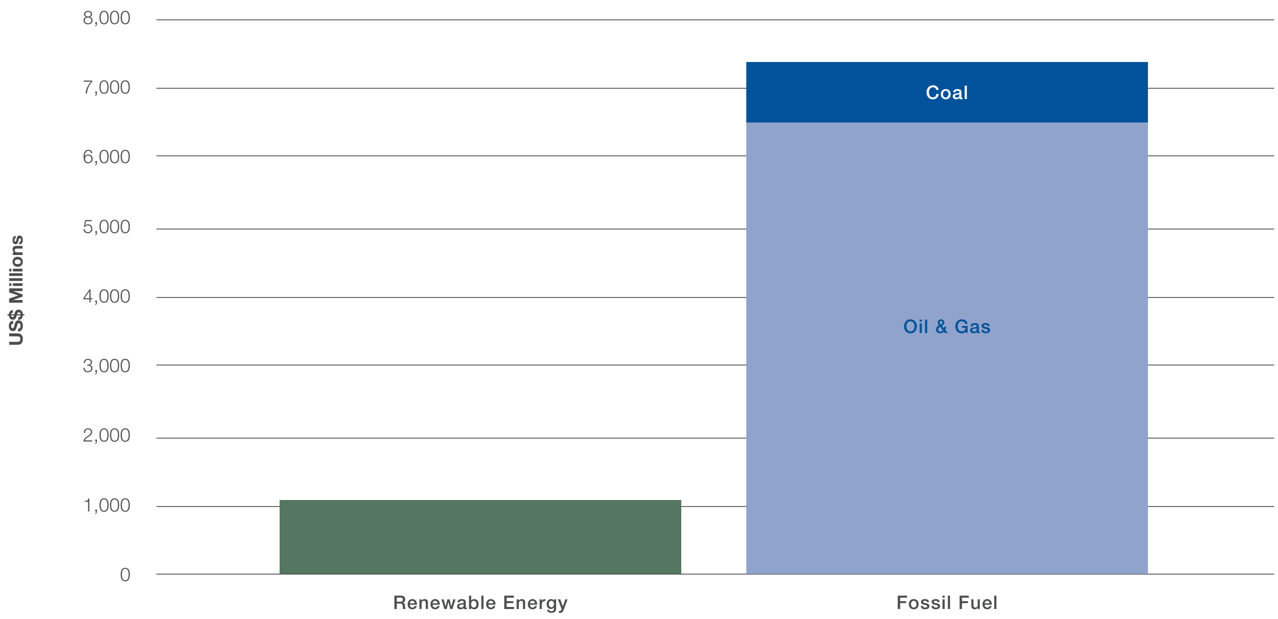


Figure 2: Value of permanent tax breaks for renewable energy vs fossil fuels, FY2016



4. **Consider publicly-funded pollution abatement a subsidy to the specific polluting industry** and tracked as such rather than counted as clean energy development subsidy.
5. **Facilitate public participation in all aspects of the planning process** so that consumers are able to define their own future – and how their taxpayer money is spent to achieve it.
6. **Encourage public-private partnerships and matching investment** when designing subsidy programmes for technology deployment. The federal government, as a provider of high-risk capital, could retain a share of the upside for successful projects and require private matching funds to help weed out weaker projects in advance.
7. **Elimination of fossil-fuel subsidies should consider economic impacts** to the state, region or country to avoid sudden elimination of these subsidies, sending an economy into a downward economic spiral. Plans for phasing out subsidies should include mechanisms to incentivize clean energy and provide a glide path for the economy to shift away from fossil-fuel resources.

Implementation examples

There are numerous examples of effective subsidy implementation. Two common types are tax credits and mandates.

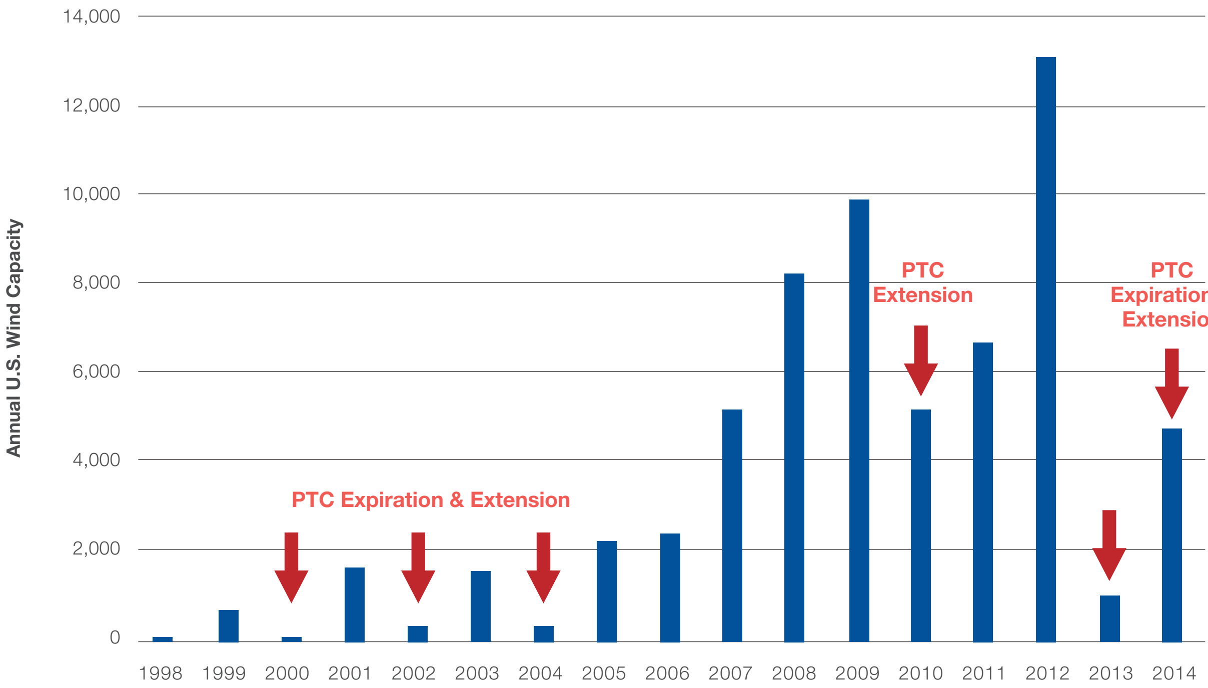
Tax credits, if designed effectively with a long enough runway and an incremental phase-down period, can be effective and efficient at spurring industry growth. For example, India and the US have offered accelerated depreciation of renewable energy assets in the first one to five years of operation.

The US Government has used both investment tax credit (ITC) and production tax credit (PTC) constructs to significantly affect deployment of wind and solar technologies, in particular. These programmes were not perfect at their start, as the credits historically had to be renewed every couple of years, resulting in a feast-or-famine development cycle (Figure 3).[10]

However, the programmes evolved– in late 2016, the credits were extended with a date-certain phase down towards the end of the subsidy. The phase down structure has created more certainty for investors and spurred unprecedented growth in the solar and wind industries.

[10] Union of Concerned Scientists

Figure 3: Impact of production tax credit expiration and extension on US annual installed wind capacity



Mandates can be similarly powerful in nudging behaviour and sparking an industry to scale. In 2013, the state of California mandated that the three largest utilities deploy collectively 1.3 GW of energy storage of all types. The impact of this mandate has been to create a new industry in the state, with scores of new companies relocating and starting up (Figure 4).[11]

When the utilities issued their procurements, they were over-subscribed with cost-effective proposals to deploy energy storage. Because of the rapid deployments and ecosystem in California, when a major gas plant shut down because of a leak, 70 MW of storage could be procured and built cost-effectively within six months to replace that peaking capacity.[12]

[11] California Energy Storage Alliance
[12] https://www.greentechmedia.com/articles/read/aliso-canyon-emergency-batteries-officially-up-and-running-from-tesla-green

Questions for policy-makers

- Does your portfolio of subsidies contain fossil-fuel subsidies or other ineffective subsidies?
- Which of your fossil-fuel subsidies can be ramped down quickly?
- Do your subsidies fully support your energy transition policy objectives, or are new programmes needed?

Figure 4: California energy storage businesses

Support innovation

Policy continues to be necessary to ensure that both public and private sectors are efficiently pushing innovation forward in support of energy transition goals, and policy-makers should ensure that they are providing the programmes and support necessary.

Definition

Innovation in the energy sector embraces problem-solving at every level, from scaling of existing technologies to advanced technological solutions to changes in business models and management practices. Here we refer to policies that support everything from fundamental research and development (R&D) to shepherding specific innovations to commercialization.

Rationale for importance

Innovation to improve existing technologies and develop new ones provides a powerful mechanism to further accelerate the energy transition. Innovation will be of critical importance in achieving climate and emissions goals, as well as in ensuring profitability for firms operating in the energy sector. Governments, business, universities and civil society must work together to create a propitious innovation ecosystem that will generate new technologies and systems.

Recent years have seen significant innovation in the energy sector, in both hydrocarbons and alternative energies. In the shale, tight and heavy oil industry, new technologies and new technological combinations have improved recovery rates and lowered costs from unconventional sources. In the renewables sector, innovation has combined with economies of scale and effective public policy to produce a surge in clean generation capacity, and has profoundly altered the outlook for energy efficiency around the world by making possible significant energy savings.

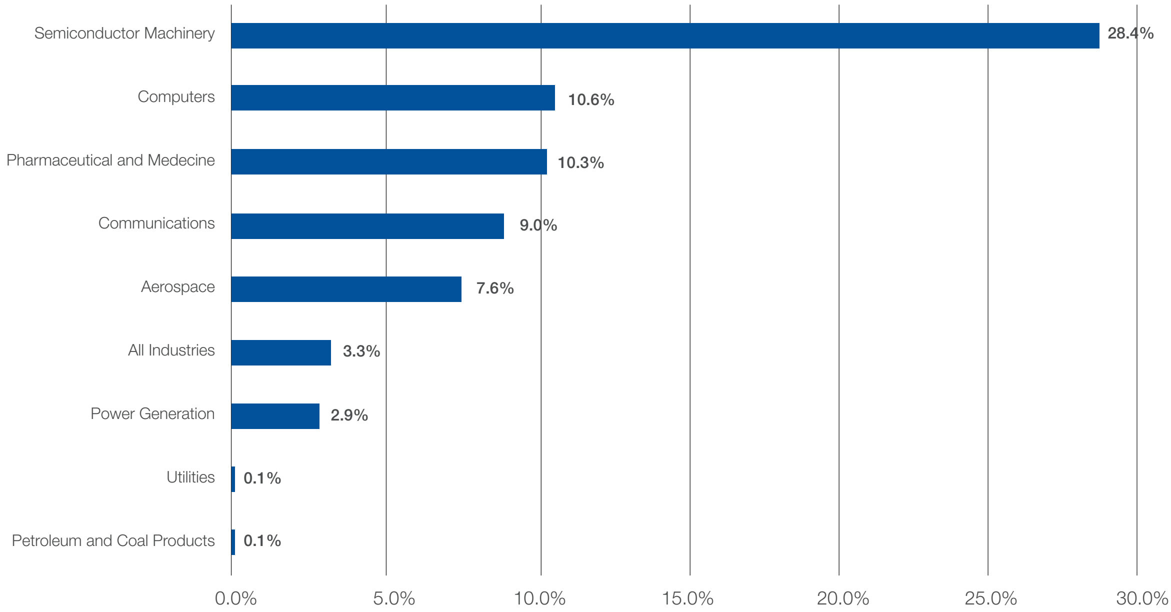
Mechanics

Innovation operates within an ecosystem of four main components: government, infrastructure, funding and community. This ecosystem varies from place to place, but each element is essential:

1. **Government**'s role is to unite and enhance the other aspects of the innovation ecosystem. In the energy sector, governments use policy to enhance innovation through innovation-friendly regulation and investment in R&D while reducing barriers to commercialization through smart codes and standards, especially for emerging low-carbon technologies.
2. **Infrastructure** includes laboratories and institutions necessary to support scientific and technological missions.
3. **Funding** comes from both government and private-sector investment. As part of the Paris agreement, over 20 countries have committed to double their government funding for energy research and development. Large firms dedicate significant funds to innovation, and the venture capital industry is shepherding some technologies through the “valley of death”. However, compared to other sectors, the energy industry as a whole dedicates relatively little money to R&D (Figure 5).[13]

[13] US National Academy of Sciences

Figure 5: US industry R&D as a percentage of sales



4. **Community** and collaboration among researchers is needed to support the sharing of ideas and insights to leverage a larger network, ultimately accelerating the pace of innovation.

Policy-makers must holistically evaluate these levers to drive energy innovation. Policy can then address barriers and provide innovation support where there are gaps.

Implementation examples

The Government of India's bulk procurement programmes are a leading example of public-sector innovation in the development of clean technology markets. In its Domestic Efficient Lighting Program, India rapidly scaled the market for LED bulbs through competitive tenders. The first year of tenders saw LED prices fall by 55%, the sale of 60 million bulbs, and a reduction in nationwide electricity demand by nearly 2 gigawatts. India expects tenders for another 700 million bulbs through 2018 will save consumers $5.9 billion annually.

Similarly, the top 10 developers in a recent 500 megawatt solar PV auction quoted tariffs below $.046/kilowatt-hour, leading the government to cancel 14GW of new coal-fired power plants. Such efforts contributed to 2.5GW of capacity commissioned between April and September 2017, bolstering the Indian government's plan for 100GW of utility-scale solar by 2022.

In the case of upstream support for technological innovation, the US Government has created a successful direct R&D investment programme named Advanced Research Projects Agency-Energy (ARPA-E). Modelled after a highly successful programme at the US Department of Defense, ARPA-E is an agency tasked with promoting and funding R&D for advanced energy technologies. Since its inception in 2007, ARPA-E has invested more than $1.5 billion in 580 projects and attracted a further $1.8 billion in private funding to carry projects to the next stage of development. Fifty-six new companies have been created out of the programme. ARPA-E's design has proven resilient to changing political administrations but, under the current administration, the programme is now at risk.

Mexico has similarly supported R&D by establishing its Energy R&D Funds in 2008. These are designed to promote research and technology to address energy-sector challenges, including increased energy demand, pollution and climate change. The funds are supported by the Federal Income Budget Law, which stipulates that 0.65% of oil revenues be divided among the Energy R&D Funds and the Mexican Institute of Petroleum.

Around the Paris climate negotiations, 22 governments committed to doubling their government R&D funding to accelerate the energy transition. Some initial progress has been made, but the Mission Innovation initiatives across countries have so far been fragmented. A coordinated effort to focus the funding on critical technology pathways in close coordination with relevant private-sector companies would enhance the effectiveness of the Mission Innovation.

Questions for policy-makers

– Are current R&D investment levels for clean energy in your jurisdiction sufficient to support energy transition goals?
– What new policies can you enact to further support R&D and ensure it is efficiently directed and supported throughout the development cycle?
– How can Mission Innovation become more effective and partner with the private sector?

Energy efficiency

Energy efficiency continues to be the most cost-effective energy option, and policy-makers should remove barriers to adoption, including providing appropriate financial mechanisms.

Definition

The International Energy Agency defines energy intensity as the amount of energy consumed per activity or output. Energy-efficiency measures are those that reduce the energy intensity of products and industries and thereby increasing energy productivity. The range of efficiency measures is too great to list here, but there are important opportunities across all industries, including the built environment, transport, the power sector, and industry.

Rationale for importance

Energy efficiency has long been shown to be the most cost-effective approach to reducing fossil-fuel use – it is cheaper to avoid the use of a kilowatt altogether than it is to provide that kilowatt with clean energy. However, adoption of many energy-efficiency measures has been far slower than economics would suggest.

Barriers to adoption vary depending on the type of energy-efficiency measure, but include the default bias of non-energy-efficient options, split incentives, greater upfront capital costs and information barriers. For example, the concept of "rebound effects" – that actual energy-efficiency savings diminish in light of new uses for the energy saved, especially in industry – is more frequently referenced than has been proven justified by authoritative studies scanning the academic literature on the topic. In light of these challenges, policy is often the right tool to address these barriers.

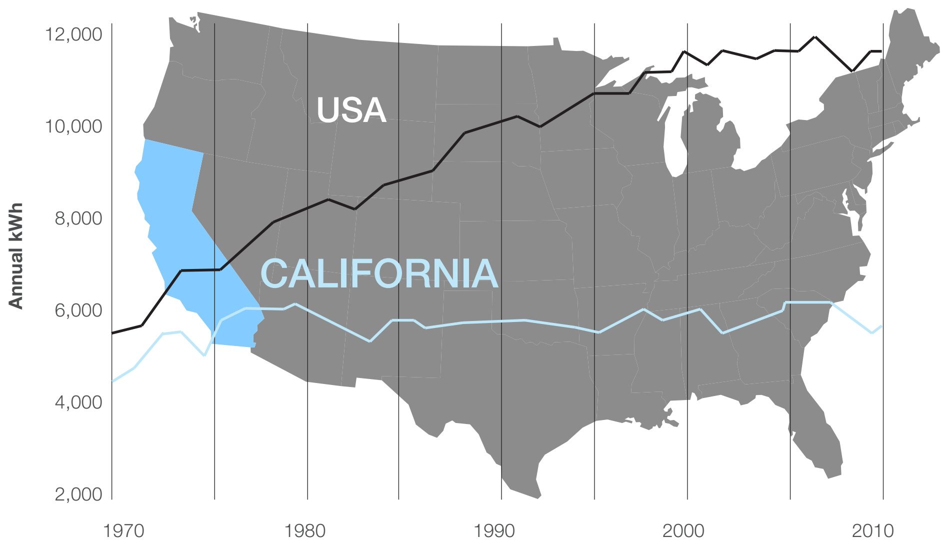
The implementation of energy-efficiency policies should begin with delineation of appropriate goals. This involves identifying the energy-intense sub-sectors where significant energy-efficiency potential exists, and establishing reduction targets for the short, medium and long term.

Once goals are defined, policy should drive towards removing barriers to adoption of energy-efficiency measures. These barriers vary depending on the measure, and therefore the policy needs will also vary by industry:

- In the built environment, major opportunities exist to implement and enforce building codes and appliance standards to ensure that baseline products and buildings are sufficiently energy-efficient.
- In transport, corporate average fuel economy (CAFE) standards are a proven mechanism for increasing fuel efficiency across vehicle fleets.
- Utilities in the power sector are often incentivized to increase electricity sales, rather than encourage energy efficiency. Decoupling regulation has been an effective tool to correct this by separating utility profits from volumetric sales.
- In industry, a wide range of opportunities exists to improve end-use energy efficiency, such as more-efficient motors and drives, waste heat recovery, and sensors and controls; incentives have been a common approach to encouraging adoption of these measures.

Broadly, the most effective way to drive energy efficiency is through mandatory standards. In addition, there is a need for policies that encourage investment in measures that require higher upfront costs. Similarly, ensuring the availability of financing mechanisms is a key component of energy-efficiency policy, including policies to support new financing tools and ensure capital availability. Financial incentives can be a broadly applicable tool, as noted above for industry, as can mandates, as noted above in the built environment.

Figure 6: Per capita electricity consumption



Source: US Energy Information Administration

Implementation examples

In an example of setting energy efficiency goals as a first step before targeted policy measures, Mexico created a broad energy-efficiency policy. The policy sets a goal of reducing the country´s energy intensity target by 42% before 2050. The Energy Transition Law was then implemented to require that energy efficiency include all actions that lead to an economically viable reduction of the amount of energy required to meet the energy needs of the services and goods society demands, ensuring an equal or superior level of quality.

The US state of California has been an early leader in using building energy codes as a policy tool to drive efficiency. In 1977, California enacted Title 24 of the Code of Regulations, which imposed building energy standards to be implemented statewide. Among other things, these standards require greater levels of efficiency in new construction, and over time have contributed to keeping California's per capita electricity use flat (Figure 6).

In an application of appliance-efficiency standards, Australia has implemented a performance standard for refrigerators since 1999. The Minimum Energy Performance Standards (MEPS) programme was introduced to prevent manufacturers from selling outdated or energy-inefficient refrigerators in Australia. The MEPS programme sets very aggressive targets, which initially were so stringent that no commercial products at the time were compliant. The resulting manufacturer response, coupled with a parallel consumer energy rating labelling programme, led to a reduction in refrigerator energy consumption of more than 60%. The programme has been replicated with other appliances, including washing machines, air conditioners and lighting.

Questions for policy-makers

- Can strict mandates to drive energy efficiency contribute to the energy transition as well as to broader economic goals?
- What other policies are necessary to remove barriers to the large-scale implementation of energy-efficiency technologies?

Electricity market design

To support rapidly evolving electricity systems, policy-makers must proactively support alignment of electricity market design with the rules and products required to efficiently operate increasingly renewables-based power systems.

Definition

Electricity market design broadly refers to the structure of wholesale and retail transactions within the power sector, including the products and services available and the rules that govern them. While all electricity systems inherently use some structure for these transactions, the key consideration as the energy transition moves forward is how the existing design must proactively adapt to the changing reality.

Rationale for importance

Historically, electricity systems have been centralized, with power produced at utility-scale plants and delivered to consumers by vertically integrated monopolies. Since the 1980s, many markets have shifted towards a restructured, market-based approach. Regardless of the current structure, all power systems are in the midst of a revolution driven by rapidly evolving technologies. Variable renewable resources have become the most cost-effective energy source for many systems, and multidirectional power flow has become a reality as the adoption of distributed energy resources has skyrocketed, including distributed generation, demand response, energy efficiency and storage.

New architectures for electricity market design are required to navigate through, and prepare for, this quantum leap in power system requirements. At their core, these policies should ensure that electricity systems are reliable, resilient, secure, environmentally sustainable and cost-effective. However, most existing market designs are poorly suited to this task. Instead, they create barriers to the integration of new technologies by failing to incentivize new approaches to value creation, and by creating cost misallocations, inefficient investment and operational risks.

All of these factors combine to slow progress and blunt innovation, as new technologies and companies are blocked from participating in the system by outdated market design.

Mechanics

Market designs must adapt to better integrate variable and demand-side resources and other distributed energy resources into the power system. To do so, while continuing to provide reliable electricity at the least cost to customers, market design needs to address the increasingly complex physical nature of power systems. New resources result in electricity costs that change significantly with time and location, which presents challenges of solving complex intertwined investment and operational decisions to minimize both short- and long-run costs.

Given the various starting points of electricity systems around the world, there is unlikely to be a one-size-fits-all approach to electricity market design in the near-term. However, there are several key principles to which all electricity markets should adhere:

- **Provide a stable environment for investment**, as transparency and predictability is paramount to attract investors and minimize inefficient allocation of capital (e.g. long-term investments in assets that do not support future system needs).
- **Maintain technology neutrality** by structuring market products and rules such that they encourage innovation by opening the door to service provision by any capable resource – including demand-side and distributed resources.
- **Use temporally and locationally differentiated price signals** to minimize cost by incentivizing service provision when and where it is most valuable.
- **Recognize the need for flexibilit**y in the system to accommodate an increasingly variable supply portfolio, and send price signals or create new products to incentivize resources to provide this service.

Implementation examples

Managing these market design transitions is just as complex as the design of the markets themselves. Similarly, transforming the industry paradigm poses challenges from the perspective of investors and financiers. Deep commitment from policy-makers is required. There are excellent examples of this commitment to market reform in both wholesale and distribution environments.

One example of reforming market design in competitive **wholesale markets** can be seen in the US, where the Federal Energy Regulatory Commission (FERC) issued Order 755 in 2011. This order requires wholesale markets to pay for the performance of any technology able to respond with speed and accuracy to grid operators' signals. As it happened, energy storage technologies like batteries and flywheels are particularly well suited to this grid service.

This pay-for-performance construct caused a boom in the deployment of energy storage facilities and allowed those technologies to become more cost-effective – simply by compensating them appropriately for services provided to the grid. Figure 7 shows how the industry grew as a result of the market-based mechanism.[14]

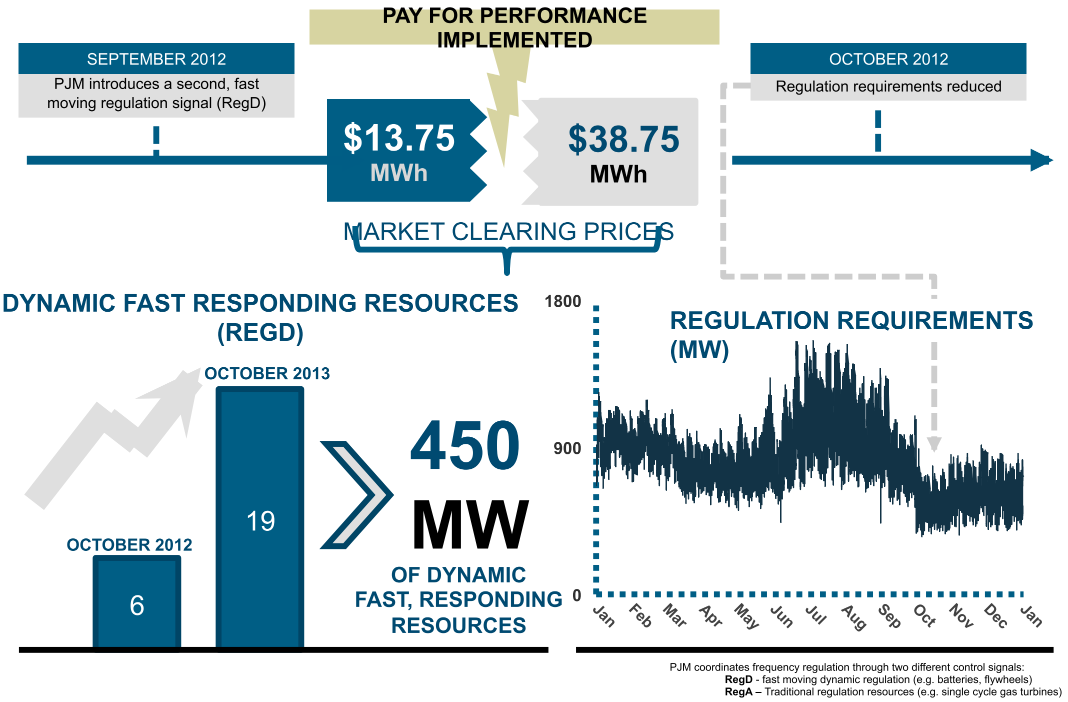
In a distribution environment, the US state of New York has enacted a multi-year effort, Reforming the Energy Vision (REV), which requires the state's distribution utilities to create markets for service provision by distributed resources. This includes creating new system operation functions, developing new markets with distribution-level products, and providing new opportunities for customer-owned resources to participate in wholesale markets through aggregation. These goals are tied to supporting the state's clean energy targets.

Questions for policy-makers

- Does the current state of market design in your electricity system enable or hinder the energy transition?
- What policy or regulation can be enacted to accelerate the pace of market alignment with evolving electricity system needs?
- Which stakeholders can you engage to begin moving these new policies forward?

[14] The Energy Collective

Figure 7: Industry growth as a result of pay-for-performance



Summary of recommendations

It is clear that there are consensus policies to support the energy transition that all policy-makers should take into their own hands to implement. These policies range from those that span the energy sector to those that focus on individual industries. But each can be pushed forward in some form by policy-makers at any level of government.

Takeaways for each recommended policy

- **Integrated policy frameworks –** Policy-makers should prioritize the creation of integrated policy frameworks that create a long-term cross-sectoral vision and stable policy environment, providing certainty to attract investment.
- **Carbon pricing –** Carbon pricing should be implemented as quickly as possible across the globe – national and international bodies should lead this charge while, in their absence, subnational bodies should impose their own programmes.
- **Smart subsidies –** It is critical that policy-makers review their current portfolio of subsidies to eliminate existing fossil-fuel subsidies and to redirect funds towards effective and targeted programmes for clean technologies.
- **Support innovation –** Policy continues to be necessary to ensure that both public and private sectors are efficiently pushing innovation forward in support of energy transition goals, and policy-makers should ensure that they are providing the programmes and support necessary.
- **Energy efficiency –** Energy efficiency continues to be the most cost-effective energy option, and policy-makers should remove barriers to adoption, including providing appropriate financial mechanisms.
- **Electricity market design –** To support rapidly evolving electricity systems, policy-makers must proactively support alignment of electricity market design with the rules and products required to efficiently operate increasingly renewable systems.

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