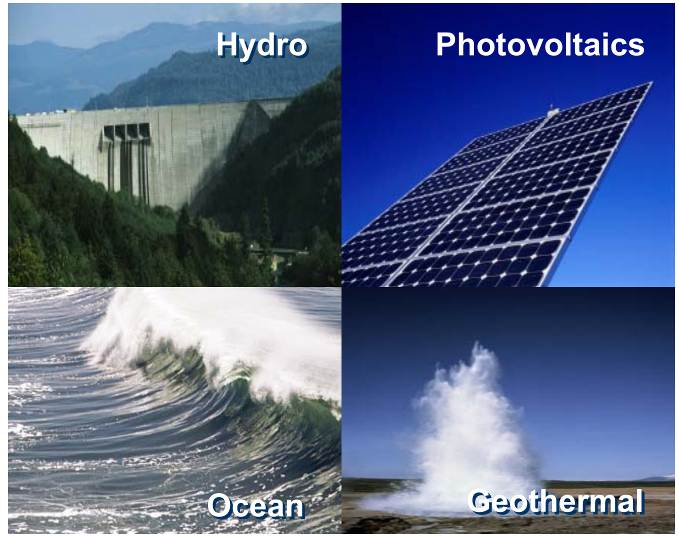
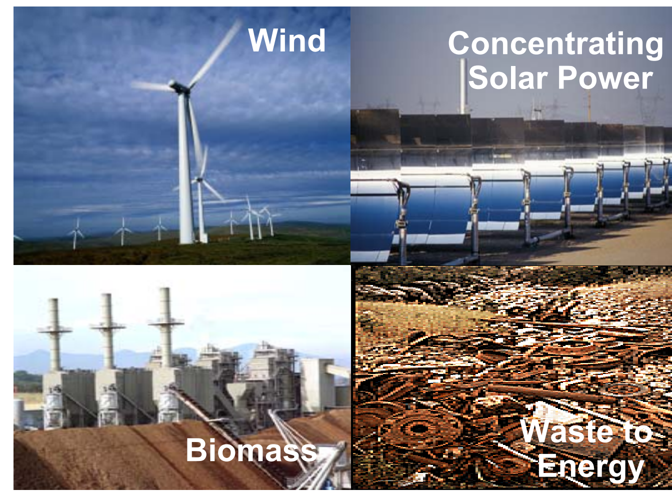
The Changing Face of Renewable Energy



A Navigant Consulting
Multi-Client Study

Participants:
We Energies
Ontario Power Generation
ARC Financial
Salt River Project
Puget Sound Energy
Hydro Quebec
and Others



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Driven by the need to understand the dramatic changes taking place in the renewable energy (RE) arena, Navigant Consulting undertook a multi-client study.

The Changing Face of Renewable Energy

- Continued technology cost and performance improvements are making renewables more competitive with conventional power.
- Renewables increasingly are seen as able to address core national strategic issues of energy security and diversity, environmental improvement, and economic development.
- Significant state-level incentives and investment funds for renewable energy are designed to help them compete in newly deregulated markets.
- Renewable portfolio standards (RPS) will continue to stimulate a significant U.S. market for renewable energy systems.
- Green "certificate" trading, labeling, and disclosure requirements will facilitate choice by letting customers know how their power is generated (e.g., how "green" it is).
- Voluntary and mandatory greenhouse gas reduction requirements are in place at federal, state, provincial, and municipal levels.

Key Questions Addressed by This Study

- What is the outlook for renewable energy technologies and markets over the next ten years?
- What are the key issues associated with grid integration of renewables?
- What is the status and outlook for emissions and renewable energy attribute trading?
- How can companies create a successful business in the renewable energy space?
- What is the outlook for RPS and what constitutes a good RPS?
- What is the status and outlook for renewable energy funds?
- What are the key permitting issues associated with the different renewable energy technologies?

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The study reviewed 13 renewable energy technologies and 2 enabling technologies at different levels of analytical detail[1].

More Detail

- Technology Performance
- Economics (with and without incentives)
- Market Drivers/Barriers
- Market Forecast/Potential
- Selected Company Profiles

◆ Onshore Wind
◆ Offshore Wind
◆ Photovoltaics
◆ Low Impact Hydro
◆ Biomass Co-Firing
◆ Biomass Gasification Combined Cycle
◆ Landfill Gas
◆ Anaerobic Digester Gas

- Technology Performance
- Economics (with and without incentives)
- Market Drivers/Barriers

◆ Concentrating Solar Power
◆ Geothermal

- General Discussion of Key Issues

◆ Wave
◆ Tidal
◆ Nano Solar Cells
◆ Inverters
◆ Energy Storage

(Inverters and Energy Storage: ***Enabling Technologies***)

Less Detail

1. Choices for the level of analytical detail were determined by consensus among the multi-client participants, and are not a reflection of the value that others may place on the individual technologies or on other technologies not listed here.

Renewable energy remains a growth market, with installed capacity expected to double over the next decade in the United States and Canada.

Key Findings

- Many renewable energy options are now relatively mature technologically, but markets remain underexploited primarily due to higher capital costs relative to conventional options.
- Wind and some biomass technologies are economically competitive or nearly competitive with conventional options. Wind and photovoltaic capital costs are expected to have the largest cost reduction at about 5% per year. In Canada, small impact hydro systems with good hydro resources and location advantages are also nearly competitive with conventional options.
- There is significant, diverse policy support for renewables, but the uncertain longevity of these programs and the need for periodic renewals remain a barrier to market development.
- Large corporations are staking out strong positions in most renewable energy technologies.

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- Led by wind power, the installed capacity of renewable energy technologies (excluding large hydro) is expected to more than double to 60 GW by 2013 in the United States and Canada.
- Technologies such as anaerobic digestion are expected to experience high growth rates, but will remain essentially niche technologies in the near-term.
- Incentives remain critical for improving the economics of renewable energy versus conventional energy options. For example:
  - Onshore wind competitiveness is greatly enhanced by incentives currently in place.
  - Incentives in the United States reduce PV LCOE almost 60% compared to 12% in Canada.
- Permitting remains a key issue for small-scale systems, especially for small hydro in the United States.

Long-term, stable incentive programs are needed to encourage financiers to invest in renewable energy technologies.

Policy Implications

Guaranteed long-term government commitment to provide incentives is critical to successful market development.

- e.g., Uncertainty about the wind Production Tax Credit in the United States in late 2001 led to a 73% decline in new capacity additions from 2001 to 2002.

The type of incentives applied need to reflect the different stages of development of the various technologies.

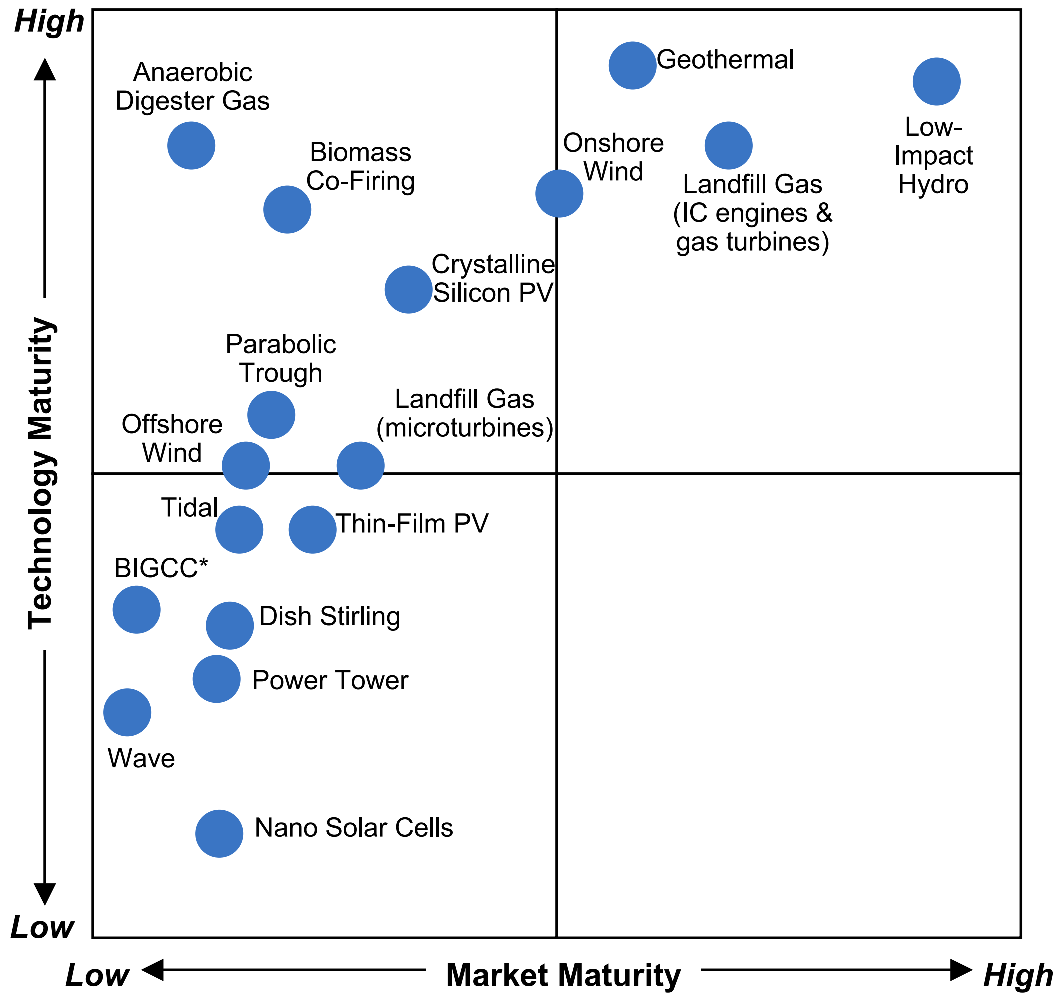
- e.g., an RPS or Production Tax Credit can support deployment of commercially available technologies, but are not well suited to those at the R&D stage or that may need support for first-of-a-kind commercial systems

Policies like an RPS could result in significant additional renewable energy.

- A 10% RPS by 2010 in the U.S., for example, could add 22-45 additional GW over a business-as-usual scenario.
- Initial studies on the impact of a 10-20% national RPS suggest that the overall impact on energy costs to the consumer will be minimal, with average electricity prices only a few percent higher than without the RPS.

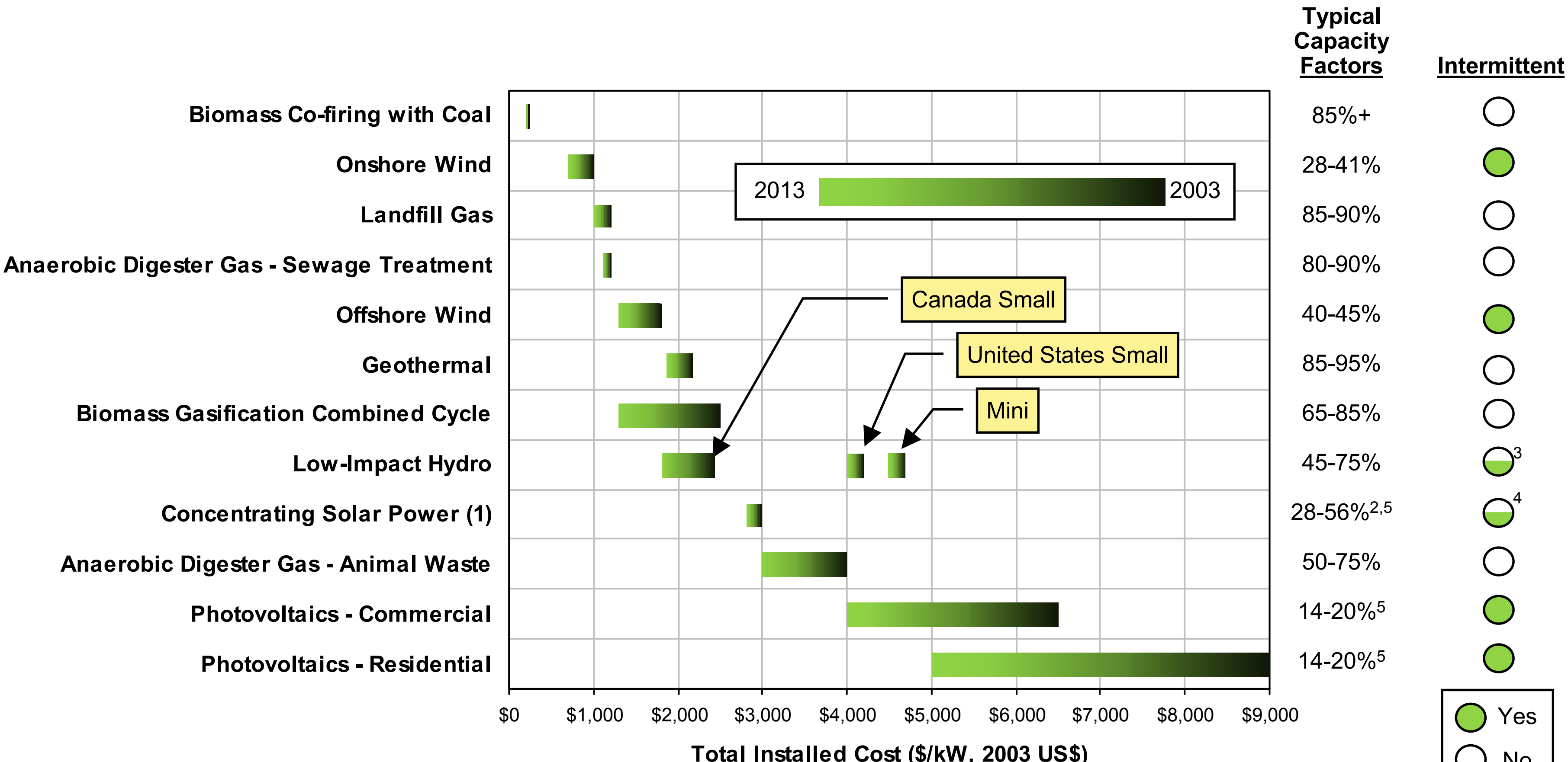
Many renewable energy options are now relatively mature technologically, but their markets remain underexploited.

- **Technology maturity** describes the potential for performance improvements and/or cost reductions
  - ***Low***: Significant improvements expected in the next 10 years
  - ***High***: Incremental improvements expected in the next 10 years
- **Market maturity** describes the existence of well-established business models, the presence of large players, the degree of saturation of the market potential, and the ability to obtain financing.
  - ***Low***: Emerging business models, fragmented market, minimal market penetration, and/or high growth rates
  - ***High***: Well-established business models, large companies with strong positions, moderate-high market penetration, and/or growth rates similar to GDP growth



* Biomass integrated gasification combined cycle

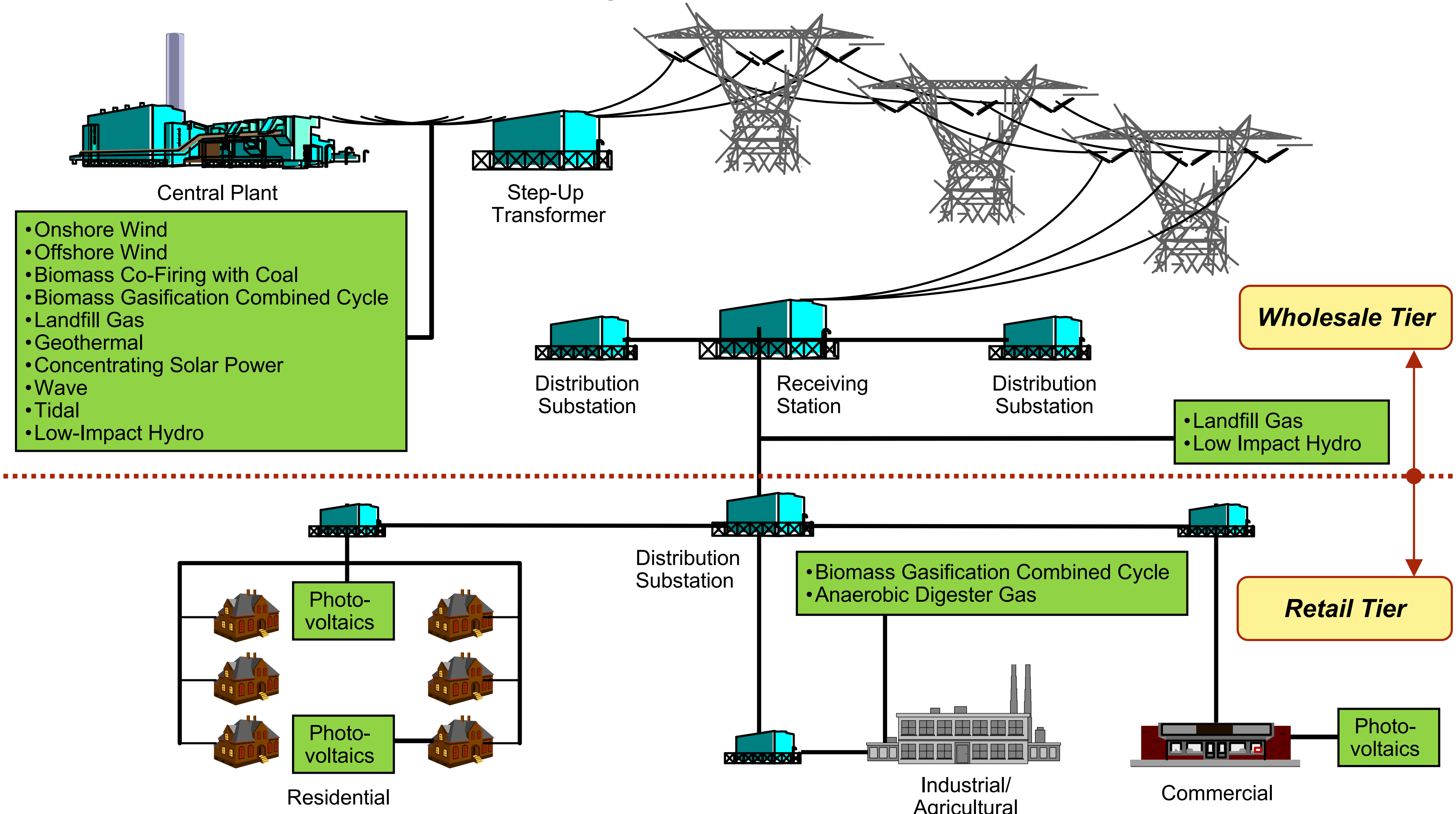
Renewable energy capital costs and performance range considerably. For some, significant cost reductions are expected over the next 10 years.



1. Parabolic trough technology. For comparison purposes, low end is for 2008, since 2003 costs exclude thermal storage.
2. Low end is without thermal storage, high end is with 12 hours thermal storage.
3. Some small hydro is dispatchible, some is not.
4. Thermal storage provide some dispatchibility and control of output.
5. These are effective capacity factors, including effects of temperature degradation and dust losses.

Note: Assumptions of system size are provided in the report.

Some renewable energy technologies compete within the wholesale power market, while others primarily offset retail power purchases.



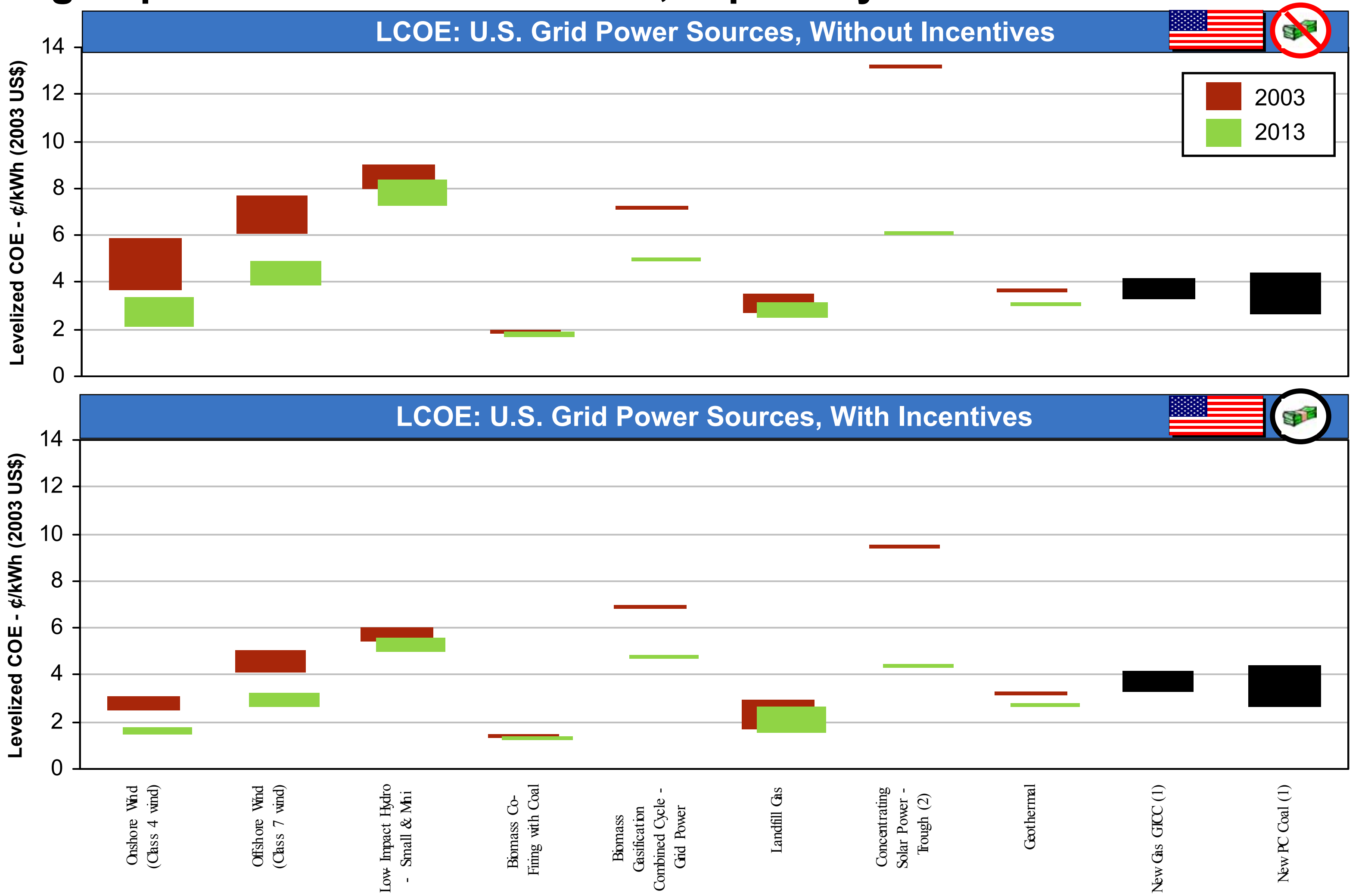
Incentives vary across technologies, but have common goals of reducing up-front investment, providing tax breaks, and encouraging production.

Key Incentives	PV		Wind		Biomass		Low Impact Hydro		Conc. Solar Power		Geothermal	
	US	CDN	US	CDN	US	CDN	US	CDN	US	CDN	US	CDN
Federal												
Tax Credit Against Investment	✓								✓		✓	
Accelerated Depreciation	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Tax Credit Against Production			✓	✓	✓	✓						
Tax Credit for Alternative Fuel					✓							
State / Province												
Rebate Against Investment	✓											
Tax Credit Against Investment[1]	✓	✓	✓	✓		✓	✓	✓	✓			
Property Tax Exemptions	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Sales Tax Exemptions	✓	✓		✓		✓	✓	✓	✓			
Tax Credit Against Production			✓				✓					
Tax Credit Against Sales[2]		✓	✓	✓		✓	✓	✓				

1) Ontario offers corporate tax write-off and capital tax exemption against purchase of assets for generation of energy from renewable sources.
2) Ontario offers tax holiday when electricity sales from renewable sources begins.

Technology Life Cycle Cost of Electricity – Grid Power Sources, United States

By 2013 most renewable energy options are expected to be competitive with grid power in the United States, especially with incentives.



(1) GTCC = gas turbine combined cycle, PC = pulverized coal. (2) Costs in 2013 decline significantly due to increased capacity factor on account of storage. Note: LCOE with incentives in 2013 assumes that incentives have the same economic impact as in 2003. Green tags could reduce LCOE by 3 ¢/kWh.See Appendix for methodology and assumptions supporting the analysis.

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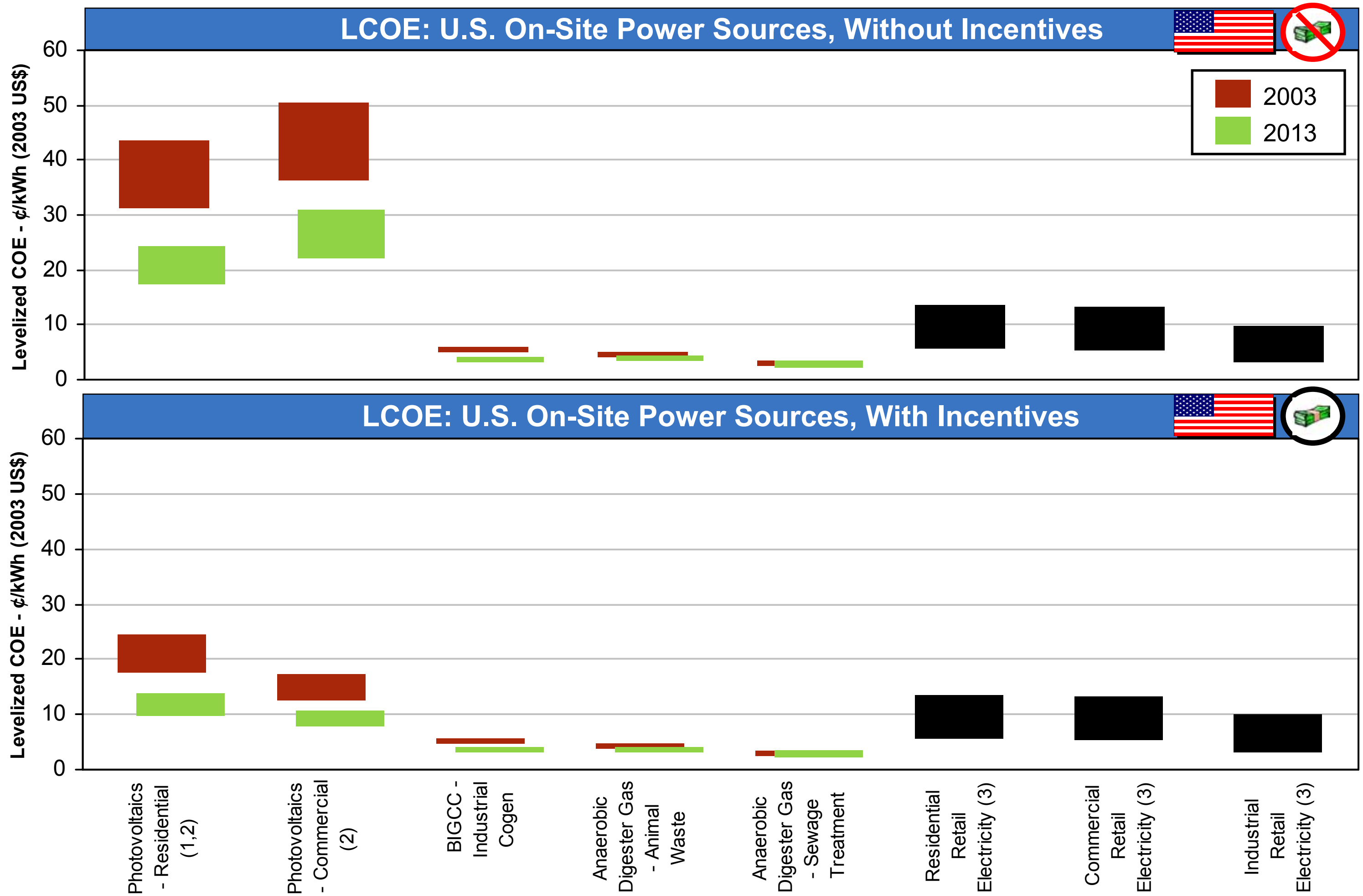
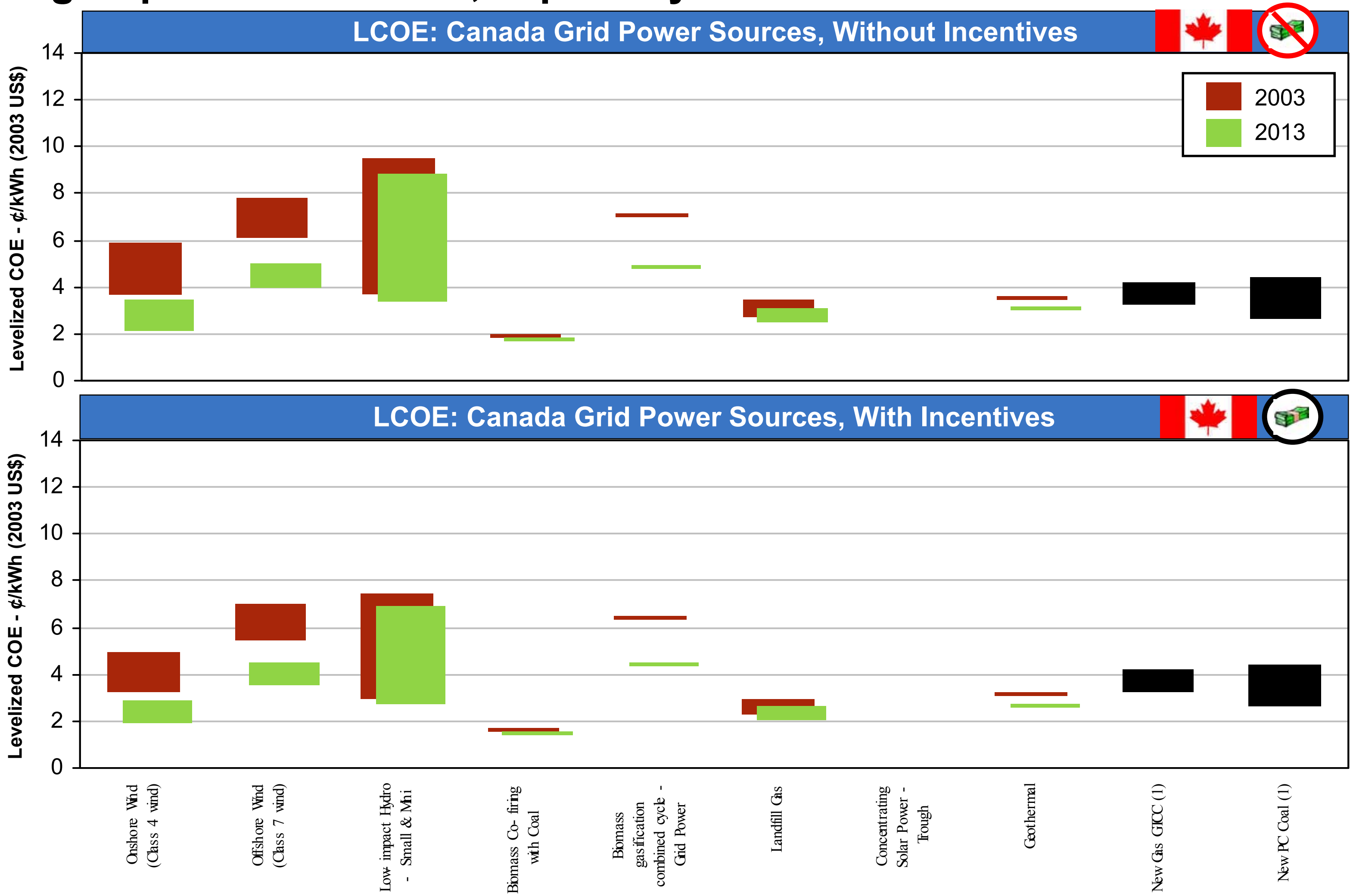
On-site use of biomass can be competitive with grid power today. PV is expected to be competitive by 2013, even without incentives.



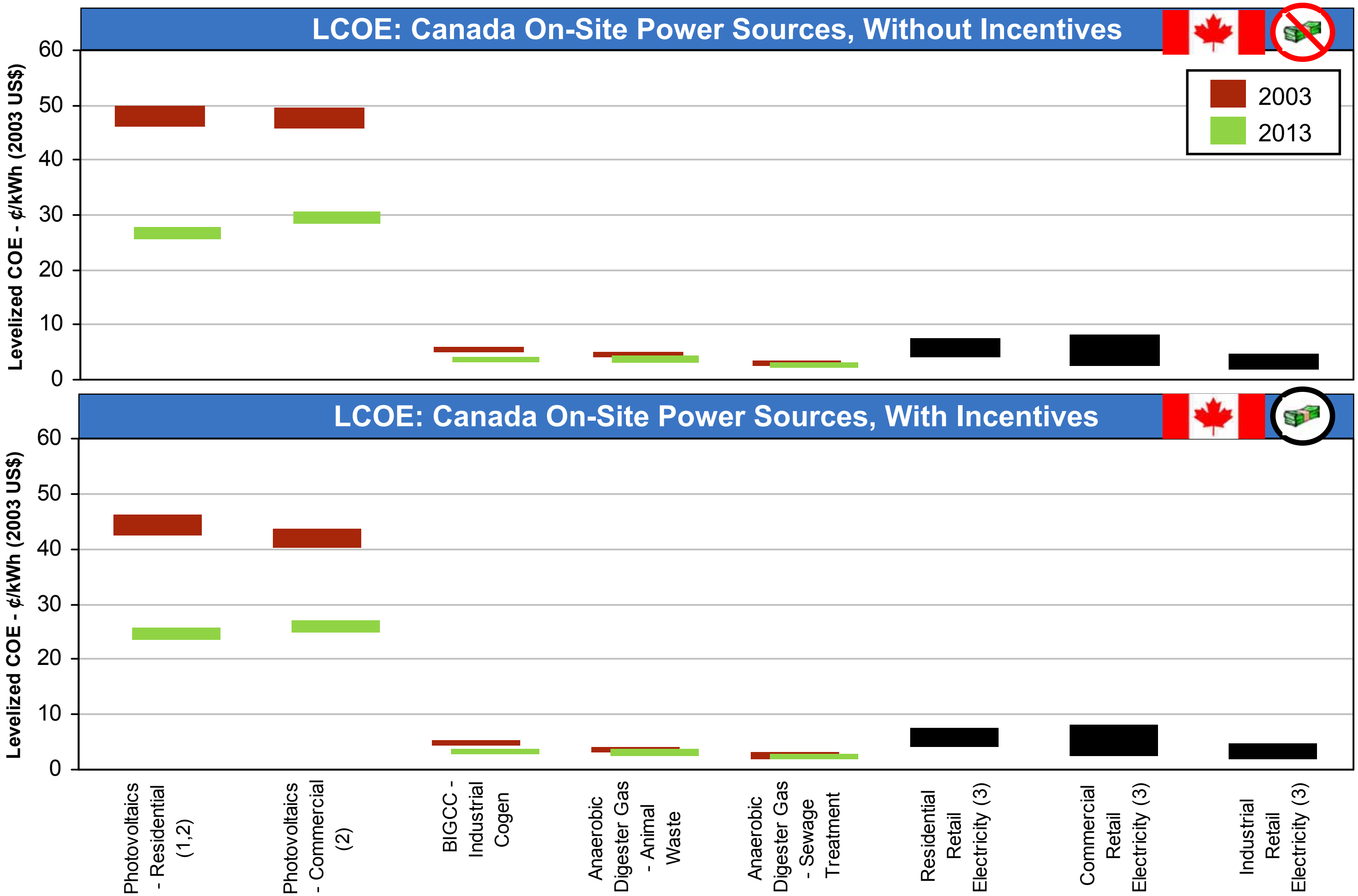
(1) Mortgage financing option. (2) High to Moderate/Low Insolation. (3.) In 2003.
Note: Retail electricity prices are for the United States in 2002, excluding Hawaii. LCOE with incentives in 2013 assumes that incentives have the same economic impact as in 2003. Green tags could reduce LCOE by 3 ¢/kWh.

By 2013 most renewable energy options are expected to be competitive with grid power in Canada, especially with incentives.



1. GTCC = gas turbine combined cycle, PC = pulverized coal. Note: LCOE with incentives in 2013 assumes that incentives have the same economic impact as in 2003. Green tags could reduce LCOE by 3 ¢/kWh.

On-site use of biomass can be competitive with grid power today, but PV is not expected to be competitive by 2013 in Canada, even with incentives.



(1.) Mortgage financing option. (2.) Moderate to Moderate/Low Insolation. (3.) In 2003.
Note: Electricity prices are as on May 2002. LCOE with incentives in 2013 assumes that incentives have the same economic impact as in 2003. Green tags could reduce LCOE by 3 ¢/kWh.

Despite variation among renewable energy technologies, common drivers and barriers continue to shape the market.

Market Drivers for Renewable Energy	Market Barriers for Renewable Energy
• Improving economics—some options are now competitive or nearly competitive with conventional options • Energy security and diversity • Economic development • Emissions benefits (air quality and climate change) • Government support: – Renewable Portfolio Standards – Feed-in tariffs – Renewable Energy Funds – Production tax credits and other similar incentives – Net metering • Consumer support for environmentally friendly technologies • Energy price volatility	• High first costs relative to competing technologies • Lack of guaranteed long-term government commitment to provide incentives • Lack of appropriate incentives that reflect the different stages of development of the various technologies • Grid integration issues: – For some, the dispersed and/or remote nature of the resources is a mismatch with the current T&D infrastructure. – For others, the small scale of application makes interconnection and permitting costly. – For some – dispatchibility is an issue. • Various concerns over aesthetics, noise and environmental impact depending on the technology • High uncertainty and instability in Renewable Energy Certificate markets

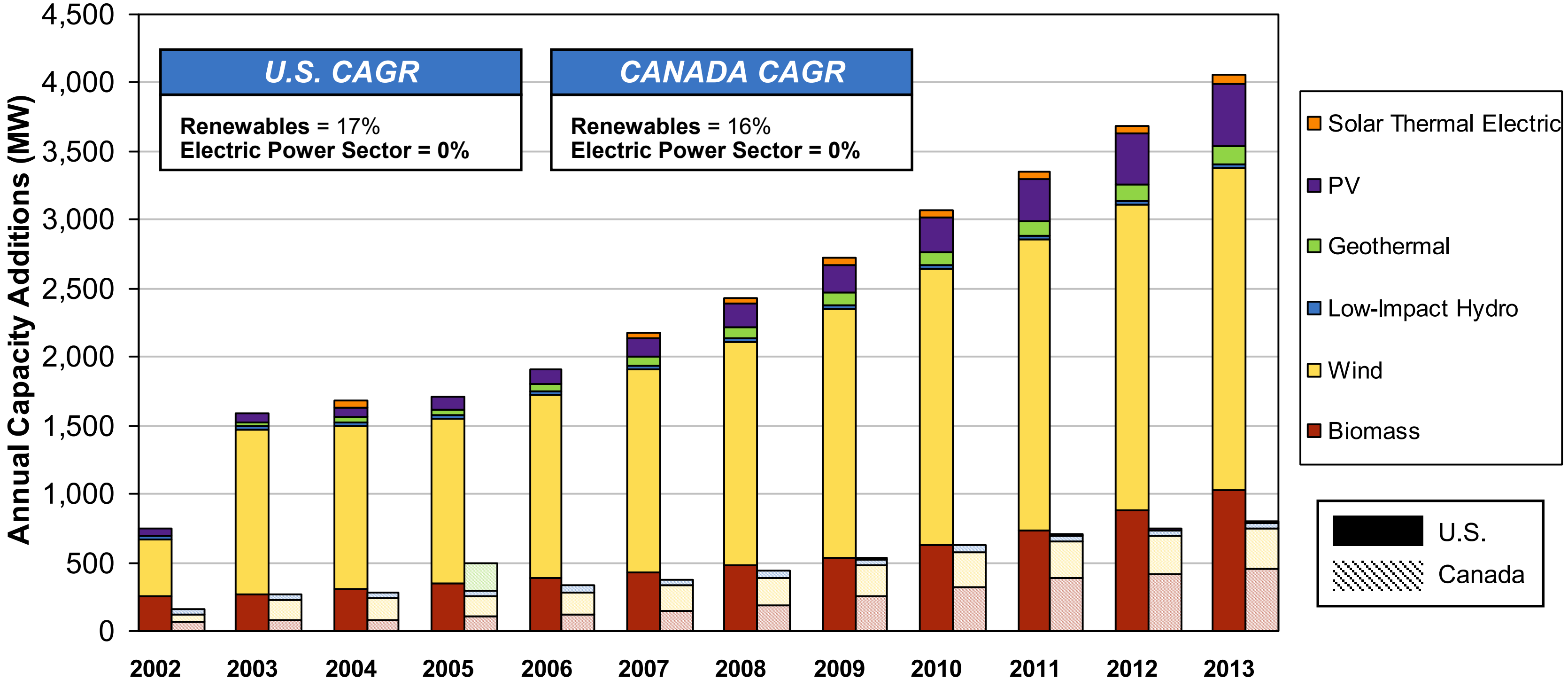
Note: Additional technology-specific issues are discussed in the main text.

Market conditions for renewable energy technologies in the United States and Canada are as varied as the technologies themselves.

Wind	• Wind is expected to be the leading technology in terms of new additions over next 10 years. • Additions of 1,000-2,500 MW per year in the United States and Canada are expected, assuming continuing policy support over the next 10 years, with off-shore wind beginning to see initial applications. • Production tax credits and RPS requirements are expected to remain drivers of this growth.
Photovoltaics	• Continued robust growth is expected in the United States, but economics with incentives today are still at least twice as expensive as grid power. • The economics of grid-connected systems suggests growth is dependent on continued government support and RPS requirements.
Biomass	• Landfill gas now leads in current opportunities, along with organic growth in biomass-based industries. • Large potential for co-firing and gasification, but market size and timing are uncertain. • Significant growth (%) expected in anaerobic digestion systems, but as a niche opportunity.
Low-Impact Hydro	• Significant untapped potential remains, but the U.S. market is expected to be small, absent major changes to the permitting and licensing process. Canadian market is more favorable.
Geothermal	• Limited development expected absent changes to incentive programs: – A possible inclusion of a Production Tax Credit for geothermal in the new U.S. Energy Bill could result in increased market penetration in the United States.
Solar Thermal Electric	• Minimal development expected due to continued high capital costs and no intermediate markets, unlike PV, which has cost-effective off-grid applications. Limited to areas of high direct solar insolation (U.S. Southwest). • A potential advantage is the ability to incorporate storage to address intermittency issues.

Achieving 60GW of installed renewable energy capacity by 2013 is based largely on the expectation that wind power additions will continue to grow.

Estimated Renewable Energy Capacity Additions, United States & Canada



Source: NCI estimates based in part on the IEA *World Energy Outlook 2002*.

Notes:

- If comprehensive U.S. energy legislation passes, it could potentially result in an increase in geothermal capacity.
- Geothermal installations for Canada during 2005 are due to a plant expected to come on-line north of Vancouver, BC.
- Biomass includes all sources and technologies, including municipal waste, not just those technologies reviewed in this report.
- Growth rates for the electric power sector reflect slowing demand growth, which leads to lack of growth in annual capacity additions.

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For most of the renewable energy technologies, large corporations are staking out strong positions to capitalize on growth opportunities.

Examples of Large Corporate Players in Renewable Energy			
Photovoltaics 	• Sharp • BP Solar • Kyocera • Shell Solar • Sanyo • RWE Schott Solar	**Low-Impact Hydropower** 	• GE Hydropower • ABB Alstom Power • VA Tech
Wind Power 	• Vestas • NEG Micon • Enercon • GE Wind • Mitsubishi • FPL Energy • National Wind Power • Shell Wind • ABB	**Concentrating Solar Power** 	• Solargenix Energy • Gamesa • Industrial Solar Technology • FPL Energy • Constellation • SMUD[3]
Biomass Power 	• Foster Wheeler • DTE Biomass • Caterpillar[1] • Waukesha[1] • Solar Turbines[1] • All pulp & paper co's[2]	**Geothermal** 	• Calpine • Caithness Energy • Ormat • Mitsubishi • Toshiba • Fuji

1. Suppliers of engines and gas turbines for landfill gas and biogas projects
2. Owners of most existing biomass power capacity in North America
3. Sacramento Municipal Utility District

RE resources are inherently more variable than conventional fuels, which can have technical and attendant market consequences for utility grids.

Key Findings

- The most significant renewable energy grid integration issue in North America is access to transmission.
- Where utility grids are robust and the RE contribution small (<20 percent), transmission system issues tend to be more procedural and less technically problematic.
- RE variability can have greater impact where transmission is congested or RE exceeds 20 percent, although contributions greater than 50 percent can be accommodated under the right circumstances.

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- Most RE generation is sold under fixed-price, take-or-pay contracts, which shifts the burden of market optimization to host utilities, power marketers, and system operators.
- Further development of wholesale and retail markets and adoption of FERC's Standard Market Design (SMD) may affect future RE valuation as generators bid on firm vs. non-firm transmission and system regulation shifts from day-ahead to real-time.
- Transmission bottlenecks have caused curtailment of as much as half of the wind energy produced in West Texas and parts of California.

Issues associated with integration of utility-scale, commercial renewable energy resources are different for each basic segment of the grid.

Key Grid Integration Issues

Generation

- Maintaining quality of power delivered to grid
  - Power factor
  - Harmonics
  - Voltage regulation
  - Frequency control
- Optimizing sales to grid
  - Capacity credits
  - Long-term storage

Transmission

- Interconnecting new facilities
- Allocating embedded costs
- Assuring system safety/stability
  - Islanding
  - Voltage fluctuations and frequency excursions
- Managing congestion
  - Allocation of congested capacity
  - Curtailment vs. take or pay
  - Virtual wheeling
  - Building new transmission
- Mitigating unintended schedule deviation

Load

- Maintaining economic commitment to load
  - Interruptible load
  - Spinning and non-spinning operating reserve
  - Long-term storage and energy “banking”
  - Liquidated damages for poor capacity factor
- Managing excess supply
  - Exporting power
  - Curtailment
  - Long-term storage

Facility-scale, non-commercial installations typically have minimal impact beyond the generator–grid interface.

Where utility grids are robust and the RE contribution small (<20%), interconnection issues tend to be more procedural and less problematic.

Operation	Description	Issue	Solutions
Interconnecting New Facilities	Interconnection rules tend to be based on assimilation of large blocks of power at single points of connection.	RE generation is typically smaller and built in phases, resulting in less impact.	Adjust scope of interconnection feasibility studies and required mitigation to reflect extent of impact
	Interconnection charges are based on injecting peak generator output into peak transmission system load to cover maximum potential impact.	RE resource peaks may not coincide with transmission peaks, so may not require proportionate accommodation. Mandated RE priced pass cost of impact on T&D to others.	• Closer alignment of interconnection fees with net contribution to system load • "Driveway access" fee structure
Allocating Embedded Transmission Costs	Embedded cost charges are sometimes based on distance from generator to load and/or maximum potential use of transmission facilities. System users sometimes also pay inter-jurisdictional access fees.	RE facilities are often located far from load centers and operate below peak capacity most of the time. Rate pan-caking discriminates against remote providers.	Elimination of rate pancaking and rate basing of transmission costs via "postage stamp" rate structure or locational marginal pricing paid by end users
Assuring System Safety and Stability	New generating facilities must meet basic safety and power quality requirements prior to interconnection.	Distributed RE facilities may present an islanding hazard. Intermittency causes voltage fluctuations, frequency excursions, and tie-line schedule variations.	• Direct transfer trip (DTT) equipment and other standard network protection • Adoption of clear guidelines for interconnection of distributed generators

Existing day-ahead scheduling norms penalize unintended schedule deviations and discourage RE participation in wholesale markets.

Operation	Description	Issue	Solutions
Managing Congestion	Transmission system upgrades have not kept pace with growth in supply and demand, leaving many areas vulnerable to instability.	• RE resources are often available in remote areas requiring radial connections to transmission systems that are already weak. • Congested transmission capacity is often allocated first come, first served; so, as the latest to seek access, RE generators are charged for systemwide problems.	• Curtailment • Take-or-pay • Energy "banking" • Virtual wheeling • Cooperative transmission line improvements • Off-peak storage • Capacity bidding
Mitigating Unintended Schedule Deviation	Initial wholesale markets have been based on day-ahead scheduling with penalties imposed for unintended deviations from filed schedules.	• RE operators cannot accurately forecast transmission requirements beyond an hour or two in advance or limit deviation to within narrow limits. • RE plants considered in isolation seem more variable than their true contribution to system variability, and often have positive influence. • Responsibility for paying the cost of additional correction is unclear.	• Shift from day-ahead to hour-ahead or real-time balancing market • Develop improved forecasting models • Rationalize penalties to account for negative and positive impacts • Energy "banking" • Long-term storage

Many jurisdictions have recently adopted special rules for interconnection of smaller distributed generators, including renewable energy plants.

Jurisdiction	Levels	Insurance	Visible Disconnect	Metering	Testing
California PUCT	< 11 kVA > 11 kVA	Yes, on sliding scale by size	Yes, except for inverter <1kW	Consistent w/ utility tariffs and manuals	Protective relays Every 4 years
New York PSC	< 300 kW	Recommended	Yes	Case-by-case; must meet PSC requirement	Protective relays Every 4 years
Massachusetts DTE	<10 kW, 10-60 kW, 60-300 kW, 300 kW-1 MW, > 1 MW	Yes	Yes, except DG meeting UL 1741 may be exempt	Specifications assigned by category	Protective Relays Every 4 years
Texas PUCT	<300 kW 300 kW – 1 MW	Not addressed	Yes, flexible on type	Case-by-case; must meet PSC requirement	Must maintain logs for utility inspection
FERC	> 2 MW 2-20 MW	Not addressed	Must meet applicable codes and standards	As needed	Not addressed

In general, larger commercial RE plants must meet the same standards as conventionally fueled generators and are governed accordingly.

Attributes – not energy revenues – are the key renewable energy driver.

Key Findings

- Tradable *renewable energy certificates* (RECs) are the key policy tool to advance RPS, green power/pricing, labeling, and retail emissions performance standards (EPS). These systems are evolving regionally, with some potential for conflicts that could hinder broader market development. Some jurisdictions require bundled renewable energy (energy and attributes cannot be separated) and RECs are not valid.
- Emerging regulatory trends favor allowance-based programs for NOx, SO_2, mercury, and CO_2. Renewable generators may benefit from both higher wholesale energy prices induced by emission caps and potential direct allocations of allowances to renewables.
- A key unresolved issue is whether RECs can still meet RPS and green power/pricing rules if emission allowances/credits have been sold off.

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- REC prices tend to reflect the excess of renewable generation costs over wholesale prices. Like other goods, REC prices will reflect supply and demand in the market.
- The REC market focus is currently short-term due to RPS uncertainties. This is hampering project development and precipitating additional government intervention.
- RECs have separate value elements; RPS compliance value, emissions credit, and green power value. The use of a single REC for more than one purpose may become impermissible under regulatory rules and green power certification standards.

Terminology relating to renewable energy in the marketplace is confusing and inconsistently applied, especially with the emergence of RECs.

Electrical Flows Observe Physics, not Contracts – On an integrated grid, electricity from a specific plant cannot be directed to specific customers. It is not possible for renewable energy customers to physically receive power from only renewable energy facilities. Therefore, contractual intent, rather than actual power flow, is the basis to define the attributes associated with the end-user's power.

Bundled Renewable Energy – The energy and attributes associated with a kWh of electricity from a renewable energy facility are sold as one, indivisible good. The renewable nature of the power delivered to retail customers can, in theory, be traced back to a specific generation facility by following the "contract path"—each of the power sales transactions between the generator and end-use customer.

Green Tags, Renewable Energy Certificates (RECs), Renewable Energy Credits, Tradable Renewable Electricity Certificates (TRECs), Tradable Renewable Certificates (TRCs), Green Tickets – The attributes associated with a renewable energy facility comprise a good that is distinct and separate from the energy produced. Buyers and sellers may choose whether to transact the energy and related attributes together or separately. The use of green tags greatly simplifies the process of defining the attributes of the power sold to end-users, since they are easily tracked. The market for a green tag, unlike the related energy from the plant, is not necessarily constrained by the physical delivery limitations of the grid. Regulatory agencies in some jurisdictions have not yet recognized (or have rejected) certificates as the basis for defining the attributes of retail renewable energy, and instead accept only bundled renewable energy for various regulatory requirements.

"Null" Energy, System Power, Residual System Mix – These terms all relate to energy that either has no attributes (because the certificates have been sold separately) or has attributes of no market value (the certificates were not purchased by anyone).

Re-Bundled Renewable Energy – In jurisdictions that recognize certificates for regulatory purposes, energy with no attributes ("null" energy) and system power/residual system mix (energy with attributes of no market value) can be combined with a renewable energy certificate to create "rebundled" renewable energy.

Terminology relating to renewable energy in the marketplace is confusing and inconsistently applied, especially with the emergence of RECs. (cont'd)

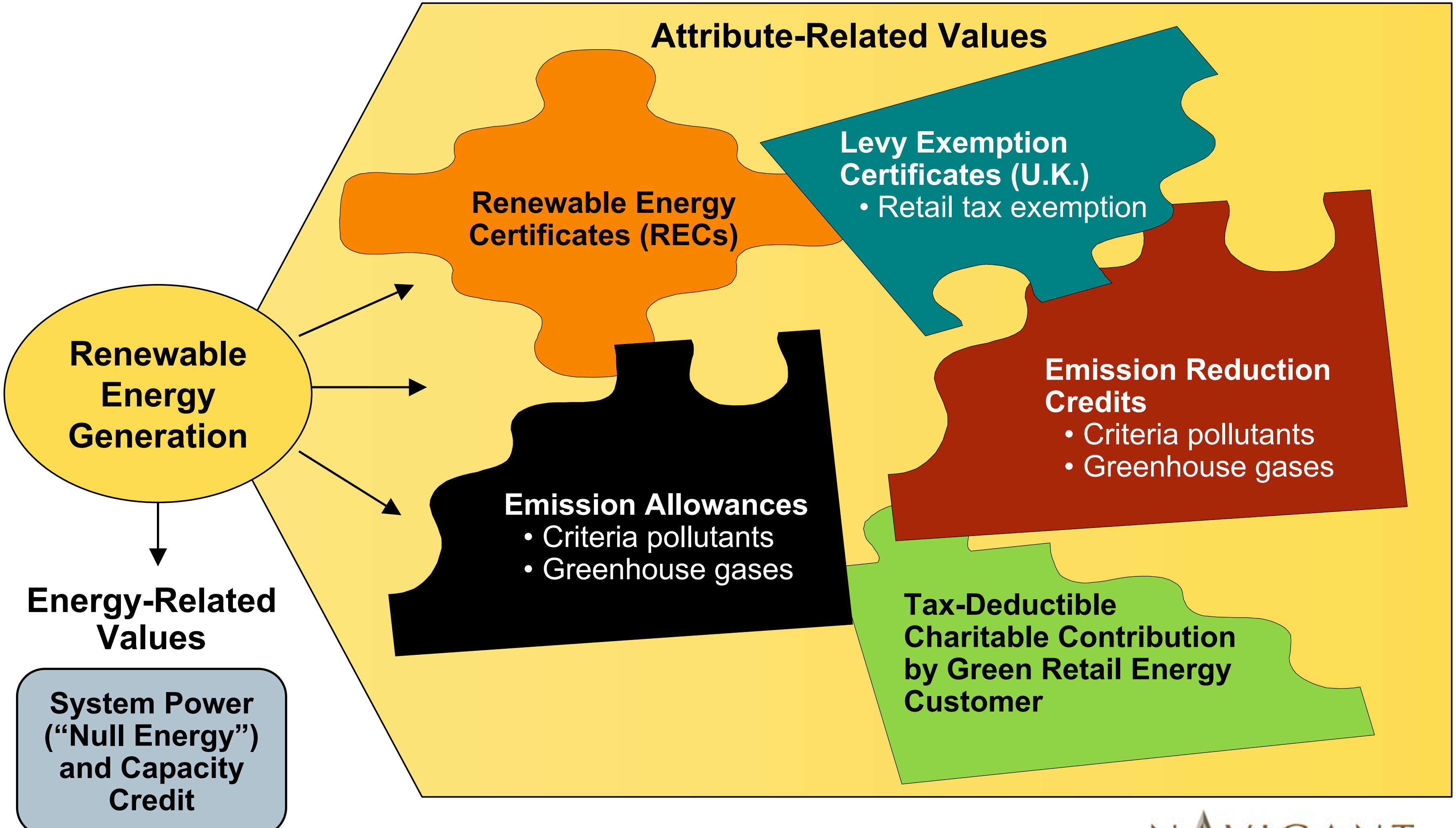
Green Pricing – Generally associated with utility providers in markets where retail choice has not occurred, "green pricing" is the sale of both energy and attributes to the retail customer. This is a premium energy service that enables the utility to add more renewables to its energy mix through purchased power agreements or by development of utility-owned renewable energy facilities. Some utilities are also beginning to serve green pricing customers via the purchase of RECs.

Green Power, Green Energy, or Green Electricity – Generally associated with retail suppliers (utility or competitive) in markets where retail choice exists, and includes the sale of both energy and attributes. The retail supplier sells the end-use customer a premium energy service product that is supported by the purchase of bundled renewable energy and/or re-bundled renewable energy. In the wake of anemic retail competition in markets where retail choice is ostensibly available, some distribution utilities are beginning to offer green power products that consist of energy sold by the utility that is co-marketed with renewable energy certificates offered by a third party.

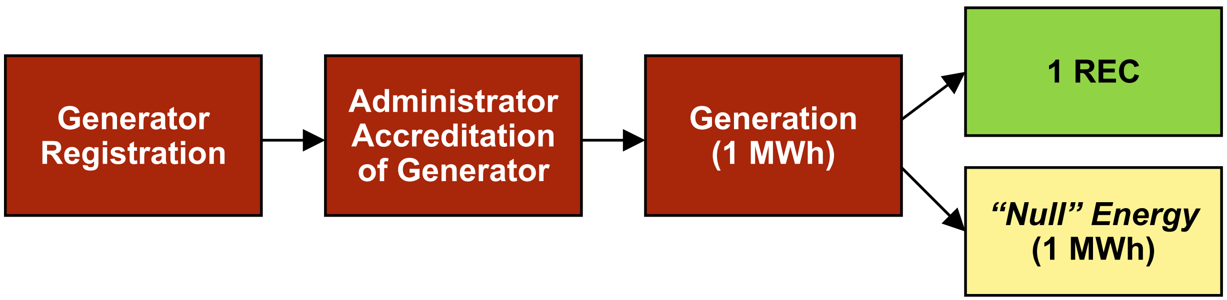
T-REC Product – Involves the sale by a vendor of the renewable attributes (but not energy) as a stand-alone product to the end-user. T-REC products are available in markets throughout the United States, Canada, and the many other countries.

Each of the above "green" products typically will cost the customer more than just purchasing standard utility energy. The voluntary nature of the purchases by the customer also means that utilities are generally precluded from counting such green product sales toward their RPS mandates.

Renewable energy is the basis of a growing list of valuable, environmentally oriented property rights, which supplement energy value.



In applicable jurisdictions, RECs can support numerous regulatory and market needs that require a system for defining the characteristics of power sold to retail customers.



1 REC:
- Emission rate attributes
- Locational attributes
- Technology/fuel attributes
- Labor attributes
- Other environmental attributes

"Null" Energy (1 MWh):
- Electrons without attributes
- Will be defined based on assignment of"leftover" attributes that are not sold

RECs

RECs can support multiple regulatory and market needs: RPS, labeling, EPS (emissions performance standards), green marketing, and claim substantiation. RECs may also define tax-deductible, charitable contributions per the IRS and are also being used in countries with carbon/energy taxes on retail customers as a basis for retail tax exemption.

- An electronic certificate is issued to generators. Retail suppliers purchase RECs for RPS and other purposes.
- Settlement period – after RECs are issued, there is a defined period of time to trade them or lose them. Some systems are quarterly (New England GIS) and others are based on 12 months or longer. Banking provisions may allow RECs to remain viable for longer periods of time.
- RECs contain the attribute data necessary to support regulatory and market needs of each jurisdiction participating in the REC system.
- Government-accredited systems are now in operation in New England, Texas, Wisconsin (soon), PJM (soon), Ontario (soon), the United Kingdom, and other European Union countries.

Renewable energy attributes have at least four value components. The key question is: Are the values additive?

Renewable Attributes

RPS, Labeling, EPS Compliance[1]

- RPS value dominates
- Currently trading at about $30/MWh in MA; $12/MWh in TX
- Under MA and TX REC rules, value could be up to $50/MWh under alternative compliance

Green Power

- Green product premiums at retail typically are about $20 per MWh

RPS and Green Power are not expected to be additive, based on most rules

Tax Benefits

- At a tax rate of 30%, tax benefit is approx $6/MWh on a $20/MWh premium

Under certain conditions, the IRS has found green power premiums paid by retail customers to be tax deductible. This may foster a higher REC value.

Illustrative Emission Allowances (EA), & Credits[2]

	Marginal lb/MWh	EA costs ($/ton)	Value ($/MWh)
NOx	1.7	$4,000	$3.40
Hg	0.0000036	$35,000/lb	$0.13
CO_2	1,394	$9	$6.27
SO_2	4.9	$165	$0.40
Total			**$10.20**

EAs or credits sold by renewable generators may or may not be additive to the other value elements, but these cap and trade rules would also increase wholesale energy prices by a similar amount and thus benefit all renewable energy generators.

1. Emissions performance standards – the maximum emission rate per MWh associated with a retail energy product. EPS provisions are to be developed in MA and CT pursuant to restructuring legislation.
2. CO_2: *Assessment of private sector anticipatory response to greenhouse gas market development.* Natsource, July 2002; NOx: NCI estimate derived from Cantor Fitzgerald trading data. April 2003; and Hg from Clear Skies Bill, 2002.

Business models for renewable energy require improved marketing to be more successful.

Key Findings

- Business models for the manufacturing, distribution, and sales of small-scale renewable energy systems are mature, but the market remains somewhat small and fragmented (PV, small biomass, etc.).
- The largest business opportunities in the near future will be driven by green portfolio (RPS) requirements and energy cost, with wind typically the best alternative in a least cost planning context.
- Green pricing programs will continue to be used as a retail model for renewable energy, but uptake has been typically only around 1%. Some successful programs have achieved 4% penetration.

Commercial Insights

- Integration across the value chain provides an advantage, especially in building large profitable RE portfolios. This is exemplified by:
  - FPL Energy, PacifiCorp, Shell Wind, EdF (enXco), that are successfully building large, profitable wind portfolios.
- Green pricing programs continue to need work around marketing, i.e., increasing awareness and understanding of the product. Best practices include increased focus on the commercial segment, providing participants with something tangible, and locking customers in to long-term contracts at a set price for green power where they can avoid future potential increases in fuel charges.
- Communication and collaboration with stakeholders is key in all businesses.

Lessons learned in "green pricing" business models underscore the importance of awareness, education, communication, and providing a hedge against future fuel price increases when possible.

Green Pricing Business Model Lessons Learned

- Provide visible recognition and project tangibility, and install local, visible projects when possible
- Provide end-users with a hedge against future fuel price increases by replacing fuel charge or fuel adjustment charge with green power charge that is fixed for a set time
- Do not underestimate the need for education
- Develop a good communication plan
- Sell the environment, not kWhs or contributions
- Target large installations (e.g., government facilities) to help reduce transaction costs

More Successful Green Pricing Programs

The emerging leaders in renewable energy project development are large companies that create value across the entire energy service value chain.

Energy Cost Business Model Lessons Learned

- **Value chain integration reduces costs**
- **Tax appetite is key to capture full value**
- **Focus on areas with favorable tax climates (sales, property)**
- **Need to work closely with local communities and politicians**
- **Strong balance sheet is needed to close projects**
- **Need for experienced, professional development team**

Successful Renewable Energy Projects and Developers

Achieving a renewable portfolio standard target will typically benefit from a diversified approach to reduce cost and increase public support.

Green Portfolio Business Model Lessons Learned

- In most regions, wind is the largest resource
- Focus on a portfolio of technologies to increase diversity
- Need to develop broad public (local and state) support for efforts
- Can help to decrease supply price volatility (versus gas)
- Typically will be a need to obtain partial cost recovery
- Portfolio targets >5% may add both cost and risk for achieving a "least cost" supply

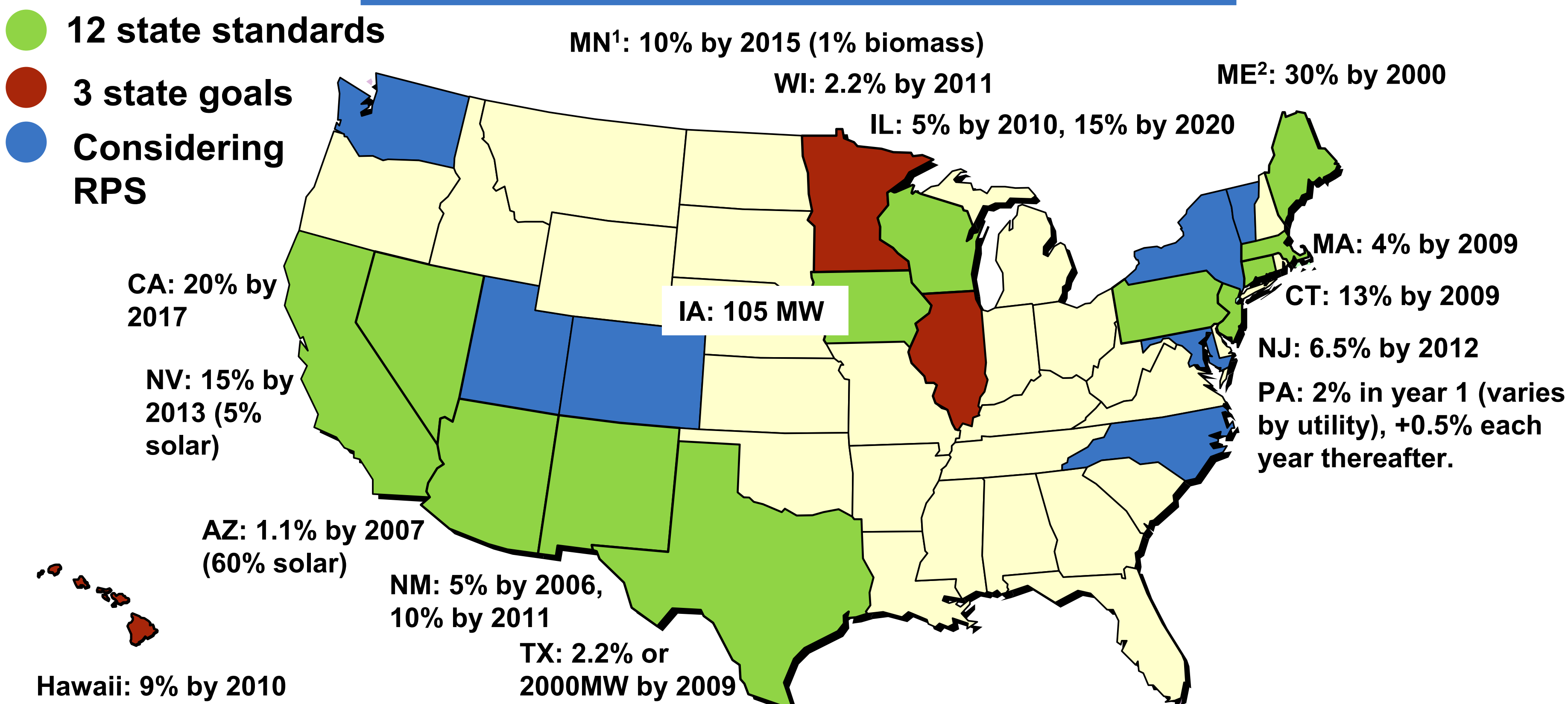
→ ***Effective Strategies for Achieving Requirements of a Renewable Portfolio Standard***

Renewable Portfolio Standards is one of the most effective policies for promoting renewables…

Key Findings
• RPS will be the most important driver for new renewables in the United States and Canada over the next 10 years. RPS will expand to several additional states, although a federal RPS is not likely. • A tremendous variety of RPS designs exist in the field. There are many ill-conceived aspects of these rules, and many "best practices" have not been used widely. • Tradable renewable energy certificates (RECs) are crucial for an effective and efficient RPS, and must be tradable across control areas. An unstoppable trend is taking us in that direction.
Commercial Insights
• REC prices (i.e. RPS costs) will be much lower if emission allowances/credits can be sold off by the generator without invalidating use of RECs for RPS use and green power sales. This is an open issue at present. • Renewable projects that are shielded from interstate competition because of RPS trade restrictions should anticipate the possibility of lawsuits under the Commerce Clause of the Constitution. • Several RPS rules are based on wishful thinking rather than rigorous analysis. An overly ambitious or badly designed RPS will not inspire investor confidence and is not likely to be successful.

Today, 12 states have renewable portfolio standards and 3 others have renewable electricity "best effort" goals/targets.

U.S. Renewable Portfolio Standards (as of Jan. 2003)



1. Not mandated, but a "good faith effort". In addition, Xcel must procure or generate 425 MW wind and 125 MW biomass by 12/2002.
2. RPS includes existing resource and ME already gets >50% from renewables.

Note: NY requires that all state buildings achieve 20% by 2010. Gov. Pataki has also called for a 25% RPS by 2013; NYPSC has docket open.

The government of Ontario is actively considering enacting a mandatory RPS by the fall of 2003, making it the first Canadian province to do so.

Canadian Provinces/Utilities Actively Pursuing RPS

Ontario	A mandatory RPS has been proposed for adoption in Ontario by fall 2003.
British Columbia	BC Hydro has adopted a voluntary RPS specifying a minimum of 1.7% new renewables by 2010, which is equal to about 10% of expected additional generation capacity.
Nova Scotia	Nova Scotia Power has committed to add 50 MW of renewable energy – or about 2.5% of current capacity.
Quebec	Proposed legislation will require Hydro Quebec to bring 1,000 MW of new wind power on line over the next 10 years, plus 200 MW of biomass. All of the wind turbines must be produced in Quebec.

Source: www.atlas.gc.ca

Various benefits of renewable electricity are cited as justification for market intervention via RPS.

Intended RPS Benefits

- Environmental improvement (e.g., avoided air pollution, climate change mitigation, waste reduction, habitat preservation, etc.)
- Increased energy supply diversity, and greater reliance on domestic sources
- Reduced volatility of power prices given the stable (or non-existent) fuel costs of renewables
- Economic development activity from jobs, taxes, and new revenue streams associated with new renewable capacity
- Reduced wholesale market prices due to low- or zero-bid price by renewable generators, reflecting their low fuel and other operating costs
- Displacement of some gas-fired power with renewables, thereby helping to moderate gas prices
- Adoption of a clear policy goal, mobilizing government to take on other complementary actions to speed development of renewables

Possible RPS Costs

- Renewable electricity (whether bundled or through RECs) may come at a higher cost than conventional power supplies.
- Intermittent nature of some renewables may require additional sources of back-up capacity or energy storage to ensure system reliability.
- Remote location on transmission grids for some renewable projects may impose higher transmission-related costs (which may be assigned directly to the renewable producer or be socialized over the entire grid).
- Some renewable projects may impose environmental externalities relating to real or perceived negative impacts on habitats, navigation, property values, views, noise, etc. Permitting and environmental approvals may substantially reduce—but not completely eliminate—these effects.

Eligible technologies for RPS vary significantly among the 15 states, but wind, photovoltaics, and biomass are included in all cases.

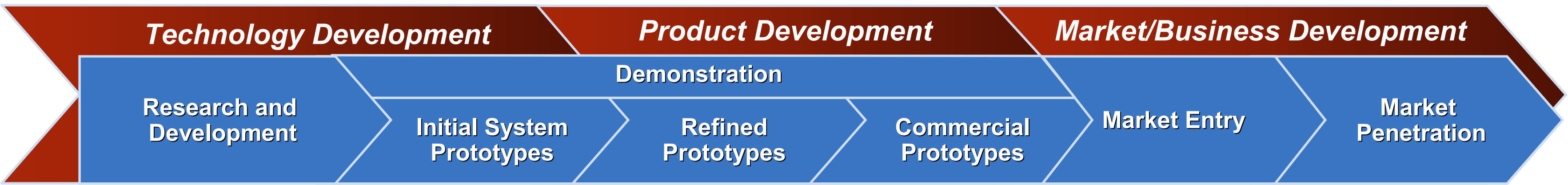
	Wind	Biomass	Hydro	PV	Geothermal	Landfill Gas	Solar Thermal Electric[1]	Ocean Thermal	Wave	Tidal	Waste	Cogeneration	Fuel Cells	Transportation Fuels	Waste Tire
ME	●	●	●	●			●			●	●	●	●	●	●
MA	●	●		●		●	●	●	●	●			●		
CT	●	●	●	●		●	●				●		●		
NJ	●	●	●	●	●	●			●	●	●		●		
PA	●	●		●	●	●	●				●				
WI	●	●	●	●	●	●	●		●	●			●		
IL	●	●		●											
MN	●	●	●	●											
IA	●	●	●	●							●				
TX	●	●	●	●	●	●			●	●					
NM	●	●	●	●	●	●	●						●		
AZ	●	●		●	● *	●	●								
NV	●	●		●	●		●								
CA	●	●	●	●	●	●	●	●	●	●	●		●		●
HI	●	●	●	●	●	●	●	●	●		●		●		

1. Equivalent to CSP (e.g., parabolic trough, power tower & dish Stirling)

* Geothermal Electric for AZ Public Service Co. only

Source: DSIRE website (www.dsireusa.org)

An RPS is seen as helping the market entry of renewable energy technologies…



• Grants • R&D Support • Low-Interest Loans	• Grants • R&D Support • Low-Interest Loans	• Grants • R&D Support • Low-Interest Loans • Accelerated Depreciation	• Gov't Facility Pilot Programs • Buydowns • Low-Interest Loans • Accelerated Depreciation	• RPS • Green Power Mkting Support • Production Tax Credits • Feed-In Tariffs • Allowance Set-Asides & Credits • Green Tags Development • Low Interest Loans • SBC "Market Backstopping" • Buy-Downs • Preferred Grid Access • Accelerated Depreciation • Stringent Regs on Fossil Sources • Government Procurement • Low-Interest Loans • Permit Reform • RE Cap Gains Preferences • Net Metering • Sales and Property Tax Exemptions • Generation Performance Standards • Labeling

An effective RPS takes into account unique state/provincial characteristics such as renewable resource potential, market structure and conditions, and the presence or absence of complementary policies.

How should an effective and efficient RPS be designed?

What goals, objectives and principles should guide the RPS?

Likely goals:

- Environmental and economic benefits
- Supports market structure
- Cost-effective and efficient
- Credible and enforceable
- Fair and consistent application to the market
- Perceived as long-lasting
- Consistent with other rules
- Specific measurable goals, as appropriate

How should resource eligibility be determined?

- What technologies should be eligible?
- Should resource tiers or multipliers be used?
- Which fuel resources should be eligible?
- How should existing resources be treated?
- How should an "RPS Zone" be defined?
- Should customer-sited or off-grid generation be eligible?
- Should environmental impacts be evaluated?

How should the RPS be structured, scaled, and applied?

- What "rates and dates" are most appropriate?
- Should an RPS be mandatory or voluntary?
- How should RPS accounting work?
- Should compliance be tied to products or linked to the company?
- Should RPS apply to POLR, Munis, self-gen?
- How should our RPS mesh with other RPSs?
- How should resource diversity be addressed?

What administrative steps will ensure that RPS works as intended?

- How will regulated companies recover RPS costs in a timely manner?
- Are cost caps needed? Where does the $ go?
- How can we verify RPS compliance?
- How can we provide appropriate flexibility?
- How can we coordinate the RPS with other related policies?
- What is the RPS end-date?

NCI recommends 10 steps for implementing a successful RPS.

10 Steps for a Successful RPS	
1	**Articulate a clear set of goals and objectives underlying an RPS and other renewable policies.** State why market intervention to advance renewable is an important policy objective and set realistic quantitative goals.
2	**Evaluate the status, technical potential, and competitive position of renewable electricity in the market area of interest.** Note disparities between technical potential and expected market penetration; specific factors that influence the cost gap between renewable technologies and expected market prices; and the results of analysis change with shifts in policy, market conditions, and technological progress.
3	**Construct a renewable technology supply curve,** including existing and potential future resources under BAU conditions. Run sensitivity cases for cases in step 2. Identify the price gap between the various renewable technologies and expected market prices. These gaps approximate REC prices necessary to support the development of the renewable resource.
4	**Identify a package of complementary renewable policies.** For each policy option, identify the expected effect of reducing RPS costs. Develop a timeline under which these policies could be developed and introduced.
5	**Conduct an RPS design analysis based on the renewable cost curve.**

NCI recommends 10 steps for implementing a successful RPS. (continued)

10 Steps for a Successful RPS	
6	**Develop a tradable REC or all-source certificate system.** Advantages: attribute transactions without added costs of transmission and energy scheduling constraints; precludes the need for bilateral unit contracts; promotes efficient operation of the wholesale energy market; makes it much easier/less costly to offer green power; and low administrative costs.
7	**Coordinate RPS with other policies,** especially labeling (e.g., identical definitions of “renewable,” emission performance standards, and substantiation of marketing claims).
8	**Incorporate reasonable flexibility provisions** like cost caps for RECs so retail suppliers are assured there is an upper bound for RPS compliance costs and ratepayer impacts. Also helps to limit potential market power of renewable generators, and “Compliance Banking” for retail suppliers to over-comply with RPS and “bank” the MWhs of excess compliance to future years. Provides market incentive for buyers to seek RECs earlier and, therefore, benefits renewable generators. Not the same as REC banking, which could present inconsistencies with labeling requiring all certificates be redeemed and used in the year.
9	**Avoid RPS loopholes.** Ensure that RPS applies to all retail suppliers; ensure no “free riders” resulting from company-based compliance rather than product-based compliance; avoid “trigger” provisions that could delay/negate effect of RPS; voluntary RPS rules should have an automatic transition to mandatory if goals/targets not met in a timely manner.
10	**Ensure That RPS Compliance is Not Sold as “Green Power.”** Green power products should be required to exceed RPS-mandated levels of renewable content. Marketing rules and labeling requirements need to be clear that green premiums are for the green portion of the product mix, above and beyond the RPS minimums.

The introduction of RE funds has been one of the most popular mechanisms for ensuring continued support and success of RE sources…

Key Findings

- Between 1998 and 2012, ~$4.37 billion will be collected by the 15 state RE SBC funds
  - California's fund accounts for more than half of all U.S. funding at $135 million/year through 2012
  - CT, MA and NJ are the next largest funds, each collecting an average of $20 – 30 million/year
- These funds, in combination with RPS, have the potential to transform RE markets into more mainstream sources of energy
- Wind, PV, and biomass are eligible under virtually every fund (biomass excluded in Delaware)
- Although biomass is eligible in most states, only a few projects have been supported; hydropower has been treated similarly, and geothermal is eligible in 8 of 15 states.
- Due to current and projected budget shortfalls, CT is trying to zero out funds for the state ($50 million over two years) and MA has taken $17 million from the state fund. Additional MA dollars may be vulnerable next year for funds not yet allocated to projects. WI and PA may also be vulnerable to state budget deficits.

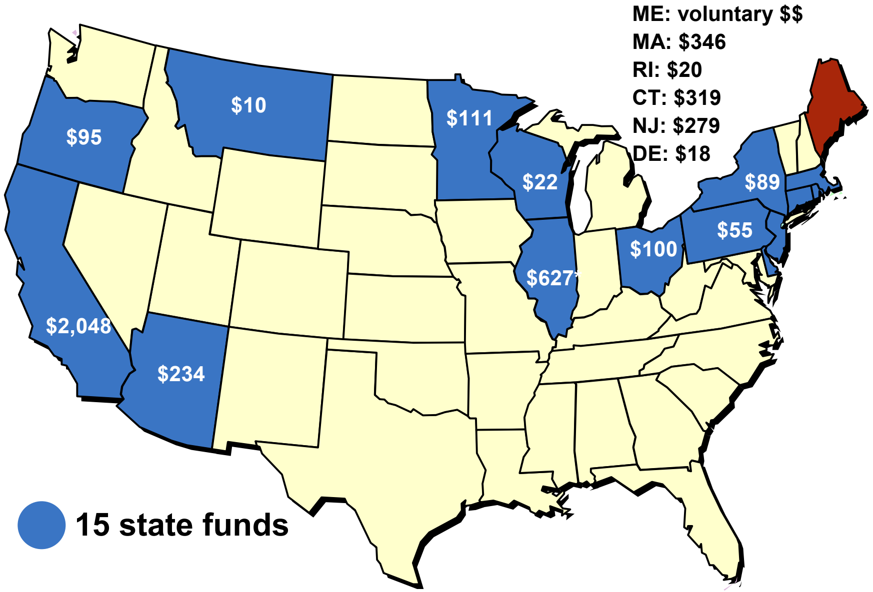
Commercial Implications

- Most visible successes: funding large-scale renewable projects
- Six states have used production incentives and grants to fund projects >1 MW (combined total of $225 million that could result in >1,100 MW of new capacity in next few years).
- When incentives normalized to 5-yr production incentive equivalent, amounts range from $0.001-0.07/kWh (wind major beneficiary).
- "Raiding" state funds creates a start/stop impression resulting in the lose of better projects.

Sources: Clean Energy Funds – An Overview of State Support for Renewable Energy, April 2001 with 2003 updates from Dsire and interviews with CT Innovations and MTC, April 2003.

Fifteen states have Renewable Energy Funds that are expected to direct up to $4.37 billion to support renewable energy development by 2012.

U.S. Renewable Energy Funds (as of 5/03) (cumulative 1998 – 2012, in million $)



	Wind	Solar	Geothermal	Biomass	Landfill Gas	Ocean-based	Hydro	Fuel Cells[2]	MSW
MA	●	●		●	●	●	●	●	●
RI	●	●		●			●	●	
CT	●	●		●	●	●		●	
NY	●	●	●	●			●	●	
NJ	●	●	●	●		●	●	●	
PA	●	●	●	●	●		●	●	●
DE	●	●	●						
OH	●	●	●	●			●	●	
IL	●	●		●			●		
WI	●	●	●	●		●	●	●	
MN	●	●		●			●	●	
MT	●	●	●	●			●		
AZ	●	●		●	●				
OR	●	●	●	●	●		●		●
CA	●	●	●	●		●	●	●	●

Note: Maine - No mandated funding level for renewables, but voluntary contribution program. New Mexico system benefit charge repealed. NY includes additional $14 million/yr for five years. MA includes reduction of $17 million. WI and PA funds may also be vulnerable to state budget deficits. *Includes a $500 million State RE Bond Initiative. Fuel cells are not always required to use renewable fuels, except in States such as MA. DE, WI and PA are included under the geothermal category which also includes geothermal heat pumps. Source: UCS and Desire database, 2003.

In recent months, 4 of the 15 state funds have been targeted to have fund dollars taken to help close the gap on state budget deficits.

Connecticut Clean Energy Fund	Massachusetts Renewable Energy Trust
• Governor Rowland has zeroed out $50 million total over two years for FY2004 and FY2005. • The expectation is that they will succeed in only taking ~$25-30 million. • The legislative session is likely to go until the Fall of 2003 due to state deficit problems, putting the Clean Energy Fund in "limbo." • A precedent was set in FY2002 with the legislature succeeding in taking $10 million from the Conservation and Load Management Fund.	• Governor Romney has tapped $17 million from the Trust in 2003 from ~$90-100 million that was unallocated. • $70-75 million is left and, if not allocated, the legislature could come back in 2004 to take more funds for budget shortfalls. • Unlike CT, MA has strong advocates in the Legislature and the Governor supports renewable energy development. – A promise has been made to require government facilities to purchase "green" electricity in the future.

Wisconsin

Pennsylvania

Uncertainty and "start/stop" can result in losing good projects from project pipelines and make financiers more reluctant to commit to needed project financing.

Connecticut, Massachusetts, Wisconsin, and Pennsylvania are the four states whose renewable energy funds are vulnerable.

Permitting remains a complex process. While the intent of the processes are sound, they can be impediments to renewable energy development.

Key Findings

- The permitting process varies considerably by region and by technology. For some (e.g., PV) it is primarily a local issue; for others, local, state and federal approvals are necessary.
- The same stakeholders that can help streamline the permitting process can also intervene to create insurmountable barriers to projects.
- Net metering exists in 36 U.S. states and is under consideration by at least two Canadian Provinces.

Commercial Insights

- Permitting "best practices" are characterized by a proactive approach that engages all stakeholders early on in the process to win support for the project.
- For small projects, permitting can be a "show stopper" This is especially true for small hydro.
- Net metering best practices include appropriate provisions for utilities to recover lost revenues from electricity sales.
- Net metering is a key driver for small-scale renewable energy project development.

The same forces that can help streamline the permitting process can also intervene to create insurmountable barriers to projects.

Developers of successful projects…

- Understand the detailed permitting requirements at each level of government
- Create a positive environment for public input early in the process
- Remain flexible and find ways to address the concerns of various interest groups
- Build political support at the local, state, and federal levels
- Know how to limit the timeframes for specific permitting steps, so that the process is knowable and, to some extent, controllable. This reduces the possibility that otherwise viable projects will be made uneconomic by a protracted permitting process.

If these approaches are not followed…

- Zoning boards, building permit offices, and even utility companies can make the permitting process so cumbersome or expensive that the project will not be economic.
- State authorities can require special environmental or economic studies, if they have any jurisdiction over anything affected by the project.
- The federal government and/or key elected federal officials can intervene in the permitting process by passing legislation, via its permitting authority (if applicable), and by exerting political pressure on state and local authorities to block projects.

Permitting of renewable energy power projects tends to follow different processes in different jurisdictions.

Onshore Wind	Permitting varies by local jurisdiction and state/province, but is likely to include local zoning and state and federal requirements. Numerous environmental issues need to be addressed.
Offshore Wind	Includes all permitting issues for onshore wind systems plus additional issues. Permitting rules and processes are being developed slowly, as applications for this new technology are being submitted in different parts of North America.
Photo-voltaics	Permitting is largely a local matter, with considerable variability among local zoning boards and building permit offices.
Biomass	Permitting is centered around air and water quality issues. For large projects, the process is similar to that for conventional power plants. For smaller systems, permitting may be solely a local issue, but may also include items not traditionally associated with power projects (e.g., animal waste management).
Small-Scale Hydro	U.S. permitting process includes a central role for FERC. Roles of other agencies differ by state and municipality. In general, the process is extensive, time-consuming, costly, and generally not cost-effective.

Net metering is well established in the United States, with best practices well understood.

Status

- Net metering exists in some form in 36 states and is under consideration in at least two Canadian Provinces.

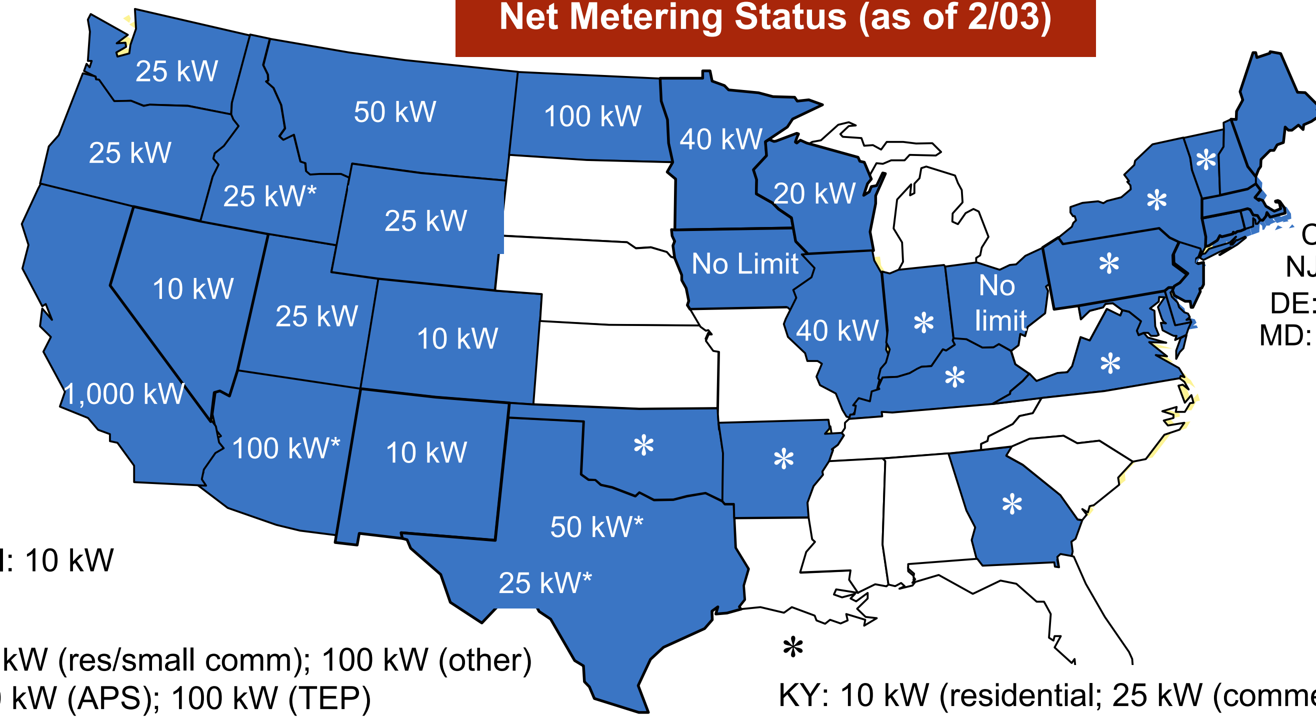
Key Features of Net Metering Best Practices

- Principle: Encourage customers to generate to meet their own needs while connected to the grid, and balance the needs of multiple stakeholders (community, utility, consumers)
- Other key features include:
  - No major additional costs[1]
  - Payment at retail rate (but not necessarily for net generation over and above consumption)
  - Ramping up of capacity to allow for learning at the host utility and to facilitate integration into grid
  - Supportive regulatory framework for utility cost recovery

1. Could include: exit fees for the amount of kWh that “leaves” the system; special metering charges; fees for interconnection, such as payment for isolation transformers.

Today, 36 states currently have net metering regulations, mostly for technologies smaller than 25kW.

Net Metering Status (as of 2/03)



*

ID: 25 kW (res/small comm); 100 kW (other)
AZ: 10 kW (APS); 100 kW (TEP)
TX: 25 kW (CPS), 50 kW (IOUs)
OK: 100 kW and 25,000 kWh
AR: 25 kW (residential); 100 kW (comm or agric)
IN: 1,000 kWh/month

*

KY: 10 kW (residential; 25 kW (commercial)
GA: 10 kW (residential); 100 kW (commercial)
VT: 15 kW, 125 kW for anaerobic digesters
NY: 10 kW (PV); 400 kW (farm waste)
PA: 10 kW – 40 kW (utility-specific)
VA: 10 kW (residential); 25 kW (commercial)

Net metering is also under consideration in at least two Canadian provinces.

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