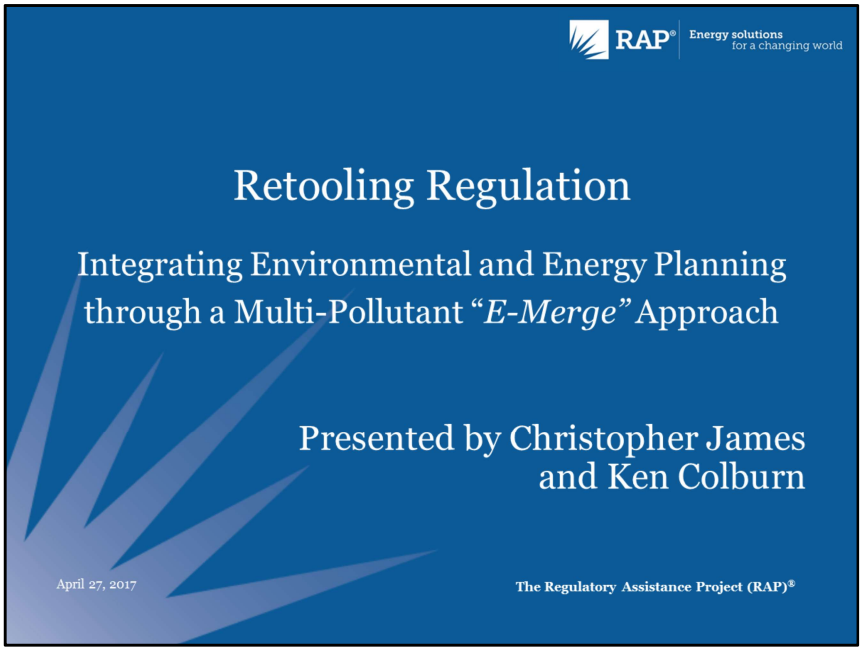
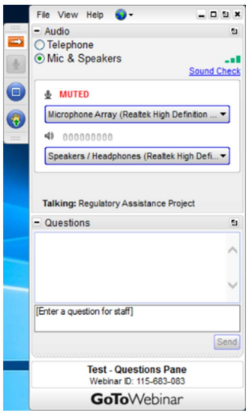

RAP®
Energy solutions
for a changing world
Retooling Regulation
Integrating Environmental and Energy Planning through a Multi-Pollutant "E-Merge" Approach
Presented by Christopher James and Ken Colburn
April 27, 2017
The Regulatory Assistance Project (RAP)®

Questions

Please send questions through the Questions pane.



Our Experts

Ken Colburn

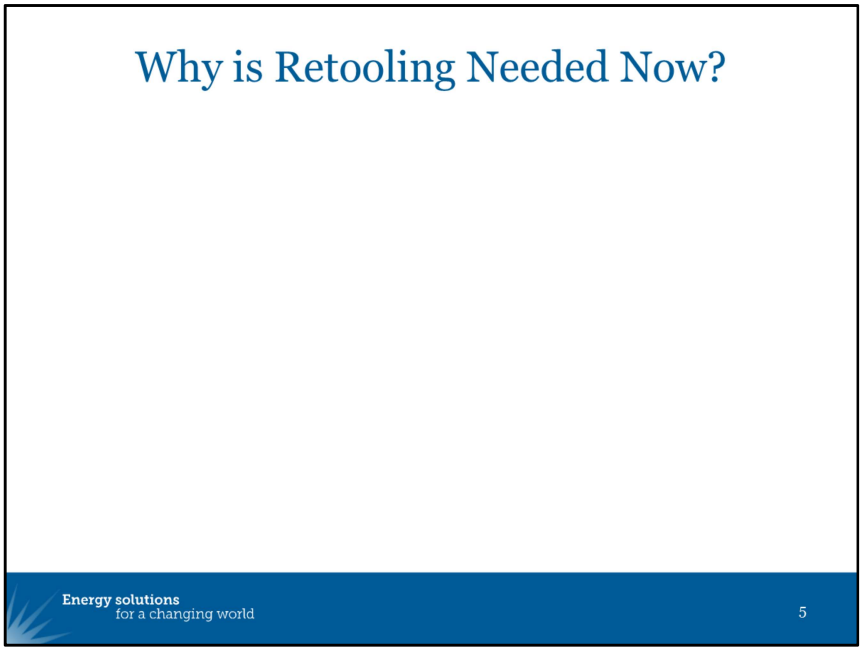
Christopher James

We've characterized this webinar and related blogposts as 'retooling', because it's a good characterization of changes occurring in power sector regulation. Our society has utilized the hand tools and electric machine tools of yesteryear for generations,

…but in the last ~2-3 decades computer-controlled machine tools have taken over.

These tools all *removed* material in order to "reveal" the product within. Today we are witnessing game-changing technologies, called "additive manufacturing" or "3D Printing," that can "print" a product layer-by-layer!

We've seen a similar evolution in the power sector from simple to complex centralized generation and grid systems, and today are witnessing game-changing, clean DERs, micro-grids, and communications system.



But… Why is Retooling Regulation needed just now?

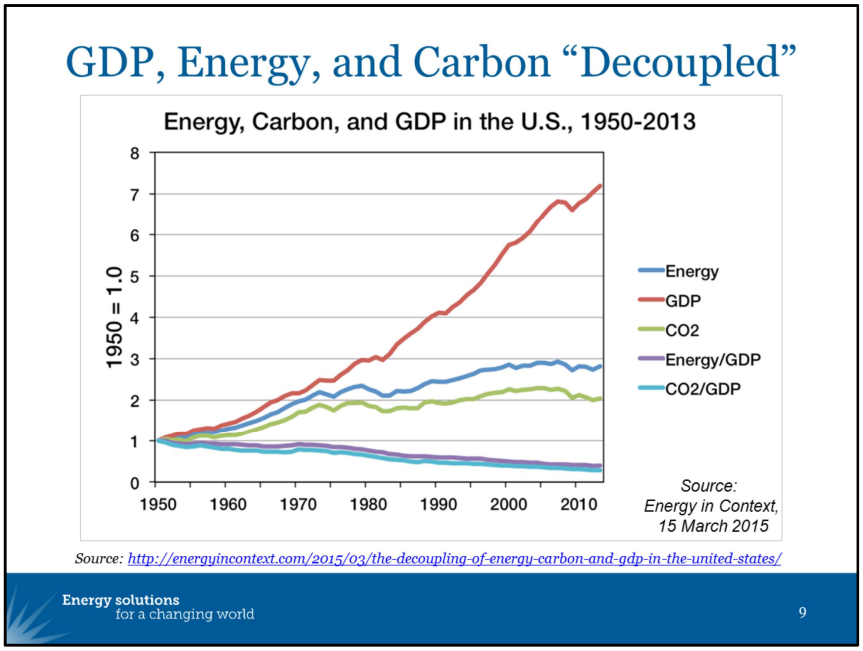
Because today's energy and environmental ***regulatory paradigms*** need retooling to take advantage of these new technological opportunities, just as yesterday's *manufacturing* paradigms did.

Let's look more closely at "why?"…

- First, utility regulation has become far more difficult and uncertain
  - The power sector is swiftly transforming, largely due to new and better technologies and software for both the supply side and for load.
  - Renewable energy and distributed energy resource (DER) technologies are certainly chief among them, but storage, beneficial electrification, analytics/"big data", grid management, micro-grids, internet of things, blockchain, and others are also playing key roles.
  - For example, load factor used to be the holy grail in grid management, now it is flexibility instead (i.e., not capacity factor, but response time!).
  - A telling example is: How can utility regulators assess project investment prudency over 20+ years with any confidence under these conditions?

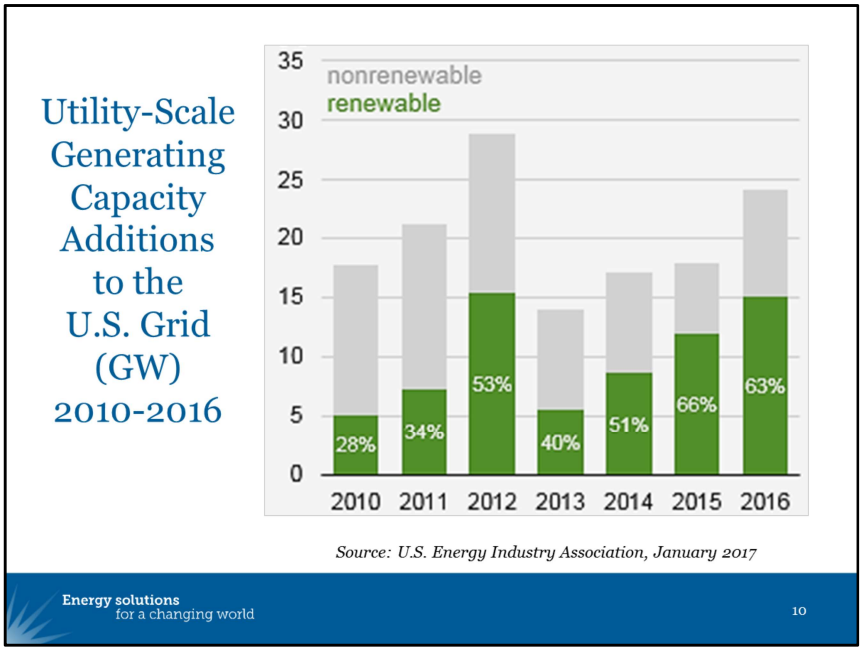
- Air quality and climate regulation has become similarly difficult:
  - The Clean Air Act (CAA) has secured ***remarkable*** public health achievements, but after almost 50 years, it is showing signs of age…
  - Today we recognize that controlling emissions of various pollutants can have interactive effects – positive or negative – yet the CAA strictly prescribes serial, pollutant-by-pollutant regulation.
  - Also, the health science that underpins determination of air quality standards has rapidly advanced. Under the CAA, EPA is obligated to adopt standards that provide "an adequate margin of safety", but how can it do so when modern detection technologies show linear pollutant impacts all the way down to zero?

- On top of these developments, and in the midst of this disruption, energy and air quality/climate policies impact ***each other*** more than ever:
  - Frances Cairncross, former editor at *The Economist*, said (and I'm paraphrasing), "Energy has the greatest impact on the environment and public health of any human endeavor."
  - And EPA has been characterized in recent years as overreaching and trying to "determine" US energy policy.



Let's look at a some examples of these disruptive elements.

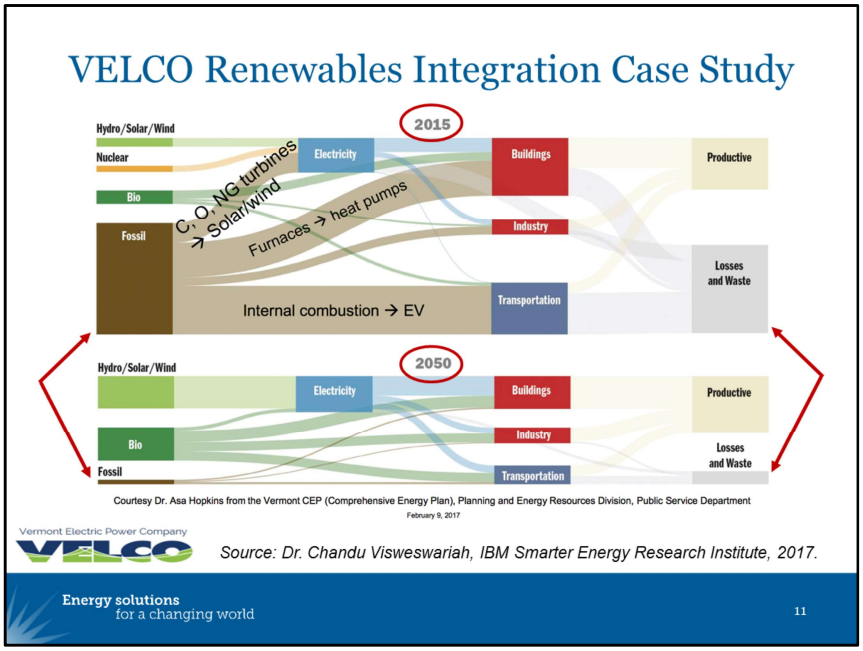
In this chart, it's easy to see how dramatically GDP (red line) and Energy (blue line) – which for a long time moved in lockstep – have been *delinked*, largely through greater energy productivity and efficiency.



Flat or declining CO2 emissions are not surprising when you look at recent developments on the "supply side" in electricity generation.

For the last several years, ***more than half*** of all new generating capacity added to the US grid (i.e., new "power plants") has been renewable resources, primarily wind and solar.

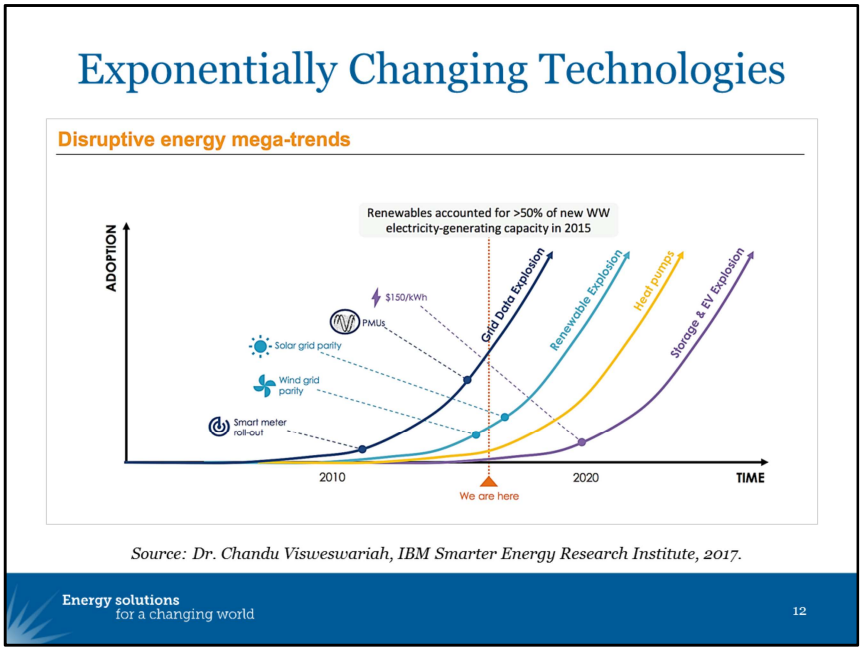
[In 2016, 62% were wind and solar.]



Further evidence of resource changes are clear in this graphic, which looks busy, but tells a big story. It shows overall energy inflows (on the left) and the uses to which energy is put (in the center and on the right).

This particular chart, developed by the Vermont Public Service Department, shows massive changes between 2015 (top) and 2050 (bottom) in two respects:

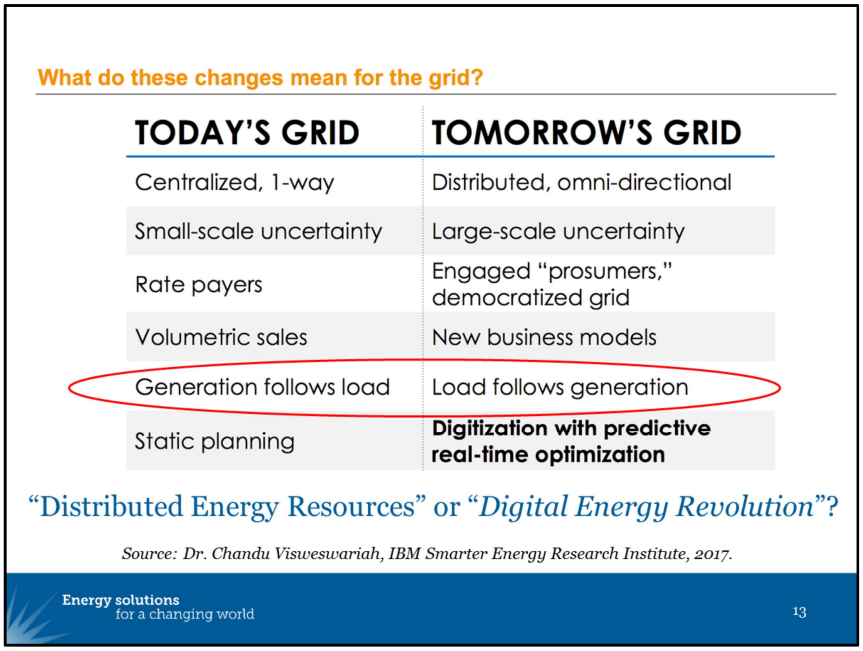
1. The decline in fossil energy inputs at the left, and a parallel increase in RE and bio resource inputs, and
2. A large reduction in energy losses and waste at the right.



That kind of transformative change is not surprising when you look at the rapidly advancing technologies underpinning the production and use of electricity, including analytics (big data), renewables, heat pumps, electric vehicles, and storage…

– all of which are improving ***exponentially***.

PMUs = Synchrophasors. With an increasingly more complex network of generation and loads, it is imperative that the electrical conditions of transmission and distribution networks are continuously being observed through advanced sensor technology—PMUs and uPMUs.



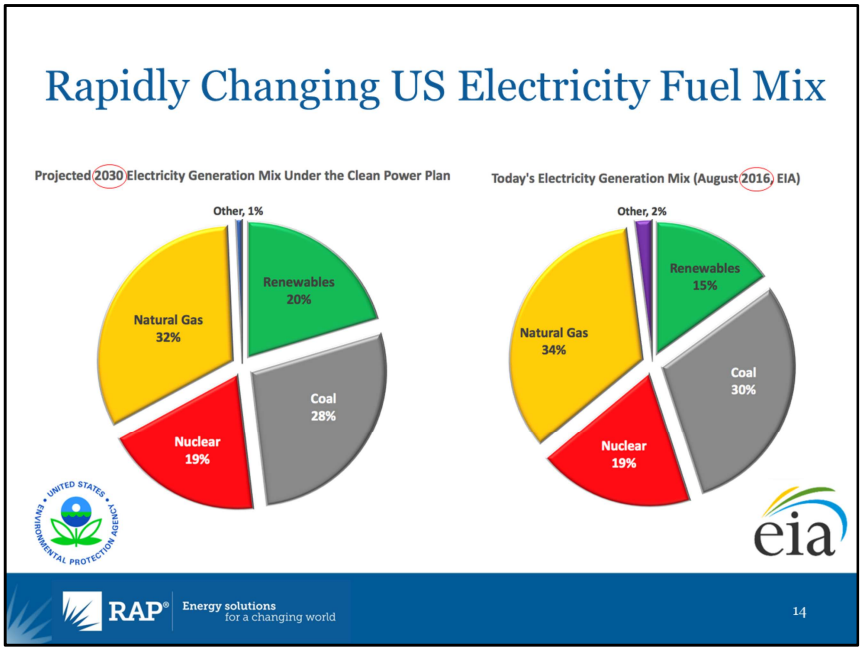
And, in turn, the effects that those technological changes are having on the grid.

No doubt you're already aware of many of these developments – the two-way grid, "prosumers", and new business models.

My favorite – the highlighted one "load following generation" – is a sea change for the grid. We've been managing supply for over 100 years, and now are able to manage demand.

Supply ***and*** demand? That sounds like a market!

What happens when a regulatory paradigm designed to reflect the ***absence*** of a market, finds a market at the door?



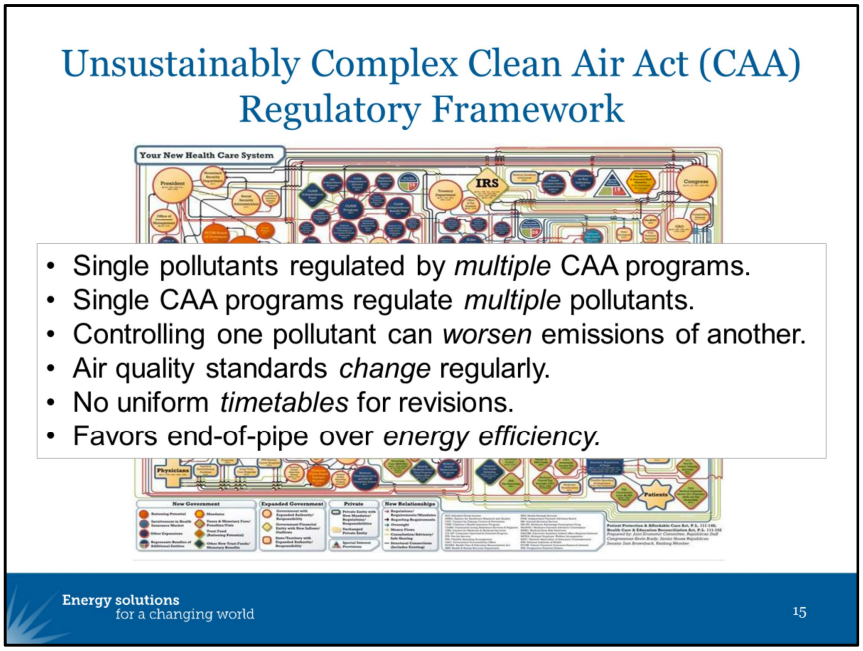
This discussion has mostly related to utility issues, but change is happening equally fast and profoundly on the environmental side as well.

Here's an example, showing on the left what EPA estimated the US power generation fuel mix would look like in ***2030*** under the Clean Power Plan. The pie chart on the right shows what the actual fuel mix was – in ***August 2016***!

Now, fuel mix doesn't equal emissions, and there are still +/- 5% points to go, but the direction and pace are evident!

Source:

http://www.eia.gov/todayinenergy/detail.php?id=25392
http://www.carbonbrief.org/a-detailed-qa-on-obamas-clean-power-plan
http://www.eia.gov/forecasts/steo/report/

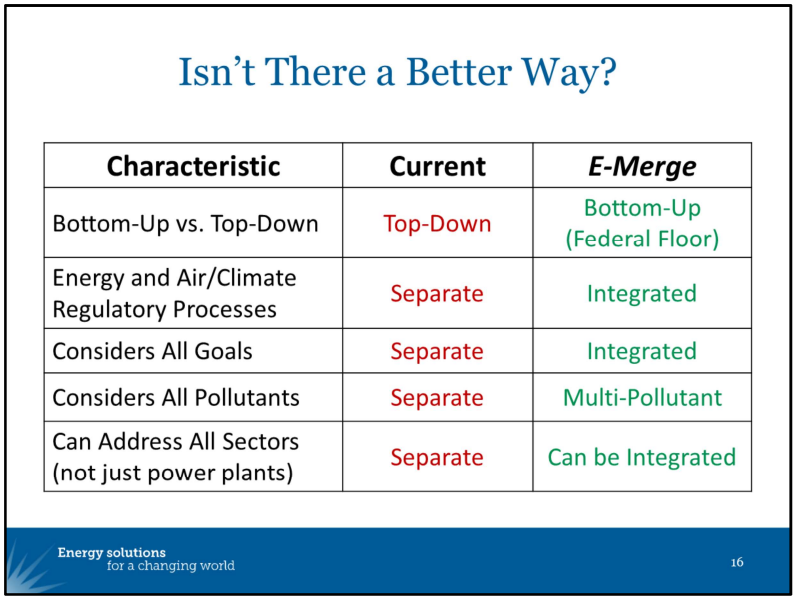


And it's not clear that the Clean Air Act is able to keep up with this kind of change.

I don't know as anyone has mapped the complexity of the CAA, but many of you may recall this schematic of the Healthcare Reform Proposal back in 1993, an era of similar vintage as the CAA Amendments of 1990.

Some of the CAA's inherent – and unsustainable – complexity includes that:

- Single pollutants are regulated by *multiple* CAA programs.
- Single CAA programs often regulate *multiple* pollutants.
- Controlling one pollutant can *worsen* emissions of another.
- Standards *change* regularly.
- There is no uniform *timetables* for revisions.
- And when the CAA was written, it anticipated end-of-pipe control measures, which has made it hard to apply preventative measures – like energy efficiency!



This complexity begs an obvious question: ***Isn't There a Better Way?…to Streamline Processes, Optimize Outcomes, and Reduce Risk/Uncertainty?***

- State and local government can't escape public health obligations imposed by the CAA (and hopefully they wouldn't want to)…
- But they CAN seize the initiative and take control of the process – ***bottom-up*** instead of top-down – as long as they stay above the floor imposed by federal regulations.

- Rather than conducting separate and distinct regulatory processes, utility regulators, environment departments, and state energy offices can ***integrate*** their work – much like the joint efforts spurred by the Clean Power Plan before it was stayed.

- The state's consideration of multiple public health and energy reliability and affordability ***goals*** can also be integrated, so that they can be co-optimized rather than conflict with each other.

- And similarly, co-optimization can't happen if you're only considering one pollutant at a time, with requirements looming for others just around the corner. E-Merge applies a comprehensive, ***multi-pollutant*** approach.

- Finally, state-initiated and –controlled processes aren't constrained to specific ***sectors***. Unlike the CPP, where emissions reductions had to come from the power sector, emissions reductions necessary to meet the state's goals could be secured wherever it is most cost-effective to do so.

- The ***benefits*** of E-Merge's comprehensive co-optimization and greater certainty would be

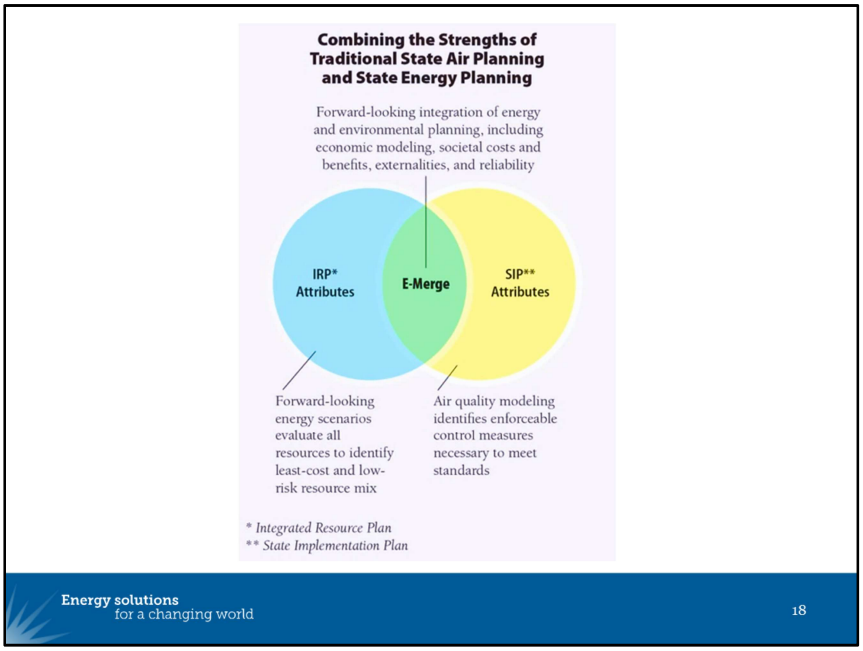
to:

- Streamline regulation
- Reduce regulatory burdens and costs of compliance
- Reduce risk, and
- Encourage economic development

So the E-Merge process puts states (or county or local governments) in the driver's seat

- By seizing the initiative and controlling the process, states can explicitly integrate state ***regulators***' efforts
  - Public utility commissions
  - Air/Environmental agencies
  - State energy offices
  - (Transportation Departments too, eventually?)
- And rather than stovepiped piecemeal approaches, they can comprehensively address the state's regulatory ***goals***, for:
  - Public health, air quality, climate
  - Safe, reliable, affordable, clean energy
  - State policies on renewable energy (RPS) and efficiency (EERS)
- And of course do so in an explicitly ***multi-pollutant*** fashion.

Note, this process should be coordinated with the appropriate EPA Regional Office, as these offices liaise with states and also coordinate with EPA policy and technical headquarter offices in Washington, DC and Research Triangle Park, NC respectively."

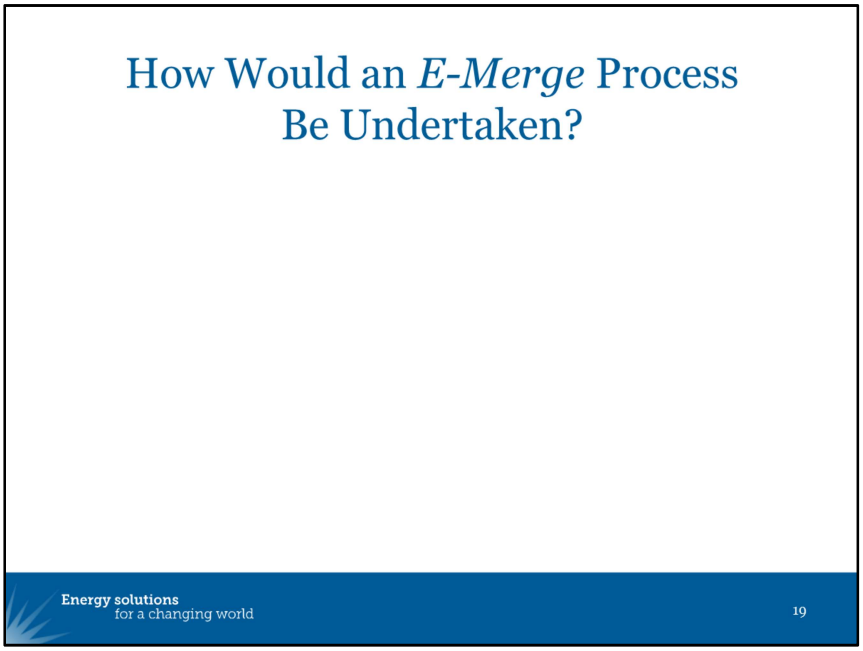


We like to think of E-Merge as a ***Venn diagram*** combining the strengths of traditional utility least-cost Integrated Resource Planning (IRP) and traditional EPA state implementation plan (SIP) approaches.

IRP looks ***forward***, and focuses on cost and reliability, but omits any consideration of public health and other costs borne externally to the power sector.

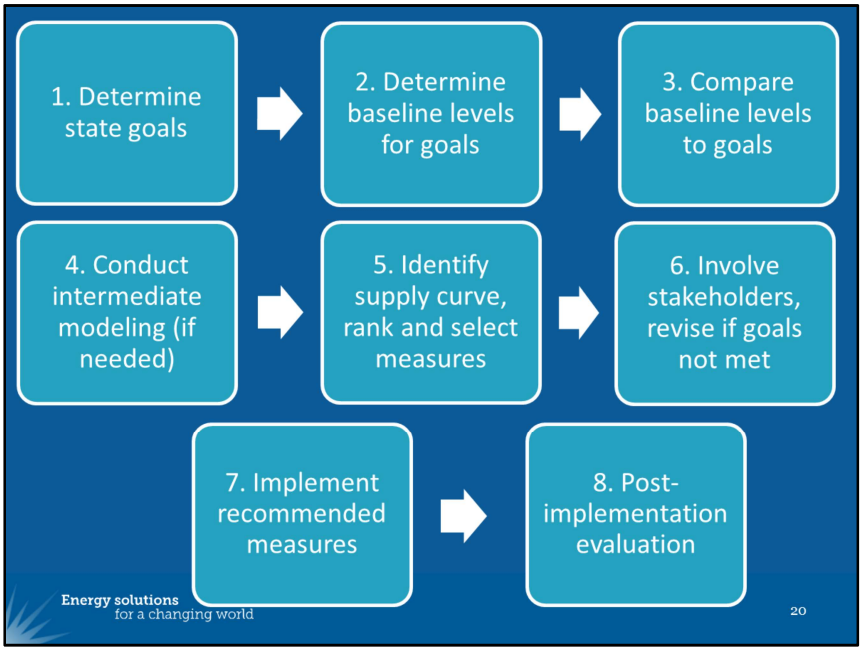
SIPs, on the other hand, look ***backward*** in determining compliance, and tilts heavily toward public health vs. reliability or cost.

E-Merge also adds state energy offices into this mix, and includes forward-looking integration of ***ALL the goals***, engaging ***ALL the parties***.



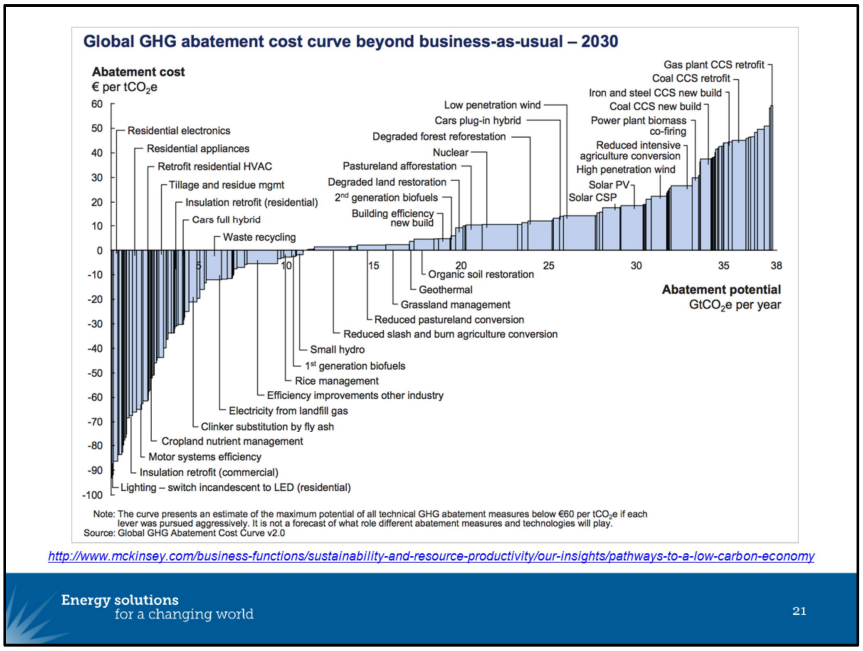
So how exactly would a E-Merge process be ***conducted***?

It's development is ***still in pilot stages***, of course, but we have outlined a series of steps, which we'll detail now.



(An E-Merge Process Table document is available to webinar participants.)

http://www.raponline.org/wp-content/uploads/2017/05/E-Merge-Steps-Table-Webinar.pdf



http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/pathways-to-a-low-carbon-economy

Some of you may less familiar with supply curves (also known as ”cost curves”).

Here's an example of a supply curve of GHG reduction options from McKinsey.

Cheaper options (including “negative-cost” ones) start on the left, and increase in cost as you move to the right.

The ***width*** of each option indicates its scale (i.e., how much it can reduce emissions).

An E-Merge process is likely to consider a number of such cost curves for multiple pollutants and policy goals.

Questions

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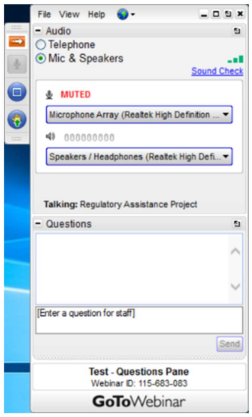
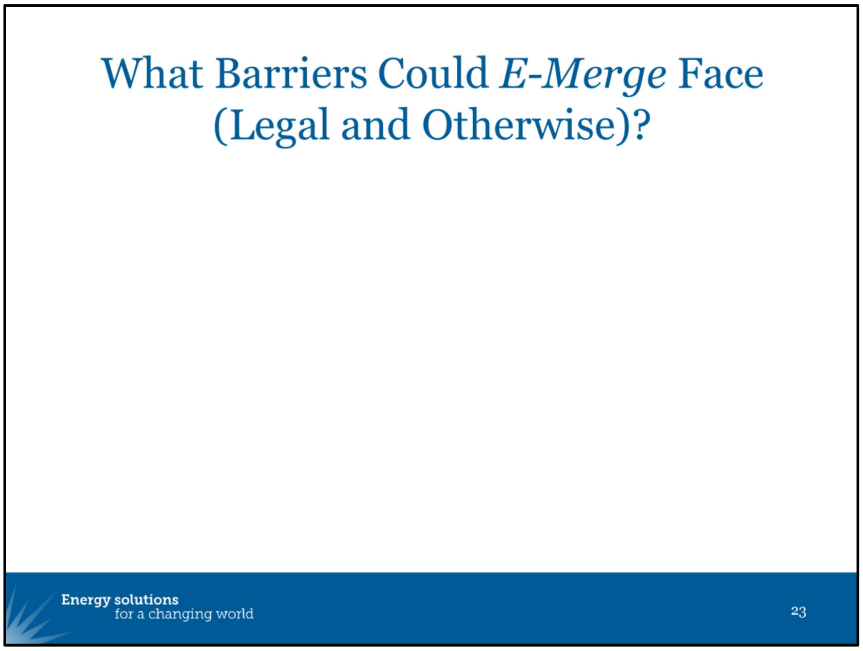
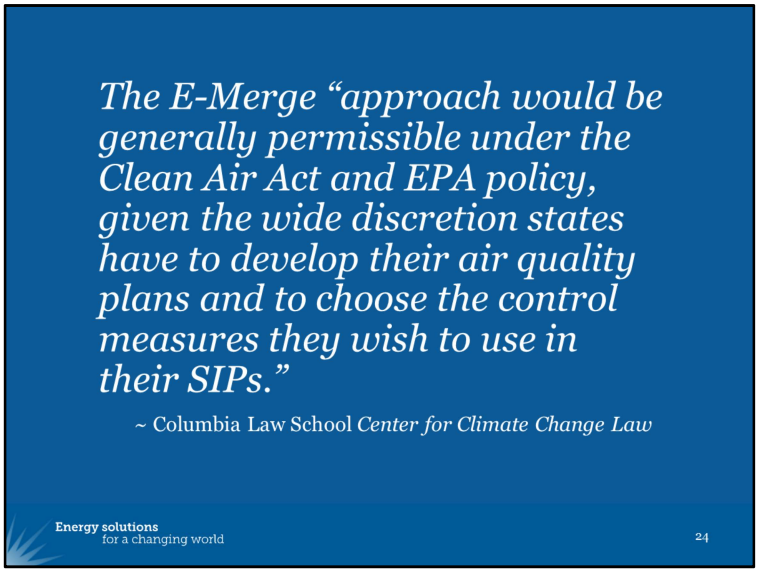




We've talked about the E-Merge concept and its process steps. A threshold question to ask: *"***Is E-Merge legal?***"*

At RAP, we are quite familiar with the Clean Air Act, but we are not lawyers, so we asked the *Columbia University Law School Center for Climate Change Law* to review the Clean Air Act, and to assess whether E-Merge was legal.

Their review is summarized on this next slide.

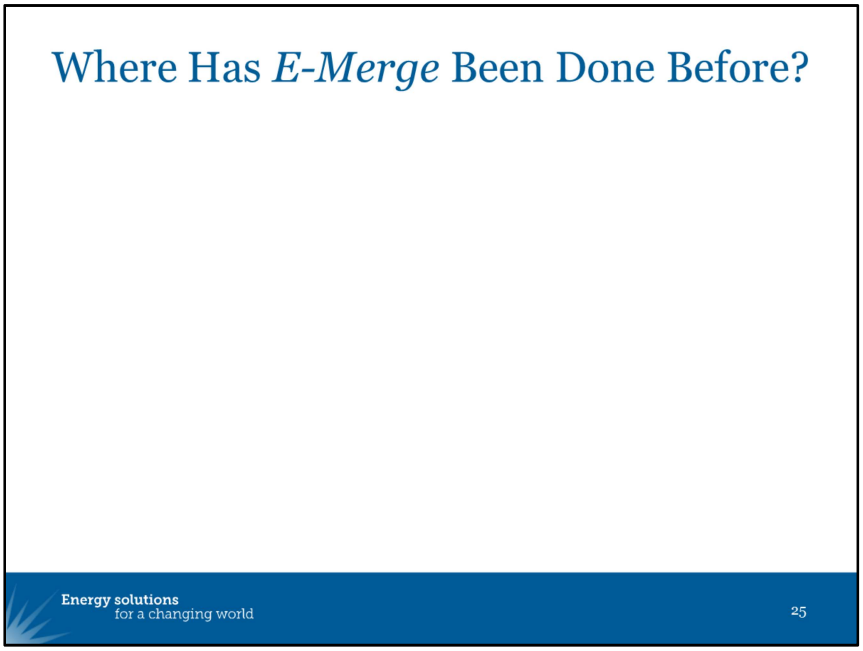


The Columbia Law School analysis concluded that EPA could not compel an E-Merge process, but that states have the freedom and flexibility to undertake such a process. EPA has the latitude to review and approve tsate-driven *E-Merge* processes.

In developing *E-Merge*, we also looked beyond the strict legality issue to identify other possible barriers to its adoption.

We found three main areas where challenges exist:

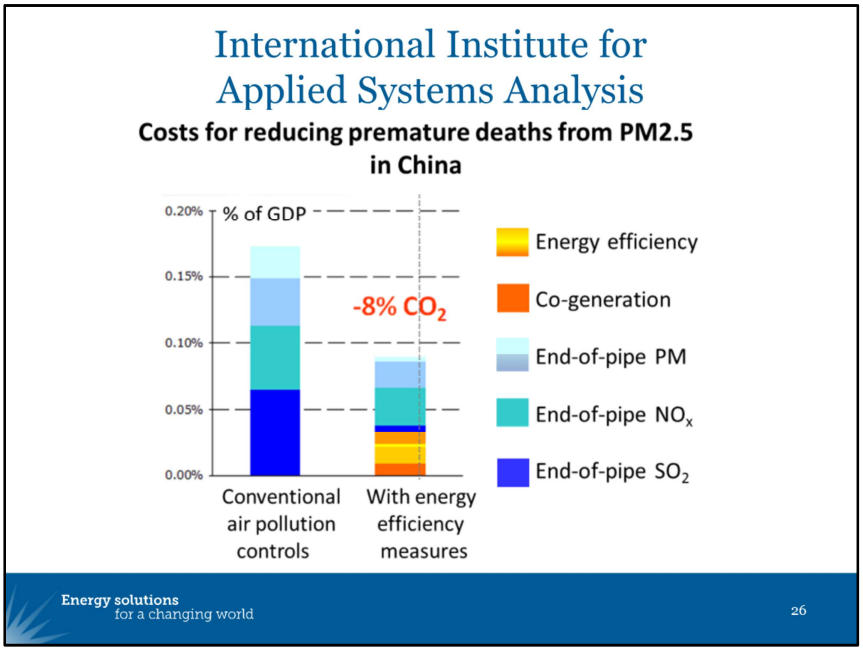
- Institutional
  - Traditional pollutant-by-pollutant AQ processes and timing
  - End-of-pipe vs. all options (RE, EE, etc.)
  - IRPs often omit EE, DR, externalities, etc.
- Cultural
  - "We've always done it this way"
  - "Not in my term of office (NIMTO)"
- Technical
  - EM&V is well-established for energy savings, but not for emissions reductions
  - Expectations of CEMs-levels of accuracy
  - Learning curve for E-Merge modeling & assessment



In developing E-Merge, we also addressed the question "If E-Merge is so good, why hasn't it been done before?"

- Greater **Regulatory Integration**
  - Bay Area Air Quality Management District *2010 Clean Air Plan:* 55 control measures across all sectors, to address criteria, hazardous and greenhouse gas emissions
  - Colorado's 2010 Clean Air-Clean Jobs legislation: this legislation compelled that state's air and energy regulators to *jointly* develop plans to improve air quality, and enabled a glidepath to cleaner energy resources, while promoting economic and job growth.
  - Initial planning for Clean Power Plan compliance: one of the take-homes we heard from many states was that, regardless of the ultimate fate of the CPP, that simply getting together the regulatory agencies was in and of itself a success. Doing so helped to reveal constraints as well as areas where inter-departmental cooperation could improve outcomes across energy, environmental and economic areas.
- **Multi-Pollutant** Policy Analysis Framework
  - EPA Detroit Project
- Not Just **End-of-Pipe**
  - Maryland's modeling of EE/RE impacts on O3/PM2.5

- China's modeling projects in nine industrial sectors
- IIASA's GAINS modeling of public health costs



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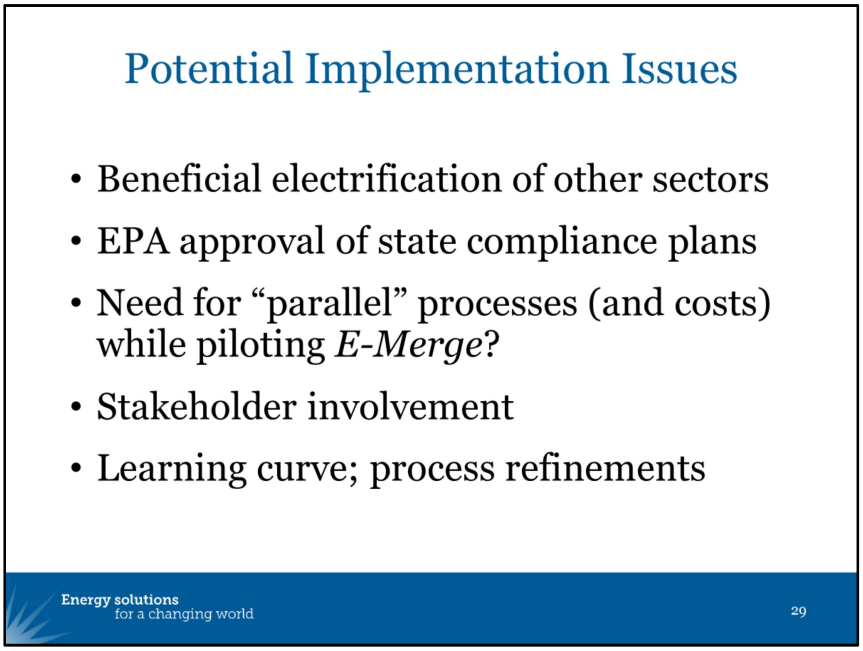
- AQ issues remain, despite the CAA stay and the change in Administrations
  - Ozone, $PM_{2.5}$, Regional Haze, SO_2 SIPs now in play
- Pressing state energy issues
  - Many state/utility IRP requirements are still in place
  - Unprecedented rate design issues across the county
- Renewed interest in Regulatory “Streamlining”, “Reform”
  - Time may be particularly ripe



EV technologies are rapidly improving. Many states have already invested significantly in charging infrastructure. Business are also on the bandwagon, understanding that providing free charging at hardware stores and shopping malls can encourage customer traffic. The VW emissions settlement is also expected to result in much more EV infrastructure investment in the states.

Any initial E-Merge process will require coordination with EPA, as well as involvement from stakeholders and the regulated community. But, the same is required now under traditional CAA SIP processes.

Also, consistent with initial regulatory efforts under traditional SIPs, one learns by doing, and making process refinements over time, and benefiting from the earlier steps taken.

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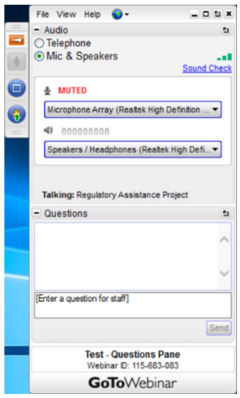
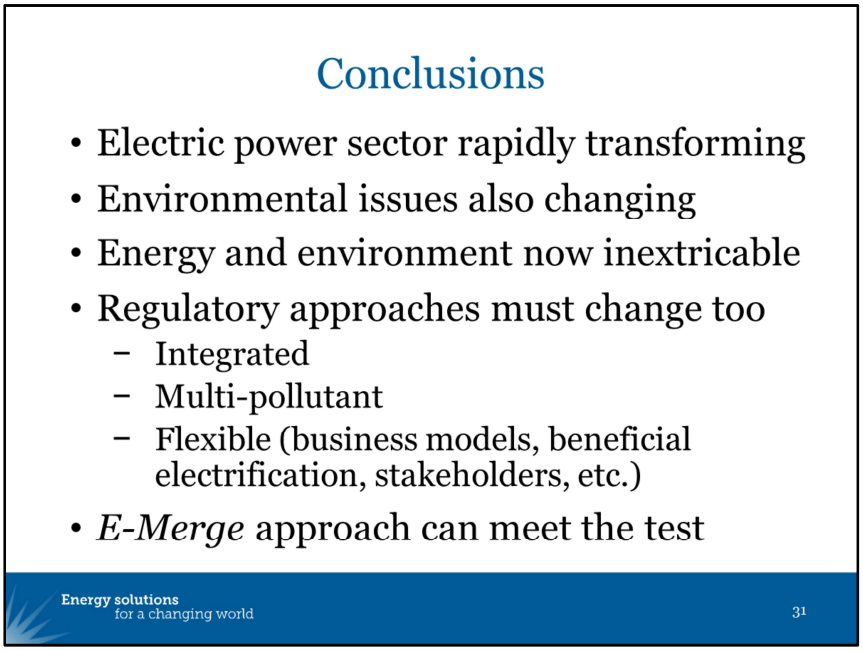
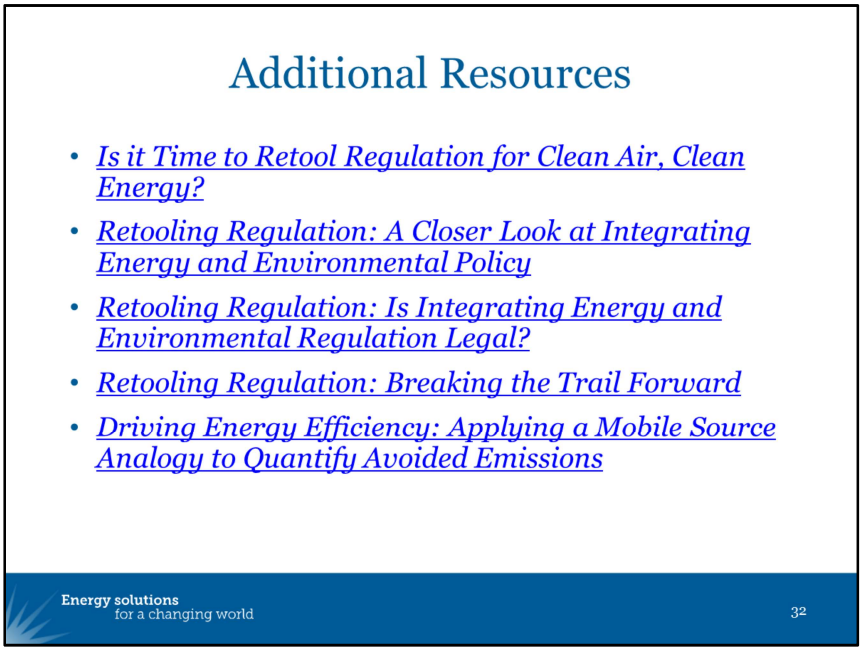




- The electric power sector is rapidly transforming with new technologies, approaches, and markets

- Environmental regulation is changing rapidly with new science, more efficiency, more renewable energy

- But to date, regulatory processes have changed little. We think that they need to do so, and the E-Merge can meet the needs of the future.



http://www.raponline.org/blog/is-it-time-to-retool-regulation-for-clean-air-clean-energy/

http://www.raponline.org/blog/retooling-regulation-closer-look-integrating-energy-environmental-policy/

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http://www.raponline.org/knowledge-center/driving-energy-efficiency-applying-a-mobile-source-analogy-to-quantify-avoided-emissions/

RAP® Energy solutions for a changing world

About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power sector. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at www.raponline.org

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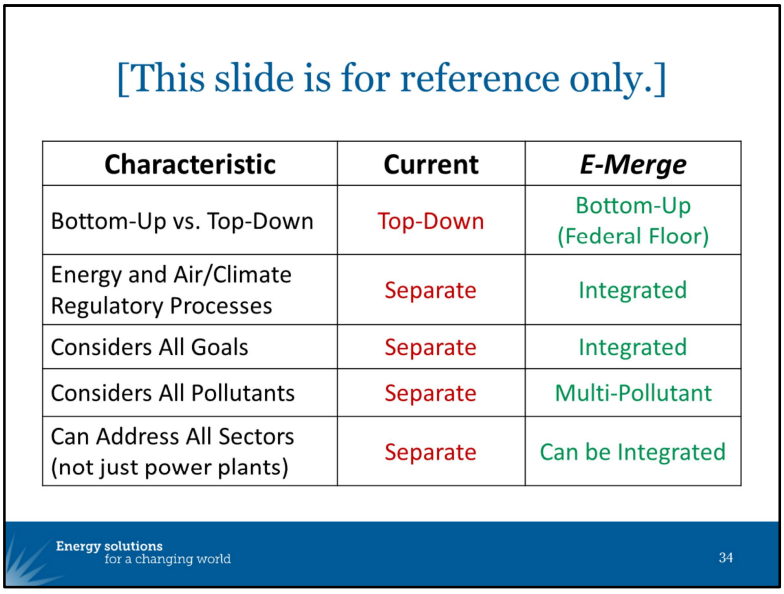

Ken
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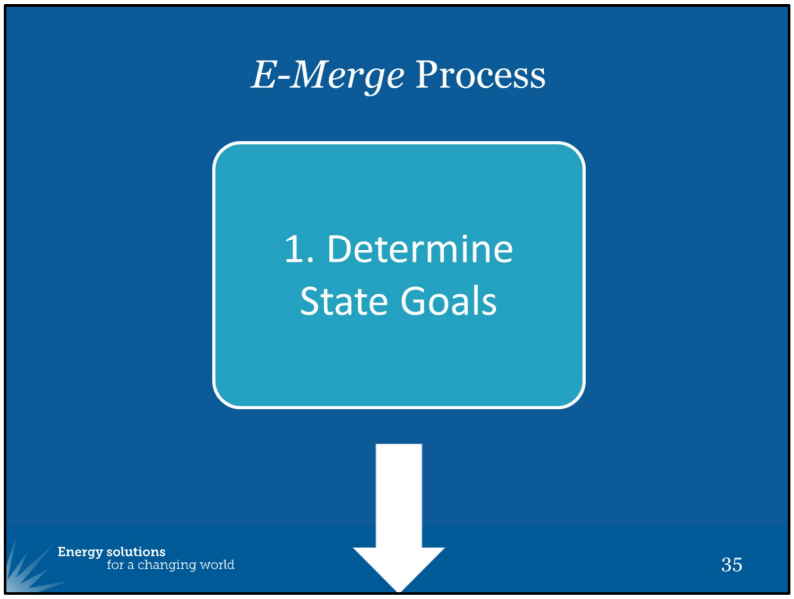
  - Reduce risk, and
  - Encourage economic development



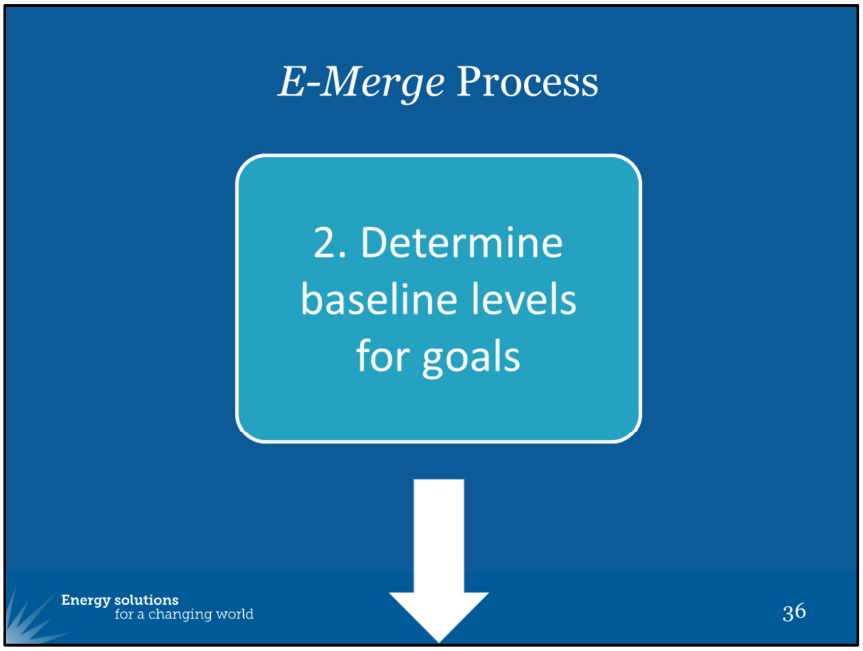
Ken

The first step, not surprisingly, is for the state to determine its goals.

- DEP would identify state public health and welfare goals affected by energy-related emissions (Mortality, morbidity, etc.)
- PUC would identify state energy goals for the electric system (reliability, affordability, safety, etc.)
- SEO would identify goals from a statewide energy perspective.
- Agencies would also plan for ***stakeholder*** involvement, which will be necessary in implementation stages, if not sooner.

Notes:

- Initiating agency needs address logistical issues, such as how best to engage the other agencies.
- Establish timeframes jointly, because planning must include what and when.
- Stakeholder involvement should occur as early as possible, even if informal at first.



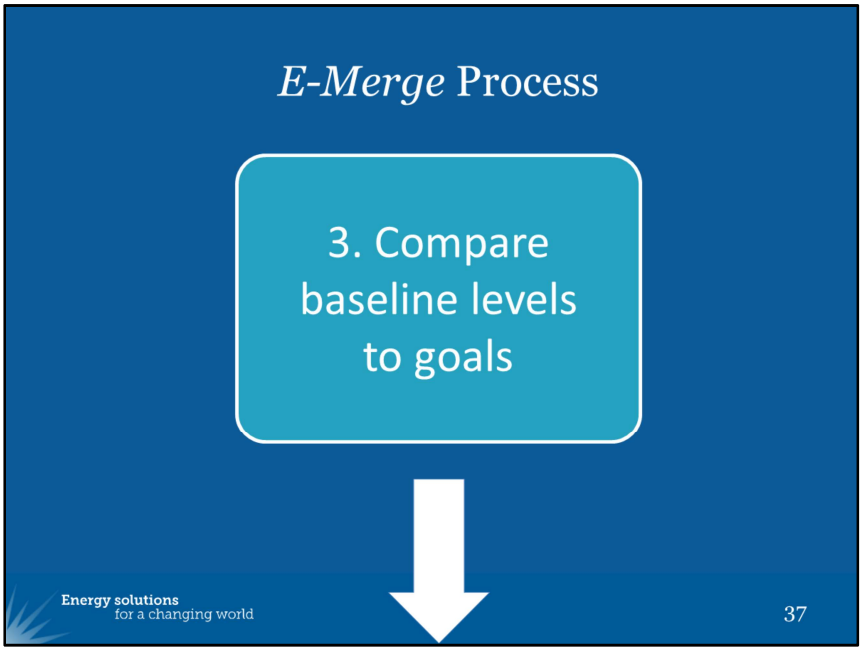
Ken

The second step is to identify where you stand now against those goals. For example:

- DEP might identify ambient air quality levels (or EPA "design values") for each pollutant (NOx, SO2, PM, etc.)
- PUC might identify metrics and existing levels for reliability, cost, risk, etc.
- SEO might identify metrics and existing levels for each state energy policy goal (e.g., RPS, EERS, low-income, etc.)

Notes:

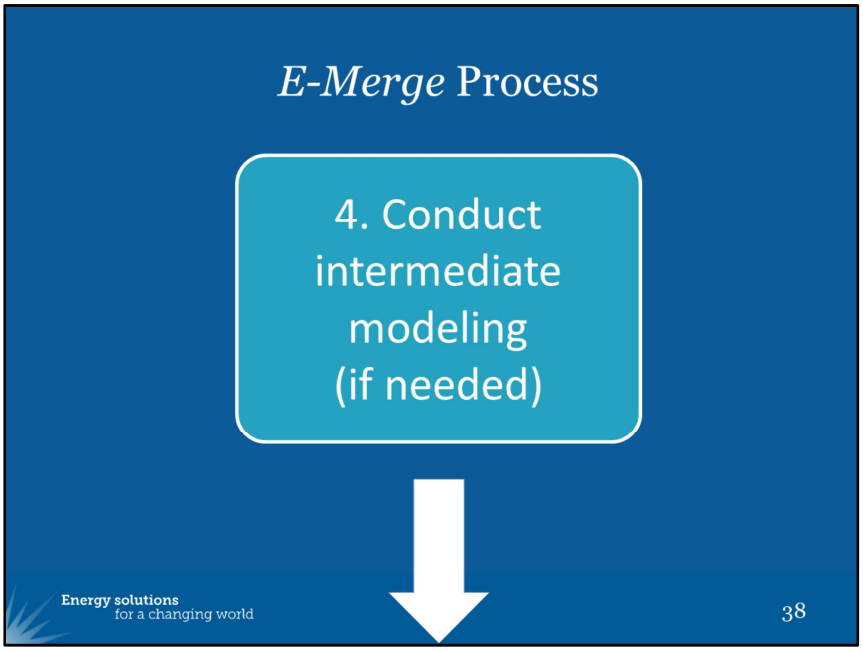
Some levels (and/or metrics) may not be known (or consensus may not exist), and would need to be jointly determined for moving forward.



Ken

The third step would be for all three agencies (DEP, PUC, and SEO) to determine:

- Does each metric (e.g., ambient AQ level) meet the identified goal?
- If not, are there policies already "on the books" that will cause each goal to be met?
- If not, determine what additional work (e.g., ambient AQ improvement) is needed to achieve each goal
- Stakeholder involvement may be valuable here.



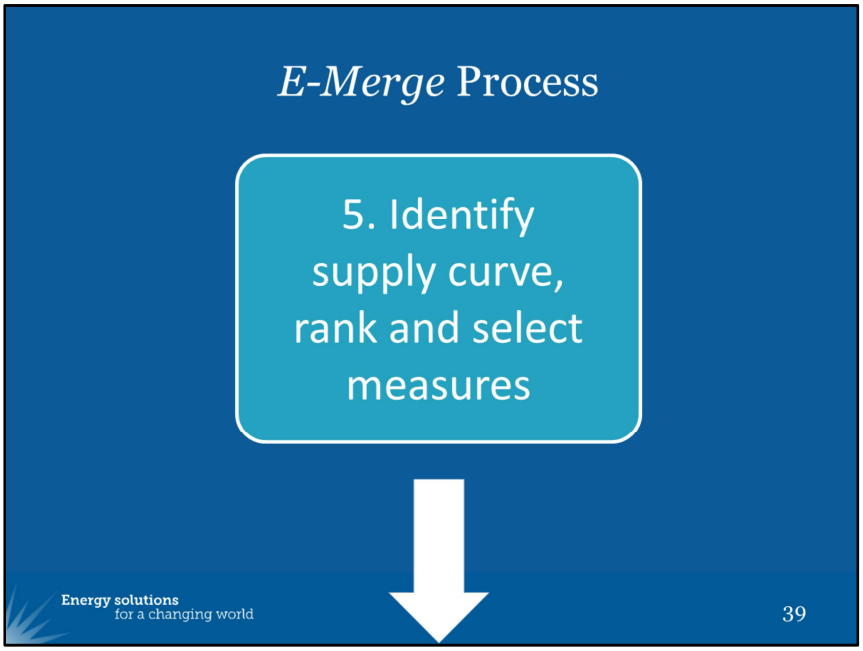
Ken

Fourth, it may be necessary to conduct some intermediate modeling:

- DEP for example, may need to conduct air quality modeling to determine the amount of emission reductions needed to achieve ambient AQ improvement sought.
- PUC may need to conduct energy system modeling to determine what resource mix(es) can achieve least-cost planning and reliability goals.
- SEO may need to conduct appropriate modeling to determine ways to meet energy goals like RPS, EERS, etc.

Notes:

- If desired, could also conduct economic modeling reflecting options.
- The choice of models is important, as data and resources to support modeling efforts are often significant.

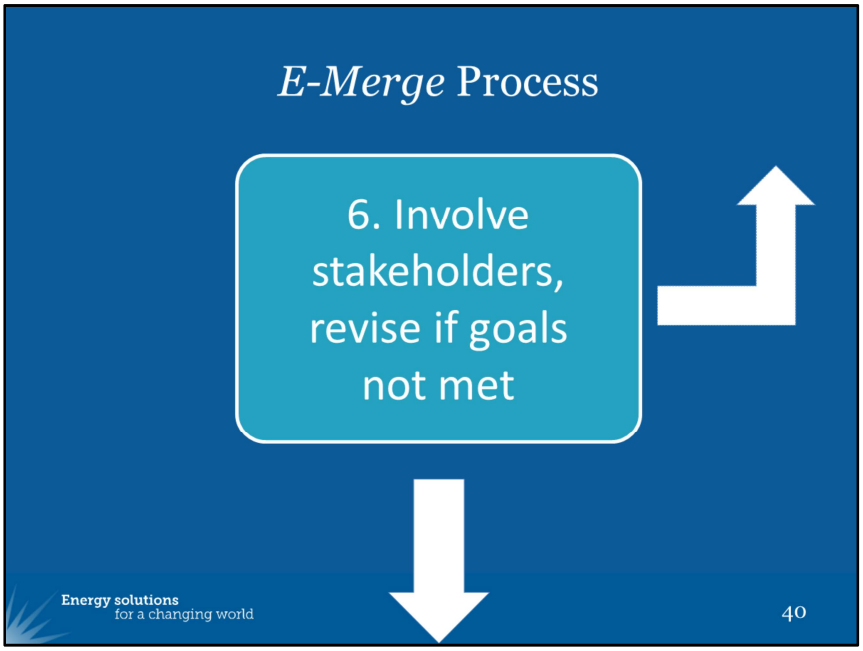


Ken

The fifth is the most involved step. Down the road, we hope it will use system dynamics or other optimization techniques.

All three agencies – perhaps involving stakeholders too – would:

- Collaboratively ***review*** supply curves to determine energy savings, emissions reductions, and co-benefits performance achievable through the most cost-effective measures. Energy efficiency (EE), demand response (DR), renewable energy (RE), etc. are likely to play a big role.
- ***Rank*** options by performance metrics on all goals and translate their energy savings into emissions reductions.
- ***Agree on preferred options*** and compare overall performance to goal levels
- ***Conduct*** modeling to confirm goal achievement; ***iterate*** if necessary.
  - Note that modeling often carries significant costs; there may be ways to estimate initial iterative results.



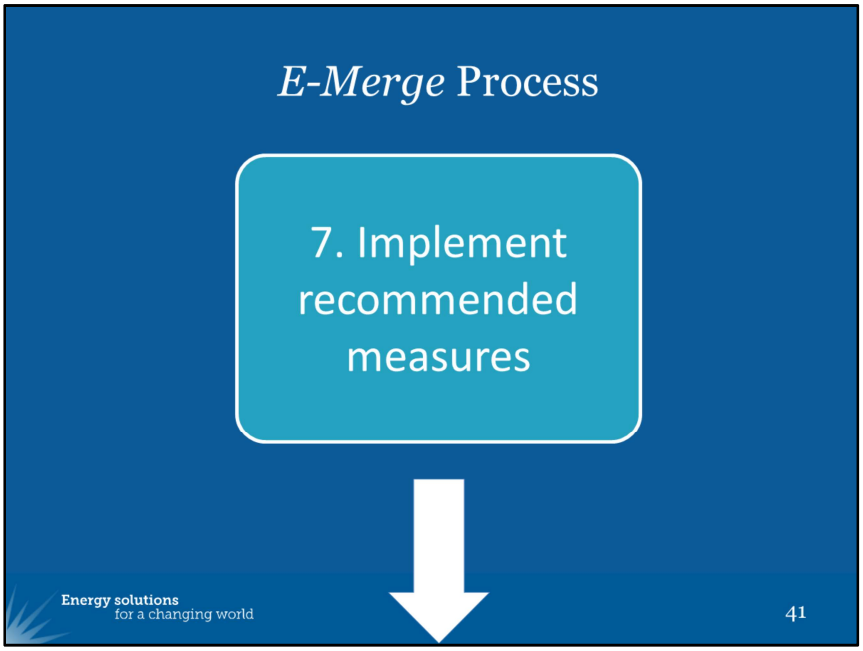
Ken

- If stakeholders were not involved previously, they should be now.
- If only a limited number of stakeholders were involved previously, expand the process to be fully inclusive.

All three agencies would collectively:

- Conduct stakeholder process(es) to provide ***input*** on what measures should be adopted, what revisions may be necessary, etc. ***Iterate*** if necessary.

Note: If stakeholders ***were*** fully engaged in the process up to this point, this step may be unnecessary.



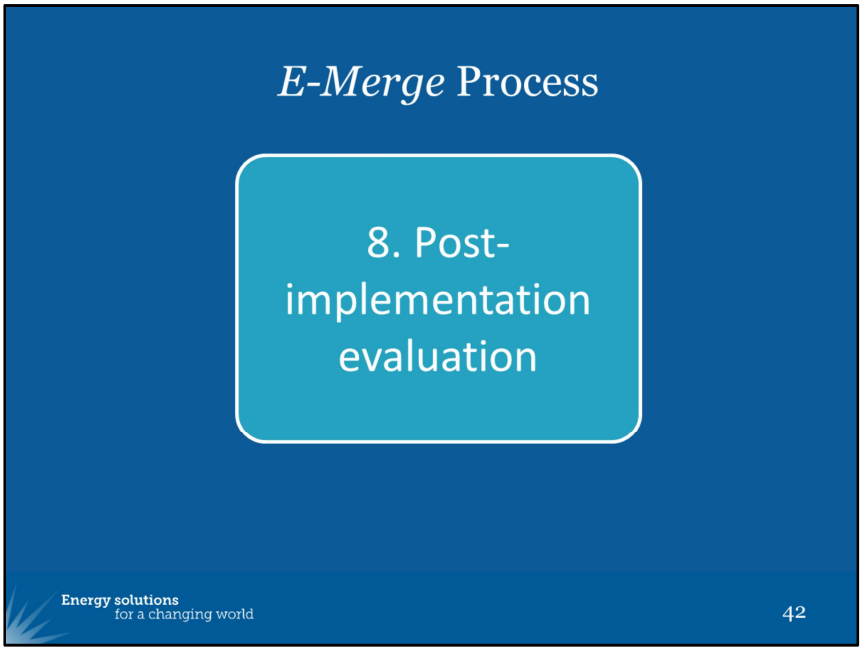
Ken

Once consensus is reached on identifying the best measures, attention turns to implementation.

- DEP would need to ensure approvability by EPA under the Clean Air Act, etc. Then it would conduct standard notice-and-comment proceedings to implement measures associated with air quality.

- PUC and SEO would adopt regulations or policies by conducting standard docket or rulemaking proceedings and/or outreach as necessary to implement the measures associated with their goals.

NOTE: It may be wise to invite EPA to participate in the full process to avoid end-of-process surprises.



Ken

Following implementation, evaluation is important. The DEP, PUC and SEO would:

- Identify process and regulatory streamlining that *E-Merge* enabled; and
- Estimate savings (or costs) from such streamlining
- Sum up net savings and costs across agencies to provide estimated total benefits or costs.
- Stakeholder involvement may be valuable here.

Notes:

- Example: The integrated *E-Merge* process is likely to be ***more*** difficult and costly than for any single agency or any single pollutant alone, but ***less*** than for each agency to handle each goal and each pollutant individually.